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Risk Analyses for the IDOT Positive Train Control System to Determine Optimum Communications Timeout: Comparison to Cab Signal Systems with Continuous Train Stop and with Speed Control

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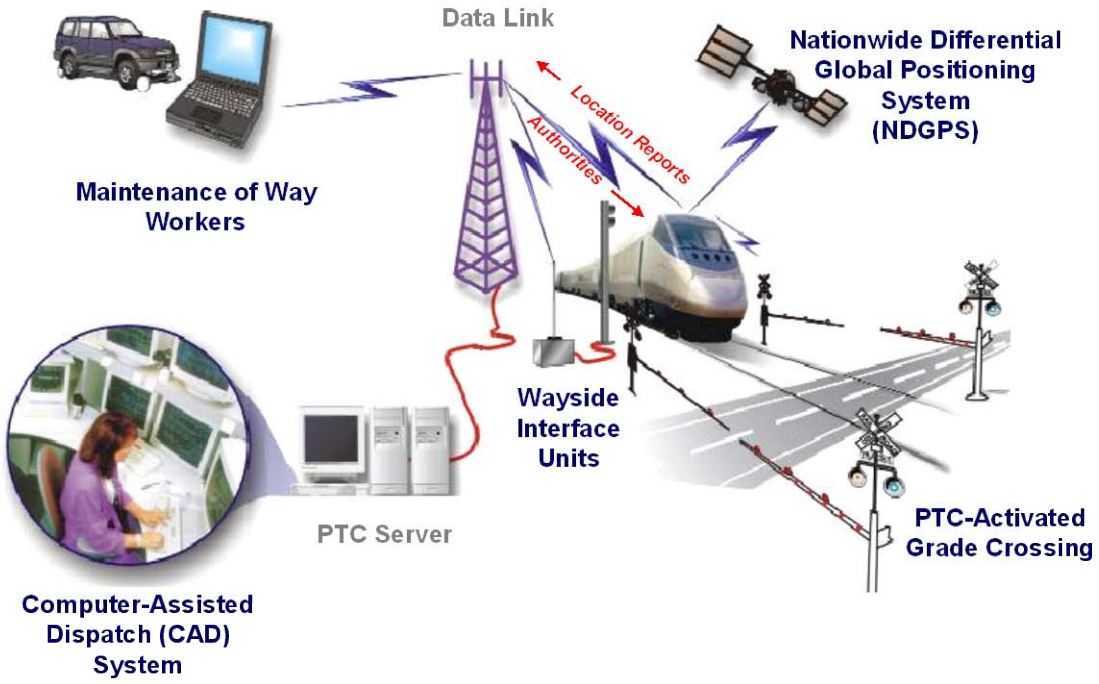

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This project examines the influence of the communication timeout threshold and latency of a positive train control (PTC) system on its overall safety performance as compared with a cab signal system with continuous Automatic Train Stop and a four-aspect cab signal system with speed control, or an automatic train control system. The analysis was based on average daily traffic on the IDOT PTC corridor, which was composed of six passenger trains, between 0.86 and 1.07 PTC-equipped freight trains, and between 0.36 and 2.30 unequipped freight trains, depending on the season of the year. Maximum speeds considered were 110 miles per hour (mph) for passenger traffic and 60 mph for freight traffic. The latency values varied from 5 to 20 seconds (s) and timeout values varied from 20 to 360 s.

Conclusions from this risk assessment are that for the traffic volume and traffic mix, the PTC latency and timeout in the ranges assumed in this study did not have a material effect on risk. Instead, nonsafety considerations such as route capacity, delay reduction, and cost may be the governing factors in the requirements for timeout and latency, instead of safety, for PTC communication network and design.

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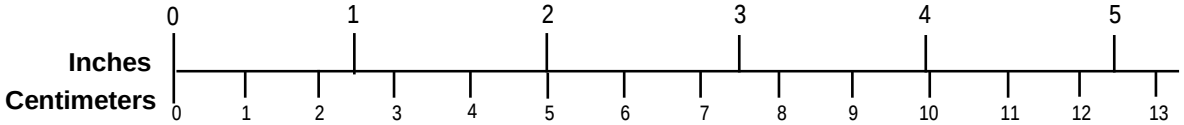

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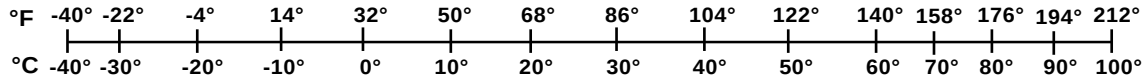

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Executive Summary

Background

Positive train control (PTC) refers to a system of train control involving the application of wireless communication technologies, locomotive tracking with global positioning system (GPS)/inertial navigation systems, and central processors. The functional capabilities of PTC are to prevent collisions by enforcing movement authorities, to prevent derailments as a result of overspeed, and to prevent violations of work zones leading to casualties among roadway workers.

In January 1998, the Federal Railroad Administration (FRA), in conjunction with the Association of American Railroads (AAR) and the Illinois Department of Transportation (IDOT), began to develop a high-speed PTC project for the St. Louis–Chicago corridor. These efforts were integrated into the North American Joint Positive Train Control Program (NAJPTC), whose major participants included FRA, AAR and the Transportation Technology Center, Inc. (TTCI), IDOT, the National Railroad Passenger Corporation (Amtrak), and major freight railroads. The implementation of PTC on the St. Louis–Chicago corridor, called the IDOT PTC system in this report, was intended to be on the St. Louis Line of the Union Pacific Railroad (UP) between Ridgely, IL, and Mazonia, IL, a total of 120 miles currently equipped with a centralized traffic control (CTC) system.

In general, two types of messages are communicated through the PTC digital radio system—those carrying functional data (e.g., location and speed of equipped trains, train movement authorities, track circuit status, switch status, etc.) and safety heartbeats. The heartbeat message generated by each system element informs other elements, including the central office system, that the originating system is healthy and that the communication is intact, thereby achieving a closed loop. During development of the IDOT PTC, it was determined that the throughput of the data radios originally specified for use in the system was not sufficient to support the message load generated by the IDOT PTC system as it performed its functions. As a result, messages may not be carried through properly when the communication network is loaded with the combination of functional data and safety heartbeats.

Two fundamental measures of communication system performance are defined as follows:

- Timeout – the length of time the PTC system detects no communication or heartbeat message from a device within the system before it declares a "fault condition" and imposes appropriate actions for fail-safe protection.
- Latency – the length of time passing between when a communications message is initiated at the point of origin and when appropriate actions corresponding to that message are initiated at the destination system. This time includes the response time of any PTC subsystems involved in the message path and communications queuing delays.

Naturally, a quicker detection of a problem reduces the risk of PTC failing to respond correctly to a hazard. However, more frequent heartbeat messages place a heavier load on the communication network, which could lead to communications overload, delayed messages, and timeout events. The requirement of the communication network will be driven largely by the

heartbeat frequency needed to ensure safe operation. If the total traffic (including heartbeats) exceeds the communication system capacity, this will generally lead to message loss and therefore unnecessary forced train stops due to unknown equipment states as a result of the closed-loop design.

Given the importance of communications system performance to the safety and operability of PTC systems, FRA initiated this risk analysis to investigate optimum communications timeout and latency values that would ensure safety while minimizing demands on the radio communications network as a result of heartbeat and functional messages. The approach to this analysis was based on FRA's *Standards for Processor-Based Signal and Train Control Systems* (49 CFR Part 236, Subpart H, effective March 7, 2005).

This standard requires the operator of a rail line segment equipped with a novel system to submit a risk assessment that demonstrates that rail operations under the novel system are at least as safe as they were under the train control system previously used on the line segment. If installation of the novel system is accompanied by substantial changes in traffic mix, traffic density, and/or speed, then the risk comparison must be conducted with an alternative base case representing the line equipped with a conventional train control system that would normally be used under the proposed operating conditions. The specific requirements for the risk analysis and safety performance are contained in paragraphs 236.907(7), 236.909, and Appendix B of the rule cited above.

With this risk analysis approach, the safety performance of the IDOT PTC system with different timeout and latency values was compared with two conventional train control systems that would provide adequate safety for proposed operations on the IDOT test corridor, including 110-miles per hour passenger service. These base case control systems were a cab signal system with continuous automatic train stop (ATS) system and a four-aspect cab signal system with speed control or an automatic train control (ATC) system, configured as currently used in Amtrak's Northeast Corridor (NEC) for high-speed passenger trains. The ATS system was the base case originally used in the IDOT PTC risk assessment for setting the level of risk that the proposed PTC system would not exceed. This document focuses on the comparison among the IDOT PTC system operated with a mix of equipped and unequipped trains, the cab signal/ATS system, and the NEC cab signal/ATC system operated with all trains equipped.

After the initiation of this study, the development of the IDOT PTC was terminated, and a new PTC development program was initiated at TTCI in Pueblo, CO, to build on the previous successes of the NAJPTC program. However, for the purpose of this analysis—which was intended to determine the optimum latency and timeout periods—using the IDOT PTC territory as a test case is still valid.

Analysis

The relevant train accident risks associated with the IDOT PTC system operated with different timeout values were compared with the same set of risks associated with the ATS base case and the NEC ATC base case control systems operating on the same IDOT corridor with the same traffic levels. The comparison provided a determination of the maximum timeout that could

exist in the PTC system that would introduce no greater level of risk than the risk associated with ATS or ATC base cases. Because there is very limited operating experience with the NAJPTC system, the risk estimates for the IDOT PTC case must be built from the bottom–up by using estimates of the failure modes as well as reliability and availability of individual system components and subsystems. Many of these values will not be known with any accuracy, and confidence in the end result could be much lower than for the base cases, which in turn means there will be a lower confidence in the comparison between base cases and the IDOT PTC case. To minimize this comparability problem, the methodologies used that make the risk analyses for the base cases and the IDOT PTC case must start from a common reference point and follow parallel paths as much as possible. This reference point is designated as the reference case. An approach of this nature has been adopted for this analysis and is described in detail within this report.

The risks associated with the cab signal system with ATS and the cab signal system with ATC, both operated on the IDOT corridor, and the IDOT PTC were determined by considering accident scenarios in which PTC or cab signals with ATS or ATC could reduce the frequency or severity of accidents. These scenarios include train-to-train collisions (those occurring between trains on the same main-line tracks), intrusion collisions, collisions at diamonds, overspeeds, work zone violations, grade crossing accidents, and incidents involving broken rails. The analysis omitted most derailment accidents caused by track and equipment mechanical failures (except broken rails) and several miscellaneous accidents such as fires and collisions with obstructions other than rail vehicles and shifted loads. The analysis did not include the effects of operating in fallback mode after a known failure of on-train or wayside equipment, because the fallback method of operation (conventional CTC with wayside signals) and the train-miles operated in fallback mode were assumed to be the same in each case and would not affect the comparisons.

Results

The following conclusions were drawn from the analysis *of the systems considered in this effort*:

- A series of model runs were performed to explore the effects of varying timeout and latency on the safety performance as measured by the dollar value of harm. On the basis of this analysis, the following statements can be made:
  - When the IDOT PTC system is considered, even when the elevated risk during timeout is taken into account, the overall impact of this risk increase on the overall risk of operating the corridor is very small. Timeout does not have a material effect on the overall safety performance of the IDOT corridor. This is because the aggregate train-miles operated in the timeout state is very small, not exceeding 0.5% of total train-miles, and the heightened risk over this period, although significant, cannot have much impact on the overall result.
  - It is difficult to recommend a timeout value based on safety alone, and other factors such as operations benefits should be considered, such as the avoidance of delays because of slow system response or unnecessary timeout events. Note that this conclusion applies only to this corridor, and the conclusion in areas of higher traffic density or with more unequipped trains could be different.

  - As with timeout, the effects of varying latency are limited and can be attributed primarily to the increase in collisions between equipped and unequipped train as latency increases, with limited additional risk increments as a result of increasing risk from intrusion collisions and other accidents.

- The IDOT PTC operating with a timeout of 120 seconds (s) and a latency of 10 s is estimated to reduce accident costs by 24 percent when compared with ATS base case and 14 percent when compared with the ATC base case for the set of accident scenarios analyzed. These results indicate that the IDOT PTC is likely to pass the test of providing a level of safety equivalent to or better than either of the base case control systems considered in this analysis.

  On the basis of accident costs over a 10-year period, the performance of ATC base case lies between that of the IDOT PTC and the ATS base case; the analysis resulted in the ATC base case showing total estimated costs of $0.44 million (14 percent) greater than those for IDOT PTC and $0.42 million (12 percent) less than those for the ATS base case.

  The principal sources of the advantage of the IDOT PTC system over the UP cab signal system with ATS and the NEC cab signal system with ATC are fewer train-to-train collisions, overspeed derailments, and work zone incursions. The difference in train-to-train collisions between the IDOT PTC and the UP ATS base case is much more pronounced than the difference between the IDOT PTC and the NEC ATC base case. Explanations for these differences are provided in the report. Passenger train costs dominate the results. Freight train accident costs on this corridor are almost insignificant. However, it should be noted that there are only an average of about two freight train trips over the corridor (averaging Sub-corridors and seasons) versus six passenger train trips.

- Cab signals with ATS/ATC exhibited a small advantage (lower accident costs) over PTC only for freight trains involved in train-to-train collisions and in intrusion and broken rail accidents. The total advantage these systems offer in terms of accident costs are massively offset by the advantage of PTC in all other accident scenarios analyzed. It is also noteworthy that the IDOT PTC advantage is still substantial even if the benefits from additional PTC functionality (overspeed, work zones, and grade crossings) are disregarded.

- The results for injuries and fatalities in accidents show the same pattern as overall accident costs.

- Passenger train costs dominate the results for all control systems, given the high cost of passenger casualties and damage to passenger equipment. Freight train accident costs on this corridor have little influence on the overall results. However, it should be noted that there are only an average of about two freight train trips over the corridor (averaging Sub-corridors and seasons) versus six passenger train trips.

- PTC is only able to prevent a relatively small fraction of grade crossing collisions and broken rail derailments. This is mainly because the detectable hazardous conditions (total rail break before train arrival, or malfunctioning crossing warning systems) are a minor part of the overall risk from those scenarios. However, the financial benefit from preventing even a small fraction of these accidents is substantial.

- *Both* PTC and cab signal-based systems with trains operating at up to 110 mph provide a substantial safety improvement over the reference case of conventional CTC at speeds up to

79 mph (as the line is currently being operated). If the acceptability criterion had been a comparison with the current operation, then any of the systems would be acceptable.

The analyses performed for this study also have limitations that should be borne in mind when reviewing the results and conclusions quoted above. These are:

- The analysis and accident costs presented include only PTC-relevant accidents. The costs for accident risks that are not changed in any way by PTC or the base case control systems are not included in the total. These include most accidents due to track and equipment failures (except broken rails), and a number of miscellaneous causes such a fires and collisions with obstructions other than rail vehicles or vehicle lading. Thus, the percentage differences between the systems somewhat overstate the overall impact of train control system characteristics on safety.
- Neither the PTC nor base case analyses include operations during the fallback mode, in this case, conventional CTC. This mode was omitted from analysis, because both train-miles and accident risks during fallback operation were assumed to be the same for both cases, thus inclusion would not affect comparisons between analysis cases. However, potential availability performance of the three systems was not analyzed and may in fact differ between the systems. This could have a significant effect on comparative safety.
- The analysis does not fully meet the requirements in 49 CFR Part 236 for a risk analysis of a PTC system to show that the system is as safe as or better than an applicable base case. Most notably the analysis treats the PTC system as a "black box" with specific capabilities and performance characteristics and lacks analyses to demonstrate that the system in fact delivers this performance. In addition, more thorough analyses to confirm and refine input parameters would be required.

1. Introduction

1.1 Background

Positive train control (PTC) refers to a system of train control involving the application of wireless communication technologies, locomotive position tracking using global positioning system (GPS)/inertial navigation systems, and central processors. The functional capabilities of PTC are to prevent train collisions, derailments as a result of overspeed, and incidents involving roadway workers operating within the equipment's authority limits. In January 1998, the Federal Railroad Administration (FRA), in conjunction with the Association of American Railroads (AAR) and the Illinois Department of Transportation (IDOT), began to develop a high-speed PTC project for the St. Louis–Chicago corridor. These efforts were integrated into the North American Joint Positive Train Control (NAJPTC) program, whose major participants included FRA, AAR, and the Transportation Technology Center, Inc. (TTCI), IDOT, the National Railroad Passenger Corporation (Amtrak), and major freight railroads. The resulting system will be referred to as the IDOT PTC system in this report.

The implementation of the IDOT PTC system on the St. Louis–Chicago corridor, heretofore referred to as the IDOT PTC, was intended to be on portions of the Joliet and Springfield Subdivisions of the Union Pacific Railroad (UP) between Ridgely, IL, and Mazonia, IL, a total of 120 miles (mi). The territory is equipped with a centralized traffic control (CTC) system with PTC envisioned as an overlay to the current control system. This corridor is referred to as the IDOT PTC Test Corridor in this report.

The implementation of IDOT PTC requires that trains be equipped with position monitoring systems and direct digital radio communications with the central processor in the control center. The PTC system monitors both equipped and unequipped trains. Unequipped trains are monitored through the block occupancy information from conventional track circuits transmitted to the PTC central processor via wayside interface units (WIUs). A simplified diagram depicting the PTC system is provided in Figure 1.1.

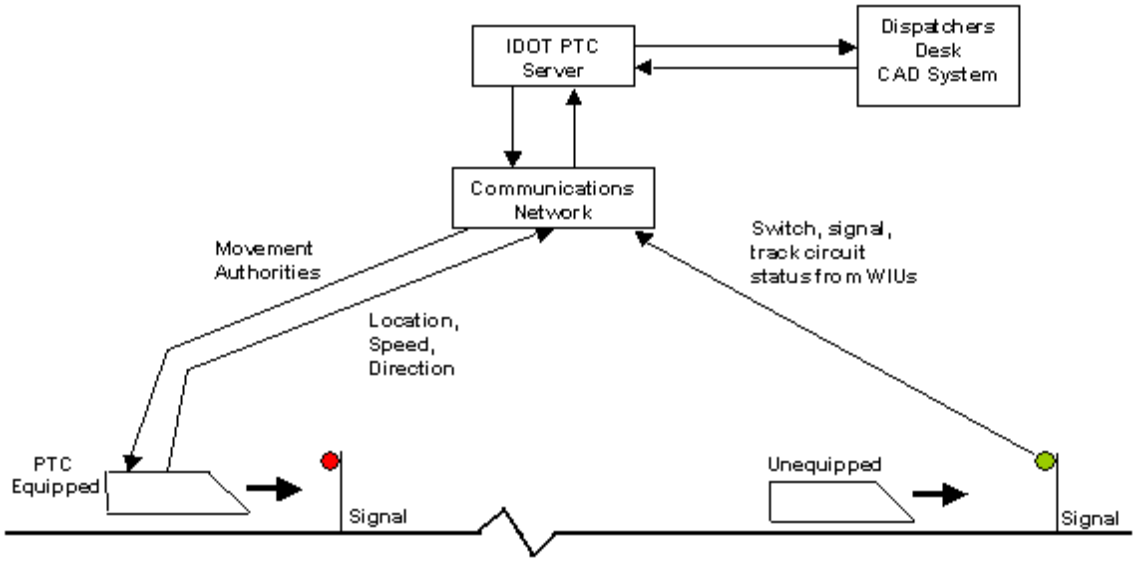


Figure 1.1. General Depiction of IDOT PTC System

It would not be practical to equip all freight trains operating on the IDOT test corridor with PTC. The proposed application of PTC by train type was as follows:

- All Amtrak passenger trains are to be PTC equipped 100 percent of the time.
- Seventy-five percent of UP local freight trains are to be PTC equipped.
- No UP through general freight or grain trains will be PTC equipped.

Generally, the General Code of Operating Rules (GCOR) adopted by most western railroads and UP's special instructions govern those train movements not affected by PTC. Appropriate additions and amendments to these rules would apply to operations of PTC-equipped trains in an active PTC system.

1.2 Problem Statement

This study is concerned with the performance of the communications network that provides the connections among trains, wayside devices, and the PTC server in the central office, in particular focusing on the potential for communications delays to have an adverse effect on the safety performance of the PTC system.

In general, two types of messages are communicated through the PTC system—those carrying functional data (e.g., location and speed of equipped trains, train movement authorities, track circuit status, switch status) and safety heartbeats. The heartbeat message generated by each system element informs other elements, including the central office system, that the originating system is healthy and that the communication is intact, thereby achieving a closed loop. During development of the IDOT PTC, it was determined that the throughput of the data radios originally specified for use in the system was not sufficient to support the total message load

generated in the IDOT PTC system as it performs all its design functions. Messages may be delayed or the communication system will declare a fault condition when the communication network is overloaded with the combination of functional data and safety heartbeats. Two fundamental measures of communication system performance are defined as follows:

- Timeout – the length of time that the PTC system detects no communication or a heartbeat message from a device within the system before it declares a "fault condition" and imposes appropriate actions for fail-safe protection. Timeout can be triggered by an actual fault or by delayed heartbeat messages due to overload.
- Latency – the length of time passing between when a communications message is initiated at the point of origin and when appropriate actions corresponding to that message are initiated at the destination system. This time includes the response time of any PTC subsystems involved in the message path and communications queuing delays.

The interval between heartbeat messages governs the time during which a PTC communications fault will be undetected. Naturally, quicker detection of a communications problem reduces the risk of a potential hazardous condition under PTC operation. However, more frequent heartbeat messages place a heavier load on the communication network and could increase the frequency of timeout events because of communications overload. The requirement and the extent of the communication network upgrade will be driven largely by the heartbeat frequency needed to ensure safe operations. The communications system must be able to carry the total communications traffic without excessive delay, which would lead to timeout events and unnecessary forced train stops because of apparent communications faults.

Given the importance of communications system performance to the safety and operability of PTC systems, the railroad industry is establishing a standard for high-performance data radio networks for current and future PTC system developments. With such an improved communications network, the necessary throughput and safety of the system can be achieved without overloading through more frequent exchanges of heartbeat messages among various elements of the system. An analysis method is required to determine the optimum timeout period for a vital PTC system. The approach to this analysis follows procedures established in FRA's *Standards for Processor-Based Signal and Train Control Systems* (49 CFR Part 236, Subpart H, effective March 7, 2005).

These standards require the operator of a rail line segment equipped with a novel system to submit a risk assessment that demonstrates that rail operations under the novel system are at least as safe as they were under the train control system previously used on the line segment. If installation of the novel system is accompanied by substantial changes in traffic mix, traffic density, and/or speed, then the risk comparison must be with an alternative base case representing the line equipped with a conventional train control system that would normally be used under the proposed operating conditions. The specific requirements for the risk analysis and safety performance are contained in paragraphs 236.907(7), 236.909, and Appendix B of the rule. Several discussions have taken place since publication of the FRA rule cited above, leading to preliminary agreement between the industry and FRA concerning the magnitude of speed and traffic changes that would trigger a requirement to define an alternative base case.

Following these standards, a risk analysis approach is used to establish the optimum timeout period for the IDOT PTC system. The risks associated with operations under the IDOT PTC system must not exceed those of operating with a base case system as defined in the FRA Standards. In this case, the base case(s) selected for this analysis must be consistent with proposed 110-miles per hour (mph) passenger train operations with the IDOT PTC system.

1.2.1 Analysis Objectives and General Approach

FRA has sponsored an independent risk assessment about the influence of the communications timeout threshold of the proposed IDOT PTC system on the overall safety performance of the system, as compared with base case, train control systems as defined in the FRA Standards. The base cases considered in this study were a cab signal system with continuous automatic train stop (ATS) system and a four-aspect cab signal system with speed control, termed an automatic train control (ATC) system, configured as currently used in Amtrak's Northeast Corridor (NEC) for high-speed passenger trains. It should be noted that the ATS system was the base case originally used in the IDOT PTC risk assessment for setting the level of risk that the proposed PTC system should not exceed.

The key objective documented in this report is determining the maximum communication timeout in the IDOT PTC system, as developed by Lockheed Martin for the NAJPTC program, so that this system will not impose a greater risk of train collisions, derailments, and accidents than cab signal systems with ATS and ATC. This analysis compared the IDOT PTC system operated with a mix of equipped and unequipped trains with the cab signal/ATS system as well as the NEC cab signal/ATC system operated with all trains equipped.

After the initiation of this study, the development of the IDOT PTC was terminated, and a new PTC development program was initiated at TTCI in Pueblo, CO, to build on the previous successes of the NAJPTC program. However, for the purpose of this analysis—which was intended to determine the optimum latency and timeout periods—using the IDOT PTC territory as a test case is still valid. The analysis conducted in this study will be valid for any similar territory.

A comparative quantitative risk analysis (QRA) was selected as the approach. The term "comparative" applies because the performance of the IDOT PTC system is assessed by comparison with appropriate base cases; the term "quantitative" is appropriate because numerical measures of risk are calculated in the analysis—in this case estimated accident numbers, casualties, and costs during 10 years of corridor operation. A comparative QRA is preferred to the alternative of an absolute QRA, where analysis results are compared with a numerical standard, because all risk analysis results are approximations and highly dependent on input data, and fewer sources of error are in a comparative analysis where many inputs do not vary between analysis cases.

A QRA involves first identifying relevant accident scenarios or those scenarios for which accident frequency and severity may be affected by the control system capabilities. Then risk is calculated for each accident scenario, operating state (normal and under different failure modes including during timeout for the IDOT PTC system), train type, operating conditions (train

speeds, traffic density, and traffic mix), and infrastructure conditions (number of tracks) and totaled to give overall risk. As well as total risk, risk analysis results are presented by train type, accident scenario, and location along the IDOT test corridor so that the analyst can understand how control system capabilities affect the results.

The risk calculation is carried out by using a multiworksheet spreadsheet model. A primary calculation spreadsheet performs the risk calculation for each accident scenario and frequency/consequence combination. Lookup tables are used to provide inputs needed to perform the calculations, such as:

- Accident frequencies for each scenario, usually expressed as events per million train-miles;
- Per-accident consequences (injuries, fatalities, and property damage) by speed, accident scenario, and train type;
- Route segment lengths, speeds, and passenger and freight traffic levels; and
- Grade crossing details and risk categories.

ENSCO assembled the team that performed this analysis. ICF Consulting (ICF) performed the majority of the analysis. Booz Allen Hamilton (BAH) provided key support in establishing the parameters associated with the different control systems as well as route characteristics and conducted essential analysis of various accident scenarios affecting the cases considered in this study.

1.3 Report Overview

Chapter 2 provides an overview of how the general approach to risk analysis was applied in this study; details on how calculations were actually implemented throughout the analysis are provided in the appendices. Chapter 3 provides the results of the analysis and conclusions are summarized in Chapter 4.

2. Description of Analysis

2.1 General Approach

A central problem in the risk comparisons in this analysis is the inevitable difference between the methods that are available to estimate risk for the base and PTC cases. The most obvious approach to estimating base case risk is to use historical accident data for comparable railroad operations, with adjustments to reflect the specific operating parameters of the line segment being analyzed (traffic density, speed, passenger/freight mix, etc.). Since there is a substantial volume of historical data, it is reasonable to have high confidence in the base case risk estimate, say ±20%. However, there is usually very limited information about the performance of individual train control system components that yielded this performance. Also, there is the implicit assumption that operating and maintenance practices, operating employee training and experience, and similar factors are typical of industry practice. Where historical accident data are used to estimate risks for a specific operation, taking into account highly localized variations in plant, equipment, personnel, and operations is nearly impossible.

With very limited operating experience with the NAJPTC system available, the risk estimates for the PTC case must be built from the bottom–up by using estimates of the failure modes**,** reliability, and availability of individual system components and subsystems. Many of these values will not be known with any accuracy, and therefore, confidence in the end result could be much lower than that associated with the base cases. This in turn means there will be diminished confidence in the comparison between base and PTC cases.

The way to minimize this comparability problem is to use a methodology in which the base cases and PTC case risk analyses start from a common reference point and follow parallel paths as much as possible. This reference point is termed the reference case. The reference case is one for which extensive historical accident data are available (accident frequency and consequence values for all relevant scenarios). Then accident frequencies and consequences for operations with the base and IDOT PTC cases are estimated as variations from the reference case. An approach of this nature has been adopted for this analysis and is described in the following paragraphs.

- ***Step 1: Define and analyze a reference risk analysis case***

  The reference case for the IDOT corridor serves as the starting point for both the two base cases and the IDOT PTC case. The reference case for this analysis is an operation with the same passenger and freight traffic operated with conventional CTC with maximum passenger train speeds of 79 mph. There is a large amount of historical experience with this type of operation from which to derive estimates of accident frequency and consequences for the relevant accident scenarios. Safety performance for the reference case is quantified by the estimated number and consequences of main-line accidents per year on the corridor, broken down by cause, and focusing on PTC-relevant accident scenarios. All accidents that a PTC, ATS, or ATC system might prevent were be designated as PTC relevant for this study, but only a subset of these would be potentially preventable by a specific individual PTC, ATS, or ATC system, depending on detailed system capabilities.

- ***Step 2: Define and analyze the safety performance of the base cases***

  The base cases considered in the study described in this document are briefly described as follows:

  ATS base case – a system using conventional-technology ATS combined with cab signals, enabling 110-miles per hour operations under current FRA regulations and guidelines. The ATS system will initiate braking if the engineer fails to acknowledge a more restrictive indication at a block or interlocking signal within 8 seconds (s). Directional coded track circuits are used for track-to-train communications.

  ATC base case – an ATC system combined with cab signals. The ATC system is similar to ATS with the additional capability to enforce approach and restricted speeds in response to signal indications. ATC does not enforce an absolute stop at block or interlocking signals. Historical data are drawn from the ATC systems used on the NEC and elsewhere.

  Both base cases analyzed in this study were developed by applying the aforementioned control systems on the IDOT corridor.

  Two methods were used to estimate the safety performance of the base case system and the results compared to reach a final estimate:

  a) Develop estimates of how many "reference case" accidents would be prevented by the ATS and ATC, taking into account system functionality, failure rates, time to repair, mix of equipped and unequipped trains, and similar factors.
  b) Derive an estimate from actual historical experience with the ATS and ATC in existing applications. Historical performance was adjusted for the base case operating conditions—speeds, number of running tracks, traffic mix, and traffic density.

- ***Step 3: Analyze the IDOT PTC case***

  The safety performance with PTC is analyzed under the same operating conditions as the base cases, also by estimating the number of "reference case" accidents that would be prevented by PTC, based primarily on system functionality, failure rates, time to repair, mix of equipped and unequipped trains, and similar factors. The lack of operating experience with PTC means that it was not possible to compare this result with actual historic data.

For both the base and the IDOT PTC analysis cases, the risk analysis considers the adverse effects on safety of operating in a degraded state after a failure, because of possible unfamiliarity with backup operating procedures, the "complacency effect" and similar factors. The complacency effect comes into play when an operator unconsciously relies on the backup provided by ATS, ATC, or PTC, even when it is known to be out of service. The more severe consequences associated with passenger trains operating at higher speeds (exceeding 79 mph) have been taken into account in each of the base cases and the PTC case.

The IDOT Test Corridor and Operation with PTC

The route over which all control systems are analyzed is UP's Joliet and Springfield Subdivisions between Ridgely, IL, and Mazonia, IL; the total length of the route is 120 mi. This corridor is equipped with conventional wayside automatic block and interlocking signals and CTC. PTC and the base case train control systems would be installed as an overlay on this existing signal system as originally envisioned in the NAJPT effort.

It would not be practical to equip all freight trains operating on the IDOT test corridor with PTC. The proposed application of PTC by train type was as follows:

- All Amtrak passenger trains are to be PTC equipped 100 percent of the time.
- Seventy-five percent of UP local freight trains are to be PTC equipped.
- No UP through general freight or grain trains will be PTC equipped.

The IDOT PTC system monitors trains that are equipped with the necessary PTC hardware as well as those trains that do not have the necessary equipment, referred to as unequipped trains. Unequipped train locations are monitored through the block occupancy information from conventional track circuits transmitted to the PTC via PTC WIUs and the UP Computer-Aided Dispatching (CAD) System.

The passenger trains operate over the full length of the IDOT test corridor. However, most freight trains operate over only a portion of the corridor, leading to variations in traffic level along the corridor. To capture the effect of these variations, the corridor was divided into three Sub-corridors. Details on the Sub-corridors and other spatial and temporal divisions used in the analysis are provided in Section 2.3.1.

ATS and Cab Signal Base Case

The ATS base case considered in the analysis documented in this report is the UP four-aspect cab signal system, configured as currently used elsewhere on UP, with all trains equipped. This system has a continuous train stop system. Whenever there is a downward change of cab signal aspect, the engineer is expected to acknowledge such a downward change by moving a lever within 8 s or a full service penalty brake application will be imposed. This alerts the engineer to the approaching signal aspect, which is also displayed by the cab signals, and can prevent collision accidents.

The capabilities of ATS with cab signals differ significantly from those of the IDOT PTC system. The differences that can affect accident risk as compared with the IDOT PTC case, and which are considered in the analysis, are:

- Speed, whether it is civil speed, maximum track speed, or signal speed, is not enforced.
- All trains are equipped to leave the terminal in accordance with operating rules and FRA regulations. Speed restrictions are imposed if the cab signal equipment fails en route and the equipment is cutout.

- The conveyance of signal aspects to the locomotive is through coded track circuit signals. Failure of the system will flip the cab signal to a restricting aspect within a very short time.
- Unlike the IDOT PTC, the cab signal equipment on board a train can detect a broken rail and shunting of the track circuit ahead of the train in the same signal block, causing the cab display to be flipped to restricting signal.
- This analysis assumes a maximum of 3-second latency (95 percent of the time) with the coded track circuits used with ATC and ATS. With coded track circuits, latency is the time interval between an event that changes or interrupts the track circuit (such as a changed signal aspect or an intrusion into an occupied block) and the corresponding change on the in-cab signal display. Latency values are lower than those with PTC because there are no radio communications delays.
- Work zones are generally not protected by the cab signal systems.

NEC ATC Base Case

The ATC base case identified for consideration with the IDOT PTC system is the four-aspect cab signal system with ATC, configured as currently used on the NEC by Amtrak for the high-speed passenger trains. All trains operated on the IDOT test corridor would be equipped under this case. Whenever there is a downward change of cab signal, the engineers, as in the ATS base case, are required to acknowledge the change by moving a lever within 8 s or the system will initiate penalty braking. With ATC, additional protections are provided. The engineers need to initiate brake reduction to suppress the penalty application. Eventually, the braking increases to the full service rate, thus permanently suppressing the penalty. The engineer can release the brake only when speed is reduced to what is appropriate to the signal aspect, or the signal aspect changes to allow a higher speed. This ensures overspeed protection for each cab signal aspect down to restricted speed. The ATC system does not enforce an absolute stop at block or interlocking signals. Except for this speed enforcement, there are no differences in capabilities between ATS and ATC.

2.2 Risk Analysis and Model Description

As indicated in Chapter 1, risk is calculated for each accident scenario, operating state (normal and under different failure modes), train type, operating conditions (train speeds, traffic density, and traffic mix), and infrastructure conditions (number of tracks) and totaled to give overall risk and breakdowns of risk by any selected parameter (e.g., location, train type, and accident scenario).

In risk analysis, risk is normally defined as the product of accident frequency and consequences:

$$[\text{TOTAL RISK}] = \Sigma\{[\text{ACCIDENT FREQUENCY}] \times [\text{ACCIDENT CONSEQUENCE}]\}$$

where:

RISK is the aggregate harm caused by all accidents. Either injuries plus fatalities as reported to FRA or a total harm financial measure can be used. Total harm is the sum of

damage and a dollar value is assigned to casualties by using standard DOT values for injuries and fatalities as widely used in transportation safety analyses.

[ACCIDENT FREQUENCY] is an accident rate expressed as the number of accidents per unit of exposure. The most common measure is accidents per million train-miles. This measure was used for passenger train accidents, and a combination of train- and car-miles was used for freight train accidents depending on accident cause; human factors accidents are usually a function of train-miles, and accidents due to mechanical failures of car or track components are a function of car-miles rather than train-miles. For grade crossing collisions, the exposure measure is the number of times a train passes over a crossing.

[ACCIDENT CONSEQUENCE] is the harm caused a single accident (injuries, fatalities and property damage) and varies by train type, train size, speed, accident scenario, and similar factors.

[TOTAL RISK] is the sum of all risks associated with a particular system.

Individual risks are calculated from frequency and consequences for each combination of accident scenario, distinct operating environment, and operating state:

- Each accident scenario and Sub-scenario;
- Train control system operating state (i.e. normal, timeout, and fallback states); and
- Operating conditions by route segment and time period (train speed, traffic density, traffic and mix for both summer and the "rest of the year").

As discussed in the previous chapter, the risk analysis detailed in this report is a comparative quantitative risk analysis (comparative QRA); the risks associated with each of the control systems are compared with one another. The output of the QRA is an estimate of the occurrence of undesired events during a defined period (e.g., 1 year's operation of a rail corridor). This analysis will focus on estimating the number of accidents and per-accident consequences (e.g., fatalities, injuries, damage, and other costs). All risk analysis results are estimates, and results are highly dependent on availability of good accident frequency and consequence estimates. Risk comparisons are more reliable than absolute risk estimates, because many inputs do not vary between analysis cases.

The risk calculation for each control system is carried out by using a Microsoft Excel spreadsheet model made up of several individual worksheets, as described below:

- **Worksheet 1:** "Segment Definition and Timeout Effects." This worksheet estimates the probability that collisions between equipped and unequipped trains can be prevented or mitigated. Definitions of route segments and traffic data are introduced, and collision-preventability calculations are carried out based on stopping distances and, in the case of the PTC system, timeout. Because timeout affects the results of calculations in this worksheet, this is a very important part of the calculation procedure for the IDOT PTC analysis case. It

is less critical for the base cases, where there is no timeout effect, and there are no unequipped trains.

The purpose of Worksheet 1 is to estimate the probability that a signal violation by an unequipped train will result in a collision with an equipped train. This probability is a function of the location of the equipped train relative to the signal at which the violation occurred and whether the equipped train would be alerted of the violation in time to stop before colliding with the unequipped violating train. To carry out this calculation, risk zones were defined for the position of the equipped, or "innocent," train at the time of the signal violation, as illustrated in Figure 2.1.

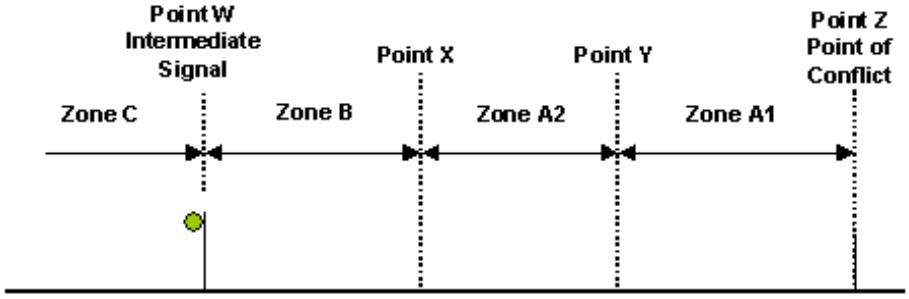


Figure 2.1. Risk Zones for Equipped Train Approaching a Point of Conflict

The ability of the equipped train to stop before Point Z depends on its risk zone location at the time of violation and, for PTC, timeout status. The zones for the location of the equipped train at the time of the violation are as follows:

- ***Risk Zone A1***, between Points Y and Z: equipped train is unable to stop or reduce speed significantly before reaching the point of conflict.
- ***Risk Zone A2***, between Points X and Y: equipped train can reduce speed sufficiently to reduce the consequences of a collision but is unable to stop before reaching the point of conflict.
- ***Risk Zone B***, between Points W and X: equipped train has passed the intermediate signal at point W but receives a warning, or the IDOT PTC timeout expires and can stop before the point of conflict.
- ***Risk Zone C***, before the intermediate signal at Point W: if the equipped train is in this zone at the time of the signal violation by the unequipped train, the engineer can see the intermediate signal change to "approach" or "stop" aspect.

The detailed approach to estimating the length of the risk zones and the relationship to collision risk is described in further detail in Appendix A.

- **Worksheet 2:** "Collision Probability and Preventability." This worksheet calculates an estimate of the frequency of train-to-train collisions for each train type pair that could be involved in a collision (freight and passenger, equipped and unequipped) and type of

collision (head-on, side rear-end) as a function of the mix of train types, characteristics of track segments, and collision preventability data from the Worksheet 1 calculations.

- **Worksheet 3:** "Risk Calculation." This worksheet carries out the basic risk calculations to estimate risks (injuries, fatalities, property damage) for all other PTC-relevant accident scenarios, including overspeed, grade crossings, work zones, and broken rails. Each worksheet of this type calculates risk for one route Sub-corridor, season, and train control system operating state (normal, in timeout). The capability of a control system to reduce accident severity is estimated by performing risk calculations within this worksheet by using slightly modified values of accident consequences.

A separate worksheet titled "Inputs" contains lookup tables providing the required model inputs, such as:

- Per-accident consequences by speed, collision scenario, and train type;
- Route segment lengths, speeds, traffic volume and mix, and grade crossing characteristics;
- Reference case accident frequency for each PTC-relevant scenario; and
- Accident preventability estimates for the analysis case for each accident scenario.

Multiple risk calculation modules, each consisting of one set of Worksheets 1, 2, and 3, are used to make up the full analysis of one train control system. Individual calculation modules are devoted to:

- Each of the three Sub-corridors;
- Each season (along this route there is a seasonal variation in the number of grain trains operated); and
- Each operating state (e.g., operating normally and in timeout, where applicable).

Model inputs can be categorized by whether they change from control system to control system or whether they are fixed for all systems or analysis cases. In general, model inputs can be associated with one of three categories:

- Fixed inputs used in all analysis cases/control systems. These inputs have a limited effect on comparison results and include:
  - Infrastructure details and segment definitions, including speed limits for passenger and freight trains, except for the CTC reference case where passenger train speeds are limited to 79 mph;
  - Train braking formulas;
  - Reference case accident frequencies; and
  - Accident consequences by scenarios and speed.
- Fixed inputs used in all analysis cases/control systems that may have moderate effect on comparison results. These include:
  - Traffic volume and patterns (by altering the relative exposure of different trains and/or differently equipped train types to collisions).

- Inputs that vary between analysis cases and that can have significant impact on comparison results. These include:
  - Control system capabilities (which accidents can be prevented or mitigated and how effectively this can be done);
  - Accident preventability characteristics; and
  - Characteristics specific to the IDOT PTC system and analysis case such as timeout and latency.

A final Excel worksheet entitled "Results Summary" provides risk subtotals and totals for a given analysis case/control system. Track and route parameters, passenger and freight train speeds, and train schedules are held constant across all risk assessments. In addition, a separate Excel workbook was prepared to assemble the results summaries from all analysis cases in one place, rather than scattered among a number of individual workbook models. This "Results" workbook was the primary reference for the results section (Chapter 3) of this report.Detailed descriptions of the calculations carried out in each portion of the risk model are provided in the appendices; Appendix A contains material related to Worksheet 1 ("Segment Definition and Timeout Effects"), including a detailed treatment of the use of the risk zones, Appendix B provides information pertaining to Worksheet 2 ("Collision Probability and Preventability"), and Appendix C includes details on Worksheet 3 ("Risk Calculation").

2.3 Representing the Corridor and Control System in the Models

Many factors have to be considered in constructing a risk model. In this case, the model had to be structured to take into account special and/or temporal variations in infrastructure, traffic mix, and traffic volume as well as in the operating states of the control systems. This section provides a discussion of how these variations were represented in the risk model in the analysis of the IDOT PTC case, the ATS base case, and the ATC base case.

2.3.1 Temporal and Spatial Variations on the IDOT Corridor

Accident risk on a rail corridor is primarily a function of operating conditions, specifically:

- Traffic density (trains/day);
- Traffic mix, relative numbers of passenger and freight trains, and whether they are equipped with train control devices;
- Speeds of passenger and freight trains;
- Signal system types, layout (block lengths), and capabilities;
- Number of main tracks (which especially affects traffic density per track and the frequency of potentially conflicting movements); and
- Special features that can represent a hazard, such as diamond crossings and/or moveable bridges.

Operating conditions on a railroad can vary both spatially and temporally. For example, traffic density and mix can vary by time of day, day of week, and seasonally. Train speeds typically vary along a rail route, depending on local infrastructure details such as curvature, junctions, and grades. Other spatial variations include number of tracks, signal block lengths (which can affect the ability of a train to respond to a changed signal indication), and traffic mix, and traffic density.

In this risk model, the approach to covering the key temporal and spatial variations in the model was to divide the overall operation on the IDOT corridor into temporal and spatial units within which operations are constant, perform the risk calculation for each unit separately, and then total them to obtain overall risk. The specific significant spatial and temporal variations represented in the models are as follows:

Sub-corridors

Sub-corridors are defined to capture the most significant spatial traffic variations. Three Sub-corridors have been defined:

- Joliet Sub-corridor – Mazonia, IL (MP 62.60), to the siding at Bunge (MP 88.35); Mazonia is considered an end point of the corridor, and the Bunge siding is where grain trains come for loading and is, therefore, the origination and termination point of some grain train trips.
- Bloomington Sub-corridor – Siding at Bunge (MP 88.35) to the Yard at Bloomington, IL (MP 124.86); Bloomington represents a point of origination for local freight trains and a point at which trains from other railroads enter the IDOT test corridor.
- Springfield Sub-corridor – from the Yard at Bloomington, IL (MP 124.86), to Interlocking at Ridgley, IL (MP 180.99); Ridgley is considered an end point of the corridor.

Detailed infrastructure and operations data the IDOT corridor used to develop these Sub-corridors were provided by BAH and are included in Appendix D.

Seasonal and Other Temporal Variations

The grain trains do not operate during the summer months of July, August, and September. Thus, a significant change occurs in traffic density and mix between these summer months and the rest of the year.

Two seasonal periods are represented in the model:

- A 3-month summer period, without grain trains; and
- A 9-month fall/winter/spring period with grain trains.

Although day-of-week traffic variations occur, with selected local and through freight train trips operating between 1 and 5 days per week, attempting to perform model runs for each day of the week would have made the model excessively complex. Average traffic level and mix are assumed for all 7 days of the week for estimating collision frequencies and are combined with

reviews of day-by-day operating string charts for analyzing the occurrence of meets and passes by train type.

Spatial Variations within Sub-corridors

The most critical issue in this risk analysis is the ability of the IDOT PTC and the base case train control systems to prevent collision accidents and the influence of IDOT PTC communications timeout on those risks. In the IDOT PTC case, the traffic mix includes both equipped and unequipped trains, and the collision scenario most influenced by timeout is when an unequipped train fails to observe a stop signal and is in danger of colliding with an equipped train. In this situation, signal block length is a critical parameter in calculating risk, along with timeout and latency. Therefore, each Sub-corridor was divided into segments corresponding to signal blocks for the risk calculation. The signal blocks are typically between 2 and 3 mi. Grade crossings and diamonds are analyzed separately as point hazards.

2.3.2 Operating States

Risk will vary with the operating state of the particular train control system. The operating states that could exist in the system and that could estimate the fraction of train-miles operated in each state need to be defined. In particular, train-miles operated while a portion of the PTC system communications network affecting a specific train is in timeout is a key parameter in this analysis. There are three operating states for the IDOT PTC system:

- ***Normal operation:*** The IDOT PTC system is working as designed and tested, with all functions available. The only communications delays are those due to normal system latency, which can be between a minimum of 3 s and the full timeout at a maximum. An average latency of 10 s was used for the analysis of timeout variations, based on field observation of the IDOT PTC system during trials. Separately, the model runs explored the effect on risk of varying latency. More exactly, if information were available on the distribution of latency (mean and standard deviation), it would be possible to understand the relationship between latency distribution, timeout, and the chance that latency would exceed timeout and trigger a timeout event. The system designers' objective is to select a timeout value that does not trigger an excessive number of timeout events due to communications congestion and queuing, rather than actual communications failures.

  Latency affects all communications messages between trains, the control system, and wayside systems and devices. In the case of any violation of authority by an unequipped train, an approaching equipped train will receive a message revising its movement authority after latency has expired. Thus, latency has a direct effect on the chance that the violation will result in a collision.

- ***Operation in timeout:*** Communication links that form the IDOT PTC system are checked regularly by a "heartbeat" message that must be sent and correctly returned over each link. If a specified interval elapses without any heartbeat message, a communications fault will be declared and the system will resort to a "fallback" mode (this term is defined below). This interval usually is the time period in which at least two heartbeat messages would have been sent. During this interval (termed the "timeout period"), if a normal communications message is received, the timeout period will be

automatically reset as if a heartbeat message had been received. However, the heartbeat checks use the limited communications capacity of the IDOT PTC system, and the timeout period has to be on the order of 100 s or greater to avoid timeout events as a result of communication delays. A failure of one of the links in the system during the timeout period can mean that a key safety message could be interrupted and fail to reach an affected train or trains. The PTC system would appear to be working correctly to the on-board system until the timeout period expires without receiving a normal communications or heartbeat message, at which point the system will assume a problem exists, announce a failure, and initiate braking. Thus, accident risk increases during timeout.

- ***Operation in fallback mode:*** After a system failure of any kind, affected trains will stop and will then continue operating in a "fallback" operating state. Since the IDOT test corridor is equipped with CTC and wayside block and interlocking signals, the fallback state is assumed to be CTC, under which passenger trains may operate at up to 79 mph.

The challenge is then to estimate what fractions of train-miles are operated under each of the three operating states. Then risk analyses can be performed for the period each operating state is in effect and summed to get an estimate of overall risk. In the case of the IDOT comparative analysis, risks are estimated for a period of 10 years of operation, primarily so that risk can be expressed in terms of estimated injuries, fatalities, and property damage without many results being very small and hard-to-interpret numbers.

As far as can be determined, no information is readily available about the frequency of occurrence of timeout events or duration of the following outage for the IDOT PTC system or for the two base case train control systems. Anecdotal information suggests that trains will be operating in a fallback state (CTC in all cases) for between 3 and 8 percent of train-miles operated. The duration of an individual outage might vary widely. A fault in the on-board system of an individual locomotive would not be repaired until the train completed its trip and the locomotive could receive attention from maintenance staff. A fault in wayside or central office equipment might take anywhere between 30 minutes (min) to several hours to repair, depending on the complexity of the problem, how far maintainers have to travel, and availability of the required part. A timeout event due to communications congestion or an unknown intermittent fault could be checked out, and the system returned to service in a few minutes.

The fraction of train-miles operating in timeout can be estimated from the duration and frequency of timeout events, starting from an estimate that 5 percent of train-miles are operated in the fallback mode, and assuming a timeout precedes each period of operation in fallback mode. The calculation is performed separately for passenger and freight trains and for on-board and wayside failures.

Passenger Trains, On-Board Failure

Passenger trains will traverse the whole IDOT corridor (118 mi) in a period of approximately 2 hours at an average speed of 60 mph (88 feet (ft)/s), including stops. In a typical failure, the train will travel approximately half this distance (59 mi) in fallback mode. The distance traveled in timeout will be a function of average speed and timeout. If the duration of timeout in seconds is

represented by TO, then the ratio between train-miles in timeout and train-miles in fallback mode is as follows.

$$\text{Ratio} = [\text{TO} \times \text{speed (ft/s)}] / [59 \times 5280]$$
$$= \text{TO} / 3540, \text{ if average speed is 60 mph (88 ft/s), including stops} \quad (1)$$

Freight Trains, On-Board Failure

Most freight trains travel over approximately half of the corridor (59 mi north or south of Bloomington) over a period of 1.5–2 hours, depending on the number and duration of stops. Average speeds are approximately 35 mph (51 ft/s) including stops. Using the same logic as for passenger trains, the ratio between distance traveled in timeout and distance in fallback mode is:

$$\text{Ratio} = [\text{TO} \times \text{speed (ft/s)}] / [0.5 \times 59 \times 5280]$$
$$= \text{TO} / 3100, \text{ if average speed is 35 mph (51 ft/s), including stops} \quad (2)$$

Wayside Failure

The ratio between train-miles during timeout and train-miles in fallback mode is simply given by the following formula:

$$\text{Ratio} = [\text{TO}] / [(\text{duration of downtime in hours}) \times 3600] \quad (3)$$

A detailed analysis was carried out to confirm that this relationship was independent of train speed, traffic levels, and the length of track affected by the communications failure, as follows:

If:
L = length of track affected by the failure (miles)
N = number of trains/day
A = average speed of trains (mph)
D = duration of downtime (time to repair) (hours)
DO = duration of operations in a day (hours)

then the chance that a train is in the failed zone is given by:

$$\text{Chance} = [N \times L] / [A \times DO] \quad (4)$$

Distance traveled during timeout is given by:

$$\text{Distance (ft)} = \text{TO} \times \text{Chance} \times A \times 88/60$$
$$= [\text{TO} \times N \times L \times 88] / [DO \times 60] \quad (5)$$

where the ratio 88/60 is used to convert speed in mph to ft/s.

Distance traveled in fallback mode (in the failed zone during the duration of the failure) is given by the formula:

$$\text{Distance (ft)} = [D \times N \times L \times 5280] / DO \quad (6)$$

The ratio is given by dividing Formula 2 by Formula 3 in which the parameters N, L, and OP cancel out, giving:

$$\text{Ratio} = [TO \times 88] / [D \times 60 \times 5280] = TO / [D \times 3600] \quad (7)$$

Taken together, Formulas 1, 2, and 3 all indicate that the ratio between train-miles during timeout and train-miles in the fallback mode is between TO/3000 and TO/5500 where the time to repair for a typical wayside failure is 1.5 hours. TO is measured in seconds. The ratio is sensitive to train speed and trip length for on-board failures but not for wayside failures. Because no information on the relative incidence of wayside and on-board failures exists, and train speeds in timeout are the same as when operating normally, a mean ratio of TO/4300 was used in all IDOT PTC analysis cases.

As an example, for TO of 120 s and 5-percent train-miles operated in fallback mode, the percentage of train-miles operated in timeout is given by:

$$5\% \times 120/4300 = 0.14\%$$

The analysis considers only normal operation and timeout operating states. The fallback mode (conventional CTC operations) is assumed to be the same for all analysis cases, both in aggregate duration and safety performance, and thus does not affect the risk comparison between the IDOT PTC system and the base case systems.

2.4 Accident Scenarios Included in the Analysis

Accident scenarios are discussed in more detail in Appendix E. This section summarizes the accident scenarios as they pertain to this analysis.

The objective of the risk analysis is to evaluate the relative safety performance for the IDOT PTC system relative to that for each of the base cases. Thus, the analysis includes all accident scenarios where the frequency or consequences of an accident could be changed by PTC or cab signals with ATS and/or ATC. These are termed PTC-relevant scenarios and are composed of the following:

- Train-to-train collisions of all kinds, including collisions at diamond crossings with trains on another rail line.
- Collisions between an active train and a rail vehicle or vehicle lading that has intruded on the track occupied by the active train.
- Overspeed derailments.
- Broken rail derailments, where the broken rail can be detected by the train control system.
- Work zone violations.
- Grade crossing collisions with a highway vehicle, where a crossing warning system malfunction can be detected by the train control system.

These scenarios are described in more detail in the paragraphs below.

Train-to-Train Collisions

Train-to-train collisions are collisions between two trains, both of which are moving over the IDOT corridor on main-line tracks under the control of the signal and train control system. Collisions are most commonly caused when one train fails to observe signals and operating authorities or when the engineers receive conflicting instructions from the dispatcher. Less commonly, collisions can be caused by a failure of on-board equipment such as brakes or in the signal, train control, or communications systems.

There are many sub-scenarios of train-to-train collisions to take into account factors that affect either the frequency or consequences of collisions. Those included in the analysis are:

- Factors affecting collision frequency:
  - Traffic density and mix: The number of trains/day and the distribution between passenger trains, PTC-equipped freight trains, and unequipped freight trains. Base collision frequency and the distribution between meets and passes are governed by the traffic mix and operating pattern. For example, passenger trains tend to be concentrated in the morning and late afternoon periods with freight trains predominately in the late morning and early afternoon. Collision frequency is estimated for each possible combination of train types.
  - Collision frequency variations as a function of route segment type: Collision risk is not evenly distributed along the line. A review of historic accident data suggests that on a single-track railroad, collision risk is higher at passing sidings and especially on the single-track segments before and after a siding. Appropriate frequency adjustments are applied to each segment type
- Factors affecting collision consequences:
  - Train types involved in the collision: Consequences are much more serious with passenger trains than freight trains given the numbers of passengers at risk of becoming casualties and the high value of passenger cars relative to freight cars and their contents.
  - Colliding vehicles in the collision: Whether the collision involves a locomotive hitting another locomotive, a locomotive hitting a freight car or a locomotive hitting a passenger car. Because of the wide differences in consequences of accidents between passenger and freight trains, the model calculates consequences separately for each train involved in a collision, taking into account the types of colliding vehicles and trains involved.
  - Train speed: Consequences vary substantially with train speed, broadly as a function of the kinetic energy to be dissipated in a collision.

Diamond collisions are a special case of train-to-train collision, where collision frequency is a function of traffic density on both lines. Factors affecting consequences are the same as above, except that the chance of a locomotive-to-locomotive collision is assumed to be negligible, and all collisions are locomotive to passenger or freight car.

Intrusion Collisions

Intrusion collisions occur when rail cars or their lading intrude from an adjacent track onto the active track and are hit by active trains. There are two subgroups of intrusion collisions:

- The first is at a connecting switch where a rail vehicle rolls out to foul the main line. This can be due to an improperly secured vehicle, a vehicle released by vandals, misjudged switching movements on the connecting track, and similar factors.
- The second occurs away from connecting switches, where a derailed vehicle or a shifted load on an adjacent track fouls the main line.

These subgroups are analyzed separately because they differ in frequency, in consequences, and in potential preventability by the PTC or base case train control systems.

Overspeed Derailments

IDOT PTC can enforce permanent and temporary civil speed limits, including maximum speed through turnouts, for example, when entering a passing siding instead of taking the main track. The base case train control systems lack this capability.

Broken Rail Derailments

Broken rail can be detected by the train control system. Conventional track circuits can detect a completely broken rail—provided that the signal block is unoccupied by a train. To warn an approaching train, the circuit changes the signal controlling entry to the block to red and alerts the approaching train through the PTC system, where available. Coded track circuits, as used for the UP and NEC cab signal systems, can warn an approaching train of a broken rail, even if the train has already entered the signal block in which the break occurred.

Work Zone Violations

IDOT PTC can prevent work zone violations when trains pass through a zone at an excessive speed or if they enter a work zone without authority from the supervisor responsible for activities in the work zone. IDOT PTC may also monitor the movements of on-track work equipment that does not normally shunt track circuits. The base case train control system lacks these capabilities.

Grade Crossing Collisions

Grade crossing collisions are defined to be collisions with a highway vehicle at a grade crossing that are reportable to FRA as a train accident. A portion of grade crossing collisions between a train and a highway vehicle are caused by a failure of the crossing warning system (e.g., gates, lights, or bells). IDOT PTC can warn the train if the crossing warning system fails to operate correctly and allows that train to initiate failed crossing procedures. Even if the first train to detect the malfunctioning crossing system cannot stop before the crossing, PTC will alert the dispatcher to notify subsequent trains and send a maintainer to inspect the crossing. The base case train control systems lack this capability.

2.5 Key Model Inputs

The risk model requires a large number of numerical inputs to perform the risk calculations as described in Section 2.2. In many ways, determining appropriate values for model inputs is the most critical and time-consuming activity in a risk analysis of this type. Estimating the input values require extensive statistical and engineering analyses, operating simulations, or reviews of past analyses conducted for similar projects. Examples may include statistical analysis of historical accident data, detailed engineering analyses (e.g., of crushing and train dynamics in collisions), or simulations of train operations over a route to determine the occurrence of meets and passes. In many cases, analyses carried out for past similar projects can be adapted for the current project, reducing the total effort involved.

To facilitate risk calculations for varying input parameters, all model inputs have been concentrated into a series of lookup tables on a single worksheet in the model, which is referenced by the worksheets that carry out the risk calculations for each operating state, Sub-corridor, and season. In most instances, additional model runs can be accomplished with modest effort by only changing the parameter of interest on the input worksheet. A full description of the data and their sources is given in Appendix F.

The following sections provide a summary of the principal groups of inputs and the data sources and analyses performed for this effort.

2.5.1 Route, Traffic, and Train Data

These data groups essentially define the operations and operating environment on the IDOT test corridor. The data and data sources used are as described in following paragraphs.

Route Data

The model calculates risk along the IDOT test corridor segment by segment, where segments are signal blocks as described in Section 2.3.1. The input table used in the risk calculation spreadsheets provides milepost locations for the beginning and end of signal blocks and a representative speed for freight trains as well as conventional and high-speed passenger trains for the signal block. Also listed in the table is the type of segment (because risk varies by segment type) and representative speed, which is the typical average speed at which trains may be expected to operate through the segment. Separate tables are provided for each Sub-corridor along with counts of diamond crossings and grade crossings by type of crossing warning system. Route data was taken from track charts and other information provided by the IDOT PTC project as presented in Appendix D.

Traffic Data

Traffic data provided by FRA are summarized in Table 2.1.

Table 2.1. Traffic Data by Sub-corridor and Season

Train Type	Average One-Way Trips/Day					
	Joliet Sub-corridor		Bloomington Sub-corridor		Springfield Sub-corridor	
	Summer	Rest of Year	Summer	Rest of Year	Summer	Rest of Year
Passenger	6.00	6.00	6.00	6.00	6.00	6.00
Equipped freight	1.07	1.07	1.07	1.07	0.86	0.86
Unequipped freight	0.36	0.36	0.36	1.21	0.87	2.30
Operating days	91	274	91	274	91	274

Train Data

The primary train characteristic used in the model is braking distance as a function of speed. Braking distance formulas, including safety factors, were obtained from Amtrak and the IDOT PTC project. It is understood that these are the same formulas as have been used in previous risk analyses for the IDOT corridor.

2.5.2 Train-to-Train Collision Frequencies and Distribution

This category includes all collisions between active trains, including head-on, rear-end, and side collisions involving two or more active trains, as reported to FRA, but not with cuts of cars during switching operations or cars that have rolled out from a siding. Collisions at diamond crossings are also analyzed separately.

The basic approach used in the model, as described in Section 2.1, is to estimate accident frequencies for a reference analysis case (conventional CTC with wayside signals and 79 mph maximum speed) and then estimate what fraction of those accidents would be prevented by each train control system being analyzed. Thus all accident frequencies are for CTC operations without train control of any type. The frequency for train-to-train collisions for this corridor for CTC operation was estimated to be 0.030 collisions per million train-miles. This number was obtained from analyses of FRA accident data performed by ICF for previous risk analyses, with adjustments for traffic density, single track, absence of major passenger terminals, and similar factors. Historical data suggest that these collisions are not uniformly distributed along the corridor but tend to be concentrated in high-risk areas, especially on single-track segments before and after a passing siding. Because of this effect, collision frequencies were adjusted to reflect risk for each segment type. A full description of the derivation of this frequency and all other details pertaining to accident frequencies is provided in Appendix F.

Then the distribution of collision accidents among different train pairs involved in collisions, and among head-on, rear-end and side collisions, was estimated. A distribution of collisions among all possible combinations of train types (passenger, equipped freight and unequipped freight trains) was estimated from the relative numbers of daily trips, modified by a review of string chart simulations of operations on the IDOT test corridor. Finally a distribution of collisions between head on and rear-end or side collisions was developed from the detailed accident scenarios, the mix of meets and passes shown in the operations simulations and historic data.

2.5.3 Collision Accident Consequences

Because of substantial differences in consequences (injuries, fatalities, and property damage) between passenger trains and freight trains, consequences are estimated per train involved in a collision. Separate consequence values are estimated by representative speed and whether the colliding vehicle in the train is a locomotive or a car and whether the locomotive hit another locomotive (as in a head-on collision) or a car (as in a side or rear-end collision). All consequence data were derived from FRA accident reports and reflect the severity thresholds used in those reports. As much as possible, use was made of consequence estimates developed by ICF for previous risk analyses.

One potentially important aspect of the risk analysis involving comparisons between several control systems is variation in the ability of each system to reduce the severity of accidents that occur. The effect of this variability was examined in a set of sensitivity analyses, one for each train control system.

To implement the capability to analyze the effect of this variability in the risk model for each control system considered in this analysis, consequence adjustment factors were applied to the base consequence values. The consequence adjustment factors are multipliers, estimated for each accident scenario, which when applied to the base consequence values provide the adjusted consequence values that are used to arrive at the model result. For the IDOT PTC model, two separate sets of consequence adjustment factors and adjusted consequence values are required—one set for the system in the normal operating state and one set used in a timeout state. With a timeout of 120 s or greater, there are no reduced consequence accidents; it is not possible for the IDOT PTC system in timeout to respond quickly enough to reduce the consequences of an accident. More details on the adjustment of consequences are provided in Appendix F.

2.5.4 Frequencies and Consequences for Other Accident Scenarios

Rollout and Other Intrusion Collisions

Two types of intrusion collision were analyzed—accidents occurring at or near a switch where a cut of cars rollout onto the main line and into the path of an active train and other intrusions caused by a derailment on an adjacent track or a shifted load. The frequency and consequences of both kinds of intrusion were estimated from historic accident data, reviewing collision descriptions in FRA reports to distinguish between rollouts as here defined and train-to-train collisions.

Diamond Crossing Collisions

As with grade crossing collisions, diamond crossing collision frequency is estimated as a function of the number of times that an active freight or passenger train passes over a diamond. There are four diamonds in the IDOT test corridor, and as collision risks at diamond crossings are a concern to FRA, some effort was devoted to deriving a reliable estimate of accident frequency. Two approaches were used—an estimate that was based on the analysis of historic diamond collision data and an estimate that was based on an analogy with meets and passes. The historic analysis was based on accident history in Illinois only, because diamonds and diamond accidents appear to be very unevenly distributed around the United States, and national data would not be representative. The second approach involved developing an estimate of the occurrence of "signals passed at danger" that led to collisions and applying this to operations across a diamond and reconciling the two estimates. Consequences for diamond collisions are the same as for train-to-train side collisions.

Overspeed Derailments

Frequencies and consequences for overspeed accidents were derived directly from FRA data, with a careful review of the accident description to ensure that the accident fit with the definition of overspeed. For example, a collision that results from not observing restricted speed rules in poor visibility is treated as a collision in the model because of the difference in consequences. It is noteworthy that for passenger trains especially, overspeed derailments often result from not observing a speed limit at the turnout into a siding rather than exceeding a posted speed on the mail line. This means a straight route with few speed restrictions on the main line is not immune from overspeed derailments.

Broken Rail Derailments

A few broken rail accidents involve a complete rail break before the arrival of a train. The track circuit detects the rail break, and approaching trains are warned via wayside signals and the train control system. Complete pull-aparts cause only a small fraction of all broken rail derailments, but given the large number of derailments overall, preventing a small fraction could be a significant contribution to overall safety. In the model, the reference case broken rail frequency is for all broken rail derailments, and the fraction of those derailments that could be prevented by PTC or cab signals with either ATS or ATC is entered as a preventability factor. Both broken rail frequency and consequences were derived directly from historic FRA data for the reference case.

Grade Crossing Collisions

Grade crossing collision frequencies and consequences were derived from historic FRA data for grade crossing collisions classified as train accidents by FRA. Grade crossing accidents that do not cause damage to railroad equipment exceeding the FRA accident reporting threshold are not included. This means that consequences only include injuries and fatalities for railroad employees and passengers and damage to railroad property. Total consequences do not include

casualties among highway vehicle occupants or damage to highway vehicles. Extensive use was made of grade crossing collision data from previous ICF corridor risk analyses.

Grade crossing collisions were included in the analysis because of the feature of PTC that notifies approaching trains of a crossing warning system malfunction. This forewarning means that the PTC-equipped train may be able to prevent a crossing accident by slowing or stopping before the crossing or by earlier implementation of operating procedures for a failed crossing.

Work Zone Intrusions

Work zone intrusions can result in collisions with maintenance or inspection equipment, as well as hitting members of a work crew. Collisions with equipment are reported as train-to-train or intrusion collisions and have been included in the model under those categories. Intrusions that cause casualties among track workers not reported as collisions are included in the model under this heading. Injury and fatality rates per million train-miles are estimated from historic data for on-track maintenance of way employees and contractors after attempting to distinguish between those in formal work zones that would be protected by PTC and those that would not be so protected.

Summary of Accident Frequencies

Accident frequencies developed for the CTC reference case are summarized in Table 2.2.

Table 2.2. CTC Reference Case Accident Frequencies

Scenarios	Units	Accident Frequency	
		Passenger	Freight
Train-to-train collisions	Per million train-miles	0.03	0.03
Rollout Intrusions	Per million train-miles	0.0086	0.0144
Other intrusions	Per million train-miles	0.0144	0.0086
Broken rails	Per million train-miles	0.0167	0.0556
Overspeed	Per million train-miles	0.0110	0.0160
Work zone intrusions	Injuries/fatalities per million train-miles	0.164/0.0164†	0.083/0.0083†
Diamonds	Per million diamond passes	0.100	0.100
Grade crossings	Per million crossing passes	0.80‡	0.36‡

†Varies by train speed; these are for passenger trains at 79 mph and freight trains at 50 mph.
‡Varies by speed and crossing type; these are for crossings with gates and lights, passenger trains at 79 mph and freight trains at 50 mph.

2.5.5 Preventability Factors

Preventability factors are the fraction of accidents that would have happened with CTC that are estimated to be prevented by the train control system being analyzed. They are the most critical inputs to the models because they drive the results of the comparison between the different train control systems. For example, if a particular preventability factor is 0.8, then this means that 80 percent of the accidents that would have occurred with CTC are prevented by the particular train control system being considered and 20 percent still take place.

Table 2.3 gives a basic set of preventability factors for the IDOT PTC operating normally and in timeout and for cab signals with both ATS and ATC. Full details of the derivation of these data and variations for sensitivity analyses for all analysis cases are provided in Appendix F.

Table 2.3. Preventability Factors for IDOT PTC and Cab Signals with ATS/ATC

Scenarios	Preventability Factor			
	IDOT PTC Normal	IDOT PTC in Timeout	UP Cab Signals with ATS	NEC Cab Signals with ATC
Train-to-train collisions	0.90†	0.90†	0.70	0.85
Rollout intrusions	0.30	0	0.35	0.43
Other intrusions	0.05	0	0.10	0.12
Broken rails	0.04	0	0.06	0.08
Overspeed	0.80	0.50	0	0
Work zone intrusions	0.50	0.25	0	0
Diamonds	0.90†	0.90†	0.70†	0.85†
Grade crossings	0.04	0	0	0

Comments on the derivation of preventability values are:

- For the cases in Table 2.3 marked with (†), there is a chance of a conflict between equipped and unequipped trains, which reduces preventability, because all through trains and some local freight trains are unequipped. With diamond crossing collisions, the crossing train (always belonging to railroad companies other than UP) is also assumed to be unequipped. The model assumes an equipped train responds to any control system input with a reliability represented by the preventability factor. The model performs a separate calculation of the probability that an accident resulting from a signal violation by an unequipped train can be prevented by the response of the equipped train. In the PTC case, this calculation is done for both the normal operating state and the timeout state. In the ATS and ATC analysis cases, all freight and passenger trains are assumed equipped with the control system, and the separate calculation is not needed.
- The value of 0.90 for the preventability of train-to-train collisions among PTC-equipped trains is a conservative estimate. PTC will prevent almost all collisions, except for collisions with on-track maintenance equipment outside of designated work zones, collisions caused by brake failures, incorrect or out-of-date data entered into the PTC system for any reason, and very rare "wrong side" or false "all clear" indications by PTC. Model runs with PTC preventability set at high and low values of 0.94 and 0.88 illustrate the sensitivity of results to this estimate.
- Preventability for cab signals with ATS of 0.70 is estimated from the actual performance of UP cab signals compared with CTC. Because the estimate depends on sparse data, risk calculations were also carried out for values of 0.60 and 0.80.
- Likewise, risk calculations with preventability set at 0.80 and 0.90 were carried out for cab signals with ATC to illustrate the sensitivity of results to preventability estimates.

- Preventability of collisions between a PTC-equipped and an unequipped train is calculated in the model as a function of train speeds and of equipped train location relative to the unequipped train when the violation takes place. A similar calculation provides an estimate of the preventability of collisions at a diamond crossing for all control systems analyzed.
- Rollout intrusions will be detected by track circuits and switch position monitors. The estimate of 0.30 for PTC in normal state is derived using the same calculation regarding train locations speeds as was used for collisions with unequipped trains. Preventability is higher for cab signals with ATS or ATC because of the quicker response of coded track circuits and the ability of these track circuits to detect intrusions ahead of an approaching train in the same signal block.
- It is judged that very few "other intrusions" and broken rails will be prevented by any of the train control systems, because only a small fraction of these accidents will be detectable by the track circuits in any case. Cab signals with ATS or ATC perform better than PTC because of the quicker response of coded track circuits to a detected event.
- PTC will prevent most overspeed derailments because of the speed monitoring and enforcement feature. Preventability will be reduced in the timeout operating state because of possible delays to messages advising the train of new slow orders. Although rare, such a delay could result in a very dangerous "false all clear" situation. Cab signals with ATS or ATC do not monitor or enforce civil speed restrictions and cannot prevent overspeed derailments.
- The preventability of work zone casualties is based on a review of casualty data and an estimate of what fraction of these casualties are potentially preventable, because they occurred in a designated work zone. As with overspeed accidents, and for similar reasons, preventability is reduced in timeout. In addition, PTC cannot protect against accidents caused by the incorrect entry of work zone or temporary slow order locations in the system. Cab signals with ATS do not monitor or enforce work zone restrictions.
- Grade crossing collisions can be prevented by PTC only where the collision was caused by a crossing warning system malfunction. The preventability estimates are based on FRA data regarding such malfunctions.

2.6 Measures of Risk Calculated by the Model

The model calculates five measures of risk for each of the accident scenarios described in Section 2.4, and for each Sub-corridor, season and operating state as defined in Sections 2.3.1 and 2.3.2. These are:

- Estimated number of FRA-reportable accidents for each accident scenario and in total over a 10-year period. FRA-reportable accidents are those that exceed the FRA's threshold cost of damage to railroad-owned plant and equipment.
- Estimated number of injuries in FRA-reportable accidents over 10 years of operation of the IDOT test corridor.
- Estimated number of fatalities in FRA-reportable accidents over 10 years of operation of the IDOT test corridor.

- Estimated cost of damage to railroad plant and equipment over 10 years, as reported to FRA in FRA accident reports. No attempt has been made to estimate non-FRA-reportable accident costs or the cost of damage to highway vehicles in grade crossing collisions.
- A financial measure of total accident consequences over 10 years obtained by adding damage cost to the cost of injuries and fatalities, using a standard DOT cost per fatality of $3 million and a cost per injury of $100,000.

Costs and casualties are calculated over 10 years so that the numbers, especially those related to injuries and fatalities, are large enough to be easily comprehended by reviewers of the results.

3. Risk Analysis Results

3.1 Introduction

The chapter provides a description and an interpretation of the results of the comparative risk analyses of IDOT PTC and the two base case systems, together with the values of the key input data. This includes:

- Results from the IDOT PTC risk analysis for the system in its intended configuration;
- Effects of increasing or decreasing timeout and latency on IDOT PTC safety performance;
- A comparison of the IDOT PTC system with the base case train control systems—cab signals system with both ATS and ATC; and
- Results from sensitivity analyses:
  - Sensitivity of results to varying preventability estimates for all three train control systems; and
  - Sensitivity to differences between the control systems in the reduction of accident consequences from the reference case.

This chapter presents a summary and discussion of the principal results of the analyses, supported by tables as required. Full results from all model runs are presented in electronic form in Appendix G, together with examples of the actual risk models used in the analysis (provided on CD). Appendix G contains the following:

- *Results Summaries PTC, ATS and ATC Cab Sigs complete.xls* - an Excel Worksheet with documented results for each of the analysis cases listed in Table 3.1;
- *IDOT Risk Model, Basic PTC Case TO120 Lat10 Final.xls* - an example of the complete risk model prepared for PTC with a timeout duration of 120 s and a latency of 10 s;
- *IDOT Risk Model, Cab Sig-ATS 70% Case Full Year Final.xls* - an example of the risk model prepared for the cab signal system employing ATS with 70 percent preventability.
- *IDOT Risk Model, Cab Sig-ATC 85% Case Full Year Final.xls* - an example of the risk model prepared for the cab signal system employing ATC with 85 percent preventability.

Table 3.1. List of Risk Analyses Performed and Included in the Results Workbook in Appendix G

Train Control System Analyzed	Ref. Number	Title Used in Results Summary Workbook	Description of Analysis Case
IDOT PTC system	1	PTC Basic TO120	Basic PTC case: timeout 120 s, latency 10 s
	2	PTC TO240	PTC Case: timeout 240 s, latency 10 s
	3	PTC TO360	PTC Case: timeout 360 s, Latency 10 s
	4	PTC TO60	PTC Case: timeout 60 s, Latency 10 s
	5	PTC TO20	PTC Case: timeout 20 s, Latency 10 s
	6	PTC Lat 20	PTC Case: timeout 120 s, Latency 20 s
	7	PTC Lat 5	PTC Case: timeout 120 s, Latency 5 s
	8	PTC Basic 88%	PTC case w/ preventability reduced from 90 to 88 %
	9	PTC Basic 94%	PTC case w/ preventability increased from 90 to 94%
	10	PTC Basic Red. Sev'ty	Basic PTC case w/ reduced severity of consequences
UP cab signals + ATS	11	ATS Basic, 70%	Basic case: cab signal and ATS, 70% preventability
	12	ATS 80%	Cab signal and ATS, 80% preventability
	13	ATS 60%	Cab signal and ATS, 60% preventability
	14	ATS Basic 70% Red. Sev'ty	Basic ATS case w/ reduced severity of consequences
Northeast Corridor ATC	15	NEC-ATC Basic 85%	Basic NEC-ATC case w/ 85% preventability
	16	NEC-ATC 80%	NEC-ATC w/ 80% preventability
	17	NEC-ATC 90%	NEC-ATC w/ 90% preventability
	18	NEC Basic 85% Red. Sev'ty	Basic NEC-ATC case w/ reduced severity of consequences
CTC reference case	19	CTC Ref	CTC reference case

All data presented in this report are taken from the corresponding model results worksheets. Model results are presented and discussed in the following sequence:

- IDOT PTC risk analyses showing the effects of varying latency and timeout;

- Comparisons between the IDOT PTC system and the ATS and ATC systems with cab signals;
- Sensitivity of analysis results to variations in accident preventability estimates for the three train control systems; and
- Sensitivity of analysis results to differences in consequence estimates among the three train control systems.

Some suggestions for further model runs are also provided.

3.2 Summary of Results – IDOT PTC Timeout and Latency

3.2.1 Effect of Varying Timeout on IDOT PTC Safety Performance

A series of model runs were performed to explore the effects of varying timeout on the safety performance as measured by the dollar value of harm. The full details of the results are provided in the spreadsheet containing the results sheet for each of the model runs (see Appendix G).

Timeout was varied in the analyses from a base value of 120 s. Given the capacity of the radio communications system originally proposed for the IDOT PTC system, 120 s was judged to be the lowest practical timeout that would not lead to communications delays and delay-related timeout events. A higher capacity communications system would be needed if timeout needs to be lower to achieve required safety or operational performance.

The first point to note from the analysis is that the number of train-miles operated during timeout is a tiny fraction of total train-miles. Thus, even if there is elevated risk during timeout, the overall impact of this risk increase on the overall risk of operating the corridor is very small.

On the basis of the assumptions regarding the occurrence of timeout events discussed in Section 2.3.2, the relevant values are as follows:

Estimated percentage of train-miles operated in the timeout state:	0.1395% (Model Input)
Total harm in the timeout state (PTC 120-second timeout case):	\$4,378[†]
Total harm with PTC operating normally:	\$2,733,539[‡]
Estimated percentage of harm in the timeout state:	0.1602% (from above numbers)
Ratio (harm in timeout)/ (harm operating normally over the same train-miles):	0.1602/0.1395 = 1.148 or 14.8% increase

[†]from Table R6d of *IDOT Risk Model, Basic PTC Case TO120 Lat10 Final.xls*
[‡]from Table R7d of *IDOT Risk Model, Basic PTC Case TO120 Lat10 Final.xls*

Thus, operations during timeout contribute only 0.16% of total risk in combined normal and timeout operation. The primary reason that the contribution is so modest is that PTC-preventable collisions between two equipped trains will still be prevented, even if the system is in timeout. Both trains will comply with previously issued nonconflicting authorities. Risk increases in otherwise preventable collisions with unequipped trains and in some of the other potentially preventable accident scenarios such as grade crossings, and because of broken rails and

intrusions, where the warning will not reach the PTC-equipped train in time to prevent an accident. The estimate of the number and duration of timeout events needed to perform this calculation was determined by considering timeout duration and the total percentage of train-miles operated in fallback mode. A simple example of this calculation is if timeout is 2 min and the time to repair is 90 min, then the distance traveled by trains during timeout is 1/45 of distance in fallback mode. If the total distance in fallback mode is 5 percent of total mileage, then the distance traveled in timeout is 5/45 or 0.11%. The detailed calculation takes into account the difference in characteristics and effects of on-board and wayside PTC failures.

Table 3.2 gives the results of varying timeout between 20 and 360 s; latency was held constant at 10 s. Timeout values are the total time the train is operating between receiving the last valid communication and the expiration of timeout. The risk increment in the table is the increase in risk during timeout compared with the same period of normal operation with 10-second latency.

Table 3.2. Effect of Varying Timeout on Risk Associated with IDOT PTC with Latency of 10 Seconds

Timeout (s)	Total Harm in Whole Corridor† ($1,000s)	Total Harm in Timeout‡ ($1,000s)	Percent of Total Corridor Harm (%)	Percent Train-Miles in Timeout¤ (%)	Risk Increase (%)
20	2,733.181	0.675	0.0247	0.0233	6.0
60	2,733.294	2.126	0.0778	0.0698	11.5
120	2,733.539	4.378	0.1602	0.1395	14.8
240	2.733.896	8.750	0.3201	0.2791	14.7
360	2,734.247	13.115	0.4797	0.4186	14.6

† Table R7d on "PTC TO20," "PTC TO60," "PTC Basic TO120," "PTC TO240," and "PTC TO360" sheets of *Results Summaries PTC, ATS and ATC Cab Sigs complete.xls*, Appendix G.

‡ Table R6d on "PTC TO20," "PTC TO60," "PTC Basic TO120," "PTC TO240," and "PTC TO360" sheets of *Results Summaries PTC, ATS and ATC Cab Sigs complete.xls*, Appendix G.

¤ Percent miles in timeout are model inputs.

As would be expected, the impact on risk is roughly proportional to timeout, because this directly affects train-miles operated in timeout. The percentage increase in risk per train-mile during timeout versus regular operation increases up to a timeout of approximately 120 s, after which it stays roughly constant. At low timeout values, performance approaches that of regular operation (with a latency of 10 s). Hypothetically, if timeout were reduced to 10 s, identical to latency, then safety performance during timeout would be identical to that in normal operation. When timeout equals or exceeds 120 s, there is no further increase in the per train-mile risk during timeout, but the aggregate risk increment during timeout increases as a result of the increase in train-miles operated during timeout.

The primary conclusion from the above results is that timeout does not have a material effect on the overall safety performance of the IDOT corridor. This is because the aggregate train-miles operated in the timeout state is very small, not exceeding 0.5 percent of total train miles for the highest timeout analyzed, and the heightened risk over this period, although significant, cannot have much impact on overall safety performance. Thus, it is difficult to recommend timeout value based on safety alone, and other factors such as operations benefits should be considered. Note that this conclusion applies only to this corridor, which is used by an average of approximately eight trains per day. The conclusions in areas of higher traffic density and/or with a greater proportion of unequipped trains could be different.

3.2.2 Effect of Latency on Risk

Model runs were performed to illustrate the effect of varying latency on risk while holding timeout constant. The IDOT PTC base case assumes a 10-second latency period, based on field observations of trials with a preliminary version of IDOT PTC. The variations investigated were doubling and halving this value. The results are shown in Table 3.3.

Table 3.3. Effect of Varying Latency on Risk Associated with IDOT PTC with Timeout of 120 Seconds

Latency (s)	Total Accident Cost† ($1,000s)
5	2,717.0
10	2,733.5
20	2,772.9

† Tables R7d on "PTC Lat 5," "PTC Basic TO120," and "PTC Lat 20" sheet; *Results Summaries PTC, ATS and ATC Cab Sigs complete.xls*, Appendix G.

The effects of varying latency between 5 and 20 s are very small, showing a difference of only $55,900 or 2 percent of total accident costs of $2.77 million. The difference can be attributed primarily to the increase in train-to-train collisions between equipped and unequipped trains as latency increases, with limited additional risk increments due to increasing risk from intrusion collisions and other accidents.

3.3 Comparisons among IDOT PTC, Cab Signals with ATS, and Cab Signals with ATC

This section discusses the results of a direct comparison between the safety performance of the IDOT PTC system and each of the two base case systems, the UP four-aspect cab signals with continuous ATS and an ATC system with four-aspect cab signals comparable to that installed on the NEC. Comparisons are provided between estimated total accident costs for PTC-relevant accidents by accident scenario and in total for the three control systems. This information is used in conjunction with similar comparisons of injuries, fatalities, and the estimated number of

accidents. The preventability estimates used in these analyses are considered the best that could be made within the constraints of this study.

Tables 3.4, 3.5, and 3.6 provide direct comparisons between estimated total accident numbers, costs, and casualties, taken directly from the models for the basic IDOT PTC (with a timeout of 120 s and a latency of 10 s), the UP cab signal system with ATS (using a preventability of 70 percent), and the NEC cab signal system with ATC (using a preventability of 85 percent) analysis cases. All accident counts, costs, and casualties are for a period of 10 years of operation of the IDOT test corridor. The costs in Table 3.4 include the cost of injuries, fatalities, and railroad property damage as reported to FRA in $1,000s. Total costs are calculated assuming a cost of $100,000 for an injury and $3,000,000 for a fatality. No attempt has been made to add other direct and indirect accident costs (e.g., to nonrailroad property—including highway vehicles at grade crossings—and indirect costs for wreck clearing and service delays).

Table 3.4. Comparison of Total Accident Costs for IDOT PTC (Timeout = 120 s, Latency = 10 s), UP Cab Signal with ATS (70% Preventability) and NEC Cab Signal with ATC (85% Preventability) Base Cases, PTC-Relevant Accidents

Train Type	Accident Scenario	IDOT PTC with TO = 120 s, Lat = 10 s ($1,000s)†	UP Cab Signal with ATS, 70% Prev. ($1,000s)†	NEC Cab Signal with ATC, 85% Prev. ($1,000s)†	Comparison, IDOT PTC to Cab Signal with ATS & ATC	
					Difference PTC-ATS ($1,000s)	Difference PTC-ATC ($1,000s)
Passenger	Train-to-train collision	309	790	395	-481	-86
	Intrusion collision	321	303	291	18	30
	Diamond collision	3	4	3	-1	0
	Overspeed	60	301‡	301‡	-241	-241
	Broken rail	439	430	421	9	18
	Work zone violation	98	196‡	196‡	-98	-98
	Grade crossing collision	1384	1442‡	1442‡	-58	-58
	Total – all scenarios	**2,614**	**3,466**	**3,049**	**-852**	**-435**
Freight	Train-to-train collision	9	8	4	1	5
	Intrusion collision	3	3	3	0	0
	Diamond collision	2	3	2	-1	0
	Overspeed	7	10‡	10‡	-3	-3
	Broken rail	34	33	32	1	2
	Work zone violation	23	30‡	30‡	-7	-7
	Grade crossing collision	40	41‡	41‡	-1	-1
	Total – all scenarios	**118**	**128**	**122**	**-10**	**-4**
Total, passenger + freight		**2,732**	**3,594**	**3,171**	**-862**	**-439**

† Table R7d on "PTC Basic TO120" sheet and Table R3d on "ATS Basic 70%" and "NEC_ATC Basic 85%" sheets; *Results Summaries PTC, ATS and ATC Cab Sigs complete.xls*, Appendix G.

‡ These values represent full accident costs; no risk reductions are present in these accident scenarios with these control system combinations.

Overall, the results show that IDOT PTC is estimated to reduce accident costs by 24 percent (a savings of $862,000 against costs of $3,594,000) when compared with ATS base case for the set of PTC-relevant accident scenarios analyzed. When the ATC base case is considered, the IDOT PTC is estimated to reduce accident costs by 14 percent (a savings of $439,000 against costs of $3,171,000). Even given the uncertainty regarding the estimates for the values of model inputs and calculations for the effectiveness of the train control systems in preventing accidents, these results indicate that the IDOT PTC is likely to pass the test of providing a level of safety equivalent to or better than either of the base cases considered in this analysis.

A comparison of accident costs over a 10-year period between the ATS and ATC base cases shows that the ATC base case has total costs $423,000 (12 percent) less than those for the ATS base case.

The principal sources of the advantage of the IDOT PTC system over the UP cab signal system with ATS and the NEC cab signal system with ATC are fewer train-to-train collisions, overspeed derailments, and work zone incursions. The difference in train-to-train collisions between the IDOT PTC and the UP ATS base case is much more pronounced than the difference between the IDOT PTC and the NEC ATC base case. The following paragraphs discuss how the differences in the capabilities of the three control systems contribute to the advantage of IDOT PTC over the cab signal base cases:

- Train-to-train collisions: For the purpose of this analysis, train-to-train collisions are defined as collisions between two trains operating on the main tracks of the IDOT test corridor. PTC will enforce safe speeds down to a stop. Cab signaling with ATS will warn the engineer of a more restrictive signal aspect; it will not enforce that aspect if the warning is acknowledged. ATC will enforce speed reduction in accordance with signal indications down to restricting speed but not to an absolute stop. The practice of slowing the PTC-equipped passenger trains to 79 mph when near an unequipped train also contributes to the advantage. With cab signals and ATS/ATC, there are no unequipped trains, and this practice does not apply. On the basis of a review of FRA-reported main-line accidents on the NEC between 1986 and 2006, clearly ATC is highly effective in preventing collision accidents and will reduce collision speed for those accidents that do occur. The data also show that a significant fraction of NEC collision accidents are low-speed "fender benders" in major passenger terminals (e.g., New York Penn Station and Washington Union Station) that have relatively minor consequences. With no major stations or terminals on the IDOT test corridor, these accidents were not considered in estimating accident frequencies for the ATC analysis.
- Overspeed accidents: PTC will enforce temporary and permanent speed limits but cab signals do not. From accident data, most passenger train overspeed accidents appear to be due to failing to slow down to take a turnout or crossover rather than exceeding a main track speed limit or slow order.
- Work zone violations: Fewer work zone violations, leading to fewer casualties among track maintenance employees and contractors (12.2 percent of the difference): PTC can provide this protection but cab signals do not. This number is more speculative than the others, and more work is desirable on the exact circumstances of casualties to better determine the effectiveness of PTC in work zone protection and the related issue of collisions with on-track maintenance and inspection equipment moving to and from formal work zones.

Diamond collisions are between a train operating on the main track of the IDOT test corridor and a train operating on another railroad that crosses the IDOT test corridor. Diamond collisions are also collisions between trains, but the risk calculation is different. An intrusion collision is between a train operating on the IDOT test corridor and a car or a cut of cars (not a train) that has incorrectly moved onto the main track from a connecting track. More information on accident scenario definitions can be found in Section 2.4.

Passenger train costs dominate the results. Freight train accident costs on this corridor are almost insignificant. However, it should be noted that there are only an average of about two freight train trips over the corridor (averaging Sub-corridors and seasons) versus six passenger train trips. Freight train accidents would be more significant if there were, say, 10 freight train trips daily.

Table 3.5 provides estimated injuries and fatalities for the same IDOT PTC and the cab signal cases addressed in Table 3.4, again using FRA reporting criteria for casualties in train accidents. Table 3.5 gives the corresponding accident counts for the three train control systems.

Table 3.5. Comparison of Casualties for IDOT PTC (Timeout = 120 s, Latency = 10 s), UP Cab Signal with ATS (70% Preventability) and NEC Cab Signal with ATC (85% Preventability) Base Cases, PTC-Relevant Accidents

Train Type	Accident Scenario	IDOT PTC Case, Timeout = 120 s, Latency = 10 s		UP Cab Signal with ATS Case, 70% Preventability		NEC Cab Signal with ATC Case, 85% Preventability	
		Injuries per 10 Years[†]	Fatalities per 10 Years[†]	Injuries per 10 Years[†]	Fatalities per 10 Years[†]	Injuries per 10 Years[†]	Fatalities per 10 Years[†]
Passenger	Train-to-train collision	1.202	0.046	3.065	0.117	1.533	0.058
	Intrusion collision	1.287	0.046	1.215	0.043	1.166	0.041
	Diamond collision	0.013	0.000	0.019	0.001	0.013	0.000
	Overspeed	0.265	0.004	1.321[‡]	0.021[‡]	1.321[‡]	0.021[‡]
	Broken rail	1.925	0.031	1.885	0.030	1.845	0.030
	Work zone violation	0.245	0.025	0.490[‡]	0.049[‡]	0.490[‡]	0.049[‡]
	Grade crossing collision	5.731	0.085	5.969[‡]	0.089[‡]	5.969[‡]	0.089[‡]
	Total – all scenarios	**10.668**	**0.237**	**13.964**	**0.350**	**12.337**	**0.288**
Freight	Train-to-train collision	0.014	0.001	0.011	0.001	0.006	0.001
	Intrusion collision	0.006	0.001	0.005	0.001	0.005	0.000
	Diamond collision	0.003	0.000	0.004	0.000	0.003	0.000
	Overspeed	0.003	0.000	0.005[‡]	0.000[‡]	0.005[‡]	0.000[‡]
	Broken rail	0.016	0.002	0.015	0.002	0.015	0.002
	Work zone violation	0.058	0.006	0.074[‡]	0.007[‡]	0.074[‡]	0.007[‡]
	Grade crossing collision	0.088	0.005	0.090[‡]	0.005[‡]	0.090[‡]	0.005[‡]
	Total – all scenarios	**0.188**	**0.015**	**0.204**	**0.016**	**0.198**	**0.015**
Total, passenger + freight		**10.856**	**0.252**	**14.168**	**0.366**	**12.535**	**0.303**

[†] Table R7d on "PTC Basic TO120" sheet and Table R3d on "ATS Basic 70%" and "NEC_ATC Basic 85%" sheets; *Results Summaries PTC, ATS and ATC Cab Sigs complete.xls*, Appendix G.

[‡] These values represent full injury/fatality counts; no risk reductions are present in these accident scenarios with these control system combinations.

Table 3.6. Comparison of Accident Counts for IDOT PTC (Timeout = 120 s, Latency = 10 s), UP Cab Signal with ATS (70% Preventability) and NEC Cab Signal with ATC (85% Preventability) Base Cases, PTC-Relevant Accidents

Train Type	Accident Scenario	Accident Counts/ 10 Years[†]			Comparison, IDOT PTC to Cab Signal with ATS & ATC	
		IDOT PTC with TO = 120 s, Lat = 10 s	UP Cab Signal with ATS, 70% Prev.	NEC Cab Signal with ATC, 85% Prev.	Difference PTC-ATS	Difference PTC-ATC
Passenger	Train-to-train collision	0.019	0.044	0.022	-0.025	-0.003
	Intrusion collision	0.049	0.046	0.043	0.003	0.006
	Diamond collision	0.001	0.002	0.001	-0.001	0.000
	Overspeed	0.005	0.027[†]	0.027[†]	-0.022	-0.022
	Broken rail	0.039	0.039	0.038	0.000	0.001
	Work zone violation	na	na	na	na	na
	Grade crossing collision	1.935	2.016[†]	2.016[†]	-0.081	-0.081
	Total – excl. grade Xings	**0.113**	**0.158**	**0.131**	**-0.045**	**-0.018**
Freight	Train-to-train collision	0.012	0.011	0.005	0.001	0.007
	Intrusion collision	0.020	0.016	0.015	0.004	0.005
	Diamond collision	0.007	0.008	0.007	-0.001	0.000
	Overspeed	0.010	0.015[†]	0.015[†]	-0.005	-0.005
	Broken rail	0.051	0.049	0.048	0.002	0.003
	Work zone violation	na	na	na	na	na
	Grade crossing collision	0.251	0.255[†]	0.255[†]	-0.004	-0.004
	Total – excl. grade Xings	**0.100**	**0.099**	**0.090**	**0.001**	**0.010**
Total, passenger + freight excluding grade Xings		**0.213**	**0.257**	**0.221**	**-0.044**	**-0.008**

[†] Table R7d on "PTC Basic TO120" sheet and Table R3d on "ATS Basic 70%" and "NEC_ATC Basic 85%" sheets; *Results Summaries PTC, ATS and ATC Cab Sigs complete.xls*, Appendix G.

[‡] These values represent full accident counts; no risk reductions are present in these accident scenarios with these control system combinations.

To summarize, the difference in the risk of train-to-train collisions between PTC and the cab signal with ATS or ATC is a direct result of the difference between collision preventability estimates for the two systems. In the case of PTC, effectiveness in preventing collisions that

would have taken place with the CTC reference case is conservatively estimated at 90 percent. The only collisions possible would be those involving unequipped trains and on-rail maintenance equipment outside of formal work zones, those not preventable by any train control system (such as due to braking failures), or very rare "wrong side" PTC system failures.

In the cab signal with ATS case, the corresponding best estimate for effectiveness in preventing train-to-train collisions is 0.70 (or 70 percent), based on historic data. Unlike PTC, the ATS does not enforce signal indications after the train crew has acknowledged a warning; there are examples of collision accidents with ATS taking place after the warning was acknowledged. Causes include inattention, falling asleep, failure to observe restricted speed rules, and misjudged braking. If cab signals with ATS and PTC are considered equally effective in preventing train-to-train collisions, PTC will have higher costs for train-to-train collisions than cab signals because of the presence of unequipped trains. The 70-percent estimate for cab signals with ATS is based on rather sparse data (per Appendix F), so sensitivity analyses were performed with effectiveness set at 60 and 80 percent; results of this consideration are provided in Section 3.4.

As stated earlier, a review of FRA-reported main-line accidents on the NEC has shown that ATC is highly effective in preventing collision accidents and will reduce collision speed for those accidents that do occur. The primary challenge in interpreting these data lies in the very large differences in the operating environment between the NEC, which is predominately high-density, high-speed, multiple-track territory, and the IDOT test corridor with single track and low to moderate traffic density. After an effort to adjust for these differences is made, preventability for main-line train-to-train collision accidents of approximately 0.85 (or 85 percent) was estimated and used in the model and for operations away from major passenger terminals. Given the uncertainties in this estimate, a sensitivity analysis comprising model runs with 80 and 90 percent preventability values was prepared to help support analysis conclusions. The results of these analyses are also tabulated and discussed in Section 3.4.

Observations on the results include:

- Considering Table 3.4, cab signals with ATS/ATC exhibited a small advantage (lower accident costs) over PTC only for freight trains involved in train-to-train collisions and in intrusion and broken rail accidents. In intrusion/rollout events and broken rail derailments, coded track circuits are able to better detect the event and provide prompt warning to the approaching train. The total advantage these systems offer in terms of accident costs are massively offset by the advantage of PTC in all other accident scenarios. It is also noteworthy that the IDOT PTC advantage is still significant, even if the benefits from additional PTC functionality (overspeed, work zones, and grade crossings) are disregarded.
- The results for injuries and fatalities in accidents (Table 3.5) show the same pattern as overall accident costs. This is as expected, given that casualties (mainly in passenger train accidents) are the largest individual contributor to total costs.
- The costs of freight train accidents have little influence on the overall results, given the high costs associated with passenger casualties and damage to passenger equipment. The freight/passenger difference is less marked in counts of trains in accidents (Table 3.6), which show that passenger and freight involvement are as would be expected from relative train-miles operated and the lack of PTC on many freight trains.

- PTC is able to prevent only a relatively small fraction of grade crossing collisions and broken rail derailments. This is mainly because the detectable hazardous conditions (total rail break before train arrival or malfunctioning crossing warning systems) are a minor part of the overall risk from those scenarios. However, the financial benefit from preventing even a small fraction of these accidents is substantial.
- Harm to passenger trains and their occupants dominate the risk. This is entirely logical and is derived from the differences between passenger and freight equipment and their operations:
  - Passenger trains have about 200 occupants at risk of becoming casualties in an accident (in this analysis), compared with two or three people that make up a freight train crew.
  - Passenger trains operate at a higher speed, increasing accident consequences.
  - Passenger equipment is more valuable and more costly to repair than freight equipment.
  - Finally on this corridor, six daily one-way passenger train trips are compared with an average of two to three freight train trips.

It should be noted that *both* PTC and cab signal-based systems with trains operating at up to 110 mph provide a substantial safety improvement over the reference case of conventional CTC at speeds up to 79 mph (as the line is currently being operated), as shown in Table 3.7. If the acceptability criterion had been a comparison with the current operation, then any of the systems would be acceptable. Also noteworthy, PTC provides an estimated benefit of $58.4 million from prevented grade crossing collisions and $18.8 million from prevented broken rail derailments, compared with CTC.

Table 3.7. Comparison of Total Accident Costs for Conventional CTC, IDOT PTC (Timeout = 120 s, Latency = 10 s), UP Cab Signal with ATS (70% Preventability) and NEC Cab Signal with ATC (85% Preventability) Base Cases, PTC-Relevant Accidents

Total Accident Costs in $1,000s for PTC-Relevant Accidents[†]								
	CTC Reference Case		**IDOT PTC Case, Timeout = 120 s, Latency = 10 s**		**UP Cab Signal w/ATS, 70% Preventability**		**NEC Cab Signal w/ATC, 85% Preventability**	
Max. Speed (mph)	**79**		**110** (79 mph when passing unequipped freight trains)		**110**		**110**	
Scenarios	**Train-to-Train Collisions**	**All Accidents**	**Train-to-Train Collisions**	**All Accidents**	**Train-to-Train Collisions**	**All Accidents**	**Train-to-Train Collisions**	**All Accidents**
Passenger	2,089	4,855	309	2,614	790	3,466	395	3,049
Freight	26	150	9	118	8	128	4	122
Total	2,115	5,005	318	2,732	798	3,594	399	3,171

[†] Table R7d on "PTC Basic TO120" sheet and Table R3d on "ATS Basic 70%," "NEC_ATC Basic 85%," and "CTC Ref" sheets; *Results Summaries PTC, ATS and ATC Cab Sigs complete.xls*, Appendix G.

3.4 Sensitivity Analyses

3.4.1 Sensitivity of Results to Estimated Collision Preventability

Preventability in the model is defined as the fraction of accidents of each type that would occur under conventional CTC operation with wayside signals that will be prevented by a specific train control system. The preventability factor in collisions between equipped trains has been estimated at 0.90 (or 90 percent) for the IDOT PTC, 0.70 (or 70 percent) for the UP cab signal system with ATS and 0.85 (or 85 percent) for the NEC cab signal system with ATC. All these estimates are subject to some uncertainty. Sensitivity analyses using higher and lower estimates for preventability estimates were carried out to investigate whether this uncertainty might influence the conclusions from the analyses.

Where PTC will enforce operating authorities down to an absolute stop before authority limits are exceeded, cab signals with ATS provide an in-cab display and a warning whenever the train is subject to a more restrictive signal aspect. If the train crew acknowledges the warning, the train can proceed under the engineer's control. Only if the warning is not acknowledged will the train be stopped. Thus, the crew possibly may acknowledge a warning but then fail to observe the signal. An example of this kind of accident was described in National Transportation Safety Board (NTSB) Report RAR 99/04.[1] At Delia, KS, the crew of a UP freight train equipped with cab signals acknowledged the restricting signal at the entry to a passing siding but fell asleep as the train traveled through the siding. The train passed the red signal at the end of the siding and collided head-on with a train approaching the siding from the opposite direction.

ATC differs from ATS in that it enforces braking to reduce speed when the cab signal indicates a more restrictive signal aspect. A penalty brake application is initiated if the engineer fails to apply the brakes, and brakes cannot be released until the speed is at or below the speed corresponding to the signal indication. Because enforced stops well short of a red signal would disrupt operations, ATC does not enforce below 20 mph, allowing a train to approach a red signal and, if the engineer in inattentive or incapacitated, pass the signal at this speed and collide with another train. An example of this type of accident was described by NTSB in its Railroad Accident Brief RAB-03-01.[2] An Amtrak train approaching Baltimore station on the NEC at restricted speed failed to observe an interlocking signal at danger and collided with another train. Although the speed enforcement means that ATC will be more effective than ATS in preventing collisions caused by signal violations, such collisions are still possible. Thus, preventability values for ATC will lie between those for ATS and PTC.

PTC preventability was conservatively estimated at 90 percent, as described in Section 3.2.3. The cab signal preventability estimate of 70 percent was based on a limited analysis of past accidents. Given the small sample size, there is substantial uncertainty as to the correct figure. In the case of ATC, preventability was estimated at 85 percent, based principally on experiences

[1] National Transportation Safety Board, 1999. *Collision between Union Pacific Freight Trains MKSNP-01 and ZSEME-29 near Delia, Kansas. July 2, 1997*. Railroad Accident Report NTSB/RAR-99/04. Washington, DC.

[2] National Transportation Safety Board, 2003. *Collision of Amtrak Train No. 90 and MARC Train No. 437, Baltimore, Maryland, June 17, 2002*. Railroad Accident Brief NTSB/ RAB-03-01. Washington, DC.

with the NEC. In the case of ATC, the uncertainty is mainly caused by the differences in operating environment between the NEC and the IDOT test corridor.

The results of the sensitivity analyses are summarized in Table 3.8 and Figure 3.1. The results show that even if collision preventability for cab signal with ATS is at the higher value of 80 percent, PTC shows a significant advantage. Clearly the benefits from the additional functions of PTC outweigh the disadvantage of operating with some unequipped freight trains. The advantage would be eroded if there were more unequipped trains, or if the operating schedules involved more meets and passes involving an equipped and an unequipped train.

Table 3.8. Results of Cab Signal Collision Preventability Sensitivity Analyses

Control System	Train-to-Train Collision Preventability	Total Accident Cost ($1,000s)	Percent Change in Cost from Using PTC 90% Estimate
PTC	88% (low est.)	2,795	-2%
	90% (consv. best est.)	2,734	
	94% (high est.)	2,613	+5%
UP cab signal with ATS	60% (low est.)	3,872	-29%
	70% (best est.)	3,593	-24%
	80% (high est)	3,314	-18%
NEC cab signal with ATC	80% (low est.)	3,314	-18%
	85% (best est.)	3,171	-14%
	90% (high est.)	3,035	-10%

† Table R7d on PTC-related sheets and Table R3d on ATS/ATC sheets, *Results Summaries PTC, ATS and ATC Cab Sigs complete.xls*, Appendix G.

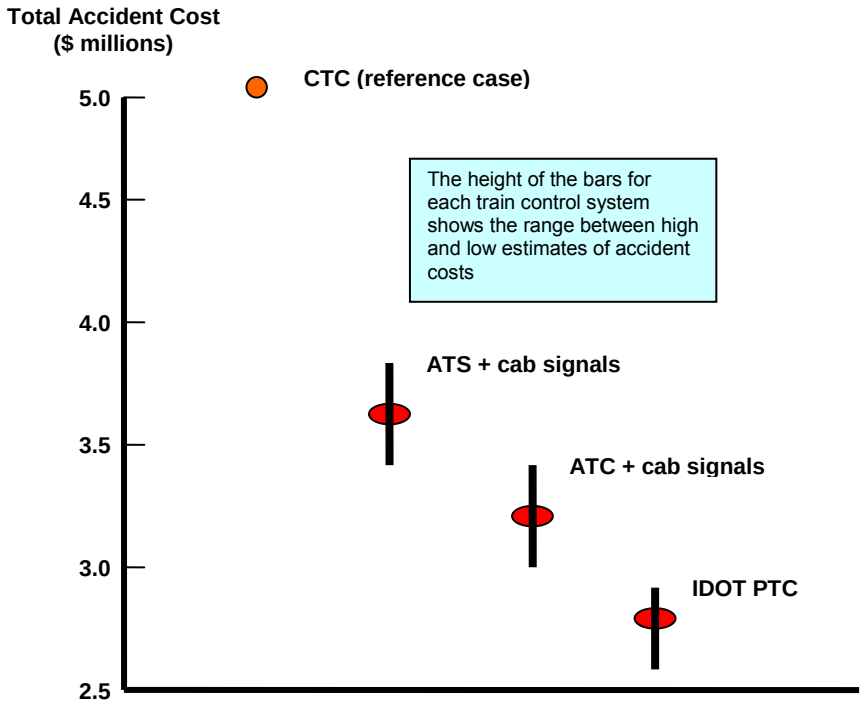


Figure 3.1. Results of Sensitivity Analysis Comparing Total Accident Costs for Each Train Control System Considered

3.4.2 Sensitivity of Results to Severity Reduction

The capability to estimate the effect of reducing accident severity was implemented by adding a step in compiling the accident consequences tables used as the inputs to the risk models. The consequence adjustment factors are multipliers, estimated for each accident scenario, which when applied to the base consequence values provide the adjusted consequence values used in separate runs of the risk models conducted for each train control system. Details associated with the determination of the severity reduction factors are provided in Appendix F.

Differences in the severity of accidents between the three train control systems were thought to be a second-order effect and have been ignored in the primary risk calculations. Consideration of the ATC Base Case, where speed enforcement is a key capability, prompted a reconsideration of this assumption. Therefore, the capability was added to the risk models, and the effect was analyzed for each control system. The results are shown in Table 3.9.

Table 3.9. Comparison of Total Accident Costs for IDOT PTC (Timeout = 120 s, Latency = 10 s), UP Cab Signal with ATS (70% Preventability) and NEC Cab Signal with ATC (85% Preventability) with and without Severity Reduction, PTC-Relevant Accidents

Train Control System	Total Accident Costs† ($1,000s over 10 years)		
	Without Severity Reduction	With Severity Reduction	Difference
IDOT PTC	2,732	2,662	70
UP Cab Signal with ATS	3,594	3,454	140
NEC Cab Signal with ATC	3,171	3,052	119

† Table R7d on PTC-related sheets and Table R3d on ATS/ATC sheets; *Results Summaries PTC, ATS and ATC Cab Sigs complete.xls*, Appendix G.

The effect of including severity reduction is to slightly narrow the difference between IDOT PTC and the other two systems. Including the severity reduction effect also reduces estimated total accident costs with IDOT PTC by $70,000, by $119,000 with NEC ATC, and by $140,000 with ATS/cab signal. Thus, including severity reduction in the analysis has only a limited effect on the comparison between the three systems.

3.5 Closing Remarks

It should be noted that the analysis did not cover all accident scenarios, only those where PTC or the base case system could reduce the frequency or severity of accidents. Notably the analysis has omitted most derailment accidents caused by track and equipment mechanical failures (except broken rails) and a number of miscellaneous accidents such as fires and collisions with obstructions other than rail vehicles and vehicle lading. Such accidents contribute about one-third of passenger train accident consequences and 75 percent of freight train accident consequences. Furthermore, the analysis does not include the effects of operating in fallback mode after a known failure of on-train or wayside equipment. This mode was omitted from analysis because both the method of operation itself (conventional CTC with wayside signals) and the train-miles operated in fallback mode were assumed to be the same in each case and would not affect the comparisons.

4. Conclusions and Recommendations

The risks associated with IDOT PTC, the UP cab signal system with ATS, and the NEC cab signal with ATC—all operated on the IDOT Corridor—were determined when considering all accident scenarios in which PTC or cab signals with ATS or ATC could reduce the frequency or severity of accidents. These scenarios include train-to-train collisions (those occurring between trains on the same main-line tracks), intrusion collisions, collisions at diamonds, overspeeds, work zone violations, grade crossing accidents, and incidents involving broken rails. The analysis omitted most derailment accidents caused by track and equipment mechanical failures (except broken rails) as well as a number of miscellaneous accidents such as fires and collisions with obstructions other than rail vehicles and shifted loads. The analyses did not include the effects of operating in fallback mode after a known failure of on-train or wayside equipment, because both the method of operation itself (conventional CTC with wayside signals) and the train-miles operated in fallback mode were assumed to be the same in each case and would not affect the comparisons.

With these qualifiers in mind, the following conclusions were drawn from the analysis *of the systems considered in this effort*:

- A series of model runs were performed to explore the effects of varying timeout and latency on the safety performance as measured by the dollar value of harm. On the basis of this analysis, the following statements can be made:
  - When the IDOT PTC system is considered, even when accounting for the elevated risk during timeout, the overall impact of this risk increase on the overall risk of operating the corridor is very small. Timeout does not have a material effect on the overall safety performance of the IDOT corridor. This is because the aggregate train-miles operated in the timeout state is very small, not exceeding 0.5 percent of total train-miles, and the heightened risk over this period, although significant, cannot have much impact on the overall result.
  - It is difficult to recommend a timeout value on the basis of safety alone, and other factors such as operations benefits should be considered, such as the avoidance of delays because of slow system response or unnecessary timeout events. Note that this conclusion applies only to this corridor, and the conclusion in areas of higher traffic density or with more unequipped trains could be different.
  - As with timeout, the effects of varying latency are limited and can be attributed primarily to the increase in collisions between equipped and unequipped train as latency increases, with limited additional risk increments as a result of increasing risk from intrusion collisions and other accidents.
- The IDOT PTC operating with a timeout of 120 s and a latency of 10 s is estimated to reduce accident costs by 24 percent when compared with ATS base case and 14 percent when compared with the ATC base case for the set of accident scenarios analyzed. These results indicate that the IDOT PTC is likely to pass the test of providing a level of safety equivalent to or better than either of the base cases considered in this analysis.

  On the basis of accident costs during a 10-year period, the performance of ATC base case lies between that of the IDOT PTC and the ATS base case; the analysis resulted in the ATC

base case showing total estimated costs of $0.44 million (14 percent) greater than those for IDOT PTC and $0.42 million (12 percent) less than those for the ATS base case.

The principal sources of the advantage of the IDOT PTC system over the UP cab signal system with ATS and the NEC cab signal system with ATC are fewer train-to-train collisions, overspeed derailments, and work zone incursions. The difference in train-to-train collisions between the IDOT PTC the UP ATS base case is much more pronounced than the difference between the IDOT PTC and the NEC ATC base case. Explanations for these differences are provided in the report. Cab signals with ATS/ATC exhibited a small advantage (lower accident costs) over PTC only for freight trains involved in train-to-train collisions and in intrusion and broken rail accidents. The total advantage these systems offer in terms of accident costs are massively offset by the advantage of PTC in all other accident scenarios analyzed. Also noteworthy, the IDOT PTC advantage is still substantial, even if the benefits from additional PTC functionality (overspeed, work zones, and grade crossings) are disregarded.

- The results for injuries and fatalities in accidents show the same pattern as overall accident costs.
- Passenger train costs dominate the results for all control systems, given the high cost of passenger casualties and damage to passenger equipment. Freight train accident costs on this corridor have little influence on the overall results. However, it should be noted that there are only an average of about two freight train trips over the corridor (averaging Sub-corridors and seasons) versus six passenger train trips.
- PTC is only able to prevent a relatively small fraction of grade crossing collisions and broken rail derailments. This is mainly because the detectable hazardous conditions (total rail break before train arrival or malfunctioning crossing warning systems) are a minor part of the overall risk from those scenarios. However, the financial benefit from preventing even a small fraction of these accidents is substantial.
- *Both* PTC and cab signal-based systems with trains operating at up to 110 mph provide a substantial safety improvement over the reference case of conventional CTC at speeds up to 79 mph (as the line is currently being operated). If the acceptability criterion had been a comparison with the current operation, then any of the systems would be acceptable.

The analyses performed for this study also have limitations that should be borne in mind when reviewing the results and conclusions quoted above. These are:

- The analysis and accident costs presented include only PTC-relevant accidents. The costs for accident risks that are not changed in any way by PTC or the base case control systems are not included in the total. These include most accidents as a result of track and equipment failures (except broken rails), and a number of miscellaneous causes such a fires and collisions with obstructions other than rail vehicles or vehicle lading. Thus, the percentage differences between the systems somewhat overstate the overall impact of train control system characteristics on safety.
- Neither the PTC nor the base case analyses include operations during the fallback mode, in this case conventional CTC. This mode was omitted from analysis because both train-miles

and accident risks during fallback operation were assumed to be the same for both cases; thus, inclusion would not affect comparisons between analysis cases. However, potential availability performance of the three systems was not analyzed and may, in fact, differ among the systems and could have a significant effect on comparative safety.

- The analysis does not fully meet the requirements in 49 CFR Part 236 for a risk analysis of a PTC system to show that the system is as safe as or better than an applicable base case. Most notably the analysis treats the PTC system as a "black box" with specific capabilities and performance characteristics and lacks analyses to demonstrate that the system in fact delivers this performance. In addition, more thorough analyses to confirm and refine input parameters would be required.

Appendix A: Description of Risk Model and Calculations in Worksheet 1 – Segment Definitions and Timeout Effects

A.1 Introduction

This appendix is the first of four appendices that fully describe the IDOT risk model in all its versions. Appendix A contains a description of the overall model structure, the way the model represents railroad operations and infrastructure on the IDOT test corridor, and a detailed description of the first of the three Microsoft Excel worksheets that make up the core of the model. Appendices B and C provide similar descriptions of Worksheets 2 and 3 of the models. Appendix F provides full information of the sources and derivation of numerical inputs to the models. The descriptions include details for versions of the model established for NAJPTC, cab signal with ATS, and cab signal with ATC.

A.1.1 Structure of the IDOT Test Corridor Risk Model

The overall structure of the model is illustrated in Figure A.1.

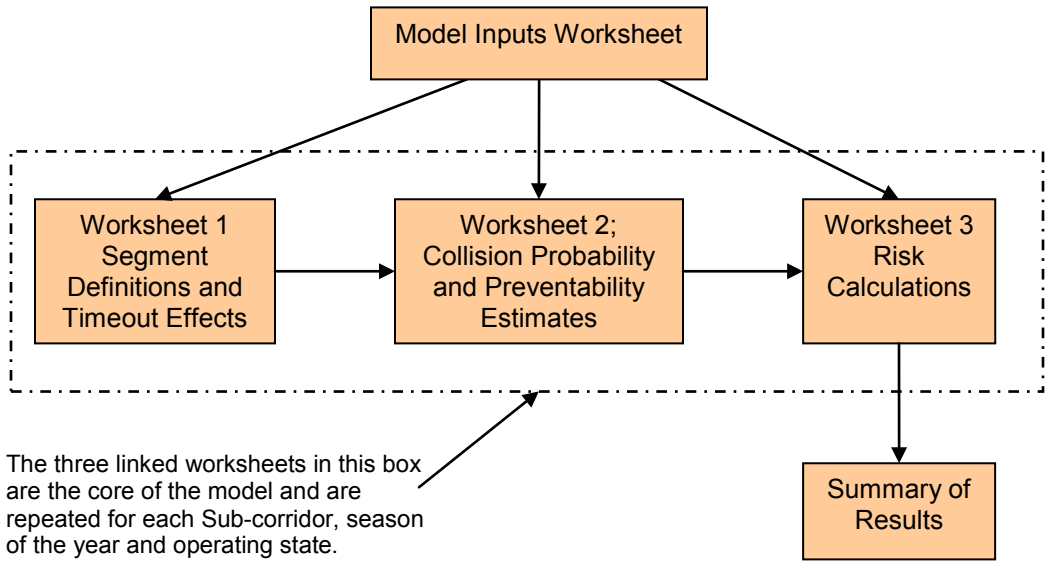


Figure A.1. Overall Structure of the IDOT Test Corridor Risk Model

The analysis starts with a model Inputs Worksheet that contains lookup tables providing all the input data needed by the model, including:

- Relevant signal system and train performance parameters such as timeout and latency values, braking distances for each train type, etc.;

- Basic infrastructure and traffic data, such as the number of main tracks, posted speeds, signal block boundaries, passing siding locations, diamond locations, and average trains per day by train type and season;
- Accident frequency and consequence estimates for each accident scenario; and
- Estimated fraction of accidents in each scenario that would be prevented by the train control system being analyzed.

Concentration of all input data onto one worksheet minimizes the effort involved in setting up the model for each analysis case. In most cases, it is only necessary to change selected numbers on the Inputs Worksheet. These numbers are then referenced by the other worksheets in the model.

The sequence of Worksheets 1, 2, and 3 accesses the input data to perform the detailed risk calculations, taking into account all applicable operating conditions. Because risk depends on traffic level and mix and the operating state of the train control system, separate sets of worksheets are required for each Sub-corridor, season, and operating state. Operating state worksheets are only needed for the NAJPTC system, where there may be significant differences in accident frequency or consequences between the normal and timeout operating states. Three Sub-corridors have been selected with boundaries at points where rail traffic enters or leaves the corridor, and two seasons, summer and "rest of year," to account for seasonal traffic variations on the "Bloomington" and "Springfield" Sub-corridors. Figure A.2 illustrates the detailed structure of the model developed to account for all the traffic and operating state variants for the NAJPTC version. The spatial and temporal divisions of the corridor are described in more detail in Section A.1.3.

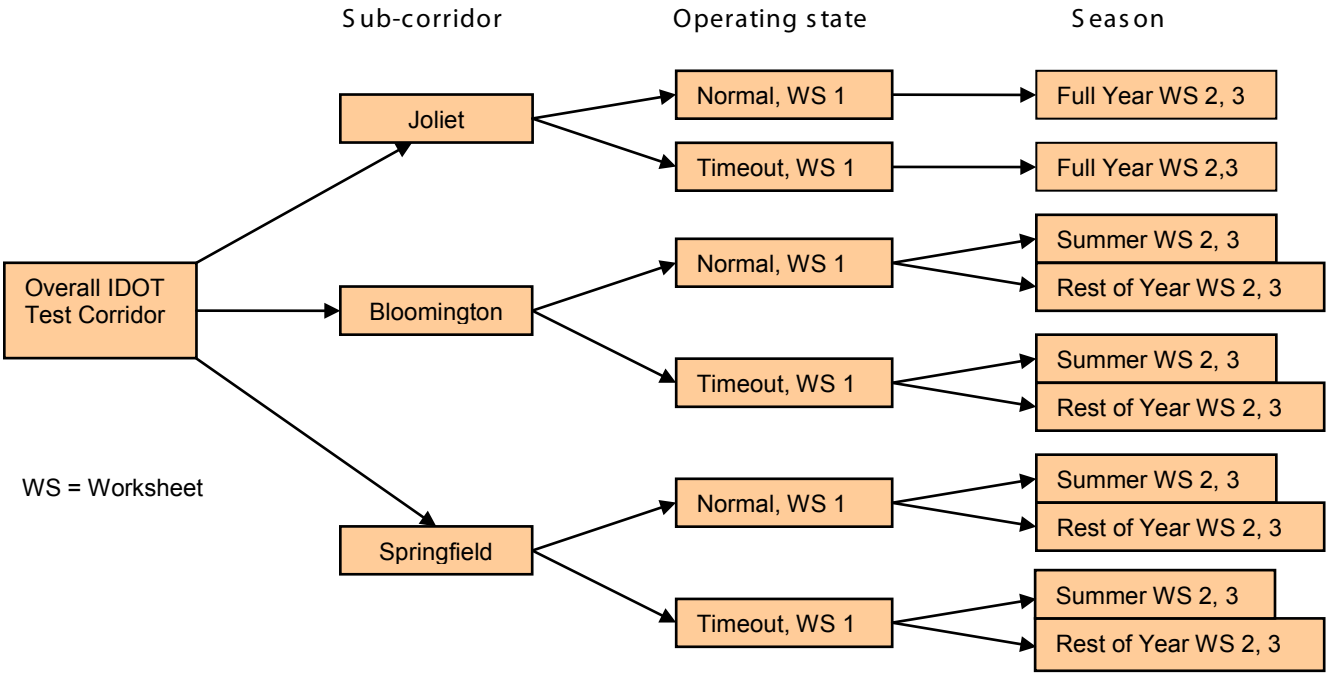


Figure A.2. Organization of Worksheets 1, 2, and 3 in the Risk Model

As shown in Figure A.2, a total of 26 worksheets are in the NAJPTC risk model in addition to the worksheets containing the inputs and summarizing the results. For the versions of the model that address cab signal with ATS and cab signal with ATC, there is no separate timeout operating state, and the number for worksheets reduces to 13 in addition to the worksheets that summarize the inputs and results.

The specific calculations carried out on each worksheet can be summarized as follows:

Worksheet 1 – Segment Definition and Timeout Effects

This worksheet concentrates on the analysis of the probability that collisions between a PTC-equipped train and an unequipped train can be prevented by the PTC system. The scenario analyzed is that the unequipped train has passed a stop signal. The violation is detected by PTC, which issues a stop command to the equipped train. The location of the unequipped train relative to the location of the violation and PTC timeout and latency is the key parameters in estimating whether the collision can be prevented or mitigated. The calculation also takes into account train braking performance, signal spacing, and track layout. The output is a set of collision preventability estimates for different collision and equipped train location scenarios. A full description of Worksheet 1 and related analyses follows in this appendix. Worksheet 1 remains in the versions of the model used for the cab signal systems, but the results are not used in subsequent worksheets, because in those cases, all trains are considered to be equipped with ATS or ATC. The results of Worksheet 1 would be used if the models were used to analyze an ATS or ATC system where unequipped or differently equipped trains were operated.

Worksheet 2 – Collision Probability and Preventability

This worksheet calculates the distribution of train-to-train collision accidents between all of the possible scenarios for such collisions (different pairings of train types in the collision, head-on and rear-end collisions, and passenger and freight trains). Then collision preventability is estimated for each scenario by using the results from the calculations on Worksheet 1 for equipped/unequipped train collisions. Finally, the collision distributions are combined with estimated collision frequencies and preventability estimates to provide estimated collision frequency for each collision scenario. The analysis takes into account the variation of collision frequency by type of segment, whether it is a passing siding, a signal block adjacent to a siding, or neither. The analysis also includes the specific scenarios for collisions at diamond crossings where the crossing train (usually operated by another railroad) is always assumed to be unequipped. A full description of Worksheet 2 is provided in Appendix B.

Worksheet 3 – Risk Calculations

This worksheet allows for the basic risk calculation (risk = frequency × consequences) for each accident scenario by using collision frequencies from Worksheet 2 and frequencies for other accident scenarios from the Inputs Worksheet. The risk parameters calculated comprise estimated injuries, fatalities and property damage, and a total cost parameter calculated by assigning standard U.S. Department of Transportation values to injuries and fatalities. For the NAJPTC system, the model also takes into account the effects (reduced collision consequences) of reducing the speed of passenger trains when in the vicinity of unequipped freight trains. The accident scenarios analyzed include all those where PTC might reduce risk, comprising intrusion collisions, overspeed derailments, grade crossing collisions, broken rail derailments, and work zone intrusions. Results of the calculations are summarized in a results table. A full description of Worksheet 3 is provided in Appendix C.

A.1.2 Train Types and Characteristics

The following presumptions regarding train types and their operation were used in the analysis.

Train Speeds:

Passenger train: maximum 110 mph
Freight train: maximum 60 mph

Train Schedule:

The schedule comprises the following trips per week:

- Passenger trains – three round trips daily, 7 days/week over the full length of the IDOT test corridor between Mazonia, IL, and Ridgely, IL. All passenger trains are PTC equipped.

- Local freight trains – three round trips/week between Burlington and Ridgely and five round trips/week between Burlington, IL, and Mazonia. Seventy-five percent of local freight trains are PTC equipped.
- Through freight trains – three round trips/week year-round between Ridgely and Bloomington, IL, and five grain train round trips/week during fall, winter and spring, mostly between Bloomington and Ridgely. None of these through freight trains are PTC equipped.

A.1.3 Spatial and Temporal Variations in the Test Corridor – Sub-Corridors, Segments, Seasonal Variations, and Operating States

Accident risk on a rail corridor is primarily a function of key operating conditions, specifically:

- Traffic density (trains per day);
- Traffic mix, relative numbers of passenger and freight trains, and whether they are equipped with train control devices;
- Speeds of passenger and freight trains;
- Signal system types, layout (block lengths), and capabilities;
- Number of main tracks (which especially affects traffic density per track and the frequency of potentially conflicting movements); and
- Special features that can represent a hazard such as diamond crossings or moveable bridges.

These operating conditions on a railroad can vary both spatially and temporally. For example, traffic density and mix can vary by time of day, day of week, and seasonally. Train speeds typically vary along a rail route, depending on local infrastructure features such as curvature, junctions, and grades. Other spatial variations include number of running tracks, signal block lengths (which can affect the ability of a train to respond to a changed signal indication), and traffic mix and density.

In this risk model, the approach to covering the key temporal and spatial variations in the model is to divide the overall operation on the IDOT test corridor into temporal and spatial units within which operating parameters are constant, perform the risk calculation for each separately, and then are totaled to obtain the overall result. The specific divisions selected to represent the most significant variations are as follows:

Sub-corridors

Sub-corridors are defined to capture the most significant spatial traffic variations. Three Sub-corridors have been defined:

- Joliet Sub-corridor – Mazonia (MP 62.60) to the siding at Bunge (MP 88.35); Mazonia is considered an end point of the corridor, and the Bunge siding is the origination and termination point for grain train trips.

- Bloomington Sub-corridor – Siding at Bunge (MP 88.35) to the Yard at Bloomington, IL (MP 124.86); Bloomington represents a point of origination for local freight trains and a point at which trains from other lines enter or leave the IDOT test corridor.
- Springfield Sub-corridor – from the Yard at Bloomington (MP 124.86) to Interlocking at Ridgley (MP 180.99); Ridgley is considered an end point of the corridor.

Seasonal and Other Temporal Variations

The grain trains do not operate during the summer months of July, August, and September. Thus, there is a significant change in traffic density and mix between these summer months and the rest of the year. Two seasonal periods are represented in the model:

- A 3-month summer period, without grain trains; and
- A 9-month fall, winter, and spring period with grain trains.

Although there are day-of-week traffic variations, with selected local and through freight train trips operating between 1 and 5 days/week, attempting to perform model runs for each day of the week would have made the model excessively complex. Average traffic level and mix are assumed for all 7 days of the week for estimating collision frequencies, combined with reviews of day-by-day operating string charts.

Spatial Variations within Sub-corridors

The most critical issue in this risk analysis is the ability of the NAJPTC and the base case train control systems to prevent collision accidents and the influence of NAJPTC communications timeout on those risks. In the NAJPTC case, the traffic mix includes both equipped and unequipped trains, and the collision scenario most influenced by timeout is when an unequipped train fails to stop at a stop signal and is in danger of colliding with an equipped train. In this situation, signal block length is a critical parameter in calculating risk, along with timeout and latency. Therefore, each Sub-corridor was divided into segments corresponding to signal blocks for the risk calculation. The signal blocks are typically between 2 and 3 mi. Grade crossings and diamonds are analyzed separately as point hazards.

Risk associated with a track segment (signal block) depends on the features within and adjacent to a signal block. Most notably, accident data and descriptions indicate that the most likely location for head-on collision accidents in a single-track signal block adjacent to a passing siding, where a "guilty" train exits the siding after failing to stop at the control point signal at the end of the passing track. To reflect this type of risk variation in the model, track segments have been divided into six types:

- Monitored sidings (where the passing siding track is track-circuited for train detection);
- Unmonitored sidings that lack track circuits on the siding track. There are two unmonitored sidings in the IDOT test corridor;
- Single-track segments adjacent to a monitored siding (called "CP adjacent (M)" in the model table headings);

- Single-track segments adjacent to an unmonitored siding (called "CP adjacent (U)" in the model table headings);
- Single-track segments that are not adjacent to a siding. These are called plain track segments in model table headings; and
- Diamond crossing segments, considered as point hazards (i.e. with no length).

There are no double-track segments on the IDOT test corridor, but if there were, they would be another segment type.

Operating States

All train control systems have at least two operating states:

- Normal operation, where all train control functions are working normally; and
- Fallback mode, where there has been a control system failure and the system has been cut out on an individual train or over a portion of the line.

For the NAJPTC system only, there is also a timeout mode, where either a communications failure or communications queuing is preventing control messages from reaching a train before timeout expires, and the system declares a fault condition and initiates braking. There is no equivalent to the timeout mode with the cab signal systems; any system failure results in no signal from the coded track circuit which is interpreted as a restricted speed command by the on-board system. An on-board failure has the same effect.

The analysis considers only normal operation and timeout operating states. The fallback mode (conventional CTC operations) is assumed to be the same for all analysis cases, both in aggregate duration and safety performance, and thus does not affect the risk comparison between the NAJPTC system and the base case systems. If there were availability variations between the control systems, then the train-miles operated in fallback mode would vary, resulting in a significant influence on a safety performance comparison.

A.1.4 Accident Scenarios

The objective of the risk analysis is to evaluate the relative safety performance for the NAJPTC system relative to that for the base cases (cab signal system with ATS and cab signal with ATC). Thus, the analysis includes all accident scenarios where the frequency or consequences of an accident could be reduced by PTC or cab signals. These are termed PTC-relevant accident scenarios and are made up of the following:

- Train-to-train collisions of all kinds, including collisions at diamond crossings with another rail line;
- Collisions between an active train and a rail vehicle or vehicle lading that has intruded on the track occupied by the active train;
- Overspeed derailments;

- Broken rail derailments, where the broken rail can be detected by the train control system;
- Work zone violations; and
- Grade crossing collisions with a highway vehicle, where a crossing warning system malfunction detectible by the train control system was a factor in causing the collision.

Illustrations of accident scenarios are provided in Appendix E. A short treatment of accident scenarios is provided in the following paragraphs to put the discussions contained in the rest of this appendix into context.

Train-to-Train Collisions

Train-to-train collisions are collisions between two trains, both of which are moving over the IDOT test corridor under the control of the signal and train control system. Collisions are most commonly caused when one train fails to observe signals and operating authorities or when the engineers receive conflicting instructions from the dispatcher. Less commonly, collisions can be caused by a failure of on-board equipment such as brakes or in the signal, train control, or communications systems.

Sub-scenarios of train-to-train collisions have been established to take into account factors that affect either the frequency or consequences of collisions. Those included in the analysis are:

- Factors affecting collision frequency:
  - Traffic density and mix: The number of trains per day and the distribution between passenger trains, PTC-equipped freight trains, and unequipped freight trains. Base collision frequency and the distribution between meets and passes are governed by the traffic mix and operating pattern. Collision frequencies are estimated for each possible combination of train types.
  - Collision frequency variations as a function of route segment type: Collision risk is not evenly distributed along the line. A review of historic accident data suggests that on a single-track railroad, collision risk is higher at passing sidings and especially the single-track segments before and after a siding. Appropriate frequency adjustments are applied to each segment type.
- Factors affecting collision consequences:
  - Train types involved in the collision: Consequences are much more serious with passenger trains than freight trains, given the numbers of passengers at risk of becoming casualties and the high value of passenger cars relative to freight cars and their contents.
  - Colliding vehicles in the collision: Whether the collision involves a locomotive hitting another locomotive, a locomotive hitting a freight car or a locomotive hitting a passenger car. Because of the wide differences in consequences between passenger and freight trains, the model calculates consequences separately for each train involved in a collision, taking into account the types of colliding vehicles and trains involved.
  - Train speed: Consequences vary substantially with train speed broadly as a function of the kinetic energy dissipated in a collision.

Diamond collisions are a special case of train-to-train collision, where collision frequency is a function of the combined traffic density on both lines. Factors affecting consequences are the same as above, except that the chance of a locomotive-to-locomotive collision is assumed to be negligible, and all collisions are locomotive to passenger or freight car.

Intrusion Collisions

Intrusion collisions occur when rail cars or their lading on an adjacent track intrude onto the active track and are hit by an active train. There are two subgroups of intrusion collisions:

- The first is at a connecting switch where a rail vehicle rolls out to foul the main line. This can be due to an improperly secured vehicle, a vehicle released by vandals, misjudged switching movements on the connecting track, and similar factors.
- The second occurs away from connecting switches, in which a derailed vehicle or a shifted load on an adjacent track fouls the main line.

These subgroups are analyzed separately as they differ in frequency, consequences and in potential preventability by the PTC or base case train control systems.

Overspeed Derailments

PTC can enforce permanent and temporary civil speed limits, including maximum speed through turnouts, for example, when entering a passing siding instead of taking the main track.

Broken Rail Derailments

Broken rail can be detected by the train control system. Conventional track circuits can detect a completely broken rail, provided that the signal block is unoccupied by a train, thus warning an approaching train by changing the signal controlling entry to the block to red and alerting an approaching train through the PTC system, where available. Directional coded track circuits, as used for the UP cab signal and NEC ATC systems, can warn an approaching train of a broken rail, even if the train already has entered the signal block.

Work Zone Violations

A work zone violation occurs when a train enters a work zone without authorization from the supervisor responsible for activities in the work zone or passes through a zone at excessive speed. Work zone locations and speed restrictions may be entered into the PTC server and enforced by PTC. PTC may also monitor the movements of on-track work equipment that does not normally shunt track circuits.

Grade Crossing Collisions

Grade crossing collisions are defined to be collisions with a highway vehicle at a grade crossing that are reportable to FRA as a train accident. A subset of grade crossing collisions between a train and a highway vehicle are caused by a failure of the crossing warning system (e.g. gates,

lights, or bells). PTC can warn the train if the crossing warning system fails to operate correctly and allow that train to initiate failed crossing procedures. Even if the first train to detect the malfunctioning crossing system cannot stop before the crossing, PTC will alert the dispatcher to notify subsequent trains and send a maintainer to inspect the crossing. Note that this definition does not include the larger number of grade crossing collisions that do not result in damage to the train exceeding FRA's train accident reporting threshold. These grade crossing collisions as well as casualties and damage to highway vehicles and their occupants are not included in this analysis.

A.2 Description of Calculations in Worksheet 1 – Segment Definitions and Timeout Effects

As described in the previous section, Worksheet 1 of the risk model estimates the probability that collisions between equipped and unequipped trains can be prevented or mitigated. Estimating these probabilities involves assembling segment data (lengths, types, and speeds) and the performance results of collision preventability calculations for collisions between equipped and unequipped trains based on stopping distances and timeout. This section will describe analysis steps and key factors associated with these processes.

A.2.1 Overview of Calculations

Worksheet 1 is exclusively concerned with estimating collision probabilities in the scenarios that involve a collision between an equipped train and an unequipped train. Because authority violations by the equipped train will almost always be prevented by PTC, these scenarios involve an authority violation by an unequipped train, followed by a head-on, side, or rear-end collision. Collisions at diamonds are a special case of collisions between equipped and unequipped trains. Trains crossing the IDOT test corridor at diamonds are assumed to be unequipped.

Worksheet 1 performs the calculations for one Sub-corridor of the IDOT test corridor and for one operating state of the train control system (normal or in timeout). Some key input parameters are also introduced into the analysis on Worksheet 1, specifically the braking performance of passenger and freight trains, and the lengths and characteristics of route segments.

The specific calculations performed on the spreadsheet are illustrated in the block diagram Figure A.3 and described in subsequent paragraphs.

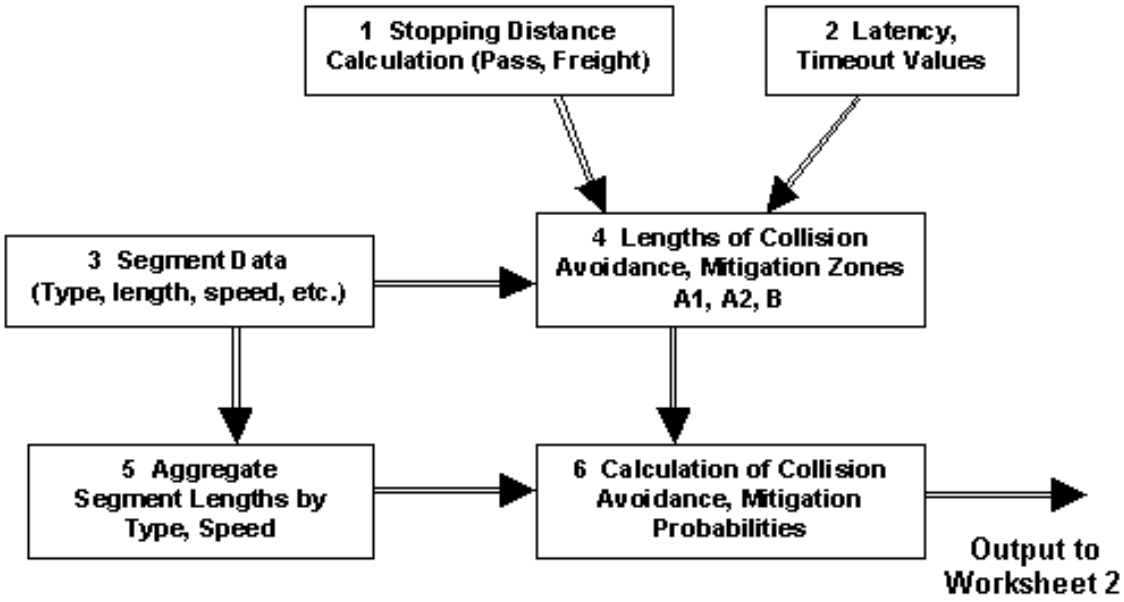


Figure A.3. Block Diagram Illustrating Calculations Performed in Worksheet 1

Step 1: Calculate stopping distances

Stopping distances are calculated from applicable braking formulas for freight and passenger trains. This calculation is performed in Table 1.1 of the Microsoft Excel worksheet and described in detail in Section A.2.2 below.

Step 2: Define latency or timeout value, as applicable

This is simply an input to the analysis and is defined for a specific analysis case and operating state of the train control system. In the normal operating state, the input is the latency expected for the train control system when operating normally (usually 10 s for NAJPTC). In the timeout operating state, the input is the timeout setting for the train control system for the specific analysis case being analyzed. For the cab signal with ATS/cab signal with ATC cases, the corresponding input is the penalty braking response time, usually 8 s. This is the time allowed for the engineer to acknowledge a more restrictive cab signal aspect and forestall an automatic brake application by the ATS/ATC. These inputs are included in the input data to Table 1.1 in the Microsoft Excel worksheet.

Step 3: Define segment type, length, speeds, etc.

These data are derived from the track information provided on track charts, timetables, and documents prepared for the NAJPTC project office. A master set of data (provided in Appendix D) has been prepared from these sources and used to compile the segment data listed in Table 1.2 of the Microsoft Excel worksheet. In all cases, segments are simply signal blocks plus point segments for at-grade rail crossings (diamonds).

The data comprise:

- The beginning and end points (milepost locations) of each signal block segment and the calculation of the length of each segment from the milepost locations. As far as possible, the track charts were reviewed to check for inconsistencies between milepost locations and actual distances.
- Segment type, using the designations defined in Section A.1.3.
- Posted speeds for all train types, including high-speed trains, permitted to travel at up to 110 mph.
- Representative speeds for all train types, derived as discussed in Section A.2.2. The list contains two speeds for high-speed trains, the normal speed used in most of the analysis and a reduced speed of 79 mph used to calculate collision consequences for collisions between a passenger train and an unequipped freight train. This reflects the operating requirement to restricting passenger train speeds when in the vicinity of an unequipped freight train.

Step 4: Calculate zone lengths A, B1, and B2

The lengths are calculated from the information assembled in Steps 1, 2, and 3. The zones are portions of the route segment where an equipped train may be located at the time an unequipped train violates its authority. This calculation is performed in Table 1.3 of the Microsoft Excel worksheet. The basis for and the details of this calculation are described in Section A.2.2 below.

Step 5: Combine like segments

The combined lengths of similar segments (same type and same passenger and freight train speeds) are calculated in Tables 1.4 and 1.5 of the Microsoft Excel worksheet. Table 1.4 is an intermediate step in the calculations to avoid excessively complex cell formulas. The results tabulated in Table 1.5 of the worksheet give the aggregate length of the segments that fall into each train speed and segment type category. Separate totals are calculated for each train type.

Step 6: Calculate estimate of collision avoidance or mitigation probabilities

These are derived from the zone lengths by segment type and for passenger and freight trains. These calculations are performed in Tables 1.6a to 1.6f for each type of segment, including diamond crossings. The calculation of the collision avoidance and mitigation probabilities is performed for each segment and train type and takes into account:

- The zone lengths derived in Step 4 and shown in Table 1.3 of Worksheet 1.
- The aggregate length of segments of each type in the Sub-corridor being analyzed.
- An estimate of the probability that a train will have entered the now-occupied signal block before or after the violation by the unequipped train.

- An estimate of the risk increment as a result of overreliance on the PTC in-cab display. This occurs in Zone C when the violation takes place before the train has passed the signal controlling entry to the now-occupied signal block. There is a risk that the train crew will rely on a display showing all-clear (because of latency or timeout) and fail to respond to a wayside signal (controlled by track circuits) that will show a stop aspect approximately 3 s after the violation. Cab signal systems that rely on coded track circuits do not have an equivalent effect because of the minimal lag between the wayside and cab signal displays.

The results from the calculations are transferred to Worksheet 2 for the next stage in the analysis.

Step 2 (Define Latency or Timeout Value) and Step 3 (Define Segment Type, Length, Speeds, etc.) are simply input data and therefore do not involve calculations. Step 1 (Calculate Stopping Distances) and Step 4 (Calculate Zone Lengths A, B1, and B2) depend critically on train speed, a key model input. The following section will detail how speed is considered in these two steps. How this information is brought into the final product of Worksheet 1, namely the estimates of collision avoidance and mitigation probabilities, will be addressed in Section A3.

A.2.2 Consideration of Speed in the Model

The basic source of information for train speed is the posted train speed as shown on applicable timetables and track charts for the IDOT test corridor. This line has very few curves, almost none of which are severe enough to require a permanent speed restriction or slow order. Likewise, no steep grades significantly affect the average speed of either freight or passenger trains over a full route segment. The only significant permanent speed restrictions in the corridor are through the city of Burlington, IL, which has multiple connections to yards and sidings and several grade crossings and a 40-mph speed limit at all at-grade rail crossings (diamonds). Braking and acceleration areas before and after passenger train stations and industry tracks and sidings being visited by freight trains are ignored. Because of the limited number of speed restrictions and the lack of significant curves and grades, both passenger and freight trains are expected to operate at or near posted speed over most of the IDOT test corridor.

Representative Speeds

As described earlier, the corridor is divided up into segments. The train speeds assigned to each route segment have been termed Representative Speeds. A value for Representative Speed is estimated for passenger and freight trains for each route segment (signal block), and is intended to be a reasonable common sense estimate of actual train speeds. The values of Representative Speeds used are constrained to a limited set of four values for passenger trains and three values for freight trains; accident consequences are only estimated for these specific values for each accident scenario. Table A.1 below gives the Representative Speeds selected to best cover the range of actual speeds in the corridor.

Table A.1. Representative Speeds Used in the NAJPTC Risk Calculation

Representative Speeds for Passenger Trains (mph)	Representative Speeds for Freight Trains (mph)
40	25
60	40
79	50
105	

The procedures for estimating representative speeds for passenger and freight trains within the model are as follows:

Passenger trains:

- For route segments where the present posted speed is 79 mph and where passenger trains would be permitted to travel at up to 110 mph with NAJPTC or either of the base case systems and the same speed is permitted in adjacent route segments:
  - Representative speed will be 79 mph for train-to-train collisions with unequipped trains in the PTC case because of the required speed reduction in the vicinity of unequipped trains. Passenger trains are expected to travel at or near the posted speed when possible, and with the low traffic and recent track upgrades, trains will rarely operate at reduced speed because of traffic conditions or slow orders.
  - Representative speed will be 105 mph for all other accident scenarios for PTC-equipped trains and for all accidents (including train-to-train collisions) for the base case cab signal systems.
- For route segments where passenger trains have to enter or leave the segment at a reduced speed, normally 30–40 mph (e.g., at a diamond), an estimate of the average speed through the segment is used, assuming the train is braking as it approaches the speed restricted point or accelerating away from the restriction. The estimated speeds will be as follows:
  - Representative speed will be 60 mph for passenger trains with initial speeds of 79 mph.
  - Representative speed will be 79 mph for passenger trains with initial speeds of 105 mph.
- For speed-restricted route segments, representative speed will be the nearest value below the actual posted speeds.

Freight trains:

- For route segments where the posted speed for freight trains is 60 mph and the same speed is permitted in adjacent route segments, representative speed will be 50 mph. The lower speed is because freight trains may be more affected by the modest grades on this route than passenger trains; some trains may have speed-restricted cars in the consist, and in any case, railroads often limit freight trains speeds to 50 or 55 mph to save fuel and wear and tear, regardless of civil speed limits.

- For route segments where freight trains enter or leave the route segment at reduced speed, a representative speed of 40 mph is used.
- For all other segments, the representative speed will be the nearest value below the actual posted speeds.

These conventions are expected to cover all route segments in the IDOT test corridor and operations under each of the train control systems being analyzed.

Calculation of Stopping Distances

The stopping distances are derived simply from applicable stopping distance formulas for passenger and freight trains. The formulas discussed in this section are those to bring the train to a stop from the moment that an unequipped train violated its movement authority, such as by passing a stop signal, including adding (at this stage in the calculation) the "free-running" distance traveled by the train during timeout, latency and/or allowances in the on-board system for engineer response.

Passenger trains:

The analysis uses a standard formula for Amtrak trains provided by Amtrak and used for all braking distance calculations for the NAJPTC project. The formulas are of the form:

Braking distance in feet from speed V to stop on level track is given by:

$$[\{(A \times V^2) + (B \times V)\} \times (\text{safety factor})] + [C \times V \times 1.467] \quad \text{.....(1)}$$

where:

V is train speed in miles per hour.

A is a coefficient representing the average braking effort and, therefore, deceleration of the train, and depends on consist makeup and the braking performance of the cars in the consist.

B is a coefficient representing the time taken for the braking system to build up to full effort after braking is initiated by the engineer and also some nonlinearity's in brake system performance. The value of B also depends on the consist and car brake performance specification.

The safety factor is a multiplier on the braking distance to allow for low rail adhesion, defective brakes, very cold weather, and similar factors. A value of 1.25 for the factor is used.

C is a delay in seconds in initiating braking caused by either timeout (with NAJPTC) or with cab signal systems, the delay between the locomotive detecting a more restrictive signal aspect and the initiation of penalty braking.

The factor 1.467 converts speed in miles per hour into feet per second.

Equation 1 accounts for grade compensation within the coefficients. The coefficients used in the calculations have been established in previous studies and are chosen on the basis of the type of train being considered. All passenger traffic on the test corridor has been categorized by Amtrak as described in Table A.2. Once a particular passenger train is "assigned," a set of coefficients for use in Equation 1 is identified.

Table A.2. Categories Used to Identify Passenger Trains Established by Amtrak

Type	Subtype	Description
B	B1	A maximum of 2 P-40 or P-42 engines and not less than 2 and nor more than 14 Amfleet/Horizon cars in the consist. No nonpassenger carrying or Superliner cars are permitted.
	B2	A maximum of 1 P-40 or P-42 engine and 14 cars or fewer with no more than 1 nonpassenger carrying car for each Amfleet/Horizon car in the consist. No more than 2 of the nonpassenger carrying cars may be MHC cars (Series 1400-1569), and no Superliner cars are permitted.
	B3	A maximum of 1 P-40 or P-42 engine, and 14 cars or less with no more than 2 RoadRailer vans for each Amfleet/Horizon car in the consist. No MHC cars, baggage cars, or Superliner cars permitted.
C†	C1	A maximum of 2 P-40 or P-42 engines and 14 cars or fewer with a minimum of 3 Amfleet, Horizon, or Superliner cars. A maximum of 11 nonpassenger carrying cars are permitted.
	C2	A maximum of 3 P-40 or P-42 engines and 15–30 cars with a minimum of 7 Amfleet/Horizon or 9 Superliner cars. Not more than 1 baggage car is permitted. No MHC cars are permitted. The remaining cars in the consist may be express cars, including RoadRailers.
D	–	All trains not fitting the above categories, with speed is limited to 90 mph.

†Train Type "C" has a maximum speed of 90 mph. Superliners are currently qualified to go up to 90 mph, but it is Amtrak's belief that on a Class 6 track with a qualified train control system, Superliners can be qualified to go up to 110 mph. This could result in Type "C" trains under Subtype C1 being qualified to operate up to 110 mph, if all nonpassenger carrying cars are MHC and/or baggage cars.

All passenger trains considered in this analysis are taken to be Train Type "B" and the appropriate coefficients are applied to Equation 1.

Freight trains:

The freight train braking distance formula is a version of the Davis formula. The braking distance to a stop from speed V on level track is given by:

$$[1.467 \times V \times (\text{brake application time})] + [P \times (\text{train weight in pounds (lbs)}) \times V^2 / (\text{braking force})] + [C \times V \times 1.467] \quad \text{.....(2)}$$

where:

V is train speed in miles per hour.

Brake application time (seconds) is 0.1 times the number of cars in the consist.

P is a coefficient equal to 0.035 for typical freight trains.

Braking force is a function of the number and types of cars in the consist and is expressed in pounds.

C is a delay, in seconds, in initiating braking. For NAJPTC, this is a function of timeout or latency. In cab signal systems, the delay is between the locomotive detecting a more restrictive signal aspect and the initiation of penalty braking.

1.467 is the multiplier converting speed in miles per hour to feet per second.

Equation 2 assumes very limited braking capabilities (worst case margin) and is effective for a very nominal grade.

The coefficients used for braking distance calculations are summarized below:

Table A.3. Values Used in Braking Distance Calculations

Train Type	Coefficients	Values
Passenger	Coefficient A	0.666
	Coefficient B	0
	Safety factor	1.25
	Coefficient C	Latency or timeout in seconds
Freight	Coefficient P	0.035
	Application time	0.1 × number of cars in train
	Train weight	37,600,000 lbs
	Brake force	779,683
	Coefficient C	Timeout or latency in seconds

A.3 Calculation of Timeout Effects on Collision Risk

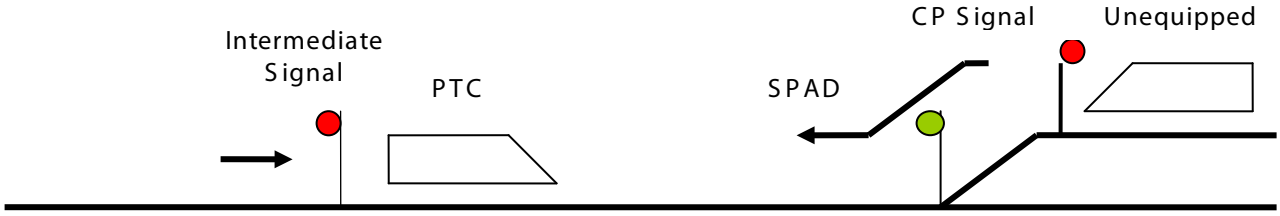
The purpose of establishing values for all the parameters discussed to this point is to use them in the consideration of specific collisions. Accident scenarios have been previously discussed in Section A.1.4. Specific accidents will now be addressed, and the determination of "risk zones" and how they pertain to accidents will be described. This discussion applies to the NAJPTC analysis case only. Because all trains are assumed to be equipped with both base case systems—cab signals with ATS and cab signals with ATC—these calculations are not applicable. However, if either of the base case systems were to be implemented with unequipped or differently equipped trains, then similar calculations would be required.

A.3.1 Risk Zones

One of the accident scenarios of most concern is the one in which a PTC-unequipped train on a controlled siding meets a PTC-equipped train on the main line. This is *not* the only accident scenario that is critical to this analysis. Collisions with unattended vehicles, incidents at grade crossings, and work zone invasions are also situations that merit consideration; however, these scenarios are best dealt with when handling risk calculations performed in Worksheet 3 and will be addressed in Appendix C. The meeting of trains at diamond crossings is also of interest to this analysis and is addressed later in this section.

The scenario selected for this description is one in which a PTC-unequipped train passes a red signal at danger (often referred to as "signal pass at danger" or SPAD) at a controlled siding and enters the main track signal block previously released to an approaching equipped train. This scenario is described on pages E-15 and E-16 of Appendix E. Page E-15 illustrates the situation where an equipped train leaves a monitored siding, passing a signal at danger when the equipped train traveling in the opposite direction has not entered the signal block between the two trains. Page E-16 shows the same scenario where the equipped train already has entered the signal block at the time of the violation by the unequipped train. In either case, a head-on collision may result if the equipped train cannot stop in time. The two Sub-scenarios are illustrated in Figure A.4.

(a) Equipped Train Approaching Intermediate Signal at Time of SPAD



(b) Equipped Train between Intermediate and Control Point Signal at Time of SPAD

Figure A.4. Illustrations of Scenarios Involving PTC-Unequipped Train Passing Signal to Enter Main Line to Meet PTC-Equipped Train

This pair of Sub-scenarios is a proxy for a group of several scenarios described in Appendix E that involve a collision between an equipped train and an unequipped train on the main running tracks or at a passing siding. These include:

- Unequipped train ignores block signal on main line as PTC-equipped train leaves uncontrolled siding within block (page E-19 of Appendix E);
- Unequipped train leaves uncontrolled siding within block onto main track in path of approaching PTC-equipped train (pages E-13 and E-14 of Appendix E); and
- Collision during overtaking or passing move at a controlled siding, where an unequipped train leaves the controlled siding, ignoring a red signal into the path of an equipped train, leading to a side or a rear-end collision as in the Chase, MD, scenario (pages E-28 and E-29 in Appendix E).

Scenarios involving an unattended car or cut of cars rolling out of a siding into the path of an equipped train are considered part of a separate scenario and are discussed in Section A.1.4 with other accident scenarios.

The rationale for combining these scenarios and taking the scenarios shown in Figure A.4 as a proxy for the group is as follows:

- Almost all encounters between trains on the IDOT test corridor meet where trains traveling at opposite directions meet at a controlled passing siding. Because of the sparse traffic operating on single track and the specific scheduling shown in the string charts, relatively few overtaking moves take place (that could lead to the scenarios on pages E-28 and E-29 or of trains leaving an industrial siding) when another train is nearby. This means that the scenarios on pages E-15 and E-16 involving trains traveling in opposite directions are more likely to occur on this corridor than the other scenarios.
- The logic of whether the PTC system can prevent or mitigate a collision is similar in all scenarios. Although there will be detailed differences in accident preventability, these are thought to be not great enough to seriously distort the end result.
- The relative likelihood of head-on, rear-end, and side collisions and differences in consequences between head-on and side or rear-end collisions are still represented in the model in the analyses in Worksheet 2.

In either Sub-scenario shown in Figure A.4, the presumption is that the stop signal violation by the unequipped train is detected, either by a switch monitor (due to "run through" of the switch that is not aligned for the movement of the guilty train) or by the track circuit of the next block. This information is transmitted to the PTC server, which generates a command to the equipped train to stop. This command is then transmitted to the train; the manner in which the violation is detected and the stop command is transmitted to the equipped train is shown in Figure A.5.

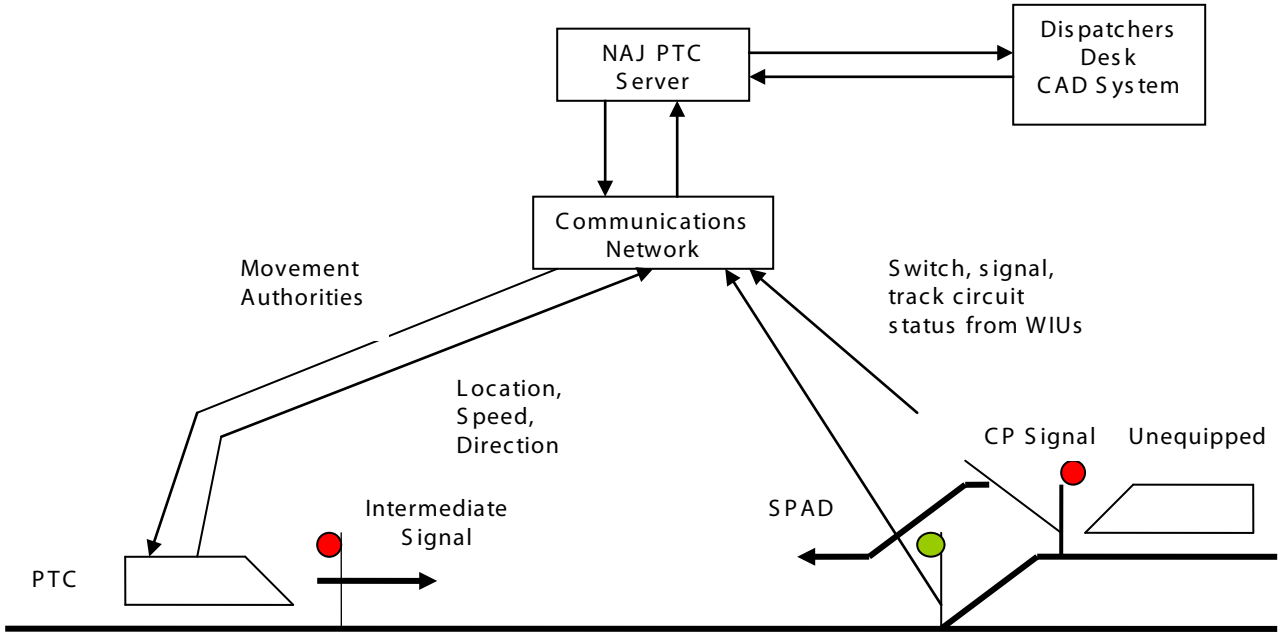


Figure A.5. NAJPTC Communications Links

After a signal violation by the unequipped train, the NAJPTC system underwent the following sequence of events:

- The signal violation is detected by switch position sensors and, if the PTC-equipped train has not passed the intermediate signal (to the left of the diagram Figure A.5), by the track circuit in the signal block between the trains.
- The sensor information is transmitted to the WIUs at the Control Point signal and then transmitted by digital radio to the NAJPTC server.
- The intermediate signal turns from all clear (green) to stop (red), because the violating train occupies the next block. If the PTC-equipped train has passed the intermediate signal, the block is already occupied, and the intermediate signal is behind the equipped train and does not play any part in subsequent events.
- The NAJPTC processor in the server interprets the sensor data, determines that the unequipped train has passed a stop signal, and issues a message to the equipped train, cancelling its previous authority and requiring an immediate stop.
- The equipped train starts to brake in response to the stop command to prevent or mitigate the collision.
- The unequipped train that passed the red signal may continue to travel through the block, getting closer to the approaching PTC-equipped train, or the crew may become aware of the error and stop. In this analysis, the unequipped train is assumed to continue moving at 15 mph, and collision points are calculated taking into account the distance traveled at this speed.

The time interval between the original signal violation and the receipt of the stop command by the equipped train is the sum of the processing time at each stage, in the WIUs, the radio transmitters and receivers, processing time at the central server and processing time on the equipped locomotive. If the PTC system is working normally, this time is called latency and may include radio transmission delays as a result of message queuing or congestion of the radio channels.

If the PTC system is in timeout due to a communications failure or overload, the message is interrupted at some point in the process and does not reach the equipped train. The equipped train continues running under the previous authority until the timeout expires and the brakes are applied. The response of the equipped train depends on timeout status and its location when the signal violation takes place.

For the purposes of risk calculations, a series of risk zones are defined for the position of the equipped or “innocent” train at the time of the signal violation by the guilty (unequipped) train. An illustration of these risk zones is provided on Figure A.6. In this case, Point Z corresponds to the signal at the switch that is shown as the green signal in Figure A.4.

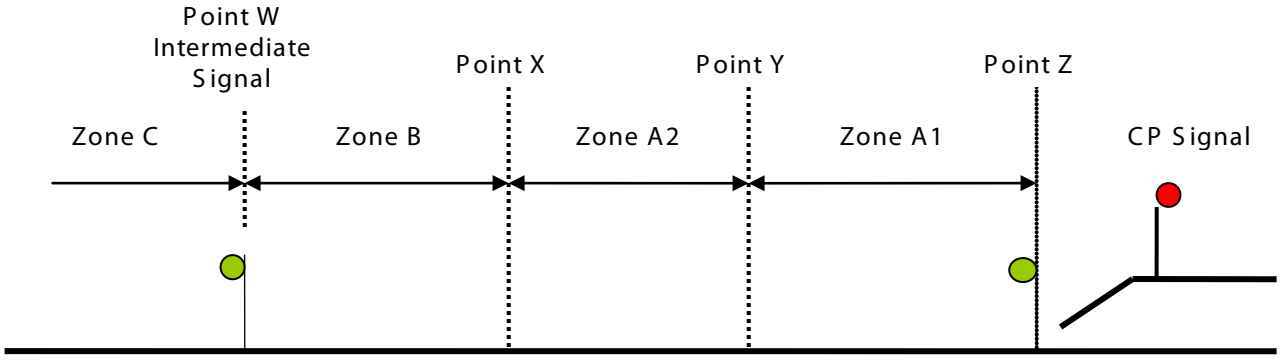


Figure A.6. Risk Zones for Equipped Train Approaching a Point of Conflict

The ability of the equipped train to stop before colliding with the violating train depends on its risk zone location at the time of violation and timeout status.

The zones for the location of the equipped train at the time of the violation are as follows:

Risk Zone A1, between Points Y and Z: equipped train is unable to stop or reduce speed significantly before reaching the point of conflict, which lies to the left of Point Z The calculation of the length of this and the other risk zones includes an estimate of the distance traveled by the guilty train after passing the signal at the end of the siding.

Risk Zone A2, between Points X and Y: equipped train can reduce speed sufficiently to reduce the consequences of a collision but is unable to stop before reaching the point of conflict. A discussion of what speed reduction is needed to reduce consequences significantly is provided later in this section.

Risk Zone B, between Points W and X: equipped train has passed the intermediate signal at Point W but receives a warning or the NAJPTC timeout expires and is able to stop before the point of conflict.

Note that Figure A.6 illustrates the situation where Points X and Y are located between Point W (location of intermediate signal) and Point Z. However, the lengths of Zones A1 and A2 depend on train speed, latency, timeout, and braking performance. Therefore, it is possible for the length of either Zone A1 or Zones A1 + A2 to exceed the distance between Points W and Z. In this case, there is no Zone B, and the end of either Zone A1 or Zone A2 remote from Point Z is always at Point W. Practically, this situation typically arises at higher speeds and when the NAJPTC system is in timeout, because distances between signals are typically longer than the braking distance from maximum posted speed. However, with timeout exceeding 120 s and a speed of 79 mph, the distance traveled during 50 percent of the timeout is on the order of 7,000 feet, which when added to braking distance often exceeds signal block length.

Risk Zone C, before the intermediate signal at Point W: if the equipped train is in this zone at the time of the signal violation by the unequipped train, the engineer can see the

intermediate signal change to the "approach" or "stop" aspect. An alert engineer can initiate braking on the basis of the signal indication alone, regardless of train control system operating state. The exception might be when the equipped train is very close to the intermediate signal so that the engineer may miss the signal flip because of a moment's inattention. Thus, very few collisions happen when the equipped train in Zone C is the reference case (CTC): an accident in this scenario requires a double failure—the original signal violation and a second violation when the innocent train in Zone C fails to respond to the wayside signal indication. Such a double failure may be more likely in the case of a PTC-equipped train in timeout or during latency. In this case, the signal aspect will change at the time of the violation, but the amended authority via the PTC system will be delayed by latency or timeout. In this situation, there is the possibility that PTC will increase the number of accidents over the CTC reference case because the crew may be more likely to miss or discount the line side signal indication.

Speeds for Reduced Consequences

The definition of risk zones is based, in part, on the concept of reduced consequences of incidents. This section addresses how speed reduction is used in the determination of reduced consequences and, therefore, the lengths of risk zones.

Passenger trains:

It is very difficult to identify and quantify the risk factors that affect accident severity from analysis of accident data in passenger train collision accidents, primarily because there are very few collision accidents overall—approximately four to six accidents per year involving fewer than 10 individual passenger trains of all types, including cab car-led trains. This low number and the variability in consist type and size mean that it is not possible to carry out a meaningful analysis of historic accident data to obtain a speed versus severity characteristic. Another difficulty is that a very small number of catastrophic accidents are responsible for the majority of fatalities. These accidents usually involve the initial collision and an aggravating factor, such as a fire or a second collision with another train that may not be influenced by initial train speeds.

Train collision modeling can shed some light on the levels of damage and casualties in collisions. Straightforward momentum and energy calculations indicate that the energy dissipated in a collision, and the resulting damage is a function of the square of the closing speed. However, trains are not simple rigid bodies and can crush, buckle or override so that the energy calculation is only a rough guide to severity. However, a substantial body of collision analyses and test results is available that, when combined with information from actual collision accidents, point the way to some general conclusions:

- Casualties are minimized when trains stay upright and in-line in a collision but rapidly increase when train buckle or override.
- Both analysis and experience suggest that in head-end collisions with locomotive hauled passenger trains (the predominant collision type on the IDOT test corridor) buckling rather than override can be expected and that buckling is initiated at closing speed of between approximately 45 and 60 mph, depending on train length and other local factors. Below this speed, trains tend to stay upright and in-line and are generally less exposed to high-

consequence situations such as secondary collisions with a train on an adjacent track or rupture of a locomotive fuel tank.

- In a collision between a locomotive and a passenger car, override can be expected at speeds more than approximately 30 mph, with the lighter passenger car riding up and over the locomotive, resulting in massive damage to the struck passenger car. The exact speed at which override occurs depends on consist length, mass and mass distribution, and other local factors. This scenario was amply demonstrated by recent collision tests at Pueblo, CO, as well as confirmed by collision and crush analyses. In the IDOT test corridor, locomotive to passenger car collisions take place only when a passenger train is rear-ended by another train or locomotive. This is expected to be a rare occurrence, given the traffic patterns on the IDOT test corridor.

Thus, more severe consequence for passenger trains can be expected with:

- Override in locomotive to passenger car collisions at above approximately 30 mph; and
- Buckling in locomotive-to-locomotive collisions at speeds approximately 45–60 mph (most common scenario on the IDOT test corridor).

Note that these conclusions apply to passenger equipment with conventional car body structures and couplers. Equipment with crushable crash energy management (CEM) structures will behave in a very different way in collisions, with the train staying upright and in-line at significantly higher speeds. However, there are no current plans to use passenger cars with CEM structures on this corridor, and the analysis assumes conventional carbody structures.

Overall this discussion suggests that the threshold for reduced consequences should be between 45 and 60 mph, below which locomotive-led passenger trains in head-on collisions will stay in line. A speed of 60 mph has been selected, bearing in mind that the reduced consequence zone (Zone A2 in Figure A.6) covers all speeds from 60 mph to stop.

Freight trains:

Review of a previous analysis of freight train accidents shows that about 57 percent of main-line collision accidents do not result in derailment of one or more freight cars. A breakdown by speed of these accidents is not available, but it seems reasonable to assume that they involve lower speeds and shorter trains. Also, there is a steady increase in the number of cars derailed by speed in accidents where one or more freight cars are derailed, with no clear threshold of sharply increased consequences at a specific speed, as shown below.

Table A.4. Average Number of Derailed Cars for Particular Speed Ranges

Speed Range	0–25 mph	26–40 mph	Over 40 mph
Average number of cars derailed	8	11	14

Most likely there is so much variability in freight train consists—length of train, length of individual cars, whether cars are loaded or empty, and so on—that there is no specific speed at which different accident consequences come to the fore.

The predominant derailment mode of freight trains is buckling, and given the strength and rigidity of typical freight locomotive structures, it is likely that the bulk of collision energy is dissipated in car derailment and buckling. No further information is readily available without carrying out further detailed analysis of the FRA database. Given this rather sketchy information, it is only possible to make an arbitrary decision regarding a speed threshold for reduced consequences in freight train collisions of 35 mph. At this speed it is likely that most collisions result in the derailment and buckling of several cars in the train.

Calculation of Zone Length

Using the arguments detailed above, risk zone lengths are calculated as follows:

Risk Zone A1 (between Points Y and Z in Figure A.6):

If within Zone A1, the equipped train is unable to stop or significantly reduce speed before reaching the point of conflict.

Length of zone is estimated by calculating the braking distance to stop as derived from the above formulas for the specific train type, representative speed in the signal block, train control system and timeout status, and subtracting the distance needed to brake from 80 percent of the representative speed for the segment for each applicable train type. Then the distance traveled by the guilty unequipped train in the time needed for the PTC-equipped train to reduce speed to 60 mph is added to the braking distance to calculate the total distance between Points Y and Z (at the switch at the siding exit).

For both passenger and freight trains, the brakes are assumed to be fully applied when the train has slowed to 60 mph for passenger trains or 35 mph for freight trains, and that the train will continue to slow down at constant retardation to a stop. With constant retardation, the distance to stop from of the initial speed is given by the V^2 term in both the freight and passenger formulas.

Thus the formulas for the length of Zone A1 are:

Passenger Trains:

[Distance to stop from the representative speed V per Equation 1)] –
[$A \times 60^2$] + [Distance traveled by guilty unequipped train in the time needed to reduce speed to 60 mph].....(3)

This formula reflects the convention discussed earlier in this section, where reduced consequences apply when speed is reduced to 60 mph or below. If initial speed is below 60 mph, then consequences are unchanged through Zones A1 and A2, and there is no difference in consequences between the zones.

Freight Trains:

[Distance to stop from the representative speed V per Equation 2] –

[P × (train weight in lbs) × 35^2 / (braking force)] + [distance traveled by guilty unequipped train in the time needed to reduce speed to 60 mph] .....(4)

This formula reflects the convention discussed earlier in this section, where reduced consequences apply when speed has been reduced to 35 mph. As with passenger trains, if initial speed is below 35 mph, no difference is found on consequences between Zones A1 and A2.

Equations 3 and 4 include a term to represent the distance traveled by the guilty train before the collision, extending the length of Zones A1 and A2. The distances traveled by the slow-moving guilty trains (assumed to be traveling at 15 mph) in the times taken for the equipped (innocent) train to reduce speed or to come to a stop in Zones A1 and A2, respectively. The total length of Zones A1 and A2 is thus the sum of the distance traveled by the innocent train while braking (including free running during latency or timeout) and the distances traveled by the guilty train.

As mentioned above, it is possible that with longer timeout periods and higher speeds that the length of Zone A1, as calculated above, will exceed the total length of the signal block between Points W and Z. In this case, the entire signal block is in Zone A1, indicating that a collision following a SPAD violation by the unequipped train cannot be prevented or mitigated, and the lengths of Zones A2 and B are zero.

Risk Zone A2 (between Points X and Y in Figure A.6):

If within this zone, the equipped train can slow sufficiently to mitigate the consequences of a collision, but the collision cannot be prevented. The length of this zone in every case is the distance to slow from 60 mph for passenger trains and 35 mph for freight trains to a full stop with full service braking. Zone lengths are given by the following formulas, applicable to all control systems and control system states. Risk Zone A2 lengths are independent of whether the NAJPTC system is in timeout.

Passenger Trains:

Zone A2 = [A × 60^2] + [distance traveled by guilty train while equipped train stops] .....(5)

Freight Trains:

Zone A2 = [P × (train weight in lbs) × 35^2 / (braking force)] + [distance traveled by guilty train while equipped train stops] .....(6)

As with Zone A1, it is possible that the combined length of Zone A1 + Zone A2 is greater than the block length. In this case, the length of Zone B, between Point X and Point W in Figure A.6 is zero. Also, the combined lengths of Zones A1 and A2 cannot exceed the block length. If the sum of A1 and A2 calculated from the formulas above exceeds block length, but Zone A1 is less than the block length, then the length of Zone A2 is given by:

Length of Zone A2 = block length – length of Zone A1 .....(7)

Risk Zone B (between Points X and W in Figure A.6):

If the equipped train is within this zone, it can stop before the point of conflict. Zone B exists only if the total length of Zones A1 and A2 is less than the signal block length, and its length is given by the formula:

$$\text{Length Zone B} = \text{signal block length} - (\text{length of Zone A1} + \text{length of Zone A2}) \quad (8)$$

If the length so calculated is less that zero, then the length of Zone B is zero.

Risk Zone C (Before Point W in Figure A.6):

As discussed above, if the train is in Zone C and has not passed the wayside signal at point "W," the engineer will, in almost every case, respond to the changing aspect of the signal at point "W" and may be able to prevent or mitigate the collision independently of PTC state. In the reference (CTC) case, there will be a low but finite probability that the engineer will fail to respond to the point "W" signal. With NAJPTC in normal mode, and with the cab signal systems, the in-cab system will be able to respond after the latency delay after the signal aspect change. Therefore, there is a chance of a "PTC-caused" collision, where overreliance on PTC resulted in a missed wayside signal and a collision.

The situation when the NAJPTC system is in timeout is similar to latency, except that the train will potentially travel a greater distance between when the line side signal changes aspect in response to the signal violation by the guilty train and when the on-board PTC system initiates braking after timeout has expired. Thus, the in-cab system and displays will indicate "all-clear" for the remaining duration of timeout after the wayside signal has changed aspect.

Although the operating rules require that the train crew comply with the most restrictive aspect in the case of conflicting indications, the "all-clear" on-board display during timeout or latency is potentially misleading, and could increase the chance of the crew failing to comply with the wayside signal. For example, the crew could "see" the aspect they expect at the wayside signal rather than the aspect that is actually displayed. This means that collision risk could actually be greater with PTC than for the reference CTC system when the train is in Zone C. The analysis provides for a risk increment to be added based on the distance the equipped train travels during latency or timeout in Zone C. The distance traveled in timeout state in Zone C is calculated from the formulas below, assuming that:

a) The NAJPTC system is in timeout or latency, and

b) [A1 + A2] exceeds the length of the signal block and overlaps into Zone C.

The distance traveled in timeout or latency in Zone C is then the smaller of the following:

Total distance in timeout, given by [C × V × 1.467] or overlap of A1 + A2 into Zone C, given by [A1 + A2] – [signal block length]

Estimating the significance of distance traveled in timeout is clearly a difficult judgment call. The risk exposure from a very short period—a few seconds—is probably too little to have much influence. A very long period might give the crew sufficient time to notice something is wrong and take preventative action. Accident data and descriptions provide little relevant data, and there is little information on which to base an estimate of an increase in collision risk with PTC, if any. The only realistic option is to estimate the outer bounds of the effect to determine sensitivity of the final risk analysis results.

Appendix B: Description of Calculations in Worksheet 2 – Collision Probability and Preventability

B.1 Overview of Calculations

Figure B.1 illustrates the sequence of operations in Worksheet 2, in which estimated accident rates for passenger and freight trains in collisions are calculated. All these calculations are concerned with collisions between active trains operating on the IDOT test corridor. Other accident scenarios are addressed in Worksheet 3. The calculations performed in each individual step in the analysis are briefly described in the following paragraphs, and step-by-step descriptions are provided in Sections B.2 and B.3.

Step 1: Define train pairs in collisions

Train pairs that could be involved in collisions were identified in part from the string charts shown in the description of the ASCAP rail system simulator developed at the Center of Rail Safety-Critical Excellence at the University of Virginia (IDOT Base Case Risk Assessment Results, University of Virginia, Rev 4, February 7, 2005) and consideration of the effects of schedule variability. These definitions cover all feasible pairings of the train types operating in the IDOT test corridor: the three train types are equipped passenger trains, equipped freight trains and unequipped passenger trains. In principle, any combination of train types can be involved in a collision. The train type pairings appear in the row headings of all analysis tables in Excel Worksheet 2.

Step 2: Estimate relative frequency of train pair collisions

On the basis of the traffic mix (daily trains of each type) and the specific schedules shown in the string charts in the ASCAP description, estimates were developed of the relative frequency of collisions among the train pairs. The estimates are inputs to Table 2.1a and 2.1b in the Excel worksheet. The analysis process is described in Section B2.

Step 3: Estimate the distribution among head-on, side, and rear-end collisions

The distribution between head-on and side/rear-end collisions were estimated for each train pairing and segment type. The distribution varied by segment type (passing siding, signal block before or after a siding, and plain track signal block) because of the different mix of collision scenarios associated with each track layout. These values are also inputs to Table 2.1 in the Excel worksheet. These estimates are described in Section B.2.

Step 4: Calculate detailed distribution of collisions

These calculations are results from the inputs of Steps 1 through 3 to provide a complete matrix of collision probabilities by segment type. The distribution is calculated for the CTC reference case, before applying estimates of which collisions can be prevented by the control system being analyzed (NAJPTC, cab signals with ATS or ATC). To facilitate the preventability calculations, the distribution matrix distinguished between "guilty" and "innocent" trains in collisions where the guilty train is the one that fails to

observe signal indications or operating instructions. This calculation is performed in Table 2.1a of the Excel worksheet. Table 2.1b performs the equivalent calculation for diamond crossing accidents, assuming all trains operating in the crossing direction are unequipped.

Step 5: Develop a preventability matrix

The preventability matrix gives numerical estimates of what percentage of CTC base case collisions can be prevented when the control system (PTC, cab signal with ATS or cab signal with ATC) is activated. For example, most collisions between two equipped trains will be prevented by PTC, but collisions between two unequipped trains will not. Preventability estimates for collisions between an equipped and an unequipped train are derived from the calculations in Worksheet 1. All these calculations are performed in Table 2.3a of the Excel worksheet. Table 2.3b performs the equivalent calculation for diamond crossing accidents. Table 2.2 contains the results from the preventability calculation transferred from Worksheet 1.

Step 6: Estimate CTC reference case accident frequencies

Accident frequencies expressed as collisions per million train-miles were estimated for the CTC reference case from historic accident data and detailed accident reports. The detailed reports were used to obtain a rough estimate of rates by segment type, because these descriptions provide specific information on the location of a collision relative to sidings and other track features. These data, transferred from the Inputs worksheet, are inputs to Tables 2.4 and 2.5 of this Excel worksheet, which calculate frequencies for passenger trains in collisions and freight trains on collisions, respectively.

Step 7: Calculate frequencies of trains in collisions for freight and passenger trains

The frequencies were estimated by combining the outputs from Steps 4, 5, and 6 and separating freight and passenger trains. The separation is required so that accident consequences can be estimated separately by train type. A vast difference occurs in consequences between freight and passenger trains involved in collisions, thus frequencies must be estimated individually. These calculations for passenger trains are performed in Table 2.4a of the Excel worksheet. Table 2.4b is the equivalent calculation for passenger trains in diamond crossing collisions and Tables 2.5a and 2.5b are the calculations for freight trains.

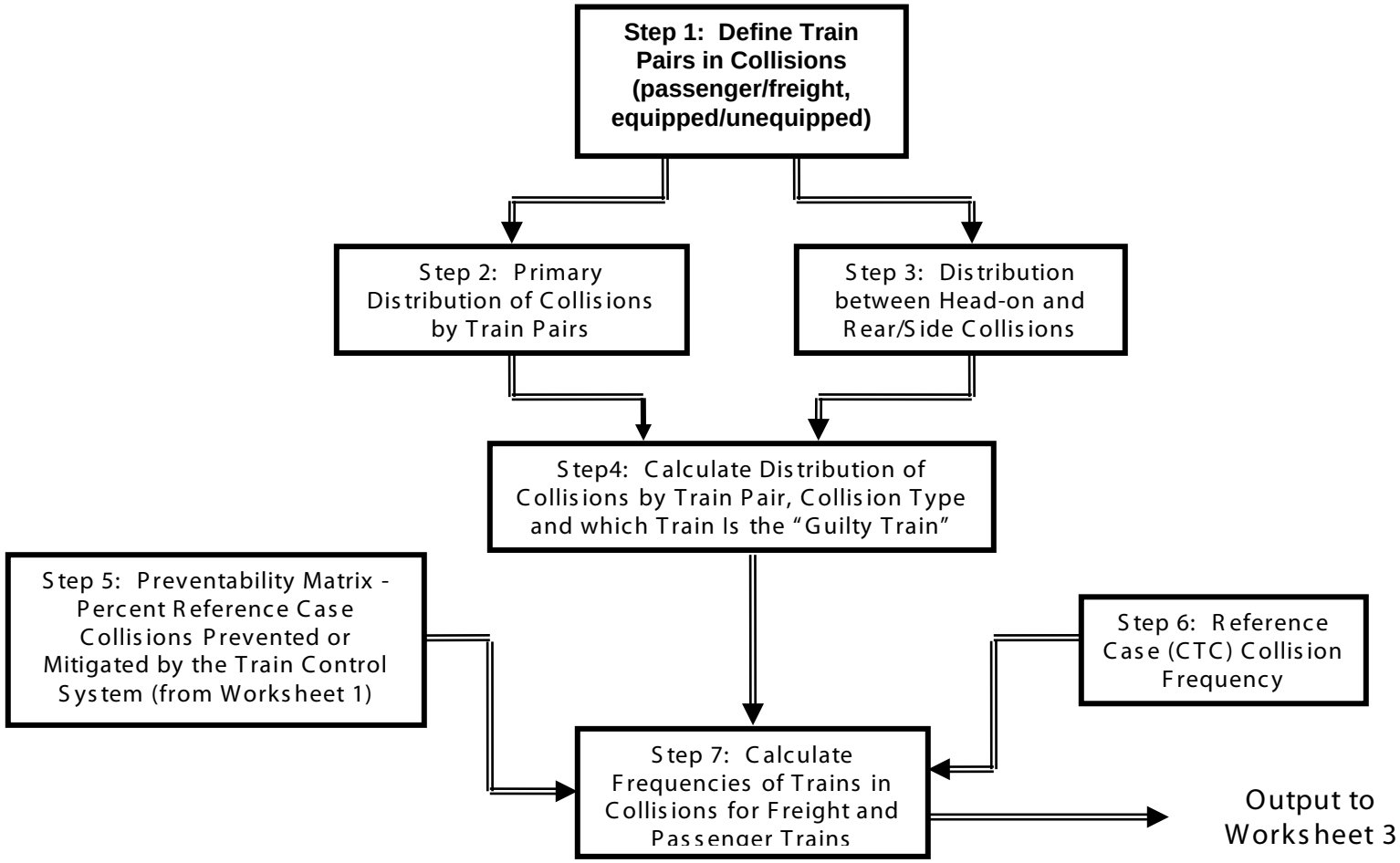


Figure B.1. Flowchart for the Calculation of Collision Frequencies by Train Pair in Collisions Conducted in Worksheet 2

B.2 Collision Probabilities

This section addresses the methodology for estimating the distribution of collision accidents among different types of trains (passenger or freight, and PTC-equipped or PTC-unequipped) and among collision scenarios (head-on, rear-end, or side collisions). The calculations comprise Steps 1 to 4 as illustrated in Figure B1. The end product of this calculation is a tabulation of accident distribution by train and collision type, expressed as a fraction of total train-to-train collision accidents.

The distribution is first calculated assuming that the train control system (PTC or other) is inactive, and trains are operating under CTC (i.e., for the reference case). The calculations are implemented for a specific analysis case, route Sub-corridor, train control system operating state, and season of the year. These data form the input to Steps 5 to 7 of the analysis. First, the distribution is multiplied by estimated collision accident frequency to obtain individual accident frequencies for each collision scenario. Then the resulting frequencies are multiplied by a collision preventability matrix that contains estimates of the fraction of collision accidents that would be prevented by activating the train control system. The values for collisions between PTC-equipped and PTC-unequipped trains are obtained from Worksheet 1.

The following paragraphs describe Steps 1 to 4 of this procedure

Step 1: Identification of train pairs in collisions

The traffic on the IDOT test corridor consists of a mix of passenger and freight trains, and in the case of the freight trains and the NAJPTC analysis cases, the locomotives may or may not be equipped with PTC. Thus, head-on, rear-end, or side collisions are possible between any feasible combination of these train types. The feasible combinations, divided into three groups, are listed below:

Table B.1. Colliding Train Types in Feasible Collisions

Group	Colliding train types
Collisions between equipped trains	Equipped passenger to equipped passenger Equipped passenger to equipped freight Equipped freight to equipped freight
Collisions between an equipped and an unequipped train	Equipped passenger to unequipped freight Equipped freight to unequipped freight
Collisions between unequipped trains	Unequipped freight to unequipped freight

In the analysis, cases of cab signal with ATS and cab signal with ATC are train control systems in which all trains are equipped and the set of collision pairs to be analyzed are reduced to the three collision pairs in the first group of collisions between equipped trains with a zero probability for the other train pairs.

Step 2: Determine the primary distribution of train pairs in collisions

The distribution required is the probability that each of the train pairs identified in Step 1 will be involved in a collision. Two approaches were used for estimating this probability:

- Assuming that encounters among the train types are random and the probability of any pair being involved in a collision is a direct function of the mix of trains operating on each portion of the IDOT test corridor. This approach is easy to apply but cannot represent significant biases due to the pattern of train operations as shown on the schedule. In particular, the current pattern of operations on the IDOT test corridor tends to concentrate passenger trains in the morning and evening and freight trains at other times of day. This increases the chance of passenger-passenger and freight-freight collisions and reduces the chance of passenger-freight collisions.
- String charts derived from train schedules are used to count the relative occurrence of meets and passes by train types involved. This exposure-based approach takes into account any systematic influence of the detailed schedule on mix of collisions but is cumbersome to apply in practice. The result is sensitive to how well trains adhere to schedule. Many sets of string charts would be needed to reflect traffic mix and volume for each Sub-corridor and season variability to maintain adherence to schedule.

The inputs used in the model made use of both sets of estimates by adjusting the results of the random calculations in the direction suggested by the string chart analysis. The results were entered into the applicable table on the inputs worksheet and references by Table 2.1a of this worksheet. Full details of the calculations and the results obtained are provided in Appendix F (Model Inputs).

Step 3: Estimate the distribution of collisions for each train pair between head-on, rear-end, and side collisions

To simplify the analysis and to avoid adding extra complication in an area where supporting data is limited, side and rear-end collisions have been combined. Both scenarios involve a locomotive hitting a passenger or freight car, and the differences in consequences will be limited.

As with the primary collision probabilities, multiple sources of information were used in making these estimates.

- Review of the schedule string charts, as for the primary collision probabilities in Step 1; and
- Analysis of historic accident data, to determine the relative occurrence of head-on, read-end, and side collisions. For example, freight trains rarely rear end a passenger train because passenger trains normally travel faster than freight, although side collisions, whereas a freight locomotive hits a passenger car, do occur, notably at siding entries and exits.

The results of the string chart analysis showed that almost all collisions on the IDOT test corridor would be between trains traveling in opposing directions. With long intervals

between trains traveling in the same direction, the chance of a rear-end collision is very small. Side collisions are possible, most commonly at the entry and exit switches of passing sidings and into or out of yards and industrial sidings, where one train fails to comply with signals or operating instructions. Historic accident data on single-track railroads, combined with information derived from string charts, were used to obtain estimate of the prevalence of rear-end and side collisions. A full description of the process and the results obtained is described in Section F.3.3 of Appendix F (Model Inputs). The results were entered in the inputs worksheet and referenced in Table 2.1 of Worksheet 2.

Two complications are related to estimating and applying the distribution between head-on and rear/side collisions in the model. These are:

1. Substantial differences occur in accident consequences for trains in rear-end/side collisions between passenger and freight trains, depending on whether the passenger locomotive hits a freight car, or whether the freight locomotive hits a passenger car. To take account of these differences, separate distribution estimates are made for these two scenarios.
2. On a single-track line with passing sidings, the types of collision that can occur depend on the location of the equipped train relative to passing sidings. Inspection of collision accident descriptions indicate that the majority of collision accidents take place in or near a passing siding, where one train fails to observe a stop signal at the end of a siding. In the risk analysis, the route is divided into segments for the risk analysis, and each segment corresponds to a signal block. The distribution between head-on and rear/side collisions is estimated separately for each of five segment types:
    - Within a monitored (track circuited) siding,
    - Within an unmonitored siding (only two such sidings are in the IDOT test corridor),
    - In a signal block immediately before or after a monitored siding, a “CP adjacent” segment is in the model because a siding is always a control point with the underlying CTC signal system,
    - A signal block immediately before or after an unmonitored siding, and
    - A plain track segment that is not immediately before or after a siding.

Table 2.1b on Worksheet 2 contains information about collisions at diamond crossings. All collisions are assumed to be between the locomotive of one train at the midpoint of the second train. The crossing trains are always unequipped and can cross the IDOT test corridor at any time. No information is available on crossing train schedules to determine if diamond collision frequency varies by the type of train operating in the IDOT test corridor.

Step 4: Calculate estimated probabilities for head-on and rear-end/side collisions for each collision pair and segment type

This is a direct calculation from the estimates made in Steps 2 and 3. Plus, a determination of whether the equipped or unequipped train is the guilty train in the collision. The distinction between guilty and innocent trains in a collision and how it is applied in the calculation need further explanation, as provided in the following paragraph.

The calculation of collision frequencies for the different collision pairs and segments types starts with an estimate of the distribution of collisions under CTC only (i.e., with the train control system isolated and not operating). Without train control, the distribution if collisions among train pairs and between head-on and rear-end/side collisions is a direct function of train mix, accident history (derived from predominantly CTC operation) and train schedules. In any collision under CTC, one of the two trains involved is the "guilty" train that failed to observe signal indications and operating instructions, and one is the "innocent" train that did not violate its authority. When the train control equipment is activated, it will prevent most or all of the accidents where the equipped train would have been the guilty train. In addition, in a collision between equipped and unequipped trains and where the unequipped train is the guilty train, the accident may still be prevented or mitigated by stopping the equipped (innocent) train. Whether the accident is prevented or mitigated depends on the proximity of the approaching equipped train and the ability of the control system to detect and respond to the authority violation by the unequipped train. Appendix A, Section A.3, "Calculation of Timeout Effects and Collision Risks" describes the process for estimating what fraction of accidents will be prevented or mitigated in collisions between equipped and unequipped trains.

The analysis also assumes that, in the CTC reference case, the two trains involved in a collision are equally likely to be the guilty train. Obviously in collisions between two equipped trains, the guilty train is always an equipped train , and in collisions between two unequipped trains the guilty train is always an unequipped train.

The end result of the collision accident distribution analysis is a set of probabilities for each segment type, distributed between colliding train pairs, head-on and rear-end/side collisions and between equipped and unequipped guilty trains. All the estimated probabilities at this stage in the calculations apply to trains operating with CTC only and under reference case conditions, with the PTC or other control system disabled. The calculations are carried out in Tables 2.1a and 2.1b of Worksheet 2.

B.3 Preventability Estimates

Step 5: Estimate and enter collision preventability values

Preventability is defined as the fraction of reference case (CTC) accidents (in this case collisions) that would be prevented by the train control system being analyzed.

Collision preventability may be estimated for each pair of colliding trains using the following arguments:

- Where both colliding trains are equipped with the train control system, the control system will prevent most collisions, depending on its exact capabilities. Even when operating normally, none of the systems analyzed can prevent all collisions. For example, collisions caused by a defective braking system cannot be prevented by any of the three systems (NAJPTC or the two base cases). Other possible causes of accidents include undetected errors made during maintenance or data entry or involving unequipped on-track maintenance or inspection equipment. PTC, which enforces braking to a stop every time, will likely be more effective than a cab-signal system with ATS, where the engineer acknowledges a warning to prevent a penalty stop and thereafter controls braking, or a cab signal system with ATC where speed is controlled down to, but not below, restricted speed.
- Where one of the two colliding trains is equipped with the train control system, the control system will prevent most collisions where the equipped train would be the guilty train. If the unequipped train is the guilty party, the original violation will still take place, but the equipped train may be warned of the violation and be able to prevent or mitigate the collision.
- Where both trains are unequipped, the control system cannot prevent a collision, and reference case collision frequencies apply.

The analysis approach has been specifically designed for the PTC analysis case where a mix of equipped and unequipped trains occur. Where all train are equipped as is the case with the cab signal system with ATS and the cab signal system with ATC cases, then the modeling gets much simpler with only "both train equipped" variants to consider. All other collision probabilities are set at zero.

Collision preventability values for collisions between equipped and unequipped trains have been calculated in Worksheet 1 and are collected on this worksheet as Table 2.2. The preventability values estimates for collisions between equipped trains for each analysis case are discussed in Appendix F (Model Inputs).

B.4 Collision Frequency Estimates

Step 6: Estimate CTC reference case accident frequencies

The approach, used in the risk model, is to first estimate accident frequencies for conventional passenger and freight operations with CTC and conventional wayside signals, and block and interlocking systems. Then, the fraction of accidents of each type with CTC that would be prevented by the train control system being analyzed is estimated, leading to an estimate of actual accident frequencies with the control system. Accident frequencies, expressed as collisions per million train-miles, were estimated for the CTC reference case from historic accident data and detailed accident reports. The analysis and results, obtained or the specific operating conditions in the IDOT test corridor, are fully described in Section F.3.2 of the Appendix F (Model Inputs). A sample of detailed accident reports of collisions in single-track territory was used to obtain a rough estimate of how collision frequency varies by segment type. These data (summarized in Table B.2) are inputs to Tables 2.4 and 2.5 of Worksheet 2. Note that the quantity estimated is the CTC reference case collision frequency in collisions per million train-miles. The same values are used for all analysis cases, so that even if some uncertainly is in the value, it would only have a limited effect on the comparison between control systems.

Table B.2. Summary of Estimated CTC Reference Case Collision Frequencies

Segment Type	Collision Frequency Collisions per Million Train-Miles CTC Reference Case
CP adjacent, monitored	0.050
CP adjacent, unmonitored	0.060
Passing siding, monitored	0.030
Passing siding, unmonitored	0.040
Plain track	0.006

Step 7: Estimating frequencies of trains in accidents for passenger and freight trains

Two separate sets of calculations are performed. Table 2.4a on Worksheet 2 contains the calculations for passenger trains in collisions, and Table 2.5a contains the calculations for freight trains in collisions. The corresponding calculations for collisions at diamond crossings are contained in Tables 2.4b and 2.5b of Worksheet 2. The end product of these calculations is an estimate of the frequency of freight and passenger trains in collisions, subdivided by the type of the collision. Two points to note about the outputs of this calculation are:

- Collision frequencies are for *trains in collisions per million train-miles*, not collisions per million train-miles. Because two trains are assumed to be in each collision, the overall frequencies for trains in collisions are twice those for collision frequency. Collisions involving more than two trains are considered to be highly improbable on this corridor with the low traffic density. Collisions with individual freight cars, cuts or cars, or on-track maintenance and inspection equipment are analyzed as intrusion collisions.
- The denominator for all the trains-in-collision frequencies for individual train types and collision scenarios is always the total train-miles operated by all trains over each type of segment, not the train-miles operated by the individual train type. Summing the individual frequencies then gives the combined frequency for all trains. Collision frequency is governed by the overall traffic density and segment type and is a function of the number of trips by individual train type.

The basic calculation is performed in Tables 2.4 and 2.5 of the worksheet for each cell represented in Table 2.1 of the worksheet. Each Table 2.1 cell provides an estimate of the fraction of collision accidents for the specific segment type/head-on, rear, and side/train pair in collision. The calculations in Tables 2.4a and 2.5a combine the following analysis steps:

- The calculations start with the overall collision frequency for each segment type for the reference case (CTC operation) from Step 6.
- Multiply together the applicable collision probability from Step 4, the preventability estimate for the control system being analyzed from Step 5, the number of passenger or freight trains involved in the collision and the applicable collision rate to obtain collision frequencies (trains in collisions per million train-miles) for each segment type/train type/collision type combination.
- Total collision rates for trains in collisions by the collision types are listed above for each segment type. These totaled rates are then applied to following stages in the analysis.

The totals give the estimated frequency of trains in collisions for each segment type for the following collision types:

Passenger train collision types are:

- Passenger locomotive collides with another locomotive,
- Passenger locomotive collides with a passenger car,
- Passenger locomotive collides with a freight car, and
- Passenger car is hit by a locomotive.

Freight train collision types are:

- Freight locomotive collides with another locomotive,

- Freight locomotive collides with a freight or passenger car, and
- Freight car is hit by a locomotive.

Each of these collision types will have different consequences (damage and human casualties and are analyzed separately in the risk calculations on Worksheet 3). Note, an assumption is that no cab car-led or multiple unit passenger trains operate in this corridor. If cab cars were used, additional collision types would occur—depending on traffic mix and train orientation—for which collisions frequencies would have to be calculated.

Appendix C: Descriptions of Calculations in Worksheet 3 – Risk Calculations

C.1 Overview of Calculations

The sequence of operations on Worksheet 3 is illustrated in the flow diagram provided in Figure C.1.

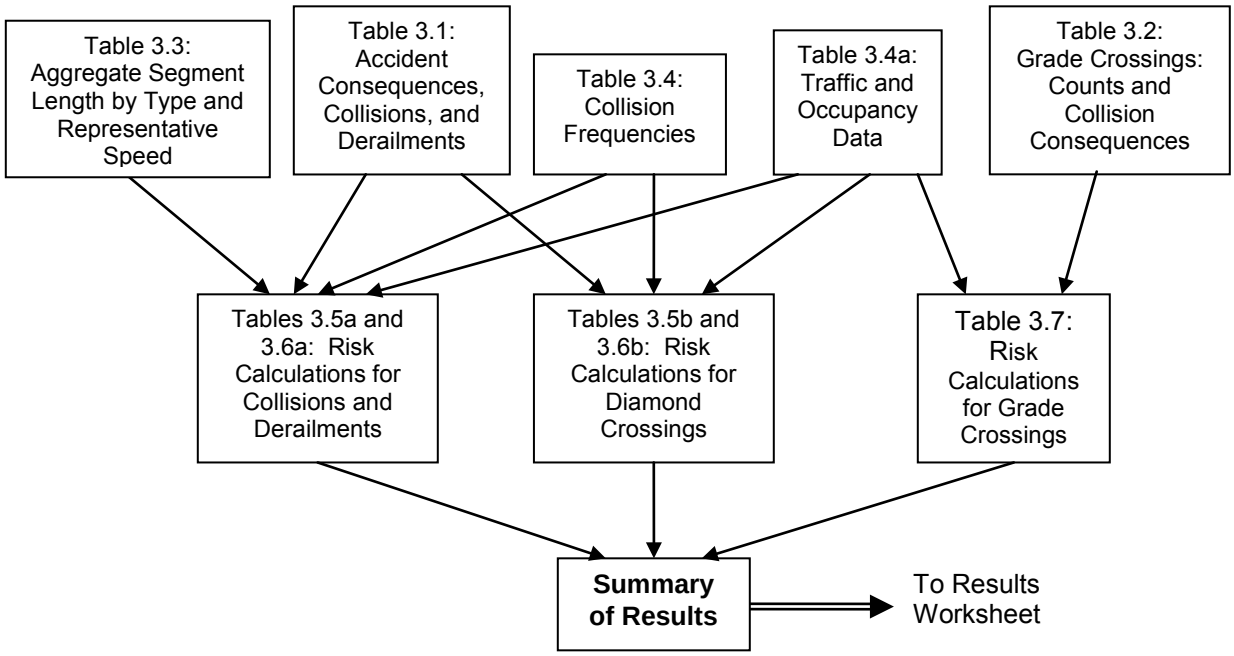


Figure C.1. Flow Diagram for Risk Calculations

The first layer of tables in this worksheet assembles the inputs needed for the risk calculations, comprising Tables 3.1, 3.2, 3.3, 3.4, and 3.4a. All these inputs are taken from the inputs worksheet or are products of the calculations carried out on Worksheets 1 and 2.

The second layer of spreadsheet tables on the worksheet perform the actual risk calculations to yield estimates of the number of accidents, injuries, and property damage costs resulting from 10 years of operation of the IDOT test corridor. Separate calculations are performed in each case for passenger and freight trains. Tables 3.5a (passenger) and 3.6a (freight) perform the risk calculations for collisions and derailments, excluding collisions at diamond crossings and at rail/highway grade crossings. Tables 3.5b and 3.6b perform the risk calculations for collisions at diamond crossings with another railroad. Table 3.7 performs the risk calculations for rail/highway grade crossings.

The third layer consists of a single spreadsheet that assembles the risk analysis results for all accident scenarios in one table and calculates totals for one Sub-corridor, season, and operating state. These results are transferred to a results worksheet to be combined with results from the

other Sub-corridors, seasons, and operating states to yield a total for the whole IDOT test corridor.

The following paragraphs summarize the analysis procedures and further sections provide detailed descriptions of each analysis step.

Step 1: Assemble inputs for the risk calculation

Four inputs are required for the risk calculation for collisions and derailments:

- Tabulation of consequences per accident, imported from the consequences tables on the inputs worksheet. Three consequence values are estimated for each accident scenario, train type, and representative speed: injuries, fatalities, and property damage. Property damage comprises damage to railroad-owned property only, as reported on FRA accident reports. With these three values, it is possible to calculate a financial measure of total harm from accidents by using standard USDOT values for an injury and a fatality. For most analysis cases, consequence values are held constant, because no changes are proposed to freight or passenger car design, train consists, or other factors that would affect consequences. However, consequences may be reduced for some analysis cases as a result of speed enforcement, and a group of sensitivity analysis were carried out to evaluate the effect of this factor on the comparison between NAJPTC and the base case systems. The reduced consequences estimates are discussed in Appendix F. Consequences values are provided in Table 3.1 on the Excel worksheet for freight and passenger trains.
- Estimated aggregate segment lengths by segment type and representative speed for passenger and freight trains. These lengths are calculated on Worksheet 1, Segment Definitions and Timeout Effects, and are imported here from Table 1.5 and placed in Table 3.3. The values are the aggregate lengths (in miles) of all individual route segments that fall into each representative speed and segment type category.
- Collision frequencies for train-to-train collisions, expressed in terms of trains in collisions per million train-miles for collisions involving two trains operating on the IDOT test corridor, and collisions per million diamond crossing passes for collisions at diamond crossings. Accident frequencies per million train-miles for other collisions and derailments are imported directly from the inputs worksheet into the risk calculations in Tables 3.5a and 3.6a.
- Traffic (daily trips) and passenger train occupancy data needed for the risk calculations as shown in Table 3.4a. These data are imported from the inputs worksheet and comprise the average number of daily trips over the IDOT test corridor by each type of train, the number of days in the summer and rest-of-year seasons, average occupancy of passenger trains (passenger and crew), and for NAJPTC only, the percentage of train-miles operated in each operating state (normal or in timeout).

Step 2: Assemble inputs for the grade crossing risk calculations

Grade crossing inputs, comprising the following data:

- The number of grade crossings partitioned by the principal factors that affect crossing accident frequency and severity, specifically train type and speed and the warning system installed at the crossing. Grade crossing collision frequency is also affected by highway traffic levels, but this factor was not included in this analysis.
- Frequency of crossing collisions between a train and a highway vehicle that cause sufficient damage to be reportable as train accidents. The model does not analyze crossing collisions that are not reportable as train accidents, regardless of the consequences for the highway user.
- Crossing collision consequence data for injuries, fatalities and property damage for the train, its occupants and other railroad property, but excluding consequences for highway users and highway vehicles and their occupants.

These data are shown in Table 3.2 of Worksheet 3 and are imported directly from the inputs worksheet from Tables IN-3a, 3b, 3c, and 3d.

It should be noted that the analysis did not address risks to highway users in grade crossing collisions. Although significant, these risks are of limited relevance to comparisons between alternative train control systems, which are the primary concern of this analysis.

Step 3: Calculate frequencies for trains in collisions by speed and train types

This calculation takes the collision frequency data from Table 2.4a (passenger trains) and 2.5a (freight trains) on Worksheet 2, as transferred to Table 3.4, and combines these data with aggregate length of the different types of segment to derive weighted collision frequencies by train type, speed and collision type. This calculation is carried out in the lower part of Table 3.4 of the Excel worksheet and is fully described in Section C.2 below.

Step 4: Risk calculations for collisions and derailments

These calculations comprise risk calculations for the following accident scenarios:

- Train-to-train collisions (a collision scenario for each pairing of colliding vehicles),
- Intrusion collisions due to unintended roll-out of rail vehicle(s) at a connecting switch,
- Intrusion collisions due to shifted loads, derailed vehicles, etc., on adjacent track away from a connecting switch,
- Overspeed derailments,
- Derailments due to broken rails (potentially detectable by track circuits), and
- Casualties due to work zone intrusions.

Calculations for passenger trains are carried out in Table 3.5a of the Excel worksheet. Table 3.5b is the equivalent calculation for diamond crossings. Tables 3.6a and 3.6b are the corresponding calculations for freight trains. The primary difference for freight

trains is that no equivalent of the calculation of passenger casualties is based on passenger load, and train crew casualties are estimated on a per accident basis.

The basic sequence of operations for a risk calculation is to multiply the applicable reference case accident frequency by applicable preventability, exposure, and consequence parameters to obtain total risk. The calculation is performed for each representative speed and accident scenario. The inputs and calculations are as follows:

- Preventability factor (a number between zero and unity) applicable to the accident scenario. A factor of zero means that no reference case accidents are prevented by the control system, and a factor of unity means that all accidents are prevented. The preventability factors for train-to-train collision have been calculated on Worksheets 1 and 2 and are already included in the collision frequency values transferred to Table 3.4. The factors for other accident types have been calculated off-line as described in Appendix F and are taken from the inputs worksheet as inputs to this calculation.
- Exposure data: for passenger trains, exposure is the number of train-miles and passenger-miles of exposure during a 10-year period for the specific Sub-corridor, season, and operating state obtained by multiplying train trips per day, days in the season, operating state percentage, and train-miles per trip at each representative speed to obtain train-miles of exposure. Then multiplying train-miles by number of seats in the train and average seat occupancy or load factor gives passenger-mile exposure
- Multiplying accident frequency by train-miles yields the number of accidents during the 10-year period. The number of accidents is multiplied by per-accident cost to get total damage for the speed and scenario. For train occupant casualties, the number of accidents is multiplied by number of occupants and injury or fatality probability from the consequence table to obtain the estimate of injuries and fatalities. A complete description of this calculation is described in Section C.3 of this Appendix.

Step 5: Risk calculations for diamond crossings

The risk calculations for diamond crossings are carried out in Tables 5b and 6b for passenger and freight trains, respectively, using the same sequence of operations as for other collisions and derailments. The primary difference is in calculating the exposure to collision risk, which in the case of collisions at diamonds is a function of the number of times a train operating on the IDOT test corridor passes over a diamond crossing.

Step 6: Risk calculations for grade crossings

The risk calculations for grade crossings are carried out in the same way as for other accident scenarios, except that accident frequency is measured in terms of collisions per million grade crossing passes, and exposure to risk as the number of crossing passes at each speed during the period are covered by the calculation. Table 3.7 on the Excel worksheet contains the grade crossing risk calculations for both passenger and freight trains.

Step 7: Risk totals

Results from all the individual risk calculations are combined into one tabulation, showing risks by train type, accident scenario and consequence, and the composite financial measure of all consequences. The table also includes totals for passenger trains, freight trains, and overall. These calculations are performed in Table 3.8 on the Excel worksheet.

The inputs to the risk calculations are contained in Tables 3.1, 3.2, 3.3, and 3.4a imported from either Worksheets 1 and 2 or from the inputs worksheet. The following sections describe the calculations contained in Tables 3.4b, 3.5, 3.6, 3.7, and 3.8.

C.2 Calculation of Train-to-Train Collision Frequencies (Table 3.4b)

The purpose of this analysis step is to calculate collision frequencies for input to the risk calculations in Tables 3.5 and 3.6 for passenger and freight trains, respectively. The calculations provide a weighted average collision frequency for trains in collisions at each representative speed based on the mix of segment types for which each speed applies. The calculation also takes into account the restriction of passenger trains to 79 mph in the vicinity of unequipped freight trains. This restriction is interpreted as meaning that all collisions between passenger and unequipped freight trains where a representative speed higher than 79 mph would normally apply take place at 79 mph. The original representative speed for that segment remains applicable to other accident scenarios.

The upper parts of Table 3.4 in Worksheet 3 contain frequencies for trains in collisions transferred from Tables 2.4a and 2.5a of Worksheet 2. The main table contains frequencies for trains in collisions by segment type and colliding vehicles in the collision. The frequencies are for the colliding vehicle pairs as listed below and include all passenger, freight, equipped, and unequipped trains for which the colliding vehicle pair could apply.

- Passenger trains:
  - Passenger locomotive collides with another locomotive (passenger or freight),
  - Passenger locomotive collides with a passenger car,
  - Passenger locomotive collides with a freight car, and
  - Passenger car hit by a passenger or freight locomotive.

- Freight trains:
  - Freight locomotive collides with a passenger or freight locomotive,
  - Freight locomotive collides with a freight or passenger car, and
  - Freight car is hit by a locomotive.

The segment types, taken from Worksheet 2, are:

- Siding (monitored),
- Siding (unmonitored),
- Control point adjacent (monitored),
- Control point adjacent (unmonitored),
- Plain track, and
- Diamond crossing.

A subsidiary table provides frequencies for collisions between passenger trains and unequipped freight trains only. The data are also taken from Tables 2.4a and 2.5a of Worksheet 1 and are applicable only to passenger trains in collisions for three colliding vehicle scenarios:

- Passenger locomotive collides with a freight locomotive,
- Passenger locomotive collides with a freight car, and
- Passenger car hit by a freight locomotive.

The calculations take place in the lower portion of Table 3.4, as described below.

- For passenger train representative speeds of 40 and 60 mph, and all freight train speeds, a weighted collision frequency is calculated for each colliding vehicle scenario by summing [(aggregate segment length) × (frequency of trains in collisions)] for each segment type and dividing by the total of segments of all types with that representative speed.
- For 79 mph speeds only, the formula for weighted collision frequency includes both "regular" 79-mph segments and collision frequencies for 105-mph segments for collisions between passenger and unequipped freight trains. Because the denominator in the equation calculating the weighted average is the sum of 79- and 105-mph segments, a corresponding change in the formulas for the 79-mph passenger train risk calculation in Table 3.5a is required to use the same sum of 79- and 105-mph segment lengths in calculating train-miles operated over 10 years as described in Section C.3.2 below.
- For 105-mph representative speeds for passenger trains, the weighted average is the frequency of trains in collisions involving two equipped trains only. This is calculated from the difference of frequencies for all trains in collisions at this speed (from the main table), less the frequency for trains in collisions with unequipped freight trains (from the subsidiary table).

Note, frequencies of trains in collisions calculated in Table 3.4 are for the contribution of each colliding vehicle collision scenario to the overall frequency of trains in collisions. Thus, in the risk calculations in Tables 3.5a and 3.6a, the applicable train-miles of exposure are calculated for all trains operated in that Sub-corridor, season, and operating state, not just those of the individual train type. This is because the approach used in the collision matrix calculations on Worksheet 2 in which collision frequencies for trains in collisions were calculated for the fraction of collision accidents that belong to each train-pair scenario. Total collision frequency is obtained by summing the individual frequencies.

C.3 Accident Risk and Preventability Calculations for Collisions and Derailments (Tables 3.5a and 3.6a)

C.3.1 Introduction

The accident scenarios included in this table are:

- Train-to-train collisions for passenger trains,
- Intrusion collisions due to unintended roll-out of a vehicle at a connecting switch,
- Intrusion collisions due to shifted loads, derailed vehicles, etc. on adjacent track,
- Overspeed derailments,
- Derailments due to broken rails (possible detectable by track circuits, and
- Casualties due to work zone intrusions.

The risk and preventability calculations for passenger trains are carried out in Table 3.5a of the Excel worksheet. Table 3.5b is the equivalent calculation for diamond crossings. Tables 3.6a and 3.6b are the corresponding calculations for freight trains. The primary difference for freight trains is that no equivalent of the passenger occupancy calculation exists, and train crew casualties are estimated on a "per accident" basis.

C.3.2 Passenger Train Train-to-Train Collisions

The risk calculations cover four passenger train collision scenarios:

- Passenger locomotive collides with another freight or passenger locomotive,
- Passenger locomotive collides with a passenger car,
- Passenger locomotive collides with a freight car, and
- Passenger car hit by a freight or passenger locomotive.

These four scenarios cover all the possible combinations for passenger trains on this corridor. Additional scenarios could arise if push-pull or multiple-unit passenger trains are used.

Collision preventability has already been included in the collision accident frequencies calculated on Worksheet 2 and the weighted collision frequencies calculated in Table 3.4. The risk calculation is performed for each representative speed to yield an estimate of the number of passenger trains in collisions for each colliding vehicle scenario over ten years as follows:

[Estimated number of passenger trains in collisions of each type over 10 years operation for a specific combination of representative speed, Sub-corridor, season and operating state] =
[weighted accident frequency (per million train-miles) from Table 3.4] ×
[train-miles at this representative speed per trip over the Sub-corridor] ×
[number of trips per day] [days in season] × [10 (for 10 years)].....(1)

Casualty rates for the consequences are estimated as the chance that a train occupant will be either killed or injured in the accident. Thus estimated casualties in these accidents are calculated as follows:

[casualties (injuries or fatalities)] =
[number of accidents] × [casualty rate (from consequences table)] ×
[seats on train] × [occupancy factor] .....(2)

Property damage costs are obtained simply from multiplying the number of accidents by per-accident cost taken from the consequences lookup table

C.3.3 Freight Train Train-to-Train Collisions

The calculations for freight trains follow the same process as for passenger trains, with the following variations:

- Three collision scenarios are analyzed, being all those possible for freight trains operating in this corridor:
  - Freight locomotive collides with another passenger or freight locomotive.
  - Freight locomotive collides with a freight or passenger car.
  - Freight car is hit by a locomotive.

  As with passenger trains, collision frequencies from Table 3.4 entered into Table 3.6a include the preventability calculations from Worksheet 2, which take into account the mix of PTC-equipped and unequipped trains operating in each Sub-corridor.
- Train crew casualties are simply calculated from a casualty rate per accident from the freight train consequences table multiplied by the estimated number of accidents. No equivalent of the calculation step referencing train seating capacity and seat occupancy factor in the passenger train risk calculations.

C.3.4 Other Collisions and Derailments, Passenger and Freight Trains

This group comprises the following accident scenarios:

- Intrusion collisions with a car or cut of cars that has rolled or been pushed out from a siding or is fouling the main track at a connecting switch,
- Intrusion collisions with a derailed vehicle on an adjacent track or with a shifted load away from a connecting switch,
- Derailments due to overspeed, and
- Derailments due to broken rails.

The passenger train calculation for each of these scenarios follows a common process, as follows:

[Estimated number of accidents over 10 years operation for a specific combination of representative speed, Sub-corridor, season and operating state] =

[Base accident frequency (per million train-miles) from inputs worksheet] ×
[1 – estimated preventability, from the inputs worksheet] ×
[train-miles at this representative speed per trip over the Subcorridor] ×
[number of trips per day] × [days in season] × [10 (for 10 years)].....(3)

Casualty rates from the consequences table are estimated as the chance that a train occupant will be either killed or injured in the accident. Thus, estimated train occupant casualties in these accidents are calculated as follows:

[Casualties (injuries or fatalities)] =

[number of accidents] × [casualty rate (from consequences table)] ×
[seats on train] × [occupancy factor] .....(4)

Property damage costs are obtained simply from multiplying the number of accidents by per-accident cost taken from the consequences lookup table.

The corresponding calculation for freight trains follows the same pattern with the following variations:

- Separate calculations are performed for PTC-equipped trains and trains not equipped with PTC for each scenario. Preventability for equipped trains is obtained from the lookup tables on the inputs worksheet and preventability for unequipped trains is set at zero.
- Train crew casualties are simply calculated from a casualty rate per accident from the freight train consequences table times the estimated number of accidents. No equivalent exists of the calculation step referencing train seating capacity and seat occupancy factor in the passenger train risk calculations.

C.3.5 Work Zone Intrusions

The calculation of risk from work zone intrusions is included in Tables 3.5a for passenger trains and 3.6a for freight trains. The calculation differs from those for the other collision scenarios in that only casualties among on track workers are calculated for this scenario. Casualties and damage to a train and its occupants in collisions with work trains or work equipment as a result of a work zone intrusion are captured in the model as either an intrusion or a train-to-train collision as appropriate. This approach was taken because the available information was rarely clear as to whether a specific incident was due to a failure to observe work zone limits or an error by on track workers. More analysis is desirable to obtain a full accounting of the causes of accidents involving on-track workers and maintenance and inspection equipment.

The specific calculation starts with estimated casualty frequencies per million train-miles for on-track workers in work zone violation incidents, derived from national statistics. The injury and fatality estimates in Tables 3.5a and 3.6a are simply obtained by multiplying train-miles operated by the injury and fatality frequencies and transferred to the risk summary table.

C.4 Accident Risk and Preventability Calculations for Diamonds (Tables 3.5b and 3.6b)

The risk and preventability calculations for diamonds, implemented in Table 3.5b for passenger trains and 3.6b for freight trains, follow the same pattern as for those for train-to-train collisions. The collision frequency for diamond crossings is calculated on Worksheet 2 and transferred to Table 3.4 of this worksheet. Diamond collision frequency is expressed as collisions per million diamond crossing passes. Because in all cases, the crossing train is a freight train operated by railroad other than UP, the crossing train is always assumed to be unequipped. The speed limit over diamond crossings for both passenger and freight trains is 40 mph in all cases. The specific collision scenarios at diamonds are:

- Passenger trains:
  - Passenger train locomotive operating on the IDOT test corridor collides with freight car of crossing train, and
  - Passenger car in train operating on the IDOT test corridor is hit by the crossing freight train locomotive.
- Freight trains:
  - Freight train locomotive operating on the IDOT test corridor collides with freight car, and
  - Freight car of train operating on the IDOT test corridor is hit by the crossing freight train locomotive.

The collision frequencies calculated in Worksheet 2 have already taken into account the mix of unequipped and equipped freight trains operating on each Sub-corridor of the IDOT test corridor.

The calculations themselves are straightforward: multiplying frequency by the number of diamond crossings in the Sub-corridor and total trips over 10 years yields an estimate of the number of diamond collisions. Then, consequences (injuries, fatalities, and property damage) are calculated in exactly the same way as for train-to-train collisions, including referencing the same collision consequence lookup tables for the specific collision type and representative speed.

C.5 Accident Risk and Preventability Calculations for Grade Crossings (Table 3.7)

The risk and preventability calculations for grade crossings are performed in Table 3.7 for both passenger and freight trains. Calculations of grade crossing risk are performed in the table for each grade crossing type and representative speed and then totaled.

The starting point for grade crossing risk calculations are the crossing data assembled in Table 3.2, which in turn is obtained from the inputs worksheet as described under Step 1 in Section C.1 of this Appendix. These data consist of:

- Counts of the number of crossings by type and representative speed. The counts are compiled separately for passenger and freight trains, given the different speeds, and for the three types of crossing:
  - Public highway crossing with gates, flashing lights, and other active warning systems;
  - Public highway with any other form of warning; and
  - Private crossings.
- Estimated collision frequencies for each crossing type, train type and representative speed are for crossing collisions that are sufficiently serious to be reportable as train accidents, not the higher frequency of all reportable grade crossing collisions. The units of crossing collision frequency are collisions per million grade crossing passes.
- Crossing collision consequences table—injuries and fatalities for train occupants and other railroad employees and railroad property damage per collision at each representative speed and for passenger and freight trains.

With this data in hand, the risk calculation proceeds as follows. The calculation is repeated for each representative speed of freight and passenger trains and for each crossing type.

- Calculate an adjusted collision frequency by applying a preventability factor (taken from the inputs worksheet) to the base collision frequency obtained from Table 3.2 in the worksheet.
- Multiply collision frequency (collisions per million crossing passes) by the number of crossing passes over 10 years to obtain the number of crossing collisions over 10 years. The number of crossing passes is given by:

$$\begin{aligned}[\text{Crossing passes}] = [\text{trips/day}] \times [\text{days in season}] \times \\ [\text{fraction of train-miles in this operating state}] \times \\ [\text{number of crossings of this type in Sub-corridor}] \times [10 \text{ (for 10 years)}] \quad (5)\end{aligned}$$

- Calculate grade crossing consequences by multiplying the number of collisions by the applicable per-collision consequences (injuries, fatalities, and property damage), in the same way as for other accident scenarios in Tables 3.5a and 3.6a.
- Sum grade crossing collision consequence totals for passenger and freight trains and transfer this data to the risk summary Table 3.8.

C.6 Risk Totals (Table 3.8)

Table 3.8 assembles the results of the risk calculations in Tables 3.5a and b, 3.6a and b, and 3.7 into a single table for the specific Sub-corridor, season of the year and NAJPTC operating state (for PTC analyses). This table allows convenient review of results by the analyst and is transferred to the results worksheet to be combined with corresponding Tables 3.8 from the other Worksheets 3 for the analysis case so that totals can be calculated for the compete corridor.

APPENDIX D: IDOT CORRIDOR

Material contained in this appendix includes documentation of the features of the IDOT corridor considered during this effort.

Information pertaining to detailed track features provided on pages D-2 through D-21 was provided by Booz Allen Hamilton. Provision of this material does not imply concurrence of results/conclusions contained in this report by Booz Allen Hamilton or its employees.

Information provided on pages D-22 through D-53 are taken from track charts used internally by the Union Pacific Railroad.

FRA IDOT PTC Project

Data

Start Reference - Mazonia, IL
MAS 110 MPH
Milepost Orientation Increases from North to South

				Sidings and Switches					Physical Characteristics					Signal System Info			
Track Mile Post	Speed Restrictions (MPH) Non-Tilting Equip	Grade Crossing Locations (Single Track unless noted)	Grade Crossing Warning System	Location Type	Connection	Length (FT)	Switch Type/Number	Orientation (North to South)	Location	Bridges & Struct.	Grade	Degeree of Curve	Length of Curve	Control Points	Home Signals	Intermediate Signals	Defect Detector
62.00																	
62.10																	
62.20																	
62.30																	
62.40										UG Bridge							
62.50																	
62.60									Project Start					Mazonia			
62.67	79								Project Start								
62.69	79						# 20 TO										
62.70	79								Mazon River	UG Bridge							
62.80																	Hot Box
62.90																	
63.00																	
63.10																	
63.20																	
63.30																	
63.40																	
63.50																	
63.60																	
63.70																	
63.80																	
63.90																	
64.00																	
64.07		Storm Road	FL&B														
64.10																	
64.20																	
64.30																	
64.36		Washington Street	FL&B														
64.40																	
64.47		Division Street	FL&B														
64.50																	
64.60		PED XING	None														
64.63		Jackson Street	Cant FL&B														
64.70																	
64.75		Main Street	FL&B														
64.80																648/649	
64.90																	
65.00																	
65.10									HGWY IL 53	OH Bridge							
65.20																	
65.30																	
65.40																	
65.50		Maher Road	XBucks														
65.60		Farm (PVT)	Gates														
65.70																	
65.80																	
65.90																	
66.00																	
66.10									Creek	UG Bridge							
66.20																	
66.30																	
66.40																	
66.50																	
66.55																664/665	
66.60																	
66.70																	
66.80																	
66.90																	
66.91		Gorman Road	XBucks														
67.00																	
67.10																	
67.20																	
67.30										UG Pipe							
67.40																	

Milepost Orientation Increases from North to South				Sidings and Switches					Physical Characteristics					Signal System Info			
Track Mile Post	Speed Restrictions (MPH) Non-Tilting Equip	Grade Crossing Locations (Single Track unless noted)	Grade Crossing Warning System	Location Type	Connection	Length (FT)	Switch Type/Number	Orientation (North to South)	Location	Bridges & Struct.	Grade	Degeree of Curve	Length of Curve	Control Points	Home Signals	Intermediate Signals	Defect Detector
67.50																	
67.60										UG Pipes							
67.70									Goodfarm Rd	OH Bridge							
67.80																	
67.90																	
67.95		Farm (PVT)	None														
68.00																	
68.10																	
68.20																	
68.23																682/683	
68.30																	
68.33		Filman Road	XBucks														
68.40																	
68.50																	
68.60																	
68.70																	
68.80																	
68.90																	
69.00																	
69.09		Stonewall Road	XBucks							UG Pipe							
69.10																	
69.20																	
69.30																	
69.40																	
69.50																	
69.60																	
69.70																	
69.74		Gantzert Road	XBucks														
69.80										UG Pipe							
69.90																	
70.00																	
70.10																	
70.17							PO # 20	Facing Left						CPX 073	2 - N, 1 - 2, Locations???		
70.20				DWIGHT	DE Passing	12,375			Creek	UG Bridge							
70.30																	
70.36														Dwight North			
70.40																	
70.50																	
70.52		Scully Road - 2 Tracks	XBucks														
70.60																	
70.70																	
70.80																	
70.90																	
71.00																	
71.10																	
71.14		Mazon Road - 2 Tracks	XBucks														
71.20																	
71.30										UG Pipe							
71.40																	
71.50																	
71.60																	
71.70																	
71.73							HO Switch										
71.75					Stub	???	PS # 10	Facing Left									
71.78							HO Switch										
71.80																	
71.90																	
71.95		Livingston Rd/TR 1H - 2 Tracks	XBucks														
72.00																	
72.10																	
72.20																	
72.30																	
72.40																	
72.50																	
72.60	79								Gooseberry	UG Bridge							
72.70	79																
72.78	79						PO # 20	Trailing Left						CPX 073	2 - S, Location???		
72.79	79													Dwight South			
72.80	40			DWIGHT END	DE Passing												

Milepost Orientation Increases from North to South				Sidings and Switches					Physical Characteristics					Signal System Info			
Track Mile Post	Speed Restrictions (MPH) Non-Tilting Equip	Grade Crossing Locations (Single Track unless noted)	Grade Crossing Warning System	Location Type	Connection	Length (FT)	Switch Type/Number	Orientation (North to South)	Location	Bridges & Struct.	Grade	Degeree of Curve	Length of Curve	Control Points	Home Signals	Intermediate Signals	Defect Detector
72.81	60								NS Crossing						1 - N, Location ??		
72.90	79																
73.00	79																
73.07	79						#10 EL LK	Trailing Left	NS Conn.								
73.10	79	Union Avenue / SR 47	Gates														
73.20	79																
73.30	79								Creek	UG Bridge							
73.40	79																
73.50	79																
73.51	79	Mazon Avenue/ SR 17	Gates														
73.55	79	North Depot (PED)	None														
73.60	79																
73.65	79	South Depot (PED)	None														
73.70	79	Chippewa Street	Gates														
73.80	79						PS # 10	Facing Right	Amtrak Depot								
73.90	79																
73.95	79	Washington Street	Gates														
74.00																	
74.10																	
74.20																	
74.30																	
74.40																	
74.50																	
74.60																	
74.70																	
74.80																	
74.90																	
74.93		TR 19 B	FL&B														
74.94																750/751	
75.00																	
75.10																	
75.20																	
75.30																	
75.40																	
75.50																	
75.60																	
75.70																	
75.80																	
75.90																	
75.93		TR 220	XBucks														
76.00																	
76.10																	
76.20																	
76.30																	
76.31									TR - 29 B	OH Bridge							
76.40																	
76.50																	
76.60																	
76.70																	
76.80																	
76.88		TR 216 B	XBucks														
76.90																	
77.00																	
77.10																	
77.20																	
77.27																772/773	
77.30																	
77.40																	
77.50																	
77.60																	
77.61	90								N. End of Curve				8° 14'				
77.70	90	Private Road (PVT)	None						Amazon Riv	UG Bridge							
77.80	90																
77.88	90								S End of Curve				END				
77.90																	
78.00																	
78.10																	
78.20																	
78.30																	

Milepost Orientation Increases from North to South				Sidings and Switches					Physical Characteristics					Signal System Info			
Track Mile Post	Speed Restrictions (MPH) Non-Tilting Equip	Grade Crossing Locations (Single Track unless noted)	Grade Crossing Warning System	Location Type	Connection	Length (FT)	Switch Type/Number	Orientation (North to South)	Location	Bridges & Struct.	Grade	Degeree of Curve	Length of Curve	Control Points	Home Signals	Intermediate Signals	Defect Detector
78.40																	
78.50																	
78.60																	
78.70																	
78.80																	
78.90																	
78.96		TR 41 C	XBucks														
79.00																	
79.10																	
79.20																	
79.30																	
79.40																	
79.50																	
79.60										UG Pipe							
79.70																	
79.80										UG Pipe							
79.90																	
80.00																	
80.10																	
80.13																800/801	
80.20																	
80.21		TR 47 B	XBucks														
80.30																	Hot Box & DED
80.40																	
80.50																	
80.60																	
80.70										UG Pipe							
80.80																	
80.90																	
81.00																	
81.10																	
81.20																	
81.30																	
81.40																	
81.43		Prairie Street	FL&B														
81.50																	
81.52		Scott Street	Gates														
81.60																	
81.65		Tremont Street	Gates														
81.70																	
81.72		Hamilton Street	Gates														
81.80																	
81.90																	
81.98														Odell North			
81.99							PS # 20	Facing Left						CPX 082	2 - N, 1 - S., Locations???		
82.00				ODELL	DE Passing	12,760				UG Pipe							
82.10																	
82.20																	
82.30																	
82.40					Stub	???	PS # 10	Trailing Left									
82.50																	
82.60																	
82.69		TR 69 - 2 Tracks	Gates														
82.70																	
82.80																	
82.90																	
83.00																	
83.10																	
83.20																	
83.30									TR 79 A	UG Bridge							
83.40																	
83.50																	
83.60																	
83.70																	
83.80																	
83.90																	
84.00																	
84.10																	
84.20																	
84.30									TR 79 A	OH Bridge							

Milepost Orientation Increases from North to South				Sidings and Switches					Physical Characteristics					Signal System Info			
Track Mile Post	Speed Restrictions (MPH) Non-Tilting Equip	Grade Crossing Locations (Single Track unless noted)	Grade Crossing Warning System	Location Type	Connection	Length (FT)	Switch Type/Number	Orientation (North to South)	Location	Bridges & Struct.	Grade	Degeree of Curve	Length of Curve	Control Points	Home Signals	Intermediate Signals	Defect Detector
84.40																	
84.50																	
84.60																	
84.65							PS # 20	Trailing Left						CPX 085	1 - N, 2 - S, Locations ????		
84.67														Odell South			
84.70				ODELL END	DE Passing					UG Pipe							
84.80																	
84.90																	
85.00																	
85.10																	
85.20																	
85.30																	
85.40																	
85.50																	
85.60																	
85.70																	
85.80										UG Pipe							
85.90																	
86.00																	
86.10																	
86.20																	
86.30																	
86.40									CO Rd	UG Bridge							
86.43																863/864	
86.50																	
86.60																	
86.70									Wolf Creek	UG Bridge							
86.80																	
86.90																	
86.92		Main Street	FL&B														
87.00																	
87.10																	
87.20																	
87.30																	
87.40																	
87.50																	
87.60																	
87.70																	
87.80																	
87.90																	
88.00																	
88.10																	
88.20																	
88.30																	
88.35																883/884	
88.40																	
88.50																	
88.52				Bunge Y	Y Track		PS # 10	Facing Left	Bunge Y - Grain								
88.60										UG Pipe				CPX 087			
88.70																	
88.80										UG Pipe							
88.81				Bunge Y END			PS # 10	Trailing Left	Bunge Y - Grain								
88.90		TR 113A/Bunge Road	FL&B														
89.00																	
89.10																	
89.20																	
89.30																	
89.40																	
89.50																	
89.60																	
89.70																	
89.80	79								North Creek	UG Bridge							
89.90	79																
90.00	79																
90.10	79									UG Pipe							
90.20	79																
90.30	79																
90.40	79																
90.50	79																
90.55	79														??	905/906	
90.60	79																
90.62	79	Aurora Street	FL&B														
90.70	50																
90.80	50																
90.90	50									UG Pipe							
91.00	50																

Milepost Orientation Increases from North to South				Sidings and Switches					Physical Characteristics					Signal System Info			
Track Mile Post	Speed Restrictions (MPH) Non-Tilting Equip	Grade Crossing Locations (Single Track unless noted)	Grade Crossing Warning System	Location Type	Connection	Length (FT)	Switch Type/Number	Orientation (North to South)	Location	Bridges & Struct.	Grade	Degeree of Curve	Length of Curve	Control Points	Home Signals	Intermediate Signals	Defect Detector
91.10	50			Off Siding	East Industrila Lead		HO	Trailing Left									
91.13	50	Main Street	FL&B														
91.20	50																
91.30	50													CPX 092			
91.32	50			Freight	Stub	???	PS # 10	Trailing Left	Indust. Lead				9° 43'				
91.40	50																
91.50	50																
91.59	50	Division Street	Gates										END				
91.60	50																
91.65	50	Cleary Street	Gates														
91.70	50																
91.75	50			Freight	Stub		PS # 10	Facing Left									
91.79	50	North Street (PED)	None														
91.80	50																
91.90	50	Howard Street	Gates														
91.91	50						HO Switch										
91.97	50	Madison Street	Gates														
92.00	50																
92.07	79	Washington Street	Gates														
92.10	79								Vermillion Rvr	UG Bridge							
92.20	79																
92.30	79																
92.40	79																
92.47	79	Reynolds Street/SR 116	Gates				PS #20 TO	Facing Right						CPX 093	2-N, 1-S, Locations??		
92.50	79			PONTIAC	DE Passing	11,770								Pontiac North			
92.60	79																
92.70	79																
92.80	79																
92.90	79																
93.00	79																
93.10	79																
93.20	79																
93.30	79																
93.40	79																
93.50	79																
93.59	79	TR 137 A/ 2 - Tracks	Gates														
93.60	79																
93.70	79																
93.80	79																
93.90	79																
94.00	79																
94.10	79																
94.20	79																
94.30	79								Turtle Creek	UG Bridge							
94.40	79																
94.50	79																
94.60	79																
94.70	79									UG Pipe							
94.71	79	TR 145 A /Lincoln 2- Tracks	Gates														
94.80	79									UG Pipe							
94.90	79																
94.97	79			PONTIAC END	DE Passing		PS #20 TO	Trailing Right						Pontiac South (CPX 095)	1 - N, 2 - S, Locations ??		
95.00	79	Farm (PVT)	None						Turnout								
95.10																	
95.20																	
95.30																	
95.40																	
95.50		Farm (PVT)	None														
95.60																	
95.70																	
95.80																	
95.85		TR 159	FL&B														
95.90																	
96.00																	
96.10																	
96.20																	
96.30																	
96.40		Farm (PVT)	None														
96.50																	
96.60		Farm (PVT)	None														Hot Box
96.70																	
96.80																	
96.81																968/969	
96.90																	
97.00									Rook Creek	UG Bridge							
97.10																	

Milepost Orientation Increases from North to South				Sidings and Switches					Physical Characteristics					Signal System Info			
Track Mile Post	Speed Restrictions (MPH) Non-Tilting Equip	Grade Crossing Locations (Single Track unless noted)	Grade Crossing Warning System	Location Type	Connection	Length (FT)	Switch Type/Number	Orientation (North to South)	Location	Bridges & Struct.	Grade	Degeree of Curve	Length of Curve	Control Points	Home Signals	Intermediate Signals	Defect Detector
97.20																	
97.30																	
97.40																	
97.50																	
97.59									Ocoya								
97.60																	
97.65				OCOYA/Freight	DE Passing	???	PS # 10	Facing Left									
97.70				↓													
97.80																	
97.90																	
97.95				OCOYA END	DE Passing		PS #10	Trailiing Left									
97.96									Ocoya					CPX 098			
98.00																	
98.08		CR 8	Gates														
98.10																	
98.20																	
98.30																	
98.40																	
98.50																	
98.60																	
98.70																	
98.80																	
98.90																	
98.98									Rook Creek	UG Bridge							
99.00																	
99.10																	
99.20		TR 195 A	FL&B														
99.30																	
99.40																	
99.50		Farm (PVT)	Stop Sign														
99.60																	
99.70																	
99.80																	
99.90																	
100.00																	
100.10																	
100.19									Rook Creek	UG Bridge							
100.20																	
100.28																1002/1003	
100.30		Farm (PVT)	None														
100.40																	
100.50																	
100.60																	
100.70																	
100.80																	
100.87		TR 209	FL&B														
100.90									Creek	UG Bridge							
101.00																	
101.10																	
101.20																	
101.30																	
101.40																	
101.44		TR 1 B	FL&B														
101.50																	
101.60																	
101.70																	
101.80																	
101.90																	
102.00																	
102.04		Division Street	Gates														
102.10				Freight	Junction	???	# 10 EL LK	Facing Right	TPW								
102.20																	
102.25	79 or 40								TPW Crossing								
102.29									TPW Xing ??					Chenoa ???			
102.30	40			CHENOA	????	NA?								CPX 102	1-N, 2-S, Locations??		
102.37		Owsley Street	Gates														
102.40																	
102.50																	
102.57		Cemetary Street/ US 24	Gates														
102.60																	
102.70																	
102.80																	
102.90																	
103.00																	
103.10																	
103.20																	

Milepost Orientation Increases from North to South				Sidings and Switches					Physical Characteristics					Signal System Info			
Track Mile Post	Speed Restrictions (MPH) Non-Tilting Equip	Grade Crossing Locations (Single Track unless noted)	Grade Crossing Warning System	Location Type	Connection	Length (FT)	Switch Type/Number	Orientation (North to South)	Location	Bridges & Struct.	Grade	Degeree of Curve	Length of Curve	Control Points	Home Signals	Intermediate Signals	Defect Detector
103.30																	
103.40																	
103.50																	
103.60																	
103.69		TR 23 A	FL&B														
103.70																	
103.80																	
103.90																	
104.00																	
104.10																	
104.20																	
104.30		Farm (PVT)	None														
104.40																	
104.50																	
104.58																1045/1046	
104.60																	
104.70																	
104.80										UG Pipe							
104.90																	
105.00																	
105.10																	
105.20																	
105.30																	
105.40																	
105.50																	
105.60																	
105.70																	
105.80																	
105.90																	
105.93		TR 35 A	FL&B														
106.00										UG Bridge							
106.10																	
106.20																	
106.30		Farm (PVT)	None														
106.40				BALLARD	DE Passing	11,440		Facing Right									
106.43							PS #20 TO							CPX 106	2-N, 1-S, Locations ??		
106.46														Ballard North???			
106.50																	
106.60																	
106.64					Stub		# 8 HO	Trailing Right									
106.70																	
106.80																	
106.90																	
107.00																	
107.10										OH Bridge							
107.20																	
107.30																	
107.40																	
107.50		Farm (PVT) / 2 Tracks	None														
107.60																	
107.70																	
107.80																	
107.90																	
108.00																	
108.10																	
108.20																	
108.30																	
108.40																	
108.47									Turkey Creek	UG Bridge							
108.50																	
108.60																	
108.70																	
108.80				BALLARD END	DE Passing			Trailiing Right									
108.83							PS # 20 TO							CPX 109	1-N, 2-S Locations?		
108.84														Ballard South			
108.90		Orange Street	FL&B														
109.00										UG Pipe							
109.10																	
109.20																	
109.30																	
109.40																	
109.50																	
109.60	90								N End of Curve				16°212'				
109.70	90																
109.80	90																
109.90	90																

Milepost Orientation Increases from North to South				Sidings and Switches					Physical Characteristics					Signal System Info			
Track Mile Post	Speed Restrictions (MPH) Non-Tilting Equip	Grade Crossing Locations (Single Track unless noted)	Grade Crossing Warning System	Location Type	Connection	Length (FT)	Switch Type/Number	Orientation (North to South)	Location	Bridges & Struct.	Grade	Degeree of Curve	Length of Curve	Control Points	Home Signals	Intermediate Signals	Defect Detector
110.00	90						# 10 TO										
110.01	90								S End of Curve				END				
110.05																	
110.10		North Street	Gates														
110.20																	
110.27		Main Street	Cant/FL&B/Gates														
110.30																	
110.36		Chestnut Street	FL&B														
110.40																	
110.50														CPX 110			
110.60																	
110.70																	
110.80																	
110.90																	
110.94	90								N End of Curve				6° 12'				
111.00	90																
111.10	90																
111.17	90								S End of Curve				END				
111.20									Makin River	UG Bridge							
111.30																	
111.36																1113/1114	
111.40																	
111.50																	
111.60																	
111.65		TR 83	FL&B														
111.70																	
111.80																	
111.90																	
112.00																	
112.10																	
112.20										UG Pipe							
112.30																	
112.40																	
112.50																	
112.60																	
112.70																	
112.80																	
112.90																	
113.00																	
113.10																	
113.20																	
113.30																1133/1134	
113.40																	
113.49		Killian Road	FL&B														
113.50																	
113.60																	
113.70																	
113.80																	
113.81										UG Pipe							
113.90																	
114.00																	
114.02									Hudson Road	OH Bridge							
114.10																	
114.20																	
114.30																	
114.40										UG Pipe							
114.50																	
114.60																	
114.70																	
114.80		Private (PVT)	None														
114.90																	
115.00																	Detector ???
115.10																	Hot Box & DED
115.18		TR 358 A	FL&B														
115.20																	
115.30																	
115.40										UG Pipe							
115.50																	
115.60																	
115.70																	
115.80																	
115.90																	
116.00																	
116.10																	
116.20																	
116.30																	

Milepost Orientation Increases from North to South				Sidings and Switches					Physical Characteristics					Signal System Info			
Track Mile Post	Speed Restrictions (MPH) Non-Tilting Equip	Grade Crossing Locations (Single Track unless noted)	Grade Crossing Warning System	Location Type	Connection	Length (FT)	Switch Type/Number	Orientation (North to South)	Location	Bridges & Struct.	Grade	Degeree of Curve	Length of Curve	Control Points	Home Signals	Intermediate Signals	Defect Detector
116.36																1163/1164	
116.40																	
116.50																	
116.60																	
116.70																	
116.80																	
116.90																	
116.99										UG Pipe							
117.00																	
117.10																	
117.20																	
117.26									Money Crk	UG Pipe							
117.30																	
117.40																	
117.50																	
117.60																	
117.70																	
117.80																	
117.90																	
118.00																	
118.05		Washington Street	FL&B														
118.10																	
118.12		Madison Street	FL&B														
118.20																	
118.25		Jefferson Street	FL&B														
118.30																	
118.40																	
118.50																	
118.58				TOWANDA / Freight	Stub	????	HO # 10 TO	Trailing Left									
118.60									Tonawanda								
118.70																	
118.80																	
118.83																1188/1189	
118.90																	
119.00																	
119.10																	
119.20																	
119.30																	
119.40																	
119.50																	
119.60																	
119.70																	
119.80																	
119.90																	
120.00																	
120.03		TR 306 A	FL&B														
120.10																	
120.20																	
120.30																	
120.40																	
120.50		Farm (PVT)	None														
120.60																	
120.70																	
120.80																	
120.90																	
121.00																	
121.01										UG Pipe							
121.10																	
121.20																	
121.30																	
121.40				NORMAL	DE Passing	17952	PS	Facing Right						Normal North (CPX 121)	2-N, 1-S, Locations ???		
121.50							No 1 ML										
121.60																	
121.70																	
121.80										UG Pipe							
121.90									Veteran Pkwy	OH Bridge							
122.00																	
122.05										UG Pipe							
122.10																	
122.20																	
122.30																	
122.40																	
122.50																	
122.60										OH Bridge							
122.70																	
122.80																	

Milepost Orientation Increases from North to South				Sidings and Switches					Physical Characteristics					Signal System Info			
Track Mile Post	Speed Restrictions (MPH) Non-Tilting Equip	Grade Crossing Locations (Single Track unless noted)	Grade Crossing Warning System	Location Type	Connection	Length (FT)	Switch Type/Number	Orientation (North to South)	Location	Bridges & Struct.	Grade	Degeree of Curve	Length of Curve	Control Points	Home Signals	Intermediate Signals	Defect Detector
122.90										UG Pipe							
123.00																	
123.10																	
123.20																	
123.30																	
123.39										UG Pipe							
123.40	40	Ft. Jesse Road	Gates						Ft. Jessie Rd								
123.50	40																
123.57	40				X-Over		2- PS # 20	Trailing						Location 883	1-S, 1-N Locations ???		
123.60	40																
123.67	40	Beech Street - 2 Tracks	Gates														
123.70	40																
123.79	40	Mulberry Street - 2 Tracks	Gates														
123.80	40																
123.90	40																
123.91	40	College Avenue - 2 Tracks	Gates														
124.00	40	Linden Street - 2 Tracks	Gates														
124.03	40				X-Over		2- PS # 20	Trailing						Location 884			
124.10	40			NORMAL END ?	DE Passing				Amtrak Stat					CPX 124			
124.11	40													Normal			
124.15	40	Station (PED) - 2 Tracks	None														
124.20	40	Broadway Street - 2 Tracks	Gates														
124.28	40	Felll Avenue - 2 Tracks	Gates														
124.30	40																
124.35	40	Hester Street (PED) - 2 Tracks	None														
124.38	40				X-Over		2- PS # 20	Facing						Location 885	2 - N , Locatons?		
124.40	40																
124.50	40								School Street	UG Bridge							
124.60	40								Verno Ave	UG Bridge							
124.68	40	University Street - 2 Tracks	Gates														
124.70	40																
124.80	40			BLOOMINGTON YD					Hghwy 51	UG Bridge							
124.83	40													Main Street			
124.86	40						HO #9 TO		Blmntn Yd					CPX 125	2 , Locations?		
124.90	40								Hghwy 51	UG Bridge				Bloomington North			
125.00	40									Sugar Crk Br							
125.10	40								Division St	UG Bridge							
125.20	40								Emerson St.	OH Bridge							
125.25	40															1252/1253??	
125.30	40																
125.40	40																
125.50	40								NS Crossing???								
125.51	40														Multiple - Locations???		
125.60	40																
125.70	40																
125.80	40																
125.90	40																
126.00	40						No 1, ML End										
126.03	40									UG Pipe							
126.10	40																
126.20	40								Locust Street	OH Bridge							
126.30	40								Market St	UG Bridge							
126.40	30			END													
126.43	30													Market Street			
126.50	30	Washington Street	Cant. FL&B	BN TARGET										BN Target			
126.51	30								NS Crossing								
126.60	30	End Spfld Division		BLOOMINGTON					Const. Trail	OH Ped BR				Bloomington			
126.70	50																
126.80	50								Bridge	UG Bridge							
126.90	50																
126.95	50									OH Bridge							
127.00	50																
127.10	50									UG Pipe							
127.19	50	Miller Street - 2 Tracks	Gates														
127.20	50																
127.30	50																
127.40																	
127.50										UG Pipe							
127.60																	
127.70																	
127.80																	
127.90										UG Pipe							
128.00																	
128.09		Six Points Road - 2 Tracks	Gates														
128.10																	
128.20																	

Milepost Orientation Increases from North to South				Sidings and Switches					Physical Characteristics					Signal System Info			
Track Mile Post	Speed Restrictions (MPH) Non-Tilting Equip	Grade Crossing Locations (Single Track unless noted)	Grade Crossing Warning System	Location Type	Connection	Length (FT)	Switch Type/Number	Orientation (North to South)	Location	Bridges & Struct.	Grade	Degeree of Curve	Length of Curve	Control Points	Home Signals	Intermediate Signals	Defect Detector
128.30																	
128.40																	
128.50																	
128.60																	
128.65										OH Bridge							
128.70										OH Bridge							
128.75														CPX 129			
128.76														Bloomington South??	1 - N, 1 - S, Locations??		
128.80										OH Bridge							
128.90																	
129.00																	
129.10																	
129.20																	
129.30																	
129.40																	
129.50																	
129.60										UG Pipe							
129.70																	
129.80																	
129.90																	
130.00										UG Pipe							
130.10																	
130.20																	
130.27	90								N End of Curve				17° 38'				
130.30	90									UG Bridge							
130.40	90																
130.50	90																
130.60	90																
130.70	90								S End of Curve				End				
130.80																	
130.90																	
130.96																1309/1310	
131.00																	
131.10																	
131.20																	
131.30																	
131.40																	
131.50																	
131.60																	
131.70																	
131.80																	
131.90																	
132.00																	
132.10																	
132.20																	
132.30										OH Bridge							
132.40																	
132.50																	
132.60																	
132.70																	
132.80																	
132.90																	
133.00																	
133.10																	
133.20																	
133.30																	
133.40																	
133.50																	
133.60																	
133.70		TR 443	FL&B														
133.72																1336/1337	
133.80																	Hot Box & DED
133.90																	
134.00																	
134.10																	
134.20																	
134.30																	
134.40																	
134.50																	
134.60										UG Pipe							
134.70																	
134.80																	
134.89										UG Pipe							
134.90		Farm (PVT)	None														
135.00																	
135.10																	

Milepost Orientation Increases from North to South				Sidings and Switches					Physical Characteristics					Signal System Info			
Track Mile Post	Speed Restrictions (MPH) Non-Tilting Equip	Grade Crossing Locations (Single Track unless noted)	Grade Crossing Warning System	Location Type	Connection	Length (FT)	Switch Type/Number	Orientation (North to South)	Location	Bridges & Struct.	Grade	Degeree of Curve	Length of Curve	Control Points	Home Signals	Intermediate Signals	Defect Detector
135.20																	
135.30																	
135.40																	
135.50																	
135.60																	
135.70																	
135.80										2 UG Pipes							
135.90																	
136.00																	
136.10																	
136.20																	
136.30																	
136.35		Funks Grove Road	FL&B														
136.40																	
136.50										Sugar Ck Bridge							
136.60																	
136.70																	
136.80																	
136.90																1369/1370	
136.95		Farm (PVT)	None														
137.00																	
137.10																	
137.20																	
137.30																	
137.40																	
137.50																	
137.60																	
137.70										UG Pipe							
137.80																	
137.90										UG Pipe							
138.00																	
138.10																	
138.20																	
138.30																	
138.40																	
138.50										UG Pipe							
138.60																	
138.63							PS # 20 TO								2 -N, 1 - S, Locations???		
138.67														McLean North			
138.69														CPX 139			
138.70				McLEAN	DE Passing	12,430	PS # 20 TO	Facing Left									
138.80																	
138.90																	
139.00																	
139.10																	
139.12		TR 533 - 2 Tracks	Gates														
139.20																	
139.30																	
139.40																	
139.50																	
139.60																	
139.70																	
139.80																	
139.90																	
140.00																	
140.10																	
140.16					Stub	???	EL LK # 10 TO	Facing Right									
140.19																	
140.20																	
140.29							PS # 20 TO								1 - N , 2 - S Location???		
140.30																	
140.40																	
140.50																	
140.60																	
140.70																	
140.80																	
140.90																	
140.91		Railroad Avenue - 2 Tracks	Gates														
141.00																	
141.10																	
141.16		US 136 - 2 Tracks	Gates														
141.20				▼													
141.30				McLEAN END	DE Passing		PS # 20 TO	Trailing Left						CPX 141			
141.32														McLean South			
141.40																	
141.50																	

Milepost Orientation Increases from North to South				Sidings and Switches					Physical Characteristics					Signal System Info			
Track Mile Post	Speed Restrictions (MPH) Non-Tilting Equip	Grade Crossing Locations (Single Track unless noted)	Grade Crossing Warning System	Location Type	Connection	Length (FT)	Switch Type/Number	Orientation (North to South)	Location	Bridges & Struct.	Grade	Degeree of Curve	Length of Curve	Control Points	Home Signals	Intermediate Signals	Defect Detector
141.60																	
141.70																	
141.80																	
141.90																	
142.00																	
142.10																	
142.20																	
142.30																	
142.40																	
142.50																	
142.60																	
142.70																	
142.80														Atlanta			
142.90																	
143.00																	
143.10																	
143.20																	
143.30																	
143.35																1433/1434	
143.40																	
143.50																	
143.60																	
143.69				FTS Fert Freight	Stub	????	HO #10	Trailing Right									
143.70														CPX 144			
143.73							HO Switch		F & S Fertilizer								
143.74		TR 38	FL&B														
143.80																	
143.90																	
144.00																	
144.10										Clear Ck Bridge							
144.20																	
144.30																	
144.40																	
144.44		Private (PVT)	None														
144.50																	
144.60																	
144.70										UG Pipe							
144.80																	
144.90																	
145.00																	
145.10																	
145.20																	
145.30																	
145.34				ATLANTA Freight	Stub	????	HO# 10	Facing Left									
145.40							HO Switch										
145.50																	
145.60																	
145.69	79								N End of Curve				12° 38'				
145.70	65																
145.75	65	Elm Street	Gates														
145.78	65								S End of Curve				End				
145.80	65			ATLANTA	???									CPX 146			
145.81	65	Vine Street	Cant. FL&B/Gates														
145.85	65	Race Street	Cant. FL&B/Gates														
145.90	65																
146.00	65																
146.07	90								N End of Curve								
146.10	90																
146.19	90								S End of Curve								
146.20																	
146.30																	
145.34																	
146.40																	
146.50																	
146.60																	
146.70																	
146.80																	
146.90																	
146.99	90								N End of Curve				25° 08'				
147.00	90																
147.10	90																
147.20	90																
147.30	90																
147.40	90																
147.50	90									UG Pipe							
147.60	90	Lazy Row Road/TR 51	FL&B														Hot Box & DED

Milepost Orientation Increases from North to South				Sidings and Switches					Physical Characteristics					Signal System Info			
Track Mile Post	Speed Restrictions (MPH) Non-Tilting Equip	Grade Crossing Locations (Single Track unless noted)	Grade Crossing Warning System	Location Type	Connection	Length (FT)	Switch Type/Number	Orientation (North to South)	Location	Bridges & Struct.	Grade	Degeree of Curve	Length of Curve	Control Points	Home Signals	Intermediate Signals	Defect Detector
147.70	90																
147.73	90								S End of Curve				End				
147.80																	
147.90																	
148.00																	
148.10																	
148.20																	
148.26																1482/1483	
148.30																	
148.40																	
148.45	90								N End of Curve				12° 38'				
148.50	90																
148.60	90																
148.70	90																
148.79	90								S End of Curve				End				
148.80																	
148.90																	
149.00																	
149.10																	
149.20																	
149.30																	
149.40																	
149.50										Kickapoo Crk Br							
149.60									West St.	OH Bridge							
149.70																	
149.75		Main Street	FL&B														
149.80																	
149.82				LAWNDALE ??	DE Passing	5,000	PS # 10 TO	Facing Right									
149.86									Lawndale								
149.90										UG Pipe							
150.00				East Lincoln Grain	Stub		Elec Lock	Trailing Right									
150.10																	
150.15		Lincoln Street - 2 Tracks	Gates														
150.20																	
150.30																	
150.40																	
150.50																	
150.60																	
150.70																	
150.80																	
150.90																	
150.92				LAWNDALE END	DE Passing		#10 Elec Lk	Trailing Right	Lawndale								
150.96																1508/1509	
151.00																	
151.10																	
151.20																	
151.30																	
151.40																	
151.50																	
151.60																	
151.70																	
151.80																	
151.90																	
152.00																	
152.10																	
152.18		TR 222	FL&B														
152.20																	
152.30																	
152.40																	
152.50																	
152.60																	
152.70										UG Pipe							
152.80																	
152.90									I-55	OH Bridge							
152.95									I-55	OH Bridge							
153.00																	
153.10																	
153.20																	
153.30																	
153.40																	
153.46		TR 93 - 2 Tracks	Gates														
153.47				Freight Siding	Stub	???		Facing Right									
153.50							HO # 10										
153.51							HO Switch										
153.52				ATHOL	DE Passing	10,010	PS # 20 TO	Facing Right									
153.56														CPX 153/Athol N	2 - N, 1 _S Locations??0		

Milepost Orientation Increases from North to South				Sidings and Switches					Physical Characteristics					Signal System Info			
Track Mile Post	Speed Restrictions (MPH) Non-Tilting Equip	Grade Crossing Locations (Single Track unless noted)	Grade Crossing Warning System	Location Type	Connection	Length (FT)	Switch Type/Number	Orientation (North to South)	Location	Bridges & Struct.	Grade	Degeree of Curve	Length of Curve	Control Points	Home Signals	Intermediate Signals	Defect Detector
153.60				ATHOL		10,010											
153.70																	
153.80																	
153.90																	
154.00																	
154.10										UG Pipe							
154.20																	
154.30																	
154.40																	
154.50																	
154.60																	
154.70																	
154.80																	
154.90	79								Bridge	UG Bridge							
154.91				Freight Siding	DE Passing	???	HO Switch	Facing Right									
154.92	79																
155.00	79																
155.10	79																
155.20	79																
155.28				Freight Siding	Stub		HO # 10	Facing Right									
155.30	79																
155.33				Freight Siding	Stub		HO # 10	Facing Right									
155.40	79																
155.50	79																
155.52	79			Freight Siding End	DE Passing		HO # 10	Trailing Right	Siding Track								
155.53	79																
155.60	40						Diamond?		CNIC Crossing?					CPX 156	4 - All Directions Loc. ???		
155.64	70			ATHOL END	DE Passing		PS # 20 TO	Trailing Right	Trailing Right								
155.67	70						Diamond		CRR Crossing								
155.69	70													Athol South			
155.70	70			END ??													
155.80	70																
155.88	70	Burlington Street (PED)	None														
155.90	70																
155.95	70	Keokuk Street	Cant. FL&B/Gates														
156.00	70																
156.09	70	Peoria Street (PED)	None														
156.10	70																
156.16	70	Tremont Street	Gates														
156.20	70																
156.30	70																
156.32	70	Pekin Street	Gates														
156.38	70	Broadway Street	Gates														
156.40	70			LINCOLN					Lincoln Station-Amtrak								
156.45	70	Pulaski Street	Gates														
156.50	70																
156.52	70	Clinton Street	Gates														
156.60	70	Decatur Street	Gates														
156.70	70																
156.74	70			Havana Siding Freight	Stub	???	EL LK # 7 TO	Facing Right									
156.76	70								Havnana Spur								
156.80	70																
156.90	79																
157.00	79																
157.10	79												9° 52'				
157.20	79									Limerick Bridge							
157.26	79															1572/1573	
157.30	79																
157.40	79												End				
157.50	79																
157.60	79									UG Pipe							
157.70	79									UG Pipe							
157.80	79																
157.90	79																
158.00	79																
158.10	79								Bridge	Salt Creek Br							
158.20																	
158.24	90								N End of Curve				18° 32'				
158.30	90																
158.40	90																
158.50	90																
158.60	90																
158.69	90								S End of Curve				End				
158.70																	
158.80																	
158.90																	

Milepost Orientation Increases from North to South				Sidings and Switches					Physical Characteristics					Signal System Info			
Track Mile Post	Speed Restrictions (MPH) Non-Tilting Equip	Grade Crossing Locations (Single Track unless noted)	Grade Crossing Warning System	Location Type	Connection	Length (FT)	Switch Type/Number	Orientation (North to South)	Location	Bridges & Struct.	Grade	Degeree of Curve	Length of Curve	Control Points	Home Signals	Intermediate Signals	Defect Detector
159.00										UG Pipe							
159.10																	
159.20																	
159.30																	
159.40		TR 128	Gates														
159.50																	
159.60																	
159.70																	
159.80																	
159.90																	
160.00																	
160.05																1601/1602	
160.10																	
160.20																	
160.30																	
160.40																	
160.50																	
160.60																	
160.70																	
160.80																	
160.90																	
161.00																	
161.10																	
161.20																	
161.30		TR 149 A	FL&B														
161.40																	
161.50																	
161.60																	
161.70																	
161.80																	
161.90																	
162.00																	
162.10																	
162.11																1621/1622	
162.20																	
162.30																	
162.40																	
162.50																	
162.60																	
162.70										UG Pipe							
162.80																	
162.90																	
163.00																	Detector Reade
163.10																	
163.20																	
163.30																	
163.40		PED XING	None														Hot Box ?
163.42																	Hot Box
163.45		Main Street	Gates														
163.50																	
163.60										UG Pipe							
163.70																	
163.80																	
163.90																	
164.00																	
164.04																1641/1662	
164.10																	
164.20																	
164.30																	
164.40																	
164.50																	
164.60																	
164.70																	
164.80																	
164.90																	
165.00																	
165.10																	
165.20										UG Pipe							
165.30																	
165.40																	
165.50																	
165.60																	
165.70																	
165.80																	
165.90																	
166.00																	

Milepost Orientation Increases from North to South				Sidings and Switches					Physical Characteristics					Signal System Info			
Track Mile Post	Speed Restrictions (MPH) Non-Tilting Equip	Grade Crossing Locations (Single Track unless noted)	Grade Crossing Warning System	Location Type	Connection	Length (FT)	Switch Type/Number	Orientation (North to South)	Location	Bridges & Struct.	Grade	Degeree of Curve	Length of Curve	Control Points	Home Signals	Intermediate Signals	Defect Detector
166.07				Elkhart Grain	DE Passing	???	PS # 10 TO	Facing Right									
166.10																	
166.16																1661/1662	
166.20		Farm	None														
166.30																	
166.31							HO w Sig										
166.40																	
166.50																	
166.60																	
166.70				Freight Siding	DE Passing	???		Facing Right									
166.78	90								N End of Curve				4° 20'				
166.80	90																
166.89	90								S End of Curve				End				
166.90																	
167.00																	
167.10																	
167.20				Freight Siding End	DE Passing	???	??	Trailing Right									
167.25																	
167.30		Oglesby Street	Cant. FL&B/Gates														
167.40										UG Pipe							
167.43				Elkhart Grain End	DE Passing		PS # 10 TO	Trailing Right									
167.46							HO w Sig										
167.50																	
167.60																	
167.70																	
167.80																	
167.90																	
168.00																	
168.05										UG Pipe							
168.10																	
168.20										UG Pipe							
168.30																	
168.34				ELKHART	DE Passing	9,625	PS # 20 TO	Facing Right							Two-N, One-S Location??		
168.37														Elkhart North			
168.40				ELKHART		9,625								CPX 168			
168.50		TR 199 A - 2 Tracks	Gates														
168.60																	
168.70																	
168.80																	
168.90																	
169.00																	
169.10																	
169.20																	
169.30																	
169.40																	
169.50																	
169.60																	
169.70																	
169.80		TR 50 A - 2 Tracks	Gates														
169.90																	
170.00																	
170.10																	
170.20																	
170.30										UG Pipe							
170.35														CPX 170	Two -S; One - N Location??		
170.40				END													
170.42				ELKHART END	DE Passing		PS # 20 TO	Trailing Right									
170.44														Elkhart South			
170.50																	
170.60																	
170.70																	
170.80																	
170.90																	
171.00																	
171.10										UG Pipe							
171.20																	
171.30																	
171.40																	
171.50																	
171.60																	
171.70																	
171.80																	
171.90																	
172.00																	
172.10										UG Pipe							
172.20																	

Milepost Orientation Increases from North to South				Sidings and Switches					Physical Characteristics					Signal System Info			
Track Mile Post	Speed Restrictions (MPH) Non-Tilting Equip	Grade Crossing Locations (Single Track unless noted)	Grade Crossing Warning System	Location Type	Connection	Length (FT)	Switch Type/Number	Orientation (North to South)	Location	Bridges & Struct.	Grade	Degeree of Curve	Length of Curve	Control Points	Home Signals	Intermediate Signals	Defect Detector
172.30																	
172.34																1723/1724	
172.35		TR 5	FL&B														
172.40										UG Pipe							
172.50																	
172.60																	
172.70																	
172.80													3° 0'				
172.90		PED XING	None														
172.95		PED XING	None														
173.00		Main Street	Gates W Median										End				
173.10																	
173.20																	
173.30		Emergency	Gates Barrier														
173.40																	
173.50																	
173.60																	
173.70																	
173.80																	
173.90																	
174.00																	
174.10																	
174.20																	
174.30																	
174.40																	
174.50																	
174.60																	
174.70																	
174.80																	
174.90																	
175.00																	
175.10																	
175.20																	
175.30																	
175.40																	
175.50																	
175.60																	
175.70																	
175.80										UG Pipe							
175.84																1758/1759	
175.90																	
176.00																	
176.10																	
176.20																	
176.30																	
176.40										UG Pipe							
176.50																	
176.60																	Hot Box & DED
176.70		TR 33/ Wolf Road	FL&B														
176.80																	
176.90																	
177.00																	
177.10																	
177.20																	
177.30										OH Hgwy							
177.32										OH Hgwy							
177.40										UG Pipe							
177.50																	
177.60																	
177.70																	
177.80																	
177.87		Andrew Road	Gates														
177.90																	
178.00																	
178.10																	
178.20																	
178.30																	
178.36	79								N End of Curve				33° 28'				
178.40	79																
178.50	79																
178.60	79																
178.70	79																
178.80	79																
178.90	79																
179.00	79																
179.01	79								S End of Curve				End				

Milepost Orientation Increases from North to South				Sidings and Switches					Physical Characteristics					Signal System Info			
Track Mile Post	Speed Restrictions (MPH) Non-Tilting Equip	Grade Crossing Locations (Single Track unless noted)	Grade Crossing Warning System	Location Type	Connection	Length (FT)	Switch Type/Number	Orientation (North to South)	Location	Bridges & Struct.	Grade	Degeree of Curve	Length of Curve	Control Points	Home Signals	Intermediate Signals	Defect Detector
179.08										UG Pipe							
179.10																	
179.20																	
179.30																	
179.40																	
179.49																1792/1793	
179.50																	
179.60		Carter Brothers (PVT)	None							UG Pipe							
179.70																	
179.80																	
179.90																	
180.00	79								Bridge								
180.10	79																
180.20	79																
180.30	79																
180.40	79																
180.50	79																
180.60	79	Sand Hill Road	Gates														
180.70	79																
180.78	79								End of Project								
180.80																	
180.90																	
180.99														Ridgely North			
181.00																	
181.10																	
181.20																	
181.30																	
181.40																	
181.50																	
181.60																	
181.65							HO Switch										
181.70	70																
181.80	70																
181.90	70																
182.00	70																
182.10	70																
182.20	70																
182.30	70																
182.40	70																
182.50	70																
182.60	70																
182.70																	
182.80																	
182.86							HO Switch		Ridgely Yard								
182.90																	
182.95									RR Xing C&IM					Ridgely			
183.00																	
183.07							Elec Lock		Illinois Midland								
183.10																	
183.20																	
183.30																	
183.31														Ridgely South			
183.40																	
183.50																	
183.60																	
183.70																	
183.80																	
183.90																	
184.00																	
184.10																	
184.20																	
184.30																	
184.40																	
184.50																	
184.60																	
184.70																	
184.80																	
184.90																	
185.00																	
END Reference																	
				Location Name - Passenger and/or Freight Access	Double Ended Passing Siding or Stub Ended													
				Data Sources Include:	UP Timetable and Track Diagrams; and IDOT PTC Project CONOPs													

SPRINGFIELD SUBDIVISION (0029)

Mile Post	Rule 6.3	CP #'s	Radio Display: Bloomington to Iles -7878 / Hazel Dell to Valley Jct. -3030 SOUTH ▼ STATIONS ▲ NORTH	Sta. #'s	Siding Feet
126.6	CTC		BLOOMINGTON (2.1)	ZS127	
128.7		GM129	CP GM129 (10.0)		
138.7 141.3		GM139 GM141	McLEAN (7.1)	ZS141	12430
145.8		GM146	ATLANTA (4.2)	ZS146	
150.0			LAWNDALE (3.6)	ZS150	5000
153.6 155.7		GM153 GM156	ATHOL (2.8)	ZS155	10010
156.4			LINCOLN (12.0)	ZS156	
168.4 170.4		GM168 GM170	ELKHART (12.6)	ZS168	9625
181.0 183.4		GM181 GM183	RIDGLEY T (4.1) (X)I&M(M)	ZS183	10175
185.1			SPRINGFIELD (2.3)	ZS185	
187.4	VIA NS	GM187	ILES (1.5)	ZS187	
188.9	CTC	GM189	HAZEL DELL (9.0)		
197.9 200.1		GM198 GM200	AUBURN (12.5) !	ZS200	10505
210.4 212.6		GM210 GM213	GIRARD ! (2.7) (X)BNSF(M)	ZS211	9625
213.1			NILWOOD (10.1)	SM275	
223.2 226.7		GM223 GM227	CARLINVILLE (13.1) !	ZS224	17490
236.3 238.6		GM236 GM239	SHIPMAN (9.5) !	ZS238	11165
245.8		GM246	BRIGHTON (3.5)	ZS246	
249.3 252.2		GM249 GM252	GODFREY (7.9) !	ZS252	13420
257.2			ALTON (4.9)	ZS257	
262.1	GWER 2 MT	GM262	WANN (0.8)	ZS262	
262.9			WOODRIVER (6.8) (X)NS(M)	ZS263	
269.7		I276	LENOX (5.8) (M)	ZB277	
275.5	CTC 2 MT	GM276	WR TOWER (2.5) (M)		
278.0		GM278	VENICE (3.0)	ZS278	
281.0	TRRA	GM281	Q TOWER (0.4) (M)Y		
281.4	DTC#2		HOLE-IN-THE-WALL (TRK 2) (2.2)		
281.5	YL#1		M&O JCT.(TRK.1) Y (2.1)		
283.6	YL		VALLEY JCT. Y (X)TRRA(M)		
			(157.0)		

SI-01 MAIN TRACK AUTHORITY

CTC between: Bloomington and Wann; WR Tower and Q Tower.

DTC Between MP 281.4 and MP 283.4 Trk 2

Yard Limits between: MP 281.5 and MP 283.6 on Trk 1. Permission must be obtained from Supervisor of Operations, GWER East St. Louis before entering yard limits on Trk 1; MP 283.4 and MP 283.6 on Trk. 2.

Movements between Wann and WR Tower dispatched by GWER.

Movements between Q Tower and Hole-in-the-Wall on Trk 2 is over the TRRA.

SI-02 MAXIMUM SPEED TABLE

Maximum Speed MPH

Between Mileposts 126.6 and 283.6	PSGR	FRT
(Except as Below)	**79**	**60**
126.6 and 127.3	50	40
145.7 and 146.0	65	50
155.6 (X)	40	40
155.6 and 156.8	70	50
181.7 and 182.6	70	50
182.6 and 186.5	25	25
186.5 and 187.3	70	60
193.2 and 194.0	50	50
210.5 (X)	40	40
226.7 and 233.9	65	60
235.6 and 236.1	70	60
250.5 and 250.7	70	60
252.1 and 252.6	50	40
254.4 and 254.9	70	60
262.0 and 262.1	40	40
275.5 and 275.6	25	25
275.6 and 277.9 Trk1	40	40
277.9 and 281.0 Trk1	25	25
281.0 and 283.6 Trk1	10	10
275.6 and 280.1 Trk2	60	60
280.1 and 280.7 Trk2	40	40
281.4 and 283.6 Trk2	25	25

SI-03 OTHER SPEED RESTRICTIONS

Maximum Speed MPH

1. **Thru Sidings & Turnouts**
   Lawndale, Athol, Ridgley and Godfrey... 10
2. **Dual Control Switch Turnouts**
   CP GM278..... 15
3. **Misc. Speed Restrictions**
   Valley Jct. (MP 283.6) - Connection track from TRRA to SP Valley Yard (including yard tracks) and connection track to Church Industrial Lead. 5

SI-04 MAIN TRACK DESIGNATIONS

Two main tracks between: CP GM262 and MP 283.6.

SI-05 MILEPOST EQUATIONS

MP 259.0 TO MP 262.0 = 0.5 MILES

SI-06 DTC BLOCK LIMITS

SOUTH	BLOCK NAME	NORTH
283.4	Track 2 Valley	281.4

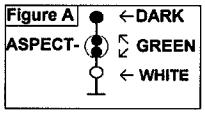
SI-07 ITEM 13 TRAIN DEFECT DETECTORS

(#) 133.8	# 214.6
(#) 147.6	(#) 229.9
# 163.4	(#) 239.8
(#) 176.6	(#) 255.6
# 191.1	(#) 272.7
(#) 202.5	

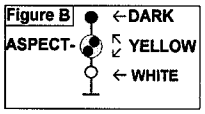
SI-08 RULES ITEMS

Rule 6.32.2 A applies at MP 140.9 (Railroad Ave.) on McLean siding.

Rule 9.2.8 Diverging Clear.



Rule 9.2.10 Diverging Approach.



Rule 9.13.2 Ridgley Interlocking: When authorized to pass an absolute signal displaying Stop indication, crew member must examine Leverman switch from the ground to see that route is properly lined and switch points are in proper position before movement is made over Leverman switch.

Rule 10.2 Hand throw switches at the following locations are equipped with an electric lock or signal to govern movement: Lawndale (MP 149.9) and (MP 150.8); Havana (MP 156.7); Elkhart, north (MP 166.1) and south (MP 167.4) elevator switches; Springfield, loop track (MP 184.60); Cisco Steel (MP 221.5).

Rule 10.3 exception: Track and Time rules apply within manual interlocking limits at Athol, Girard and Wann and Lenox.

SI-09 FRA EXCEPTED TRACKS

Lincoln: Havana District Tracks

Ridgely: Tracks No. 6,7,8,9 and 11.

East St. Louis: Tolson Main.

SI-10 BUSINESS TRACKS

Track Name	MP	STA. #'S
F&S Fertilizer	143.7	. . .
East Lincoln Grain S	150.0	. . .
Kruger Elevator S	153.5	. . .
Incon N	155.4	. . .
Havana District N	156.8	. . .
Elkhart Grain	167.5	. . .
Midstates S	188.7	. . .
Virden S	207.0	. . .
Cisco N	221.5	. . .
QC Track S	223.6	. . .
Plainview N	235.3	. . .

SI-11 INDUSTRIAL LEADS

Airline Industrial Lead: Extends from KC Jct. 1.8 miles to Cockrell.

Church Industrial Lead: Extends from MP 283.6 (Valley Jct.) 3.6 miles to MP 287.2, Church (Sta. # ZS287).

Granite City Industrial Lead: Extends from Madison (MP 149.3), Sta.# ZB282 to MP 141.0 (end of track).

Business Tracks	MP	Sta.#'s
ALS (X) (A)	147.8	C 009
Granite City	146.5	ZB282
Stallings	144.0	SM329

SI-12 TONNAGE RESTRICTIONS - None.

SI-13 TRAIN MAKE-UP RESTRICTIONS - None.

SI-14 MISC. INSTRUCTIONS

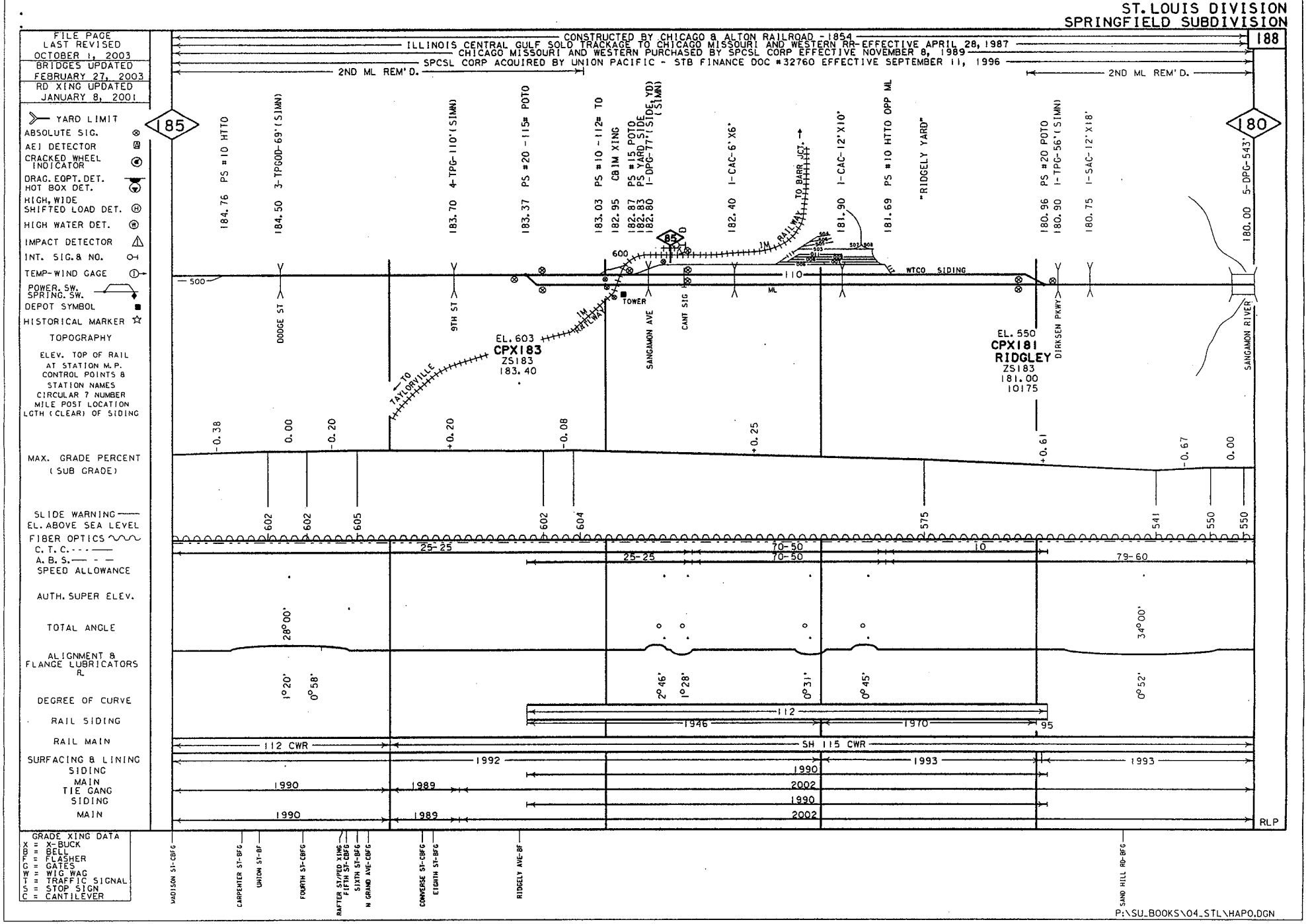
Bloomington: All train crews (including Amtrak) when lined into the yard or runner at Bloomington, prior to entering the yard, are to contact Train Dispatcher 14 on Channel 78-78 for instructions.

Movements on NS: Movements between Iles, MP 187.4, Hazel Dell, MP 188.9, between KC Jct., MP 190.6 and Iles MP 187.4 will be governed by Norfolk Southern Railway Rules and Timetable.

Iles (NS crossing): Manual interlocking is controlled by NS train dispatcher. The NS train dispatcher can be contacted on radio channel 2222, DTMF 9-4-2 or by wayside radio located in box in the northwest quadrant of the interlocking.

Woodriver Interlocking: Controlled by NS Luther Operator; Radio 2222, DTMF 5-5-5.
Phone (314) 679-1717

Operation Wann to Valley Jct.: Wann to WR Tower - KCS/GWER dispatcher; Radio 9090
WR Tower - TRRA Merchants dispatcher Radio 2626
WR Tower to Q Tower - UP dispatcher Radio 3030
Q Tower - TRRA West Belt dispatcher; Radio 2626
Q Tower and M&O Jct. track 1TRRA West Belt Train Dispatcher; Radio Channel 2626.
Q Tower to Valley Jct. Track 2 - UP dispatcher; Radio 3030
Mo. Jct. To Church St. Track 1 - KCS/GWER yard supervisor; Radio 6060


ST. LOUIS DIVISION
SPRINGFIELD SUBDIVISION
188
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BRIDGES UPDATED
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CONSTRUCTED BY CHICAGO & ALTON RAILROAD - 1854
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CHICAGO MISSOURI AND WESTERN PURCHASED BY SPCSL CORP EFFECTIVE NOVEMBER 8, 1989
SPCSL CORP ACQUIRED BY UNION PACIFIC - STB FINANCE DOC #32760 EFFECTIVE SEPTEMBER 11, 1996
2ND ML REM'D.
2ND ML REM'D.
185
180
YARD LIMIT
ABSOLUTE SIG.
AEI DETECTOR
CRACKED WHEEL INDICATOR
DRAG. EQPT. DET.
HOT BOX DET.
HIGH, WIDE SHIFTED LOAD DET.
HIGH WATER DET.
IMPACT DETECTOR
INT. SIG. & NO.
TEMP-WIND GAGE
POWER SW.
SPRING SW.
DEPOT SYMBOL
HISTORICAL MARKER
TOPOGRAPHY
ELEV. TOP OF RAIL AT STATION M.P. CONTROL POINTS & STATION NAMES CIRCULAR 7 NUMBER MILE POST LOCATION LGTH (CLEAR) OF SIDING
MAX. GRADE PERCENT (SUB GRADE)
SLIDE WARNING
EL. ABOVE SEA LEVEL
FIBER OPTICS
C. T. C.
A. B. S.
SPEED ALLOWANCE
AUTH. SUPER ELEV.
TOTAL ANGLE
ALIGNMENT & FLANGE LUBRICATORS RL
DEGREE OF CURVE
RAIL SIDING
RAIL MAIN
SURFACING & LINING
SIDING
MAIN
TIE GANG
SIDING
MAIN
184.76 PS #10 HTTO
184.50 3-TPGOD-69'(SIMN)
183.70 4-TPG-110'(SIMN)
183.37 PS #20 - 115# POTO
183.03 PS #10 - 112# TO
182.95 CB 1M XING
182.87 PS #15 POTO
182.83 PS YARD SIDE
182.80 1-DPG-77'(SIDE YD) (SIMN)
182.40 1-CAC-6'X6'
181.90 1-CAC-12'X10'
181.69 PS #10 HTTO OPP ML
"RIDGELY YARD"
180.96 PS #20 POTO
180.90 1-TPG-56'(SIMN)
180.75 1-SAC-12'X18'
180.00 5-DPG-543'
TO BARR JCT.
1M RAILWAY
TO TAYLORVILLE
EL. 603
CPX183
ZS183
183.40
EL. 550
CPX181
RIDGLEY
ZS183
181.00
10175
DODGE ST
9TH ST
SANGAMON AVE
CANT SIG
TOWER
WTCO SIDING
DIRKSEN PKWY
SANGAMON RIVER
ML
-0.38
0.00
-0.20
+0.20
-0.08
+0.25
+0.61
-0.67
0.00
602
602
605
602
604
575
541
550
550
25-25
25-25
70-50
70-50
10
79-60
28°00'
34°00'
1°20'
0°58'
2°46'
1°28'
0°31'
0°45'
0°52'
112
1946
1970
95
112 CWR
SH 115 CWR
1992
1990
1989
1990
1989
1990
1993
1990
2002
1990
2002
1993
RLP
GRADE XING DATA
X = X-BUCK
B = BELL
F = FLASHER
G = GATES
W = WIG WAG
T = TRAFFIC SIGNAL
S = STOP SIGN
C = CANTILEVER
MADISON ST-CBFG
CARPENTER ST-BFG
UNION ST-BF
FOURTH ST-CBFG
RAFTER ST/PED XING
FIFTH ST-CBFG
SIXTH ST-BFG
N GRAND AVE-CBFG
CONVERSE ST-CBFG
EIGHTH ST-BFG
RIDGELY AVE-BF
SAND HILL RD-BFG
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194

180

175

YARD LIMIT
ABSOLUTE SIG.
AEI DETECTOR
CRACKED WHEEL INDICATOR
DRAG. EQPT. DET. HOT BOX DET.
HIGH, WIDE SHIFTED LOAD DET.
HIGH WATER DET.
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POWER SW. SPRING SW.
DEPOT SYMBOL
HISTORICAL MARKER
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MAX. GRADE PERCENT (SUB GRADE)

SLIDE WARNING
EL. ABOVE SEA LEVEL
FIBER OPTICS
C. T. C.
A. B. S.
SPEED ALLOWANCE

AUTH. SUPER ELEV.

TOTAL ANGLE

ALIGNMENT & FLANGE LUBRICATORS RL

DEGREE OF CURVE

RAIL SIDING

RAIL MAIN

SURFACING & LINING
SIDING
MAIN
TIE GANG
SIDING
MAIN

180.00 5-DPC-543'
179.60 1-SSP-4.8'
179.08 1-CAC-6'X5'
"SHERMAN"
177.40 1-BAC-6'X4'
177.32 OH VIADUCT 78'
177.30 OH VIADUCT 78'
176.6 DETECTOR
176.40 1-SPP-30'
175.80 1-CAC-10'X9'
"SELBYTOWN"

SANGAMON RIVER
1793
1792
NORTH BOUND I-55
SOUTH BOUND I-55
1759
1758

+0.67 -0.64 -0.02 -0.43 +0.22 0.00 -0.26 0.00

542 571 572 581 576 576 591

79-60

33°28'

0°25' 0°03' 0°16' 0°17' 0°11'

112 CWR | 136CWR | 112 CWR
1994 | 2002 | 1994
1989 | 2002
1989 | 2002

DRW

GRADE XING DATA
X = X-BUCK
B = BELL
F = FLASHER
G = GATES
W = WIG WAG
T = TRAFFIC SIGNAL
S = STOP SIGN
C = CANTILEVER

PRIVATE-S
ANDREW RD-BFG
TR 33-BF

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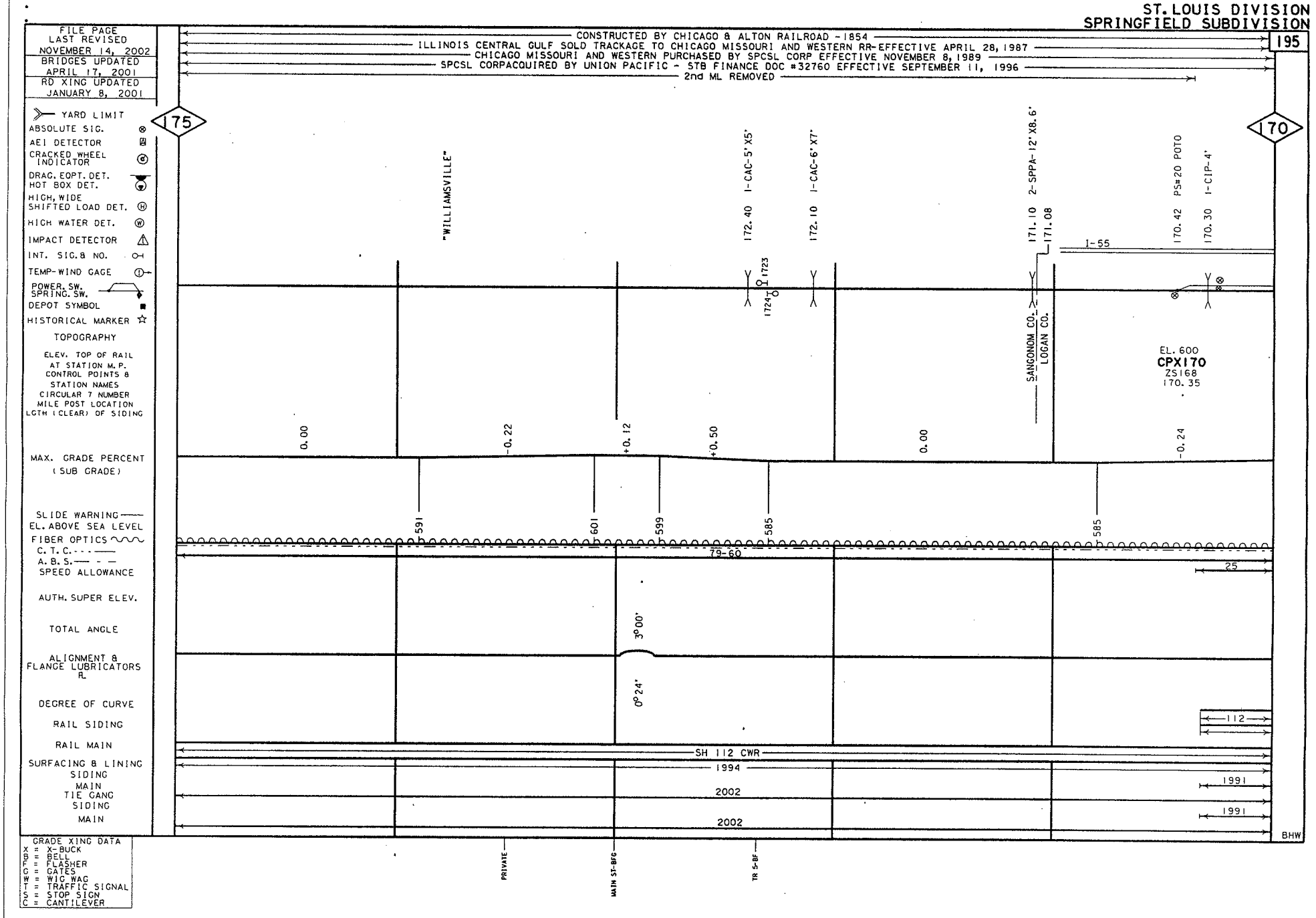
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195
175
170
YARD LIMIT
ABSOLUTE SIG.
AEI DETECTOR
CRACKED WHEEL INDICATOR
DRAG. EQPT. DET.
HOT BOX DET.
HIGH, WIDE SHIFTED LOAD DET.
HIGH WATER DET.
IMPACT DETECTOR
INT. SIG.& NO.
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SPRING. SW.
DEPOT SYMBOL
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FIBER OPTICS
C. T. C.
A. B. S.
SPEED ALLOWANCE
AUTH. SUPER ELEV.
TOTAL ANGLE
ALIGNMENT &
FLANGE LUBRICATORS
R
DEGREE OF CURVE
RAIL SIDING
RAIL MAIN
SURFACING & LINING
SIDING
MAIN
TIE GANG
SIDING
MAIN
"WILLIAMSVILLE"
172.40
1-CAC-5' X5'
172.10
1-CAC-6' X7'
171.10
2-SPPA-12' X8.6'
171.08
170.42
PS#20 POTO
170.30
1-CIP-4'
1723
1724
I-55
SANGONOM CO.
LOGAN CO.
EL. 600
CPX170
ZS168
170.35
0.00
-0.22
+0.12
+0.50
0.00
-0.24
591
601
599
585
585
79-60
25
3°00'
0°24'
112
SH 112 CWR
1994
2002
2002
1991
1991
BHW
GRADE XING DATA
X = X-BUCK
B = BELL
F = FLASHER
G = GATES
W = WIG WAG
T = TRAFFIC SIGNAL
S = STOP SIGN
C = CANTILEVER
PRIVATE
MAIN ST-BFG
TR 5-BF
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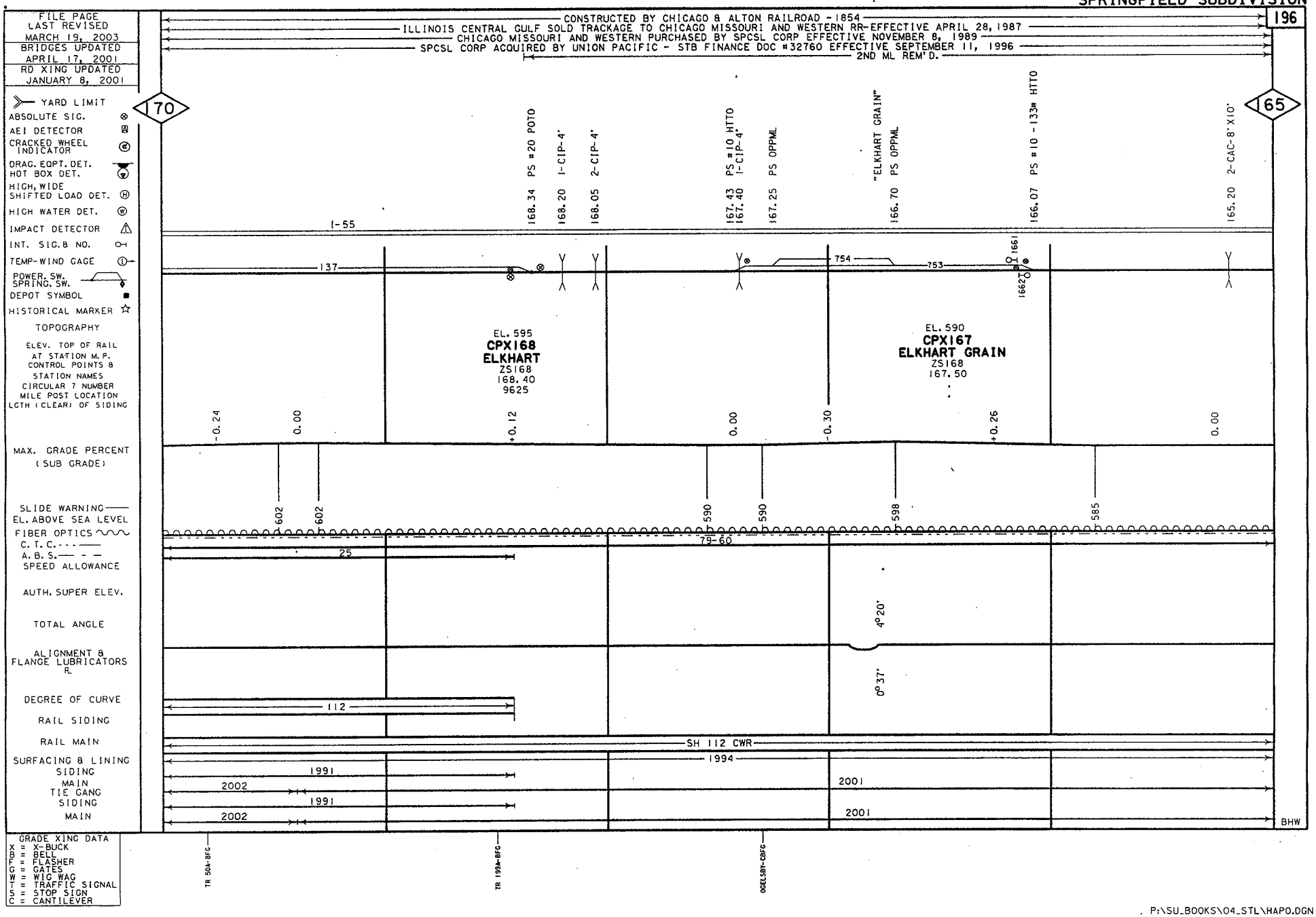

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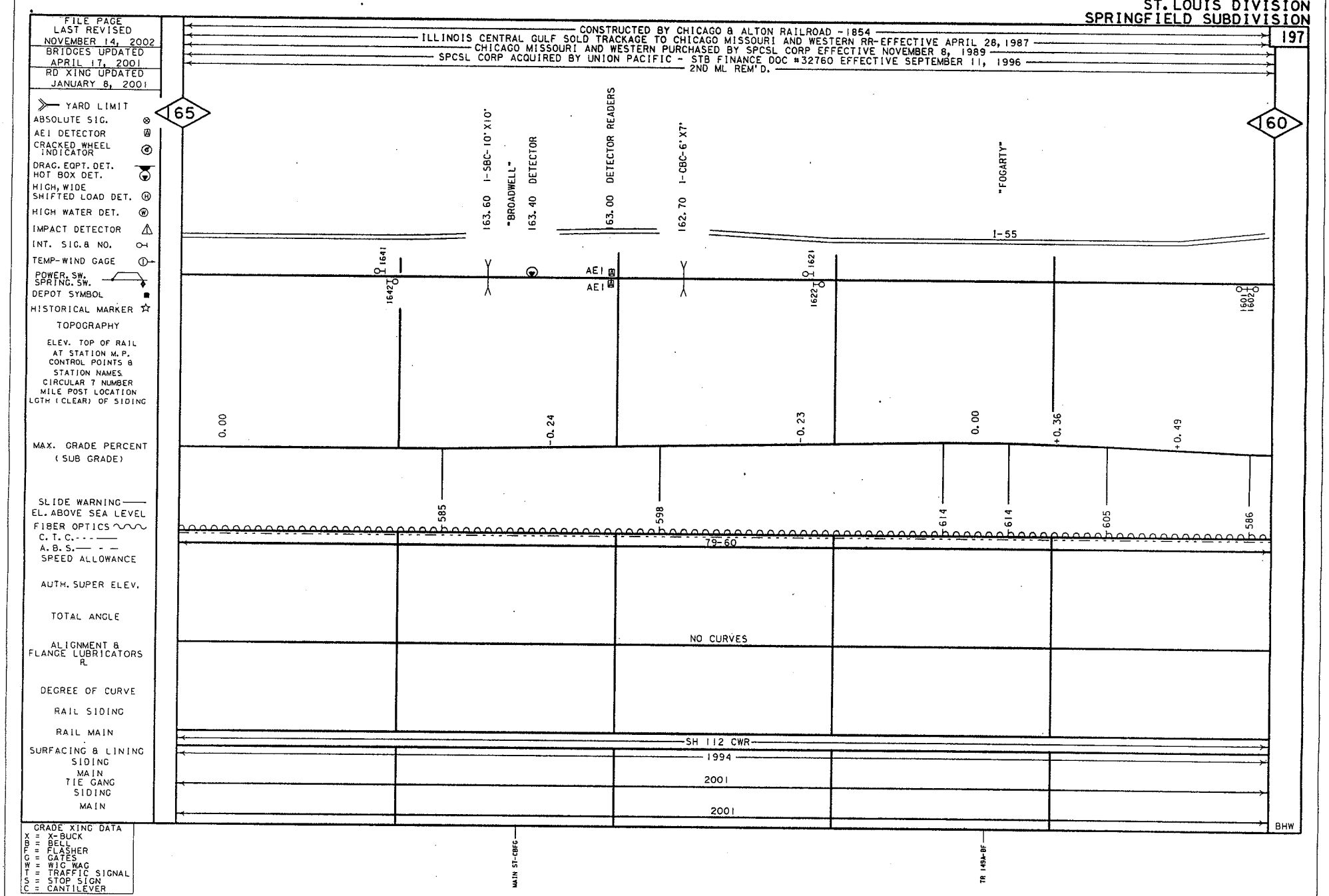
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65
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YARD LIMIT
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AEI DETECTOR
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HOT BOX DET.
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ALIGNMENT &
FLANGE LUBRICATORS
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RAIL SIDING
RAIL MAIN
SURFACING & LINING
SIDING
MAIN
TIE GANG
SIDING
MAIN
GRADE XING DATA
X = X-BUCK
B = BELL
F = FLASHER
G = GATES
W = WIG WAG
T = TRAFFIC SIGNAL
S = STOP SIGN
C = CANTILEVER
163.60 I-SBC-10'X10'
"BROADWELL"
163.40 DETECTOR
163.00 DETECTOR READERS
162.70 I-CBC-6'X7'
"FOGARTY"
I-55
1641
1642
AEI
AEI
1621
1622
1601
1602
0.00
-0.24
-0.23
0.00
+0.36
+0.49
585
598
614
614
605
586
79-60
NO CURVES
SH 112 CWR
1994
2001
2001
BHW
MAIN ST-CBFG
TR 1494-BF
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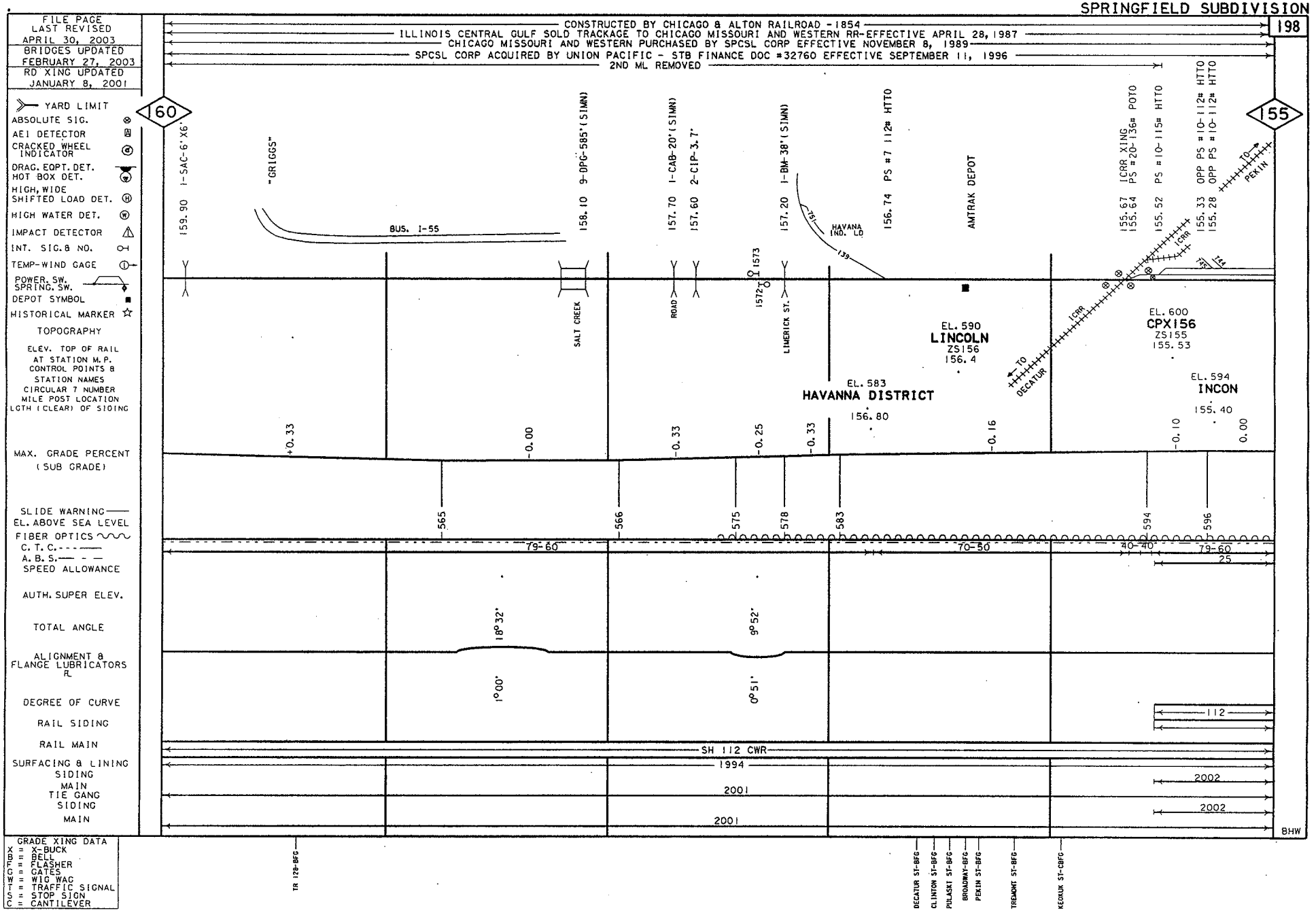

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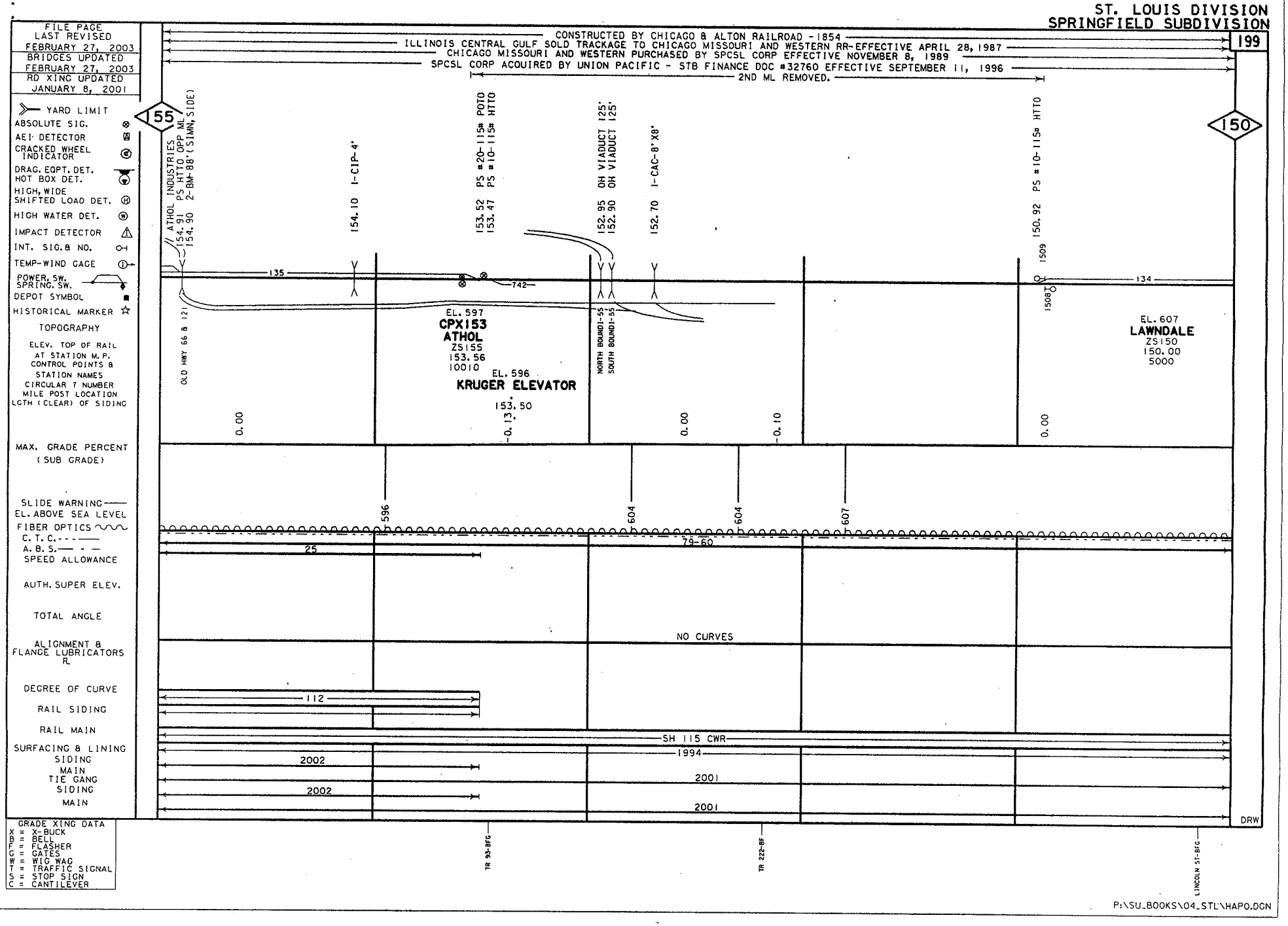
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YARD LIMIT
155
150
ABSOLUTE SIG.
AEI DETECTOR
CRACKED WHEEL INDICATOR
DRAG. EQPT. DET.
HOT BOX DET.
HIGH, WIDE SHIFTED LOAD DET.
HIGH WATER DET.
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AUTH. SUPER ELEV.
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ALIGNMENT & FLANGE LUBRICATORS
DEGREE OF CURVE
RAIL SIDING
RAIL MAIN
SURFACING & LINING
SIDING
MAIN
TIE GANG
SIDING
MAIN
ATHOL INDUSTRIES
154.91 PS HTTO OPP ML
154.90 2-BM-88' (SIMN, SIDE)
154.10 1-CIP-4'
153.52 PS #20-115# POTO
153.47 PS #10-115# HTTO
152.95 OH VIADUCT 125'
152.90 OH VIADUCT 125'
152.70 1-CAC-8' X8'
150.92 PS #10-115# HTTO
OLD HWY 66 & 121
EL. 597
CPX153
ATHOL
ZS155
153.56
10010
EL. 596
KRUGER ELEVATOR
153.50
NORTH BOUND I-55
SOUTH BOUND I-55
EL. 607
LAWNDALE
ZS150
150.00
5000
135
742
1509
1508
134
0.00
0.13
0.10
596
604
604
607
79-60
25
NO CURVES
112
SH 115 CWR
1994
2002
2001
2002
2001
GRADE XING DATA
X = X-BUCK
B = BELL
F = FLASHER
G = GATES
W = WIG WAG
T = TRAFFIC SIGNAL
S = STOP SIGN
C = CANTILEVER
TR 93-BFG
TR 222-BF
LINCOLN ST-BFG
DRW
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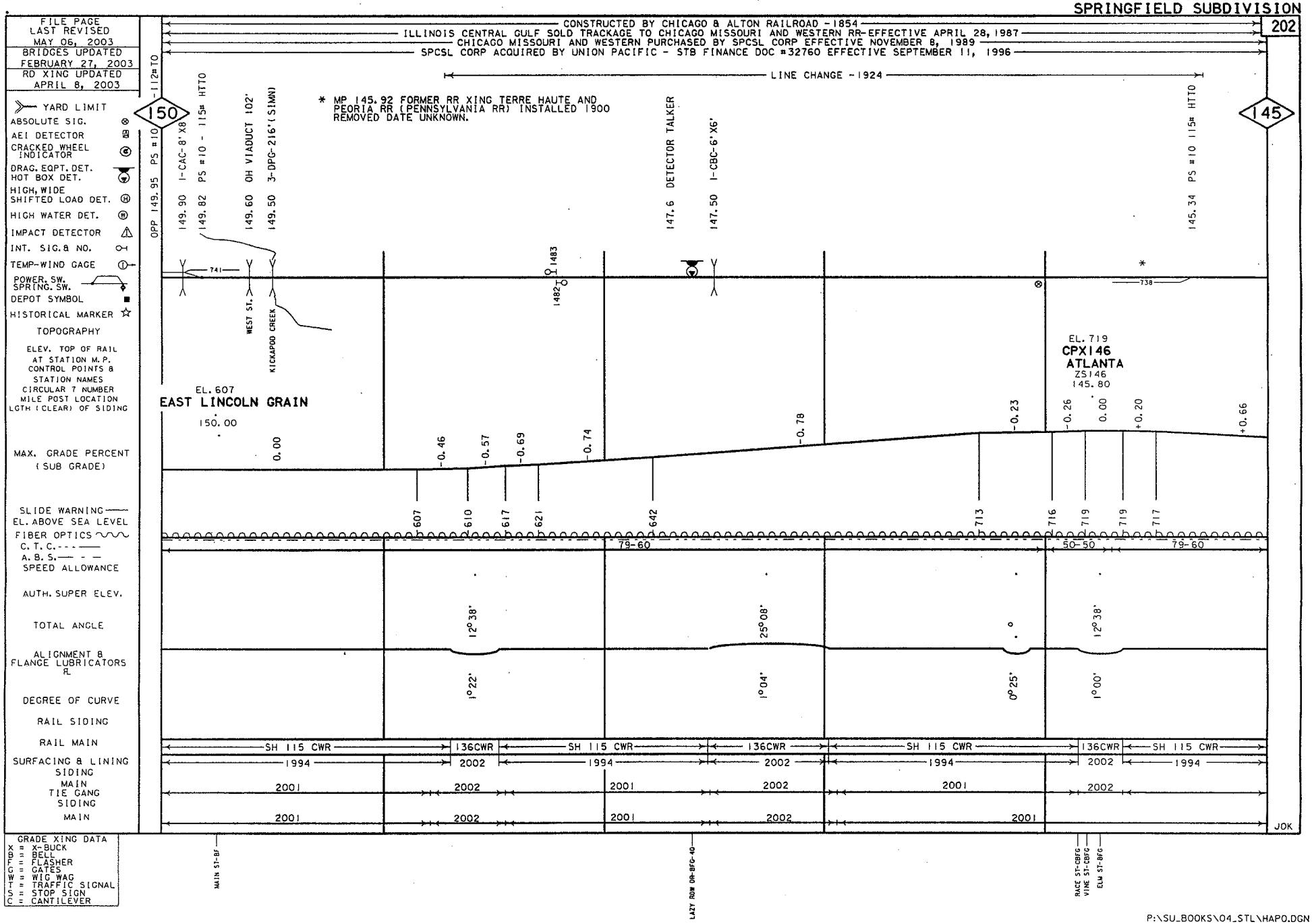

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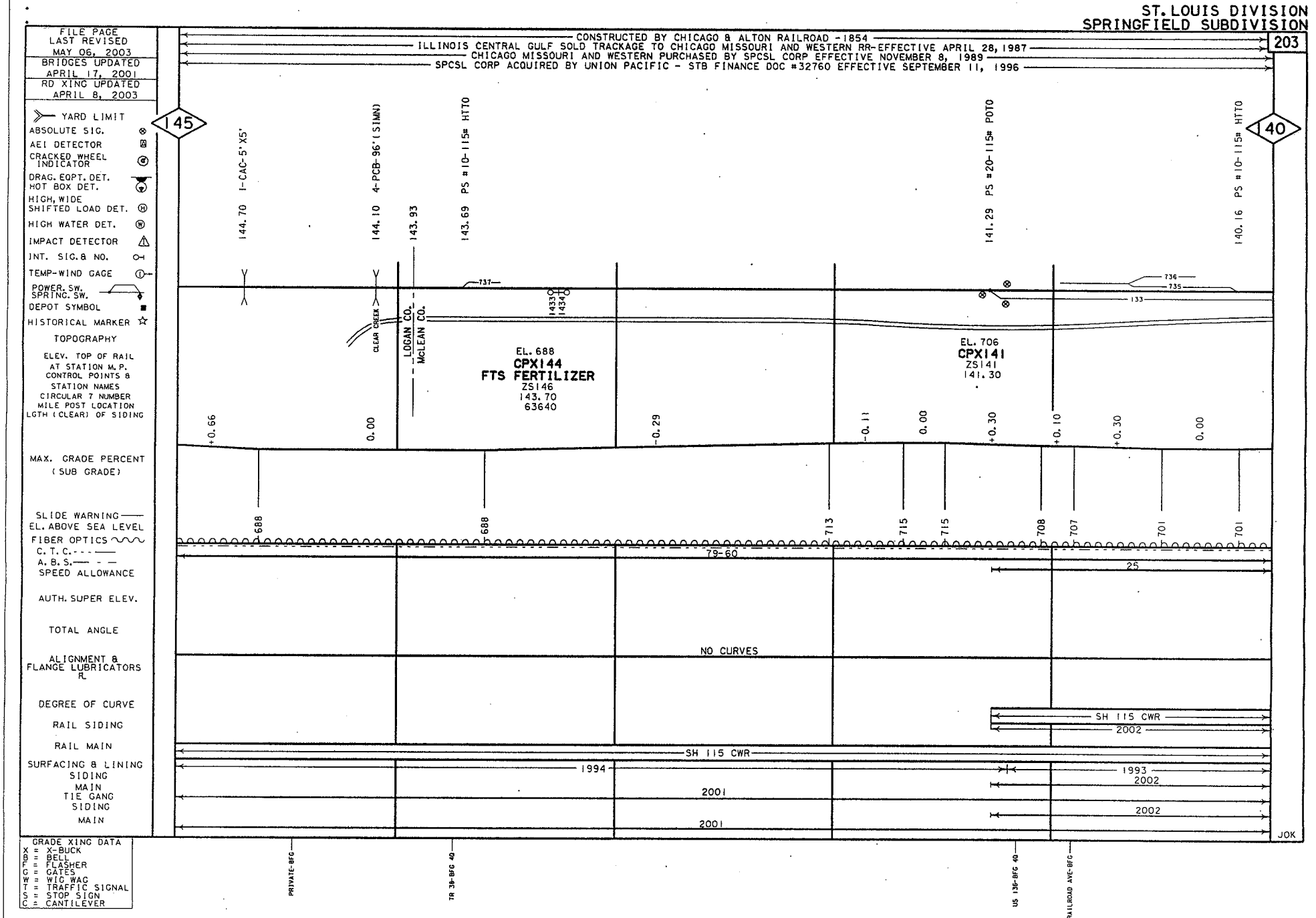
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145
140
YARD LIMIT
ABSOLUTE SIG.
AEI DETECTOR
CRACKED WHEEL INDICATOR
DRAG. EQPT. DET.
HOT BOX DET.
HIGH, WIDE SHIFTED LOAD DET.
HIGH WATER DET.
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POWER SW.
SPRING SW.
DEPOT SYMBOL
HISTORICAL MARKER
TOPOGRAPHY
ELEV. TOP OF RAIL AT STATION M.P.
CONTROL POINTS & STATION NAMES
CIRCULAR 7 NUMBER
MILE POST LOCATION
LGTH (CLEAR) OF SIDING
MAX. GRADE PERCENT (SUB GRADE)
SLIDE WARNING
EL. ABOVE SEA LEVEL
FIBER OPTICS
C. T. C.
A. B. S.
SPEED ALLOWANCE
AUTH. SUPER ELEV.
TOTAL ANGLE
ALIGNMENT & FLANGE LUBRICATORS
DEGREE OF CURVE
RAIL SIDING
RAIL MAIN
SURFACING & LINING
SIDING
MAIN
TIE GANG
SIDING
MAIN
144.70 I-CAC-5'X5'
144.10 4-PCB-96'(SIMN)
143.93
143.69 PS #10-115# HITTO
141.29 PS #20-115# POTO
140.16 PS #10-115# HITTO
CLEAR CREEK
LOGAN CO.
McLEAN CO.
EL. 688
CPX144
FTS FERTILIZER
ZS146
143.70
63640
EL. 706
CPX141
ZS141
141.30
+0.66
0.00
-0.29
-0.11
0.00
+0.30
+0.10
+0.30
0.00
688
688
713
715
715
708
707
701
701
79-60
25
NO CURVES
SH 115 CWR
2002
SH 115 CWR
1994
1993
2002
2001
2002
2001
JOK
GRADE XING DATA
X = X-BUCK
B = BELL
F = FLASHER
G = GATES
W = WIG WAG
T = TRAFFIC SIGNAL
S = STOP SIGN
C = CANTILEVER
PRIVATE-BFG
TR 38-BFG 4Q
US 136-BFG 4Q
RAILROAD AVE-BFG
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FILE PAGE LAST REVISED APRIL 8, 2003
BRIDGES UPDATED FEBRUARY 27, 2003
RD XING UPDATED APRIL 8, 2003

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CONSTRUCTED BY CHICAGO & ALTON RAILROAD - 1854
ILLINOIS CENTRAL GULF SOLD TRACKAGE TO CHICAGO MISSOURI AND WESTERN RR-EFFECTIVE APRIL 28, 1987
CHICAGO MISSOURI AND WESTERN PURCHASED BY SPCSL CORP EFFECTIVE NOVEMBER 8, 1989
SPCSL CORP ACQUIRED BY UNION PACIFIC - STB FINANCE DOC #32760 EFFECTIVE SEPTEMBER 11, 1996
2nd MAIN LINE REMOVED

40

35

YARD LIMIT
ABSOLUTE SIG.
AEI DETECTOR
CRACKED WHEEL INDICATOR
DRAG. EQPT. DET. HOT BOX DET.
HIGH, WIDE SHIFTED LOAD DET.
HIGH WATER DET.
IMPACT DETECTOR
INT. SIG. & NO.
TEMP-WIND GAGE
POWER SW. SPRING SW.
DEPOT SYMBOL
HISTORICAL MARKER

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C. T. C.
A. B. S.
SPEED ALLOWANCE

AUTH. SUPER ELEV.

TOTAL ANGLE

ALIGNMENT & FLANGE LUBRICATORS RL

DEGREE OF CURVE

RAIL SIDING

RAIL MAIN

SURFACING & LINING
SIDING
MAIN
TIE GANG
SIDING
MAIN

138.63 PS #20-115# POTO
138.50 1-CAC-10'X10'
137.90 1-CAC-8'X8'
137.70 1-CBC-8'X8'
136.50 2-DPG-128'(SIMN)
"FUNK'S GROVE"
135.81 1-CIP-4'
135.80 2-CMP-5'

133
EL. 699
CPX139
McLEAN
ZS141
138.69
12430
1369
1370
I-55
SUGAR CREEK

-0.22 +0.07 0.00 +0.36 +0.04 0.00 -0.26 0.00 +0.29 +0.24 0.00 -0.30

707 706 706 698 698 698 704 704 697 689 689

79-60
25
NO CURVES
SH 112 CWR
2002
SH 115 CWR
1993
2002
2001
2002
2001

RLP

GRADE XING DATA
X = X-BUCK
B = BELL
F = FLASHER
G = GATES
W = WIG WAG
T = TRAFFIC SIGNAL
S = STOP SIGN
C = CANTILEVER

TR 533-BFG-40
PRIVATE-BFG
FUNKS GROVE RD-BFG-40

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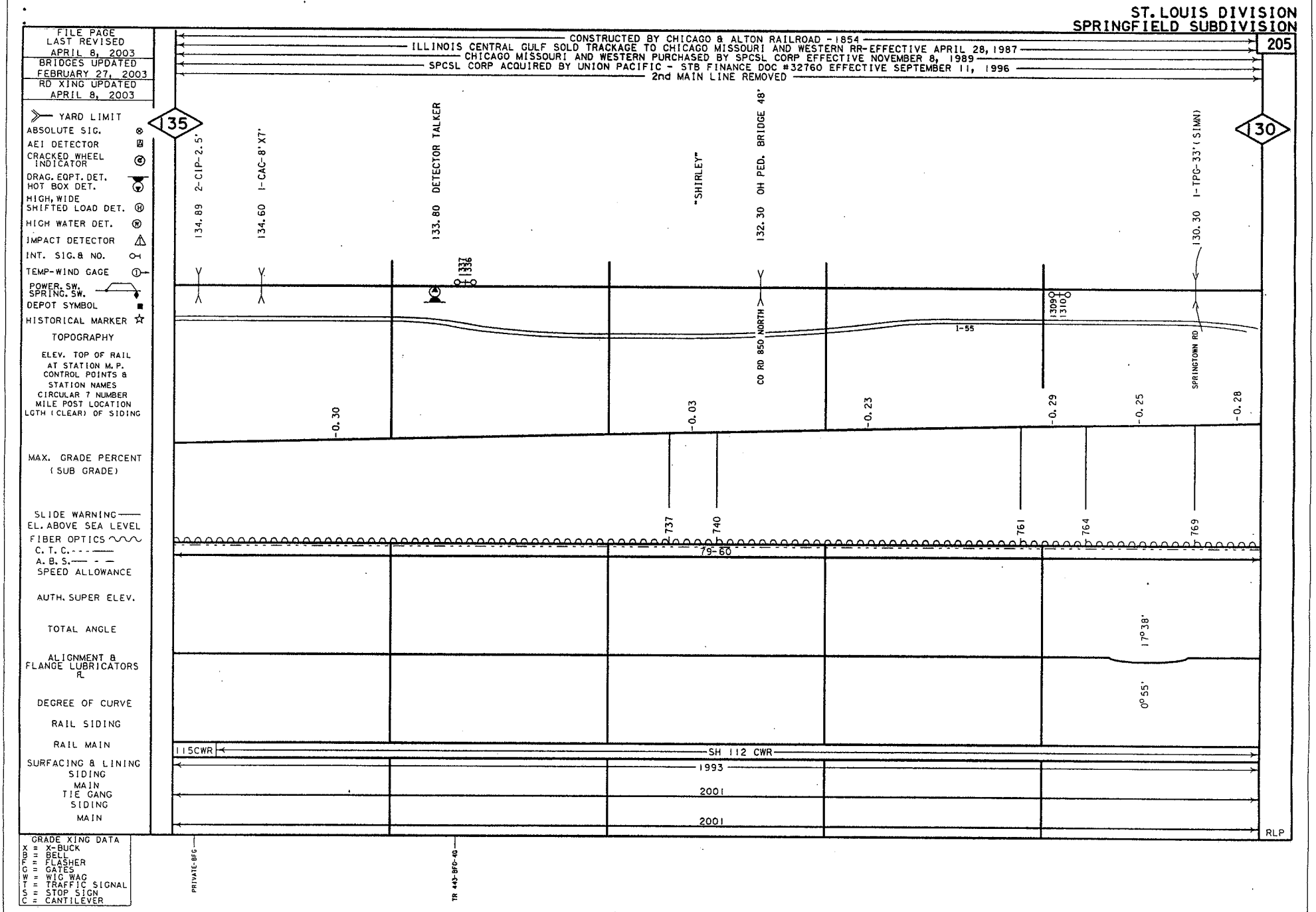
ST. LOUIS DIVISION
SPRINGFIELD SUBDIVISION
205
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RD XING UPDATED
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HOT BOX DET.
HIGH, WIDE SHIFTED LOAD DET.
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ALIGNMENT & FLANGE LUBRICATORS
DEGREE OF CURVE
RAIL SIDING
RAIL MAIN
SURFACING & LINING
SIDING
MAIN
TIE GANG
SIDING
MAIN
35
30
134.89 2-CIP-2.5'
134.60 1-CAC-8' X7'
133.80 DETECTOR TALKER
"SHIRLEY"
132.30 OH PED. BRIDGE 48'
130.30 1-TPG-33' (SIMN)
1337
1336
CO RD 850 NORTH
1309
1310
I-55
SPRINGTOWN RD
-0.30
-0.03
-0.23
-0.29
-0.25
-0.28
737
740
761
764
769
79-60
17°38'
0°55'
115CWR
SH 112 CWR
1993
2001
2001
RLP
GRADE XING DATA
X = X-BUCK
B = BELL
F = FLASHER
G = GATES
W = WIG WAG
T = TRAFFIC SIGNAL
S = STOP SIGN
C = CANTILEVER
PRIVATE-BFG
TR 443-BFG-40
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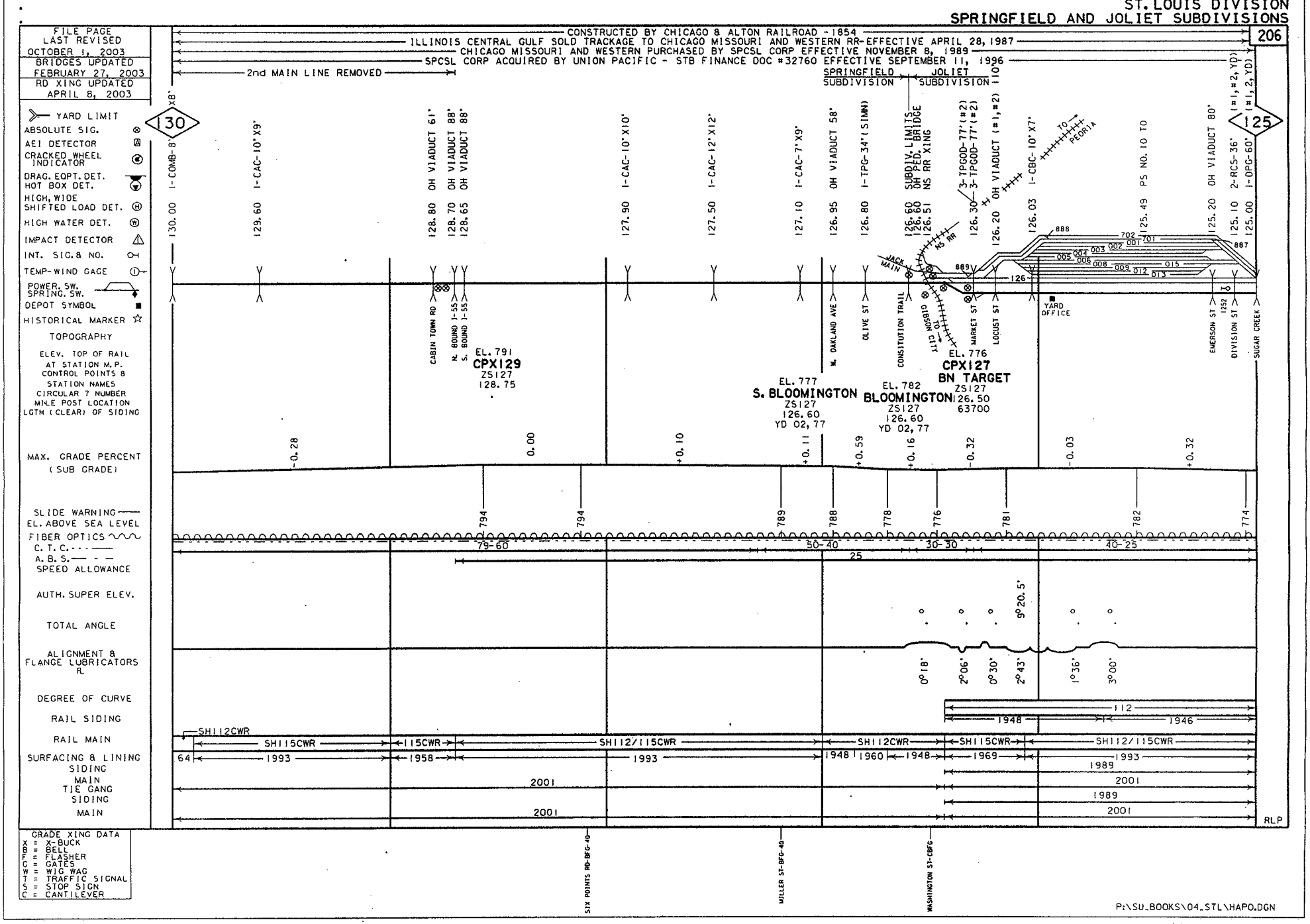
ST. LOUIS DIVISION
SPRINGFIELD AND JOLIET SUBDIVISIONS
206
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JOLIET SUBDIVISION
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CRACKED WHEEL INDICATOR
DRAG. EQPT. DET. HOT BOX DET.
HIGH, WIDE SHIFTED LOAD DET.
HIGH WATER DET.
IMPACT DETECTOR
INT. SIG.& NO.
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F = FLASHER
G = GATES
W = WIG WAG
T = TRAFFIC SIGNAL
S = STOP SIGN
C = CANTILEVER
30
125
130.00 I-COMB-8' X8'
129.60 I-CAC-10' X9'
128.80 OH VIADUCT 61'
128.70 OH VIADUCT 88'
128.65 OH VIADUCT 88'
127.90 I-CAC-10' X10'
127.50 I-CAC-12' X12'
127.10 I-CAC-7' X9'
126.95 OH VIADUCT 58'
126.80 I-TPG-34' (SIMM)
126.60 SUBDIV. LIMITS
126.60 OH PED. BRIDGE
126.51 NS RR XING
126.30 3-TPGOD-77' (#2)
3-TPGOD-77' (#2)
126.20 OH VIADUCT (#1,#2) 110'
126.03 I-CBC-10' X7'
125.49 PS NO. 10 TO
125.20 OH VIADUCT 80'
125.10 2-RCS-36' (#1,#2 YD)
125.00 I-DPG-60' (#1,2 YD)
CABIN TOWN RD
N. BOUND I-55
S. BOUND I-55
EL. 791
CPX129
ZS127
128.75
W. OAKLAND AVE
OLIVE ST
CONSTITUTION TRAIL
JACK MAIN
NS RR
GIBSON CITY
MARKET ST
LOCUST ST
YARD OFFICE
EMERSON ST
DIVISION ST
SUGAR CREEK
EL. 777
S. BLOOMINGTON
ZS127
126.60
YD 02,77
EL. 782
BLOOMINGTON
ZS127
126.60
YD 02,77
EL. 776
CPX127
BN TARGET
ZS127
126.50
63700
-0.28
0.00
+0.10
+0.11
+0.59
+0.16
-0.32
-0.03
+0.32
794
794
789
788
778
776
781
782
774
79-60
50-40
30-30
40-25
25
9°20.5'
0°18'
2°06'
0°30'
2°43'
1°36'
3°00'
112
1948
1946
SH112CWR
SH115CWR
115CWR
SH112/115CWR
SH112CWR
SH115CWR
SH112/115CWR
64
1993
1958
1993
1948
1960
1948
1969
1993
1989
2001
2001
1989
2001
SIX POINTS RD-BFG-40
MILLER ST-BFG-40
WASHINGTON ST-CBFG
RLP
P:\SU_BOOKS\04_STL\HAPO.DGN

JOLIET SUBDIVISION (0025)

Mile Post	Rule 6.3	CP #'s	Radio Display: Joliet to Bloomington -7878 SOUTH ▼ STATIONS ▲ NORTH	Sta. #'s	Siding Feet
36.7	YL ABS		JOLIET Y (0.6)	ZS036	
37.3			UD TOWER (0.6) (X)METRA(M)		
37.9	DTC ABS		SOUTH JOLIET (7.9)	ZS039	
45.8			ELWOOD (6.7)	ZS046	4000
52.5			WILMINGTON (2.0)	ZS053	
54.5			HITT (8.1)	ZS055	2750
62.6	CTC	GM063	MAZONIA (7.6)	ZS063	
70.2 72.8		GM070 GM073	DWIGHT (11.8) (X)NS(M)	ZS073	12375
82.0 84.7		GM082 GM085	ODELL (10.5)	ZS082	12760
92.5 95.0		GM093 GM095	PONTIAC (9.8)	ZS093	11770
102.3			CHENOA (4.1) (X)TP&W(M)	ZS102	
106.4 108.8		GM106 GM109	BALLARD (15.0)	ZS107	11440
121.4 124.1		GM121 GM124	NORMAL (3.4)	ZS124	
124.8 126.4		GM125 GM126	BLOOMINGTON YARD (1.7)		
126.5		GM127	BN TARGET (0.1) (X)NS(M)		
126.6			BLOOMINGTON	ZS127	
			(89.9)		

SI-01 MAIN TRACK AUTHORITY

Interlocking Limits between MP 36.8 and MP 37.9

DTC between MP 37.9 and MP 62.6.

CTC between CP GM063 and Bloomington (MP 126.6); and on running Track between MP 124.2 and MP 124.9.

Yard Limits between MP 36.7 and MP 36.8

ABS between MP 36.7 and CP GM063 (Mazonia).

SI-02 MAXIMUM SPEED TABLE

Maximum Speed	MPH	
Between Mileposts		
36.7 and 126.6	**PSGR**	**FRT**
(Except as Below)	**79**	**60**
36.7 and 37.1	30	30
37.1 and 37.3	10	10
37.3 and 38.0	30	30
38.0 and 39.8	65	60
45.7 and 46.0	70	60
51.9 and 53.2	65	55
72.8 (X)	40	40
90.7 and 92.0	50	40
102.3 (X)	40	40
123.8 and 126.3	40	25
126.3 and 126.6	30	30

SI-03 OTHER SPEED RESTRICTIONS

Maximum Speed	MPH
1. Thru Sidings & Turnouts	
Hitt	10
2. Dual Control Switch Turnouts	
UD Tower - crossovers 130 and 131 (MP 37.9), crossovers MP 38.0	10
3. Misc. Speed Restrictions (No Exceptions.)	

SI-04 MAIN TRACK DESIGNATIONS

Two main tracks between: MP 36.7 and MP 36.8

SI-05 MILEPOST EQUATIONS - None.

SI-06 DTC BLOCK LIMITS

SOUTH	BLOCK NAME	NORTH
45.8	Joliet	37.9
54.2	Elwood	45.8
62.6	Mazonia	54.2

SI-07 ITEM 13 TRAIN DEFECT DETECTORS

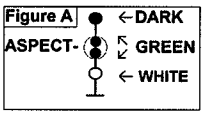
(#) 44.0
62.8
(#) 80.4
96.6
(#) 115.1

SI-08 RULES ITEMS

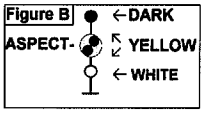
Rule 1.36: Prior to setting out a loaded double stack and or multi-level car on a back track or industry track between Joliet and East St. Louis, crew member must determine track has sufficient overhead clearance to handle car.

Rule 6.32.2 A applies at: MP 82.7 on the siding at Odell; MP 93.6 and MP 94.7 on the siding at Pontiac; and crossings between MP 123.3 and MP 124.0 on the siding at Normal.

Rule 9.2.8 Diverging Clear.

Figure A


Rule 9.2.10 Diverging Approach.

Figure B


Rule 10.2: Hand throw switches at the following locations are equipped with an electric lock or signal to govern movement: Dwight (MP 73.1); Bunge Elevator, North switch of wye(MP 88.5) and South switch of wye (MP 88.8); Pontiac (MP 91.3); Ocoya (MP 97.6) and (MP 97.9); Chenoa (MP 102.1); Lexington Elevator (MP 110.0).

Rule 10.3 exception: Track and Time rules apply within manual interlocking limits at Dwight, Chenoa, and BN Target. At BN Target Interlocking Track and Time is issued for Cargill Lead separately. When it is necessary to work on or foul both main track and Cargill lead it will be necessary to request track and time on each track separately.

SI-09 FRA EXCEPTED TRACKS

South Joliet: All Yard Tracks

JOLIET SUBDIVISION (0025)

SI-10 BUSINESS TRACKS

Track Name	MP	STA. #'S
Cytex	38.8	. . .
Prairie Creek	49.8	ZS049
Braidwood	58.8	NZ059
Bunge	88.6	. . .
Donnley	91.3	. . .
Ocoya	97.8	ZS097
Lexington	110.5	ZS111
Towanda	118.5	ZS120

SI-11 INDUSTRIAL LEADS

Plaines Industrial Lead: Extends from UD Tower Interlocking Limits (MP 37.9) 1.5 miles, ABS, to MP 39.4 (beginning of CN/IC controlled track. Permission must be received from UD Tower operator before entering.

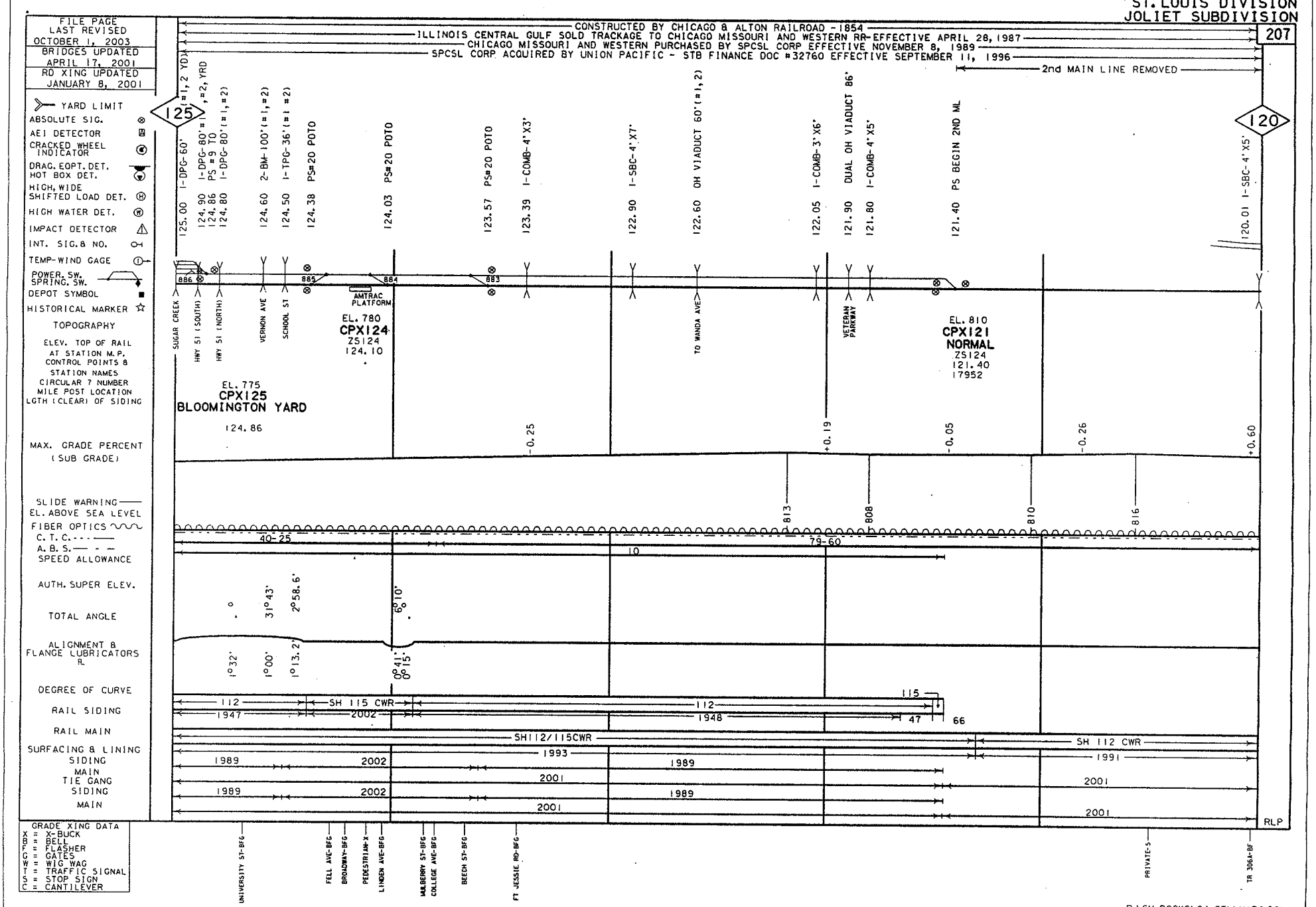
SI-12 TONNAGE RESTRICTIONS - None.

SI-13 TRAIN MAKE-UP RESTRICTIONS - None.

SI-14 MISC. INSTRUCTIONS

Joliet - UD Tower: Trains may operate between Joliet and UD Tower without a track warrant. A crew member must determine from the Control Operator at UD Tower if any track bulletins are in effect before occupying the track. Foreign railroads are governed by the CORA Operating Guide.

Operation north of Joliet on all foreign railroads will be governed by CORA Operating Guide.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JOLIET SUBDIVISION
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207
120
125
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DRAG. EQPT. DET.
HOT BOX DET.
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ALIGNMENT & FLANGE LUBRICATORS
DEGREE OF CURVE
RAIL SIDING
RAIL MAIN
SURFACING & LINING
SIDING
MAIN
TIE GANG
SIDING
MAIN
125.00 1-DPG-60' (#1, 2 YD)
124.90 1-DPG-80' #1, #2, YRD
124.86 PS #9 TO
124.80 1-DPG-80' (#1, #2)
124.60 2-BM-100' (#1, #2)
124.50 1-TPG-36' (#1 #2)
124.38 PS#20 POTO
124.03 PS#20 POTO
123.57 PS#20 POTO
123.39 1-COMB-4'X3'
122.90 1-SBC-4'X7'
122.60 OH VIADUCT 60' (#1, 2)
122.05 1-COMB-3'X6'
121.90 DUAL OH VIADUCT 86'
121.80 1-COMB-4'X5'
121.40 PS BEGIN 2ND ML
120.01 1-SBC-4'X5'
886
885
884
883
SUGAR CREEK
HWY 51 (SOUTH)
HWY 51 (NORTH)
VERNON AVE
SCHOOL ST
AMTRAC PLATFORM
TO WANDA AVE
VETERAN PARKWAY
EL. 775
CPX125
BLOOMINGTON YARD
124.86
EL. 780
CPX124
ZS124
124.10
EL. 810
CPX121
NORMAL
ZS124
121.40
17952
-0.25
+0.19
-0.05
-0.26
+0.60
813
808
810
816
40-25
79-60
10
0° 31° 43' 2°58.6'
6°10'
1°32' 1°00' 1°13.2'
0°41' 0°15'
112
SH 115 CWR
112
115
1947
2002
1948
47
66
SH 112/115CWR
SH 112 CWR
1993
1991
1989
2002
1989
2001
2001
1989
2002
1989
2001
2001
RLP
GRADE XING DATA
X = X-BUCK
B = BELL
F = FLASHER
G = GATES
W = WIG WAG
T = TRAFFIC SIGNAL
S = STOP SIGN
C = CANTILEVER
UNIVERSITY ST-BFG
FELL AVE-BFG
BROADWAY-BFG
PEDESTRIAN-X
LINDEN AVE-BFG
MULBERRY ST-BFG
COLLEGE AVE-BFG
BEECH ST-BFG
FT JESSIE RD-BFG
PRIVATE-S
TR 3061-BF
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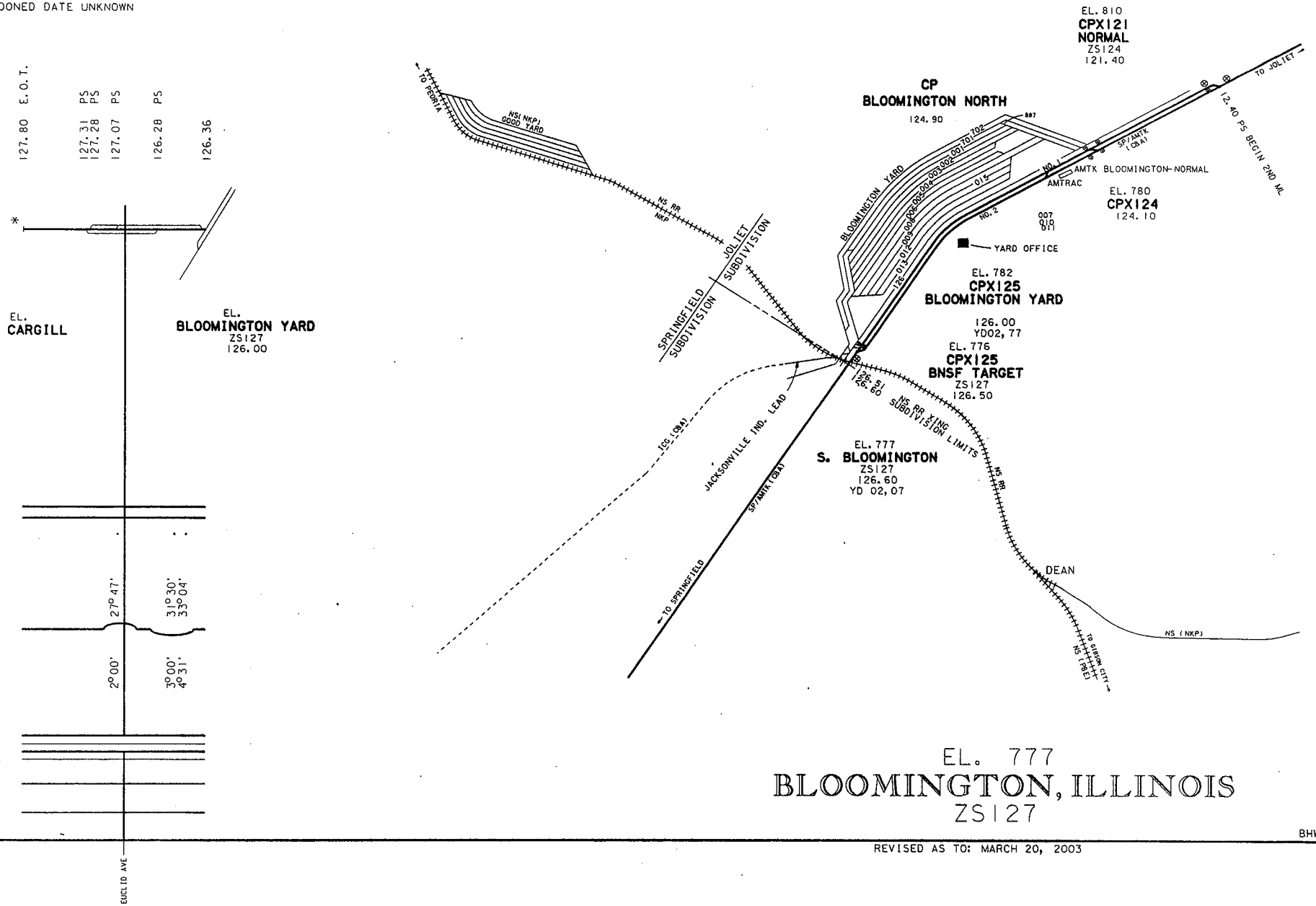
* FORMER CHICAGO AND ALTON
LINE TO JACKSONVILLE
ABANDONED DATE UNKNOWN



EL. 777
BLOOMINGTON, ILLINOIS
ZS127

BHW

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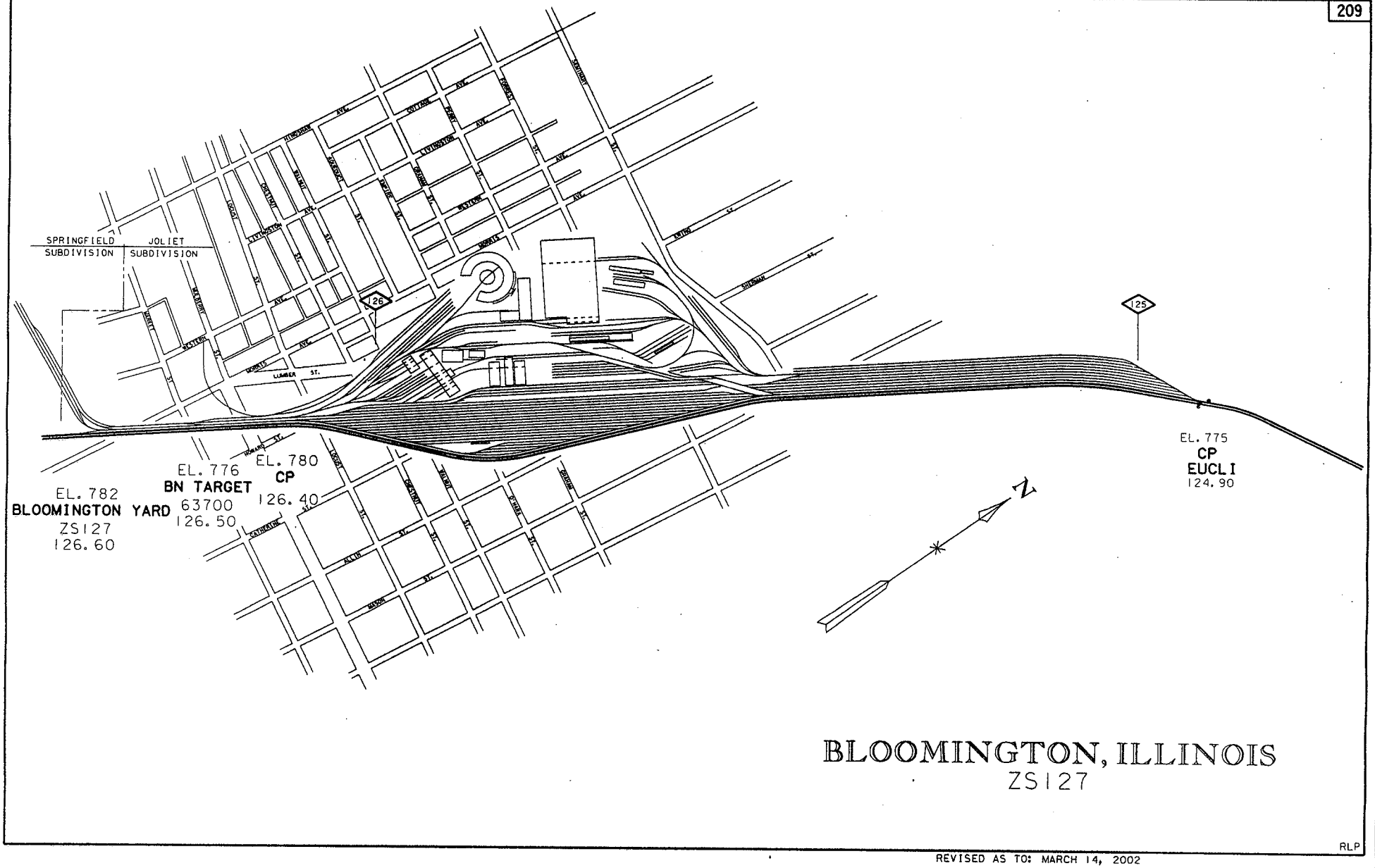

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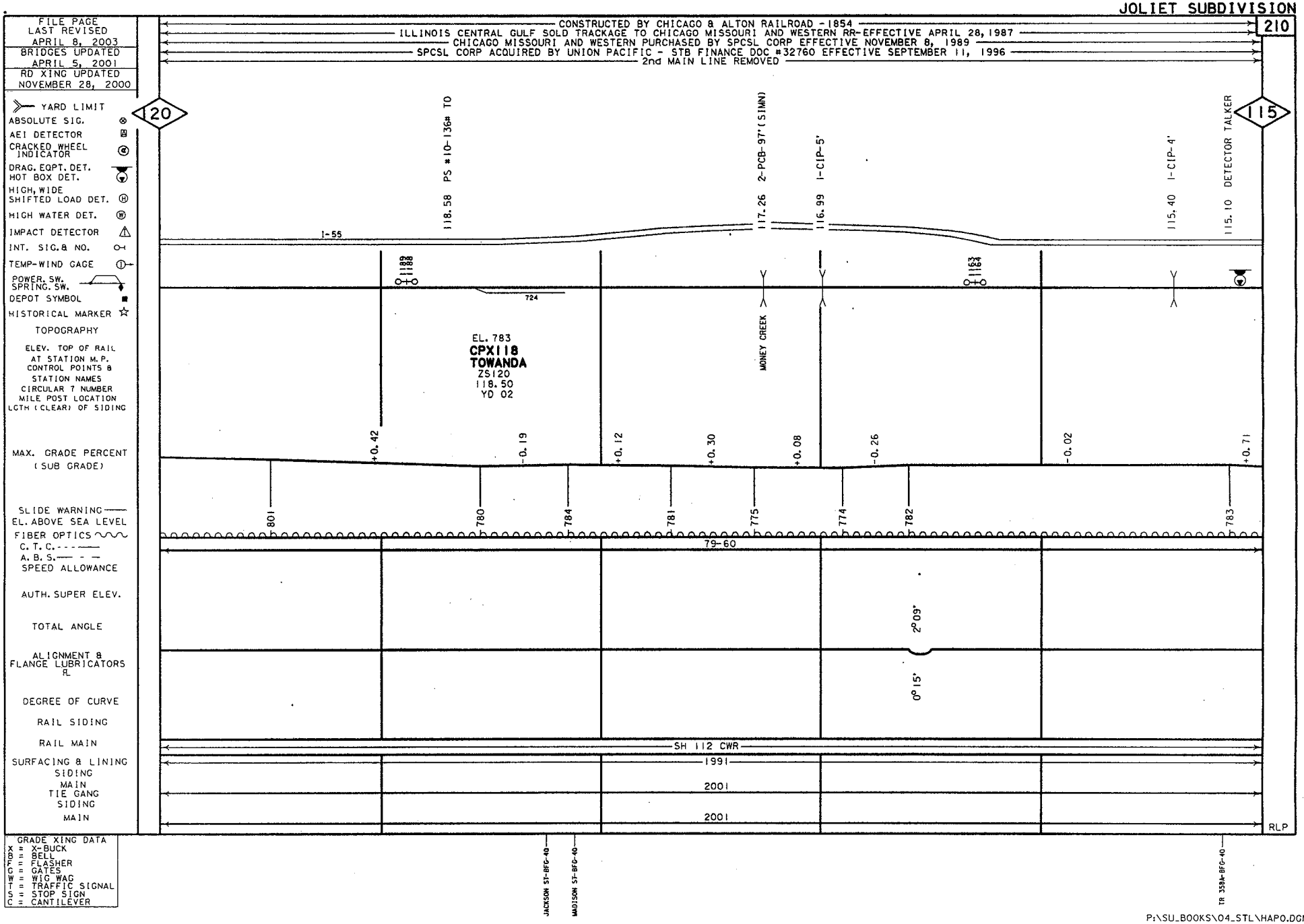

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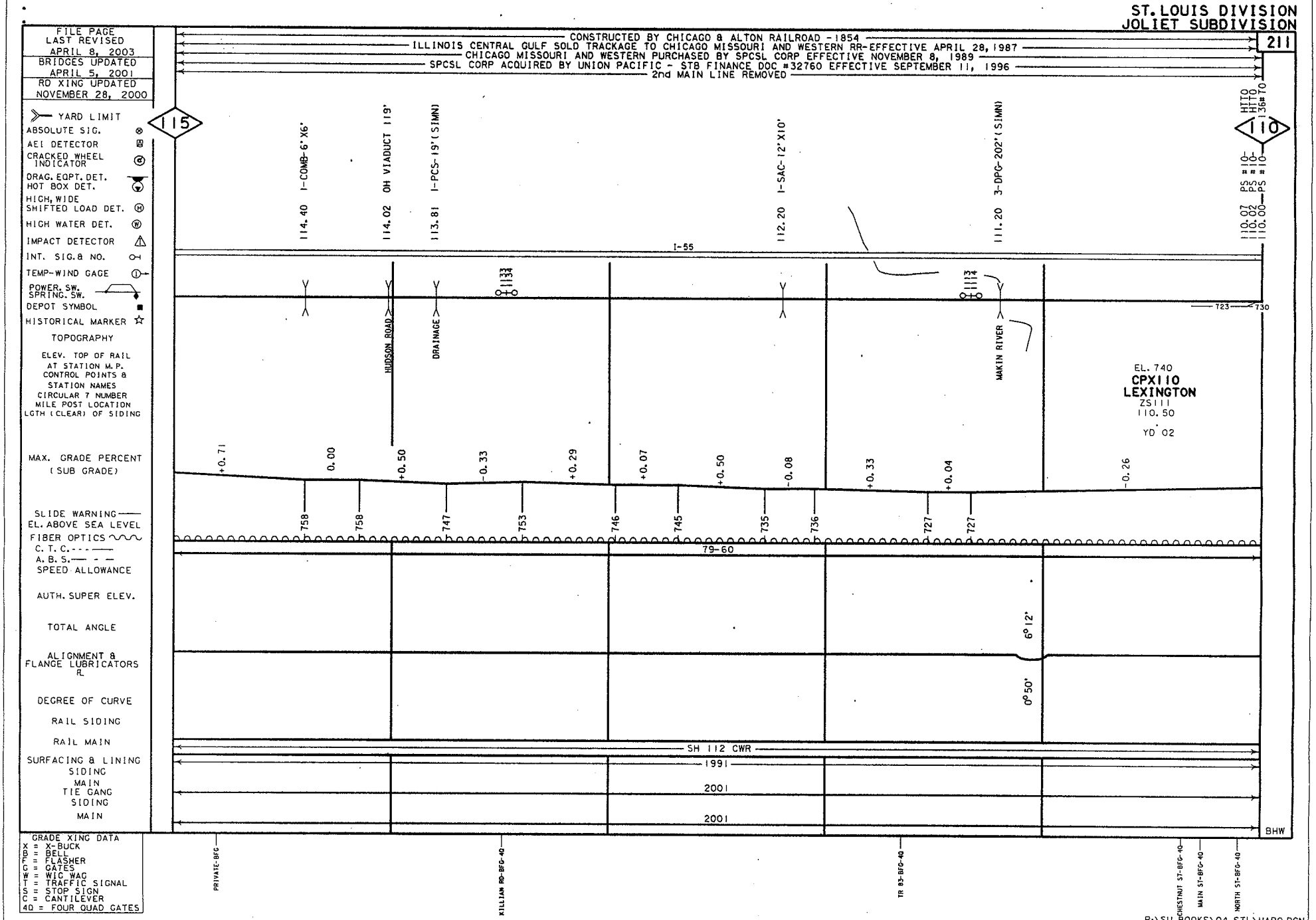
ST. LOUIS DIVISION
JOLIET SUBDIVISION
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BRIDGES UPDATED
APRIL 5, 2001
RD XING UPDATED
NOVEMBER 28, 2000
CONSTRUCTED BY CHICAGO & ALTON RAILROAD - 1854
ILLINOIS CENTRAL GULF SOLD TRACKAGE TO CHICAGO MISSOURI AND WESTERN RR-EFFECTIVE APRIL 28, 1987
CHICAGO MISSOURI AND WESTERN PURCHASED BY SPCSL CORP EFFECTIVE NOVEMBER 8, 1989
SPCSL CORP ACQUIRED BY UNION PACIFIC - STB FINANCE DOC #32760 EFFECTIVE SEPTEMBER 11, 1996
2nd MAIN LINE REMOVED
211
115
110
YARD LIMIT
ABSOLUTE SIG.
AEI DETECTOR
CRACKED WHEEL INDICATOR
DRAG. EQPT. DET. HOT BOX DET.
HIGH, WIDE SHIFTED LOAD DET.
HIGH WATER DET.
IMPACT DETECTOR
INT. SIG. & NO.
TEMP-WIND GAGE
POWER SW. SPRING SW.
DEPOT SYMBOL
HISTORICAL MARKER
TOPOGRAPHY
ELEV. TOP OF RAIL AT STATION M.P. CONTROL POINTS & STATION NAMES CIRCULAR 7 NUMBER MILE POST LOCATION LGTH (CLEAR) OF SIDING
MAX. GRADE PERCENT (SUB GRADE)
SLIDE WARNING EL. ABOVE SEA LEVEL
FIBER OPTICS
C. T. C.
A. B. S.
SPEED ALLOWANCE
AUTH. SUPER ELEV.
TOTAL ANGLE
ALIGNMENT & FLANGE LUBRICATORS RL
DEGREE OF CURVE
RAIL SIDING
RAIL MAIN
SURFACING & LINING
SIDING
MAIN
TIE GANG
SIDING
MAIN
GRADE XING DATA
X = X-BUCK
B = BELL
F = FLASHER
G = GATES
W = WIG WAG
T = TRAFFIC SIGNAL
S = STOP SIGN
C = CANTILEVER
4Q = FOUR QUAD GATES
114.40 1-COMB-6' X6'
114.02 OH VIADUCT 119'
113.81 1-PCS-19'(SIMN)
112.20 1-SAC-12' X10'
111.20 3-DPG-202'(SIMN)
110.07 PS #10
110.02 PS #10
110.00 PS #10
HTTO
HTTO
136# TO
I-55
1133
1134
1113
1114
HUDSON ROAD
DRAINAGE
MAKIN RIVER
723
730
EL. 740
CPX110
LEXINGTON
ZS111
110.50
YD 02
+0.71
0.00
+0.50
-0.33
+0.29
+0.07
+0.50
-0.08
+0.33
+0.04
-0.26
758
758
747
753
746
745
735
736
727
727
79-60
6°12'
0°50'
SH 112 CWR
1991
2001
2001
BHW
PRIVATE-BFG
KILLIAM RD-BFG-4Q
TR 83-BFG-4Q
CHESTNUT ST-BFG-4Q
MAIN ST-BFG-4Q
NORTH ST-BFG-4Q
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APRIL 5, 2001
RD XING UPDATED
NOVEMBER 28, 2000

CONSTRUCTED BY CHICAGO & ALTON RAILROAD - 1854
ILLINOIS CENTRAL GULF SOLD TRACKAGE TO CHICAGO MISSOURI AND WESTERN RR- EFFECTIVE APRIL 28, 1987
CHICAGO MISSOURI AND WESTERN PURCHASED BY SPCSL CORP EFFECTIVE NOVEMBER 8, 1989
SPCSL CORP ACQUIRED BY UNION PACIFIC - STB FINANCE DOC #32760 EFFECTIVE SEPTEMBER 11, 1996
2nd MAIN LINE REMOVED
2nd MAIN LINE REMOVED

212

110

105

YARD LIMIT
ABSOLUTE SIG.
AEI DETECTOR
CRACKED WHEEL INDICATOR
DRAG. EQPT. DET.
HOT BOX DET.
HIGH, WIDE SHIFTED LOAD DET.
HIGH WATER DET.
IMPACT DETECTOR
INT. SIG.& NO.
TEMP-WIND GAGE
POWER SW. SPRING SW.
DEPOT SYMBOL
HISTORICAL MARKER

TOPOGRAPHY

ELEV. TOP OF RAIL AT STATION M.P. CONTROL POINTS & STATION NAMES CIRCULAR 7 NUMBER MILE POST LOCATION LGTH (CLEAR) OF SIDING

109.00 1-RCS-12"(SIMN)
108.83 PS #20 POTO
108.47 4-PCS-62"(SIMN) 4-DPG-60"(SIDE)
107.10 OH VIADUCT 119'
OPP106.63 PS #8 TO
106.43 PS #20 POTO
106.00 1-CIP-4"

I-55
802
125

DITCH
TURKEY CREEK

EL. 720
CPX109
ZS107
108.83

EL. 745
CPX106
BALLARD
ZS107
106.43
11440
YD 02

+0.35 -0.25 0.00 -0.38 0.00 -0.26 +0.41

MAX. GRADE PERCENT (SUB GRADE)

SLIDE WARNING
EL. ABOVE SEA LEVEL
FIBER OPTICS
C. T. C.
A. B. S.
SPEED ALLOWANCE

746 720 729 729 745 745 750

79-60
25

AUTH. SUPER ELEV.

TOTAL ANGLE

16° 22'

ALIGNMENT & FLANGE LUBRICATORS RL

0° 55'

DEGREE OF CURVE

RAIL SIDING

SH 115 CWR
SH 115 CWR
SH 112 CWR
2002

RAIL MAIN

115
SH 112 CWR
SH 112 CWR
SH 115 CWR

SURFACING & LINING
SIDING
MAIN
TIE GANG
SIDING
MAIN

1991
1991
1991
66
2002
2001
2002
2001

RLP

GRADE XING DATA
X = X-BUCK
B = BELL
F = FLASHER
G = GATES
W = WIG WAG
T = TRAFFIC SIGNAL
S = STOP SIGN
C = CANTILEVER

ORANGE ST.-BFG-40
PRIVATE-BFG
TR 354-BFG-40

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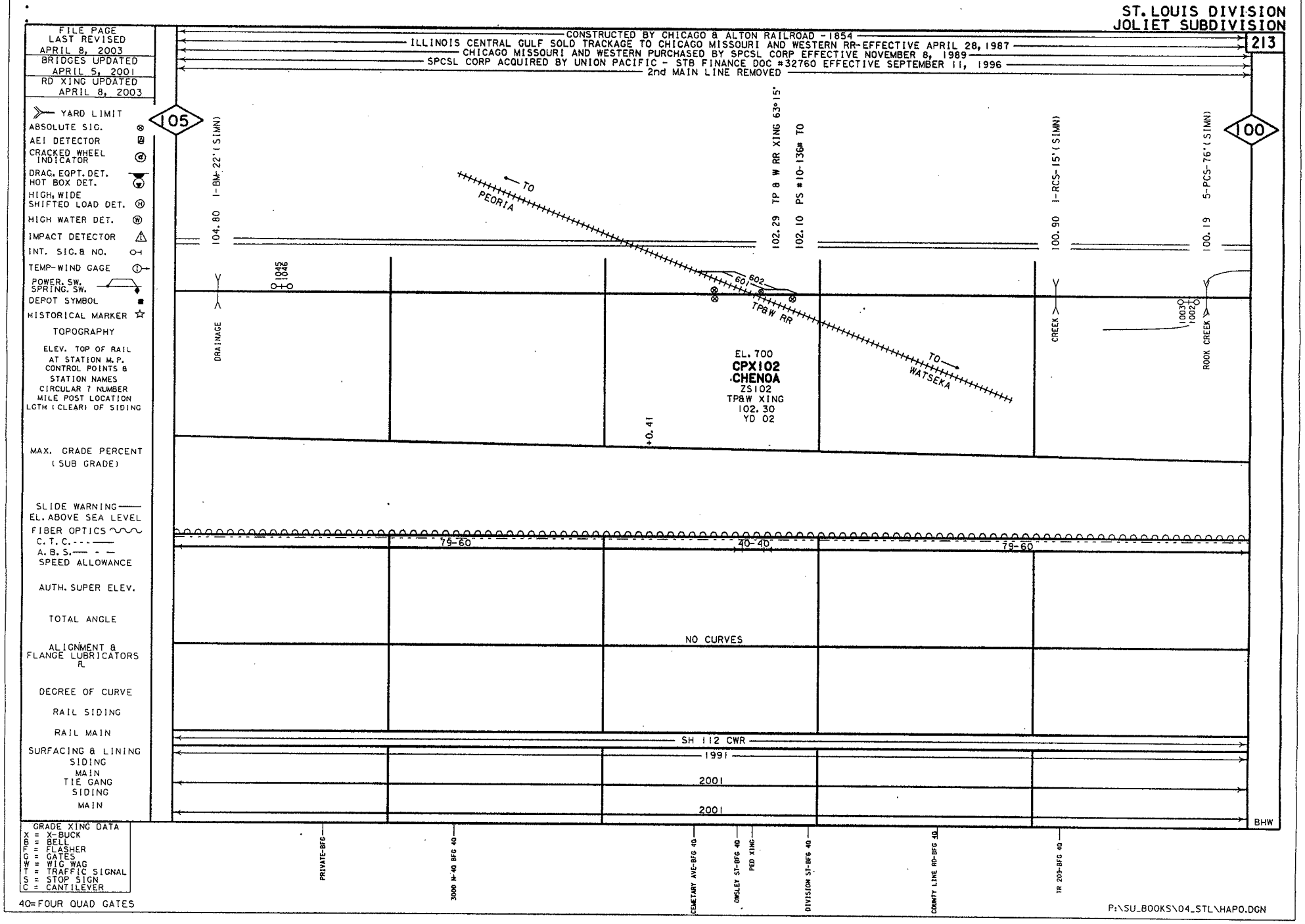
ST. LOUIS DIVISION
JOLIET SUBDIVISION
213
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APRIL 5, 2001
RD XING UPDATED
APRIL 8, 2003
CONSTRUCTED BY CHICAGO & ALTON RAILROAD - 1854
ILLINOIS CENTRAL GULF SOLD TRACKAGE TO CHICAGO MISSOURI AND WESTERN RR-EFFECTIVE APRIL 28, 1987
CHICAGO MISSOURI AND WESTERN PURCHASED BY SPCSL CORP EFFECTIVE NOVEMBER 8, 1989
SPCSL CORP ACQUIRED BY UNION PACIFIC - STB FINANCE DOC #32760 EFFECTIVE SEPTEMBER 11, 1996
2nd MAIN LINE REMOVED
YARD LIMIT
ABSOLUTE SIG.
AEI DETECTOR
CRACKED WHEEL INDICATOR
DRAG, EQPT. DET.
HOT BOX DET.
HIGH, WIDE SHIFTED LOAD DET.
HIGH WATER DET.
IMPACT DETECTOR
INT. SIG.& NO.
TEMP-WIND GAGE
POWER SW.
SPRING SW.
DEPOT SYMBOL
HISTORICAL MARKER
TOPOGRAPHY
ELEV. TOP OF RAIL AT STATION M.P. CONTROL POINTS & STATION NAMES
CIRCULAR 7 NUMBER
MILE POST LOCATION
LGTH (CLEAR) OF SIDING
MAX. GRADE PERCENT (SUB GRADE)
SLIDE WARNING
EL. ABOVE SEA LEVEL
FIBER OPTICS
C. T. C.
A. B. S.
SPEED ALLOWANCE
AUTH. SUPER ELEV.
TOTAL ANGLE
ALIGNMENT & FLANGE LUBRICATORS
DEGREE OF CURVE
RAIL SIDING
RAIL MAIN
SURFACING & LINING
SIDING
MAIN
TIE GANG
SIDING
MAIN
105
100
104.80 1-BM-22' (SIMN)
102.29 TP & W RR XING 63°15'
102.10 PS #10-136# TO
100.90 1-RCS-15' (SIMN)
100.19 5-PCS-76' (SIMN)
TO PEORIA
TO WATSEKA
TP&W RR
DRAINAGE
CREEK
ROCK CREEK
1045
1046
1003
1002
602
60
EL. 700
CPX102
CHENOA
ZS102
TP&W XING
102.30
YD 02
+0.41
79-60
40-40
79-60
NO CURVES
SH 112 CWR
1991
2001
2001
BHW
GRADE XING DATA
X = X-BUCK
B = BELL
F = FLASHER
G = GATES
W = WIG WAG
T = TRAFFIC SIGNAL
S = STOP SIGN
C = CANTILEVER
4Q=FOUR QUAD GATES
PRIVATE-BFG
3000 N-4Q BFG 4Q
CEMETARY AVE-BFG 4Q
OMSLEY ST-BFG 4Q
PED XING
DIVISION ST-BFG 4Q
COUNTY LINE RD-BFG 4Q
TR 209-BFG 4Q
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BRIDGES UPDATED APRIL 5, 2001
RD XING UPDATED NOVEMBER 28, 2000

CONSTRUCTED BY CHICAGO & ALTON RAILROAD - 1854
ILLINOIS CENTRAL GULF SOLD TRACKAGE TO CHICAGO MISSOURI AND WESTERN RR-EFFECTIVE APRIL 28, 1987
CHICAGO MISSOURI AND WESTERN PURCHASED BY SPCSL CORP EFFECTIVE NOVEMBER 8, 1989
SPCSL CORP ACQUIRED BY UNION PACIFIC - STB FINANCE DOC #32760 EFFECTIVE SEPTEMBER 11, 1996
2nd MAIN LINE REMOVED

214

100

95

YARD LIMIT
ABSOLUTE SIG.
AEI DETECTOR
CRACKED WHEEL INDICATOR
DRAG. EQPT. DET. HOT BOX DET.
HIGH, WIDE SHIFTED LOAD DET.
HIGH WATER DET.
IMPACT DETECTOR
INT. SIG. & NO.
TEMP-WIND GAGE
POWER SW. SPRING SW.
DEPOT SYMBOL
HISTORICAL MARKER

TOPOGRAPHY

ELEV. TOP OF RAIL AT STATION M.P. CONTROL POINTS & STATION NAMES
CIRCULAR T NUMBER
MILE POST LOCATION
LGTH (CLEAR) OF SIDING

MAX. GRADE PERCENT (SUB GRADE)

SLIDE WARNING
EL. ABOVE SEA LEVEL
FIBER OPTICS
C. T. C.
A. B. S.
SPEED ALLOWANCE

AUTH. SUPER ELEV.

TOTAL ANGLE

ALIGNMENT & FLANGE LUBRICATORS R

DEGREE OF CURVE

RAIL SIDING

RAIL MAIN

SURFACING & LINING
SIDING
MAIN
TIE GANG
SIDING
MAIN

1-CBC-9'X6'
98.98
I-55
PS #10-136 HTTO
97.95
PS #10-136 HTTO
97.65
5-TPG-208'(SIMM)
97.00
NOTE: REPLAING WOOD DECK WITH STEEL PANS
DETECTOR
96.6
969
968
722
ROOK CREEK
EL. 670
CPX098
OCOYA
ZS097
97.96
YD 02
ROOK CREEK
-0.11
-0.06
+0.56
+0.15
-0.14
+0.12
+0.08
+0.25
681
685
687
678
669
671
667
663
79-60
NO CURVES
SH 112 CWR
1991
2001
2001
BHW

GRADE XING DATA
X = X-BUCK
B = BELL
F = FLASHER
G = GATES
W = WIG WAG
T = TRAFFIC SIGNAL
S = STOP SIGN
C = CANTILEVER

PRIVATE-BFG
TR 1954-BFG 40
CH 8-BFG 40
PRIVATE-BFG
PRIVATE-BFG
1400 N-BFG 40

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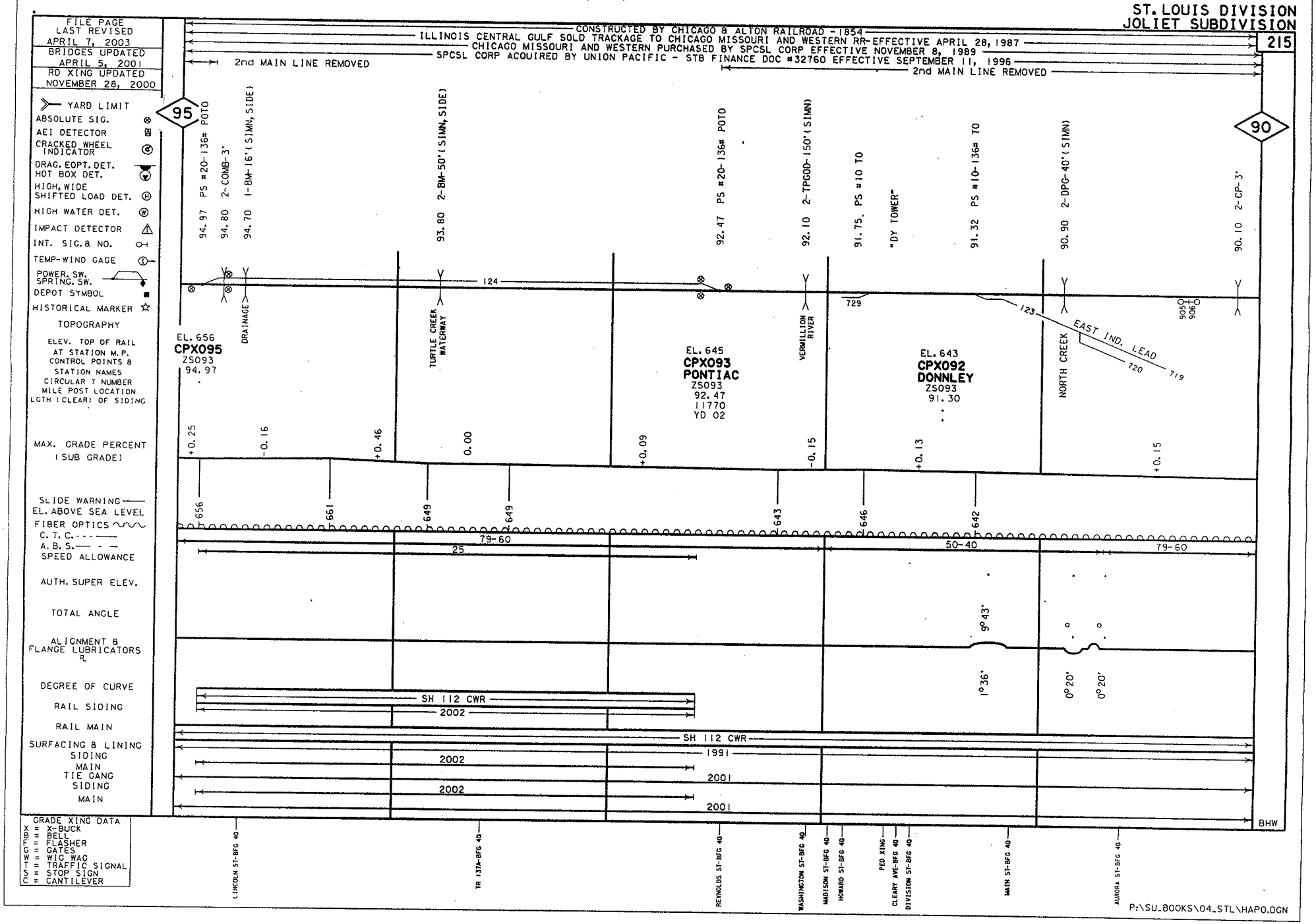
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JOLIET SUBDIVISION
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APRIL 5, 2001
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NOVEMBER 28, 2000
CONSTRUCTED BY CHICAGO & ALTON RAILROAD - 1854
ILLINOIS CENTRAL GULF SOLD TRACKAGE TO CHICAGO MISSOURI AND WESTERN RR-EFFECTIVE APRIL 28, 1987
CHICAGO MISSOURI AND WESTERN PURCHASED BY SPCSL CORP EFFECTIVE NOVEMBER 8, 1989
SPCSL CORP ACQUIRED BY UNION PACIFIC - STB FINANCE DOC #32760 EFFECTIVE SEPTEMBER 11, 1996
2nd MAIN LINE REMOVED
2nd MAIN LINE REMOVED
215
95
90
YARD LIMIT
ABSOLUTE SIG.
AEI DETECTOR
CRACKED WHEEL INDICATOR
DRAG. EQPT. DET. HOT BOX DET.
HIGH, WIDE SHIFTED LOAD DET.
HIGH WATER DET.
IMPACT DETECTOR
INT. SIG. & NO.
TEMP-WIND GAGE
POWER SW. SPRING SW.
DEPOT SYMBOL
HISTORICAL MARKER
TOPOGRAPHY
ELEV. TOP OF RAIL AT STATION M.P.
CONTROL POINTS & STATION NAMES
CIRCULAR 7 NUMBER
MILE POST LOCATION
LGTH (CLEAR) OF SIDING
MAX. GRADE PERCENT (SUB GRADE)
SLIDE WARNING
EL. ABOVE SEA LEVEL
FIBER OPTICS
C. T. C.
A. B. S.
SPEED ALLOWANCE
AUTH. SUPER ELEV.
TOTAL ANGLE
ALIGNMENT & FLANGE LUBRICATORS
DEGREE OF CURVE
RAIL SIDING
RAIL MAIN
SURFACING & LINING
SIDING
MAIN
TIE GANG
SIDING
MAIN
94.97 PS #20-136# POTO
94.80 2-COMB-3'
94.70 1-BM-16' (SIMN, SIDE)
93.80 2-BM-50' (SIMN, SIDE)
92.47 PS #20-136# POTO
92.10 2-TPGOD-150' (SIMN)
91.75 PS #10 TO
"DY TOWER"
91.32 PS #10-136# TO
90.90 2-DPG-40' (SIMN)
90.10 2-CP-3'
124
DRAINAGE
TURTLE CREEK WATERWAY
VERMILLION RIVER
729
123
905
906
EAST IND. LEAD
720
719
NORTH CREEK
EL. 656
CPX095
ZS093
94.97
EL. 645
CPX093
PONTIAC
ZS093
92.47
11770
YD 02
EL. 643
CPX092
DONNLEY
ZS093
91.30
+0.25
-0.16
+0.46
0.00
+0.09
-0.15
+0.13
+0.15
656
661
649
649
643
646
642
79-60
25
50-40
79-60
9°43'
1°36'
0°20'
0°20'
SH 112 CWR
2002
SH 112 CWR
1991
2002
2001
2002
2001
BHW
GRADE XING DATA
X = X-BUCK
B = BELL
F = FLASHER
G = GATES
W = WIG WAG
T = TRAFFIC SIGNAL
S = STOP SIGN
C = CANTILEVER
LINCOLN ST-BFG 4Q
TR 137A-BFG 4Q
REYNOLDS ST-BFG 4Q
WASHINGTON ST-BFG 4Q
MADISON ST-BFG 4Q
HOWARD ST-BFG 4Q
PED XING
CLEARY AVE-BFG 4Q
DIVISION ST-BFG 4Q
MAIN ST-BFG 4Q
AURORA ST-BFG 4Q
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FILE PAGE LAST REVISED APRIL 8, 2003
BRIDGES UPDATED APRIL 5, 2001
RD XING UPDATED APRIL 8, 2003

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CONSTRUCTED BY CHICAGO & ALTON RAILROAD - 1854
ILLINOIS CENTRAL GULF SOLD TRACKAGE TO CHICAGO MISSOURI AND WESTERN RR-EFFECTIVE APRIL 28, 1987
CHICAGO, MISSOURI AND WESTERN PURCHASED BY SPCSL CORP.-EFFECTIVE NOVEMBER 8, 1989
SPCSL CORP ACQUIRED BY UNION PACIFIC-STB FINANCE DOC #32760 EFFECTIVE SEPTEMBER 11, 1996
2ND MAIN LINE REMOVED

90

85

YARD LIMIT
ABSOLUTE SIG.
AEI DETECTOR
CRACKED WHEEL INDICATOR
DRAG. EQPT. DET. HOT BOX DET.
HIGH, WIDE SHIFTED LOAD DET.
HIGH WATER DET.
IMPACT DETECTOR
INT. SIG. & NO.
TEMP-WIND GAGE
POWER SW. SPRING SW.
DEPOT SYMBOL
HISTORICAL MARKER
TOPOGRAPHY

ELEV. TOP OF RAIL AT STATION M.P. CONTROL POINTS & STATION NAMES
CIRCULAR 7 NUMBER
MILE POST LOCATION
LGTH (CLEAR) OF SIDING

MAX. GRADE PERCENT (SUB GRADE)

SLIDE WARNING
EL. ABOVE SEA LEVEL
FIBER OPTICS
C. T. C.
A. B. S.
SPEED ALLOWANCE

AUTH. SUPER ELEV.

TOTAL ANGLE

ALIGNMENT & FLANGE LUBRICATORS R

DEGREE OF CURVE

RAIL SIDING

RAIL MAIN

SURFACING & LINING
SIDING
MAIN
TIE GANG
SIDING
MAIN

89.80 2-RCS-28' (SIMN)

88.81 PS #10 TO
88.80 1-CAC-6'X4'

PRAIRIE CENTRAL GRAIN
88.60 1-CAC-8'X8'
88.52 PS #10 TO

"CAYUGA"

86.70 1-DPG-44' (SIMN)

86.40 1-PCB-30' (SIMN)

85.80 1-CAC-7'X7'

I-55

NORTH CREEK

PRAIRIE CENTRAL COOP

883
884

121
122
714
715
917
717
716
721
718

WOLF CREEK

863
864

CO RD 2200 N RD

EL. 670
CPX087
BUNGE
ZS087
88.60
YD 02, 77

-0.15

-0.20

659.00

79-60

NO CURVES

SH 112 CWR

1991

2001

2001

BHW

GRADE XING DATA
X = X-BUCK
B = BELL
F = FLASHER
G = GATES
W = WIG WAG
T = TRAFFIC SIGNAL
S = STOP SIGN
C = CANTILEVER

PUBLIC-BFG 40

MAIN ST-BFG 40

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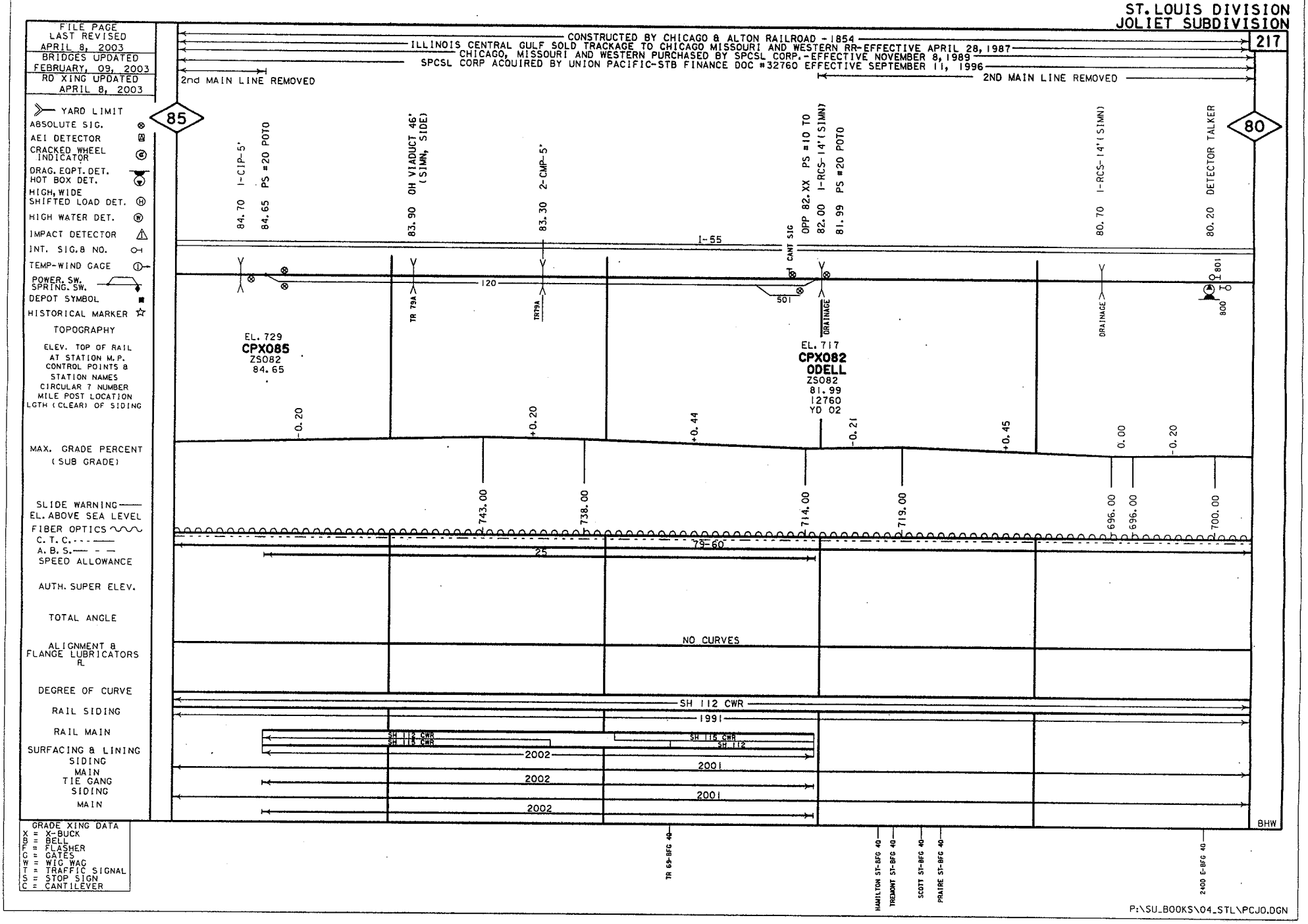
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JOLIET SUBDIVISION
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FEBRUARY, 09, 2003
RD XING UPDATED
APRIL 8, 2003
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ILLINOIS CENTRAL GULF SOLD TRACKAGE TO CHICAGO MISSOURI AND WESTERN RR-EFFECTIVE APRIL 28, 1987
CHICAGO, MISSOURI AND WESTERN PURCHASED BY SPCSL CORP.-EFFECTIVE NOVEMBER 8, 1989
SPCSL CORP ACQUIRED BY UNION PACIFIC-STB FINANCE DOC #32760 EFFECTIVE SEPTEMBER 11, 1996
217
2nd MAIN LINE REMOVED
2ND MAIN LINE REMOVED
85
80
YARD LIMIT
ABSOLUTE SIG.
AEI DETECTOR
CRACKED WHEEL INDICATOR
DRAG. EQPT. DET. HOT BOX DET.
HIGH, WIDE SHIFTED LOAD DET.
HIGH WATER DET.
IMPACT DETECTOR
INT. SIG.& NO.
TEMP-WIND GAGE
POWER SW. SPRING SW.
DEPOT SYMBOL
HISTORICAL MARKER
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ELEV. TOP OF RAIL AT STATION M.P. CONTROL POINTS & STATION NAMES
CIRCULAR 7 NUMBER
MILE POST LOCATION
LGTH (CLEAR) OF SIDING
MAX. GRADE PERCENT (SUB GRADE)
SLIDE WARNING
EL. ABOVE SEA LEVEL
FIBER OPTICS
C. T. C.
A. B. S.
SPEED ALLOWANCE
AUTH. SUPER ELEV.
TOTAL ANGLE
ALIGNMENT & FLANGE LUBRICATORS
DEGREE OF CURVE
RAIL SIDING
RAIL MAIN
SURFACING & LINING
SIDING
MAIN
TIE GANG
SIDING
MAIN
84.70 I-CIP-5'
84.65 PS #20 POTO
83.90 OH VIADUCT 46' (SIMN, SIDE)
83.30 2-CMP-5'
OPP 82.XX PS #10 TO
82.00 I-RCS-14' (SIMN)
81.99 PS #20 POTO
80.70 I-RCS-14' (SIMN)
80.20 DETECTOR TALKER
I-55
CANT SIG
120
501
TR 79A
DRAINAGE
801
800
EL. 729
CPX085
ZS082
84.65
EL. 717
CPX082
ODELL
ZS082
81.99
12760
YD 02
0.20
+0.20
+0.44
-0.21
+0.45
0.00
0.20
743.00
738.00
714.00
719.00
696.00
696.00
700.00
25
79-60
NO CURVES
SH 112 CWR
1991
SH 112 CWR
SH 115 CWR
SH 115 CWR
SH 112
2002
2001
2002
2001
2002
BHW
GRADE XING DATA
X = X-BUCK
B = BELL
F = FLASHER
G = GATES
W = WIG WAG
T = TRAFFIC SIGNAL
S = STOP SIGN
C = CANTILEVER
TR 69-BFG 40
HAMILTON ST-BFG 40
TREMONT ST-BFG 40
SCOTT ST-BFG 40
PRAIRE ST-BFG 40
2400 E-BFG 40
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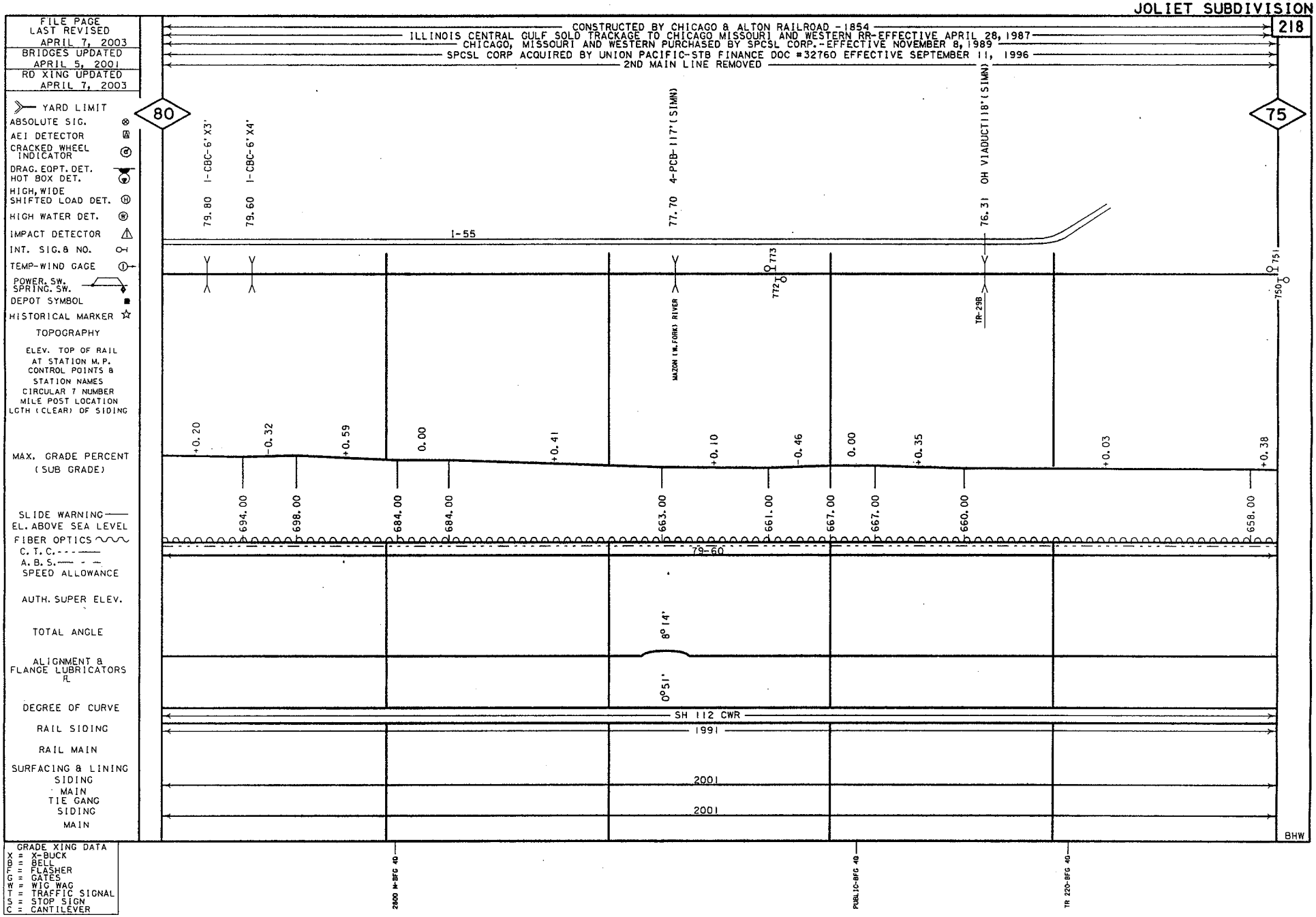

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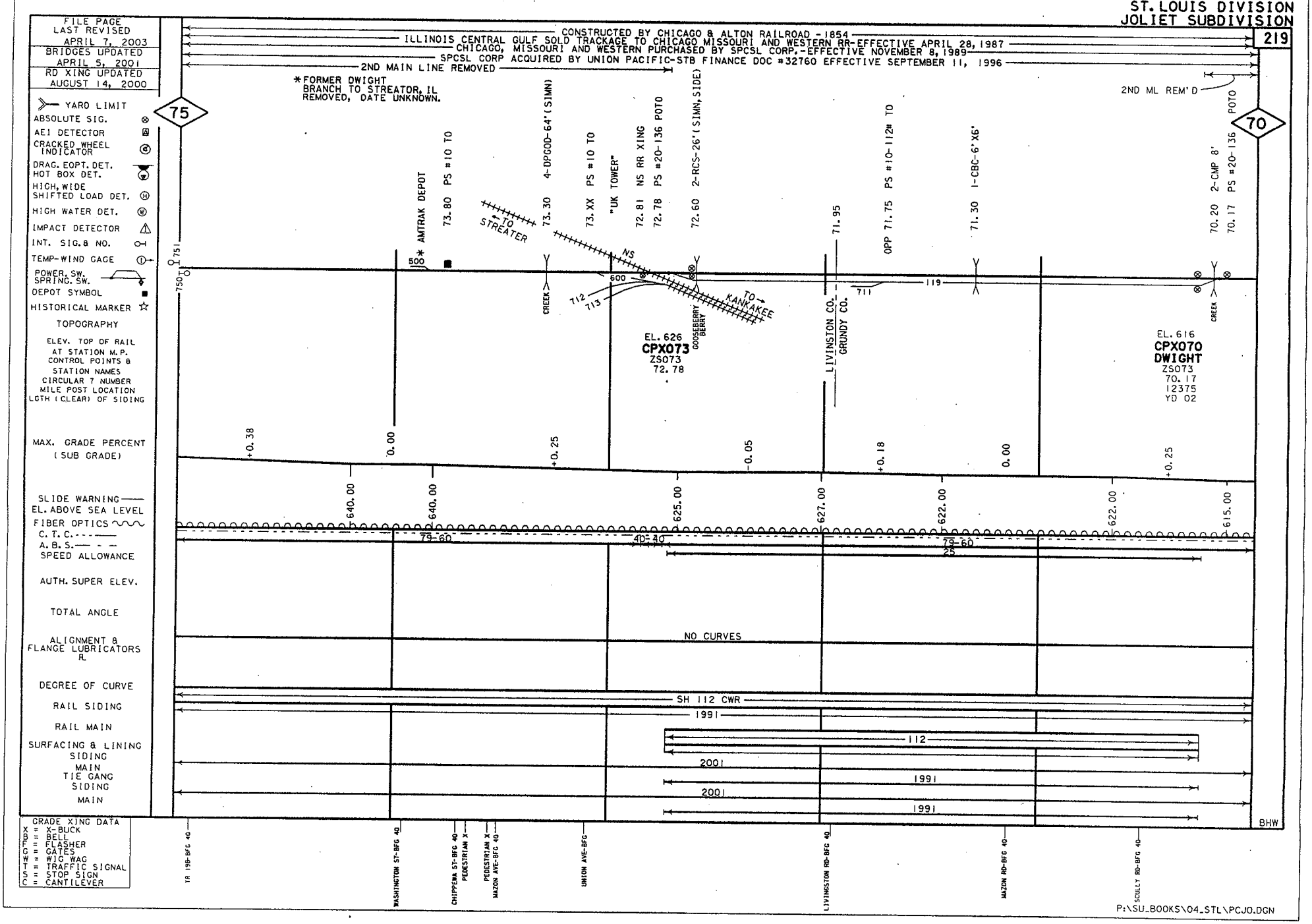
ST. LOUIS DIVISION
JOLIET SUBDIVISION
219
FILE PAGE
LAST REVISED
APRIL 7, 2003
BRIDGES UPDATED
APRIL 5, 2001
RD XING UPDATED
AUGUST 14, 2000
CONSTRUCTED BY CHICAGO & ALTON RAILROAD - 1854
ILLINOIS CENTRAL GULF SOLD TRACKAGE TO CHICAGO MISSOURI AND WESTERN RR-EFFECTIVE APRIL 28, 1987
CHICAGO, MISSOURI AND WESTERN PURCHASED BY SPCSL CORP.-EFFECTIVE NOVEMBER 8, 1989
SPCSL CORP ACQUIRED BY UNION PACIFIC-STB FINANCE DOC #32760 EFFECTIVE SEPTEMBER 11, 1996
2ND MAIN LINE REMOVED
2ND ML REM'D
*FORMER DWIGHT BRANCH TO STREATOR, IL REMOVED, DATE UNKNOWN.
75
70
YARD LIMIT
ABSOLUTE SIG.
AEI DETECTOR
CRACKED WHEEL INDICATOR
DRAG. EQPT. DET.
HOT BOX DET.
HIGH, WIDE SHIFTED LOAD DET.
HIGH WATER DET.
IMPACT DETECTOR
INT. SIG. & NO.
TEMP-WIND GAGE
POWER SW.
SPRING SW.
DEPOT SYMBOL
HISTORICAL MARKER
TOPOGRAPHY
ELEV. TOP OF RAIL AT STATION M.P. CONTROL POINTS & STATION NAMES CIRCULAR 7 NUMBER MILE POST LOCATION LGTH (CLEAR) OF SIDING
MAX. GRADE PERCENT (SUB GRADE)
SLIDE WARNING
EL. ABOVE SEA LEVEL
FIBER OPTICS
C. T. C.
A. B. S.
SPEED ALLOWANCE
AUTH. SUPER ELEV.
TOTAL ANGLE
ALIGNMENT & FLANGE LUBRICATORS
DEGREE OF CURVE
RAIL SIDING
RAIL MAIN
SURFACING & LINING
SIDING
MAIN
TIE GANG
SIDING
MAIN
CRADE XING DATA
X = X-BUCK
B = BELL
F = FLASHER
G = GATES
W = W/O WAG
T = TRAFFIC SIGNAL
S = STOP SIGN
C = CANTILEVER
AMTRAK DEPOT
73.80 PS #10 TO
4-DPGOD-64'(SIMN)
73.30
73.XX PS #10 TO
"UK TOWER"
72.81 NS RR XING
72.78 PS #20-136 POTO
2-RCS-26'(SIMN, SIDE)
72.60
71.95
OPP 71.75 PS #10-112# TO
1-CBC-6'X6'
71.30
2-CMP 8'
70.20
70.17 PS #20-136 POTO
TO STREATER
NS
TO KANKAKEE
CREEK
GOOSEBERRY BERRY
LIVINGSTON CO.
GRUNDY CO.
EL. 626
CPX073
ZS073
72.78
EL. 616
CPX070
DWIGHT
ZS073
70.17
12375
YD 02
+0.38
0.00
+0.25
0.05
+0.18
0.00
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640.00
625.00
627.00
622.00
622.00
615.00
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79-60
25
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112
2001
1991
2001
1991
BHW
TR 195-BFG 40
WASHINGTON ST-BFG 40
CHIPPEWA ST-BFG 40
PEDESTRIAN X
PEDESTRIAN X
MAZON AVE-BFG 40
UNION AVE-BFG
LIVINGSTON RD-BFG 40
MAZON RD-BFG 40
SCULLY RD-BFG 40
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BRIDGES UPDATED
FEBRUARY 09, 2003
RD XING UPDATED
AUGUST 14, 2000

YARD LIMIT
ABSOLUTE SIG.
AEI DETECTOR
CRACKED WHEEL INDICATOR
DRAG. EQPT. DET.
HOT BOX DET.
HIGH, WIDE SHIFTED LOAD DET.
HIGH WATER DET.
IMPACT DETECTOR
INT. SIG. & NO.
TEMP-WIND GAGE
POWER. SW.
SPRING. SW.
DEPOT SYMBOL
HISTORICAL MARKER

TOPOGRAPHY

ELEV. TOP OF RAIL
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CONTROL POINTS &
STATION NAMES
CIRCULAR 7 NUMBER
MILE POST LOCATION
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MAX. GRADE PERCENT
(SUB GRADE)

SLIDE WARNING
EL. ABOVE SEA LEVEL
FIBER OPTICS
C. T. C.
A. B. S.
SPEED ALLOWANCE

AUTH. SUPER ELEV.

TOTAL ANGLE

ALIGNMENT &
FLANGE LUBRICATORS
FL

DEGREE OF CURVE

RAIL SIDING

RAIL MAIN

SURFACING & LINING
SIDING
MAIN
TIE GANG
SIDING
MAIN

CONSTRUCTED BY CHICAGO & ALTON RAILROAD - 1854
ILLINOIS CENTRAL GULF SOLD TRACKAGE TO CHICAGO MISSOURI AND WESTERN RR-EFFECTIVE APRIL 28, 1987
CHICAGO, MISSOURI AND WESTERN PURCHASED BY SPCSL CORP-EFFECTIVE NOVEMBER 8, 1989
SPCSL CORP ACQUIRED BY UNION PACIFIC-STB FINANCE DOC #32760 EFFECTIVE SEPTEMBER 11, 1996.
2ND MAIN LINE REMOVED

220

70

65

69.80 1-CIP-4'
69.09 2-COMB-3'
67.70 OH VIADUCT 121'
67.60 1-CMP-4' 2-SSP-3'
67.30 3-CMP-6'
66.10 1-SSP-6' 1-CMP-6'
65.10 OH VIADUCT 91'

I-55

683
682
TE 151
GOODFARM ROAD
665
664
CREEK
HWY IL 53

+0.12
+0.07

601.00

79-60

NO CURVES

SH 112 CWR
1991
2001
2001

BHW

GRADE XING DATA
X = X-BUCK
B = BELL
F = FLASHER
G = GATES
W = WIG WAG
T = TRAFFIC SIGNAL
S = STOP SIGN
C = CANTILEVER

CANTZERT RD-BFG 40
STONEWALL RD-BFG 40
FILMAN RD-BFG 40
PRIVATE-BFG
GORMAN RD-BFG 40
MAHER RD-BFG 40

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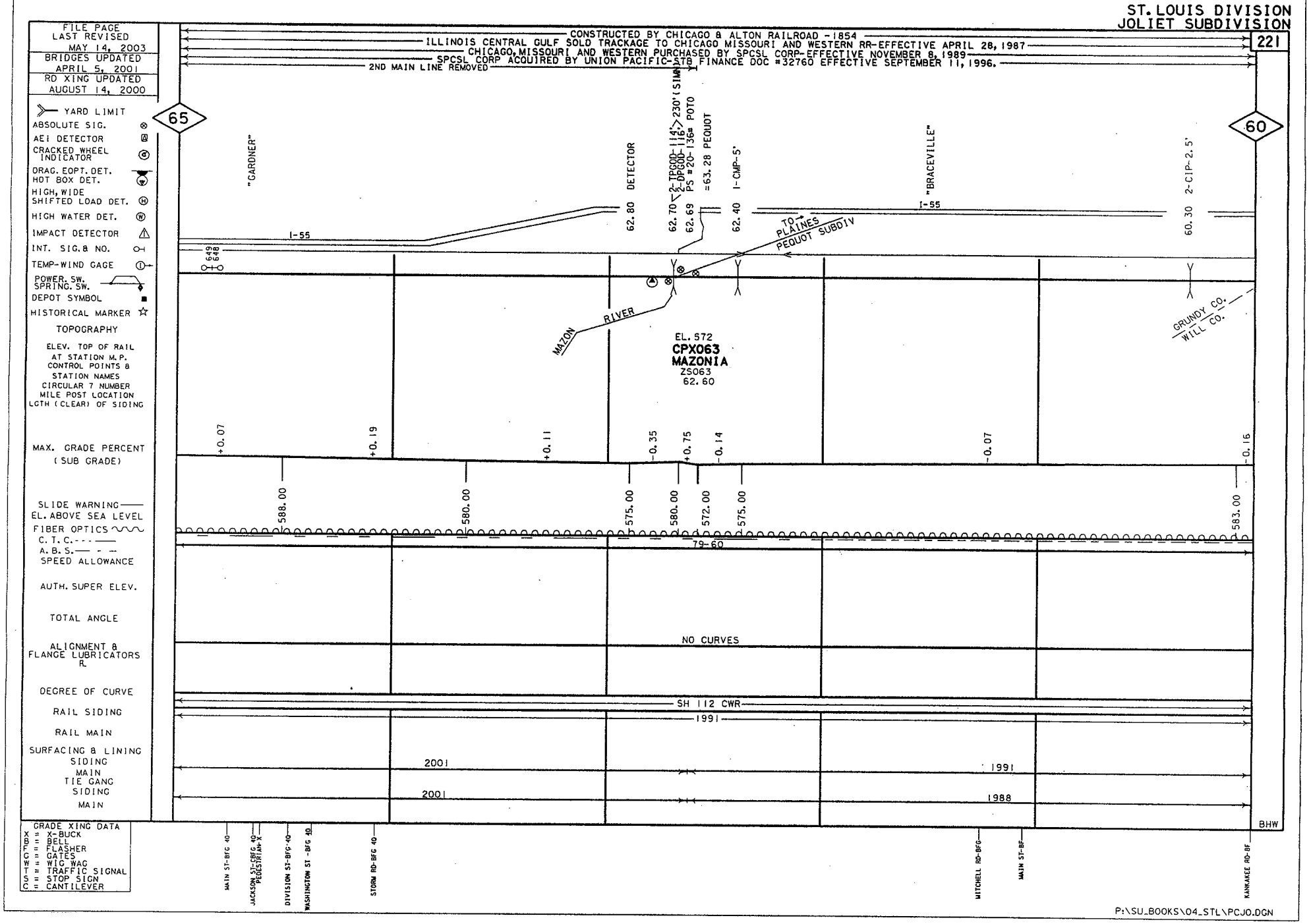
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SPCSL CORP ACQUIRED BY UNION PACIFIC-STB FINANCE DOC #32760 EFFECTIVE SEPTEMBER 11, 1996.
2ND MAIN LINE REMOVED
65
60
"GARDNER"
"BRACEVILLE"
I-55
I-55
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62.70 2-TPGOO-114"> 230' (SIM.)
2-DPGOO-116"
PS #20-136# POTO
62.69 =63.28 PEQUOT
62.40 1-CMP-5'
60.30 2-CIP-2.5'
TO PLAINES PEQUOT SUBDIV
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648
MAZON RIVER
GRUNDY CO.
WILL CO.
EL. 572
CPX063
MAZONIA
ZS063
62.60
YARD LIMIT
ABSOLUTE SIG.
AEI DETECTOR
CRACKED WHEEL INDICATOR
DRAG. EQPT. DET.
HOT BOX DET.
HIGH, WIDE SHIFTED LOAD DET.
HIGH WATER DET.
IMPACT DETECTOR
INT. SIG. & NO.
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C. T. C.
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TOTAL ANGLE
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DEGREE OF CURVE
RAIL SIDING
RAIL MAIN
SURFACING & LINING
SIDING
MAIN
TIE GANG
SIDING
MAIN
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+0.19
+0.11
-0.35
+0.75
-0.14
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-0.16
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575.00
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2001
1991
2001
1988
BHW
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F = FLASHER
G = GATES
W = WIG WAG
T = TRAFFIC SIGNAL
S = STOP SIGN
C = CANTILEVER
MAIN ST-BFG 40
JACKSON ST-CBFG 40 PEDESTRIAN-X
DIVISION ST-BFG-40
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MAIN ST-BF
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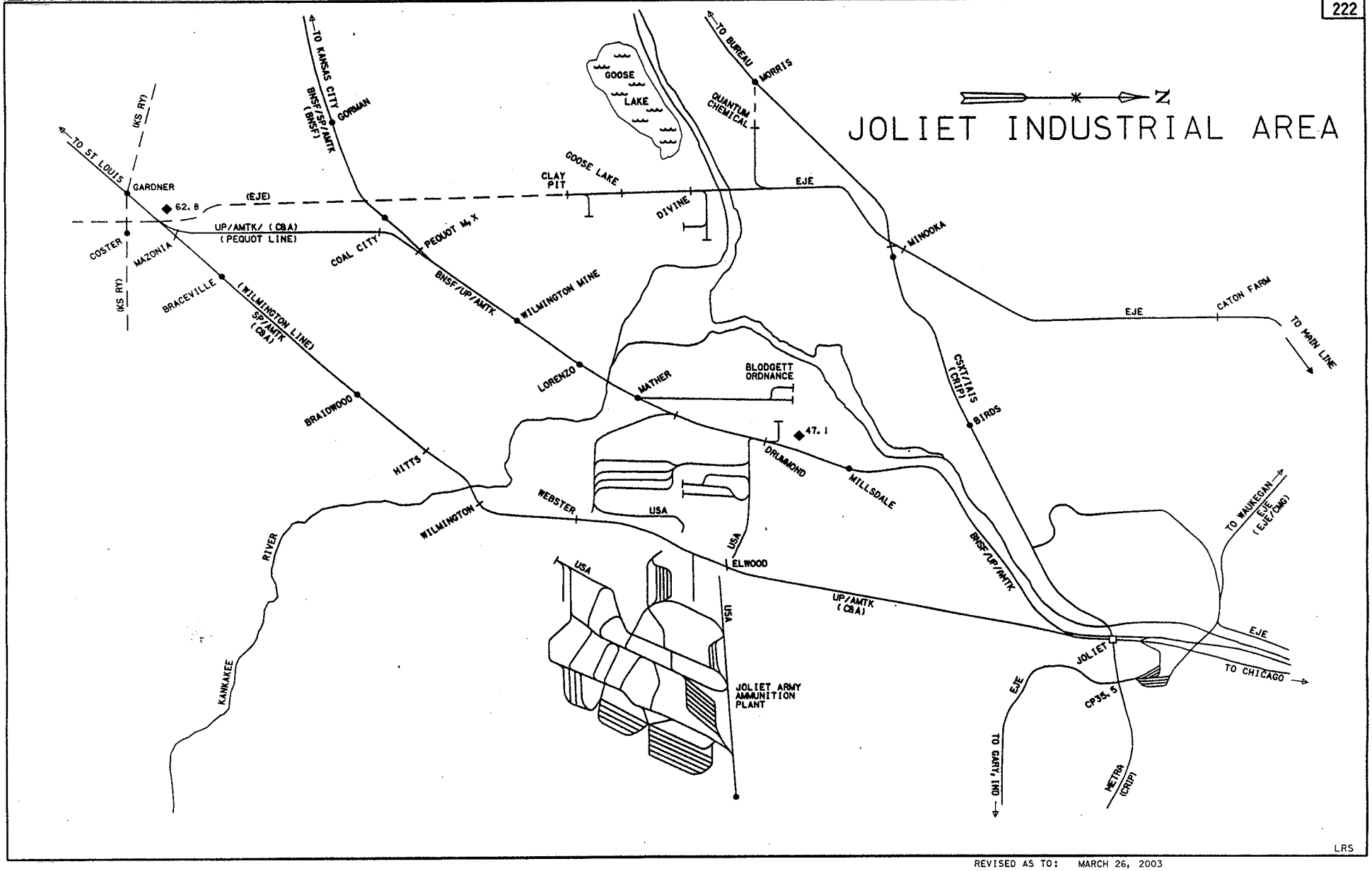

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REVISED AS TO: MARCH 26, 2003

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Appendix E: PTC Optimum Communications Timeout Study: Accident Descriptions for NAJPTC, UP Cab Signaling with ATS and Northeast Corridor ATC

Accident scenarios, descriptions and illustrations presented in this document were adapted from those prepared by:

Don Wiles and Lori M. Kaufman, Ph.D.
Booz Allen Hamilton

By

ENSCO, Inc.
ICF Consulting

For the purpose of characterizing accident scenarios for risk analysis

June 2008

Provision of this material does not imply concurrence of results/conclusions contained in this report by Booz Allen Hamilton or its employees.

PTC Optimum Communications Timeout Study: Accident Descriptions

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Part I: Overview and Approach

Part II: NAJPTC with Equipped and Unequipped Trains

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Section 2: Collision between two active IDOT Corridor trains: head (locomotive) with rear or side of second train.
Section 3: Collision between the head (locomotive) of an active IDOT Corridor train and intruding rail vehicle or vehicle lading.
Section 4: Other accident types involving a single active IDOT Corridor train

Part III: Cab Signaling and Automatic Train Stop (ATS)

Section 1: Head on collision between two locomotives heading active IDOT Corridor trains.
Section 2: Collision between two active IDOT Corridor trains: head (locomotive) with rear or side of second train.
Section 3: Collision between the head (locomotive) of an active IDOT Corridor train and intruding rail vehicle or vehicle lading.
Section 4: Other accident types involving a single active IDOT Corridor train

Part IV: Cab Signaling and Automatic Train Control (ATC)

Section 1: Head on collision between two locomotives heading active IDOT Corridor trains.
Section 2: Collision between two active IDOT Corridor trains: head (locomotive) with rear or side of second train.
Section 3: Collision between the head (locomotive) of an active IDOT Corridor train and intruding rail vehicle or vehicle lading.
Section 4: Other accident types involving a single active IDOT Corridor train

PTC Optimum Communications Timeout Study: Accident Descriptions

Part I: Overview and Approach

Train Control Systems Analyzed

- This Appendix presents an analysis of the response of each control system to each PTC-relevant accident scenario and scenario variants. The control systems are:
  - NAJPTC – Positive Train Control system as proposed for application to the IDOT corridor, operated with a mix of equipped and unequipped trains.
  - Cab Signals with ATS – Cab signal and train stop system without speed enforcement. All trains equipped.
  - Cab Signals with ATC – Cab signal and automatic train control with speed enforcement as used on the Northeast Corridor (4-aspect signals). All trains equipped.

Organization of Analyses

- The analysis of each train control system is presented in four sections
  - Section 1: Head on collision between two locomotives heading active IDOT corridor trains
  - Section 2: Side or rear-end collision between two active IDOT Corridor trains, where locomotive collides with rear or side of second train
  - Section 3: Collision between the head (locomotive) of an active IDOT Corridor train and a rail vehicle or vehicle lading intruding from an adjacent track, including roll-outs, shifted loads and derailed vehicles.
  - Section 4: Other accident types involving a single active IDOT test corridor train, comprising grade crossings, broken rails and diamond crossing accidents

Background

- PTC is designed as an overlay system for CTC and “Dark Territory”
  - On the IDOT line, it overlays CTC.
  - Allows passenger trains to travel at 110 MPH in an operational environment shared with freight traffic
- CTC only allows passenger trains to travel at 79 MPH
- Automatic Train Control (ATC) and UP cab Signals with ATS allow 110 MPH traffic
- Office of Safety selected UP Cab Signals with ATS and Northeast Corridor ATC as base cases because they allow 110 MPH operation, as does PTC.

Issues to be Considered in the Comparison Between NAJPTC, Cab Signals with ATS and ATC

- How does the communications timeout limit the effectiveness of the NAJPTC system?
  - Are situations created in NAJPTC that are not accounted for in the existing accident database?
  - Are UP Cab Signal or ATC-preventable accidents created by NAJPTC?
  - Is the severity of ATC or UP Cab Signal accidents increased relative to NAJPTC?
  - Does NAJPTC prevent any accidents that are not prevented by UP Cab Signal or ATC?
- For each accident scenario, is there a communications timeout value which makes NAJPTC equal to or better than UP Cab Signal or ATC?
- Is there a communications timeout value that makes NAJPTC equal to or better than UP Cab Signal or ATC when considering each system across all accident scenarios?
- What level of NAJPTC timeout is acceptable?

Accident Types (All Cases)

- Head (locomotive) to head collision (can occur on siding or main)
- Head to rear collision (can occur on siding or main)
- Raking or side impact with an active train (e.g. train improperly leaving a siding)
- Head to side collision or vice-versa with non-test-corridor crossing at a diamond
- Fouling (e.g. cars or equipment rolled or otherwise intruding onto main)
- Train to motor vehicle (e.g. grade crossing)
- Overspeed derailment (e.g. train ignores permanent or Form A speed restriction)
- Roadway worker/work zone incursion (e.g. train violates Form B authority limit)
- Derailments can also occur from broken rails, which can be detected by track circuits in signal blocks ahead of the approaching train, but not in the block occupied by the NAJPTC equipped train. In case of communications failure, an NAJPTC-equipped train must rely on wayside signals to respond to a broken rail in approaching blocks.

PTC Optimum Communications Timeout Study: Accident Descriptions

Part II: NAJPTC with Equipped and Unequipped Trains

Assumptions for NAJPTC Case

- Bi-directional wayside signaling for all cases
- Route lock from control point to control point
- NAJPTC equipped trains cannot pass signals at danger (SPAD)
  - NAJPTC train can never exceed last authority issued by system
- Work trains are equivalent to unequipped trains
- CTC track circuits provide block occupancy detection for all trains (NAJPTC equipped and unequipped) to the wayside and to the control center, but do not communicate directly to the train.
- NAJPTC, which is a CTC overlay, provides detection and communicates information to the locomotive via wireless, digital communications, for NAJPTC equipped trains only
- All NAJPTC equipment is operational and does not fail during operations over the route, except when NAJPTC is in Timeout due to a communications failure.
- NAJPTC is assumed to prevent all collisions between equipped trains, whether the system is in timeout or not. (Trains will always comply with the most recent authority received, which by definition cannot conflict with authorities issued to other NAJPTC-equipped trains in the vicinity) Therefore, no collision scenarios with two equipped trains are included in this assessment.

NAJPTC Operational Constraints

- IDOT NAJPTC System Specifications Section 4.3.2.5
  - SSR155: The IDOT NAJPTC system shall apply a Head-End Only (TBC) Temporary Speed Restriction between railroad operator-defined protection limits of a Point of Route Convergence located on controlled track and in the direction of an approaching communicating train when:
  - SSR155.1: A non-communicating train occupies railroad operator defined limits adjacent to the Point of Convergence; and
  - SSR155.2: Authority past the Point of Route Convergence is issued to a communicating train.

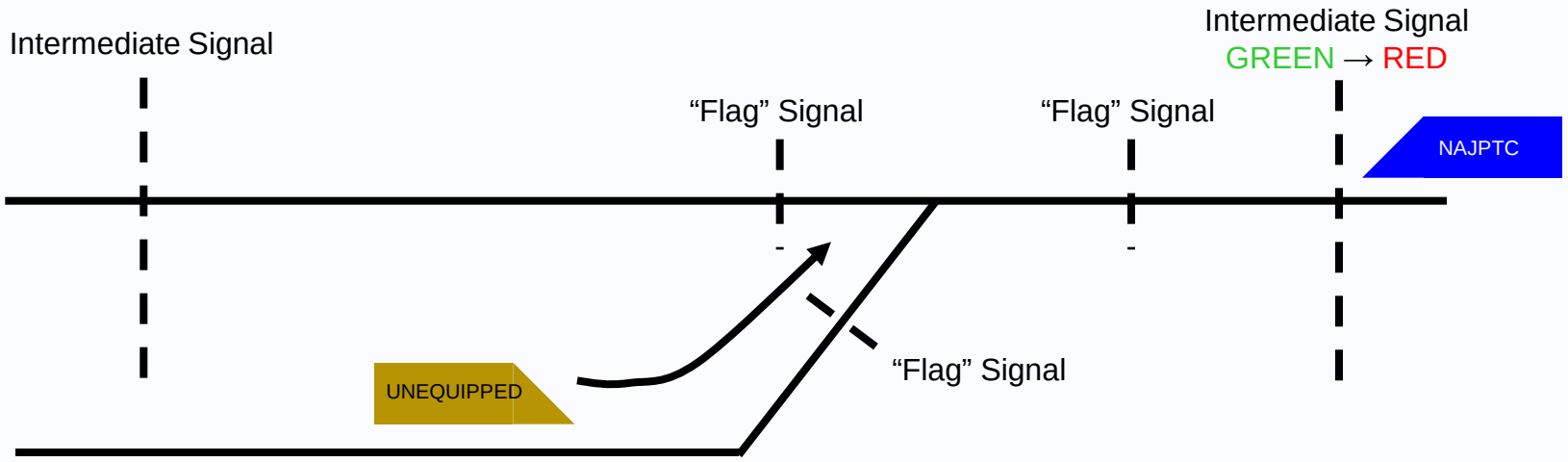
- Application of SSR155
  - When a non-communicating (NAJPTC unequipped) train is “near” a siding switch, a high-speed communicating (NAJPTC equipped) train will be slowed to 79 MPH while passing “near” the non-communicating train and over the switch.
  - The 79 MPH restriction does not apply at crossover locations in multiple track territory unless the plant was lined for a crossover move.

Section 1: Head-On Collision Between Two Locomotives Heading Active IDOT Corridor Trains

- Collision between train leaving uncontrolled siding and train on main track
- Collision between train leaving controlled siding and train on main track.

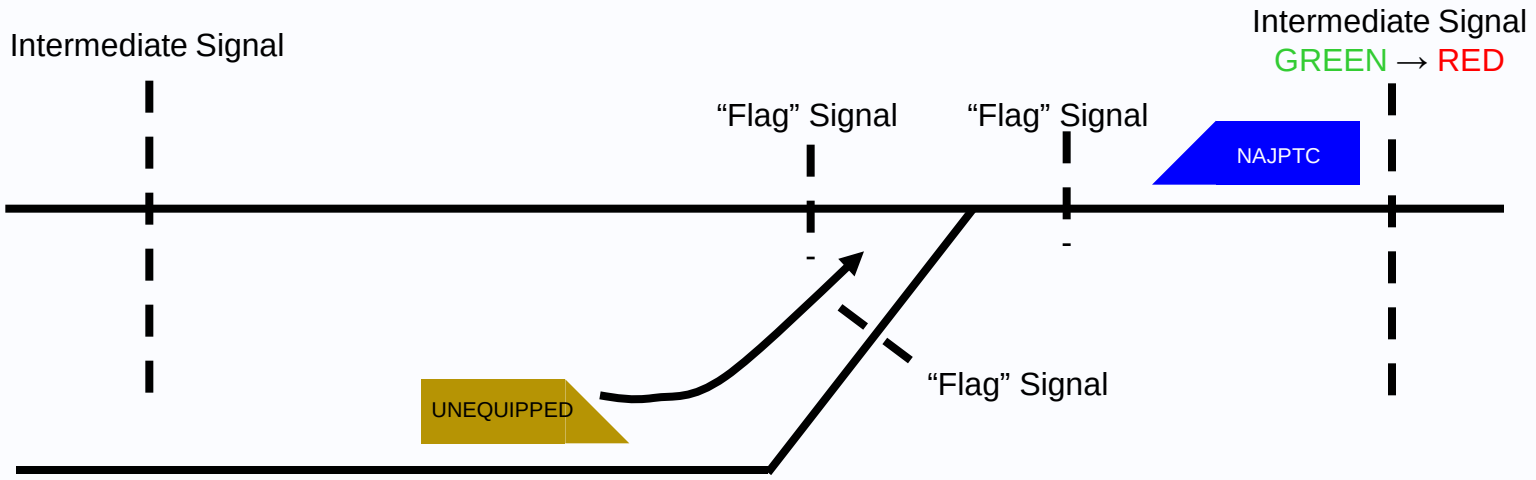
Accident Scenario: NAJPTC-Unequipped Train on Uncontrolled Siding & NAJPTC-Equipped Train on Main

- Accident Scenario: NAJPTC unequipped train leaving siding & NAJPTC equipped train entering block
  - Cause: Dispatcher misreads map or crew ignores signal
  - Action: NAJPTC unequipped train erroneously exits siding and enters main; NAJPTC equipped train passing Intermediate Signal
  - NAJPTC equipped train on main: Train will see Intermediate Signal change, timeout results in potentially late enforcement
  - NAJPTC unequipped train entering main from siding: The train will be unaware of the approaching train
- Accident Type: Head-on collision between locomotives
- NAJPTC Benefit: Collision may be prevented or collision speed reduced



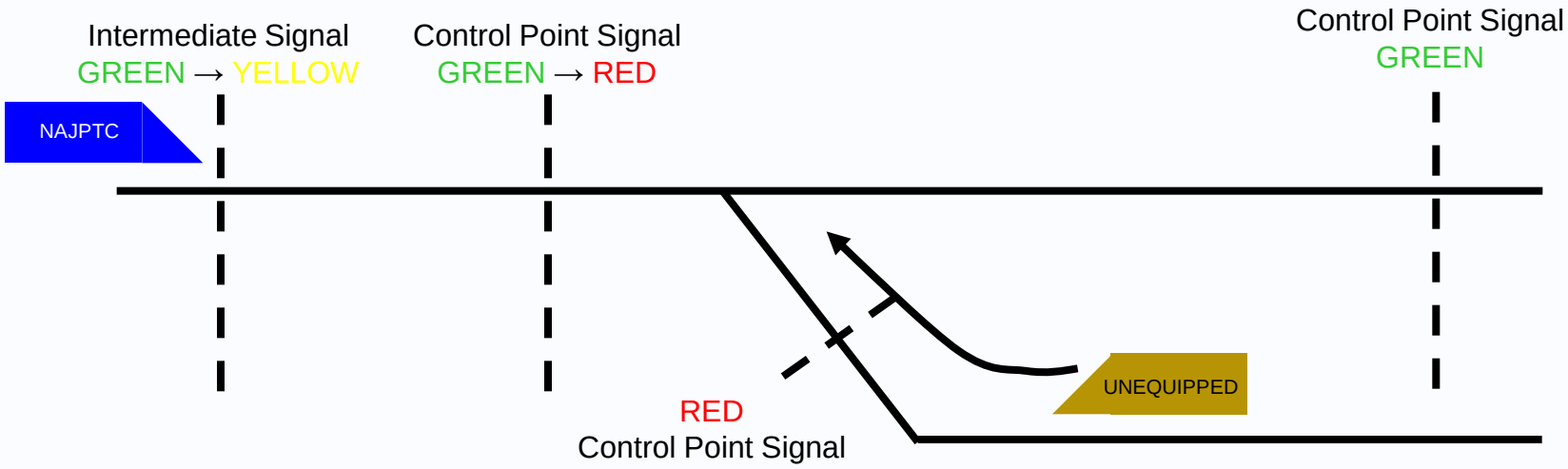
Accident Scenario: NAJPTC-Unequipped Train on Uncontrolled Siding & NAJPTC-Equipped Train on Main

- Accident Scenario: NAJPTC unequipped train leaving siding & NAJPTC equipped train in block
  - Cause: Dispatcher misreads map or crew ignores signal
  - Action: NAJPTC unequipped erroneously exits siding and enters main; NAJPTC equipped train has passed Intermediate Signal
  - NAJPTC equipped train on main: NAJPTC does not use coded track circuit, therefore design, not timeout, impacts safety; timeout has no effect, The train will be unaware of the encroaching train
  - NAJPTC unequipped train entering main line from siding: The train will be unaware of the approaching train
- Accident Type: Head-on collision between locomotives. See Section 2, Page E-26 for corresponding side impact scenario
- NAJPTC Risk Effect: Collision could be prevented or collision speed reduced



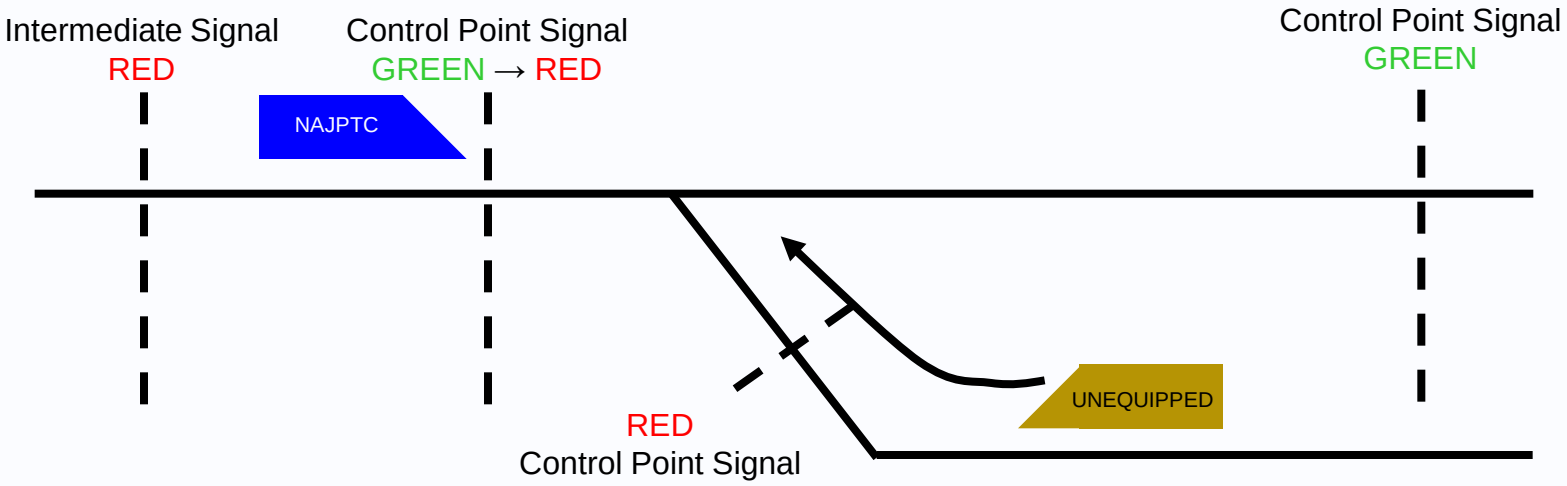
Accident Scenario: NAJPTC-Unequipped Train on Controlled (Passing) Siding & NAJPTC-Equipped on Main

- Accident Scenario: NAJPTC unequipped train erroneously leaving siding (SPAD); NAJPTC equipped train passing Intermediate Signal and approaching the Control Point
  - Cause: Dispatcher misreads map or crew ignores Control Point Signal
  - Action: NAJPTC unequipped train passes RED Control Point Signal and exits siding; NAJPTC equipped train on main passes Intermediate Signal
  - NAJPTC equipped train on main: NAJPTC will detect the unequipped train when it shunts the main track, timeout results in potentially late enforcement
  - NAJPTC unequipped train entering main from siding: The train will not be aware of the approaching train on the main
- Accident Type: Head-on collision between locomotives
- This and page E16 scenarios are probably the most common scenarios on this corridor. Almost all meets are at controlled sidings
- NAJPTC risk effect: Collision will be prevented or collision speed reduced



Accident Scenario: NAJPTC-Unequipped Train on Controlled (Passing) Siding & NAJPTC-Equipped Train on Main

- Accident Scenario: NAJPTC unequipped train erroneously leaving siding (SPAD); NAJPTC equipped train entering the Control Point block
  - Cause: Dispatcher misreads map or crew ignores signal
  - Action: NAJPTC unequipped train passes RED Control Point Signal and exits siding; NAJPTC equipped train on main between Intermediate & Control Point Signals
  - NAJPTC equipped train on main: NAJPTC System will detect the unequipped train when it shunts the main track, timeout results in potentially late enforcement
  - NAJPTC unequipped train entering main from siding: The train will be unaware of the approaching train on the main
- Accident Type: Head-on collision between locomotives. See also Section 2, page E-27 for corresponding side impact scenario
- NAJPTC risk effect: Collision will be prevented or collision speed reduced

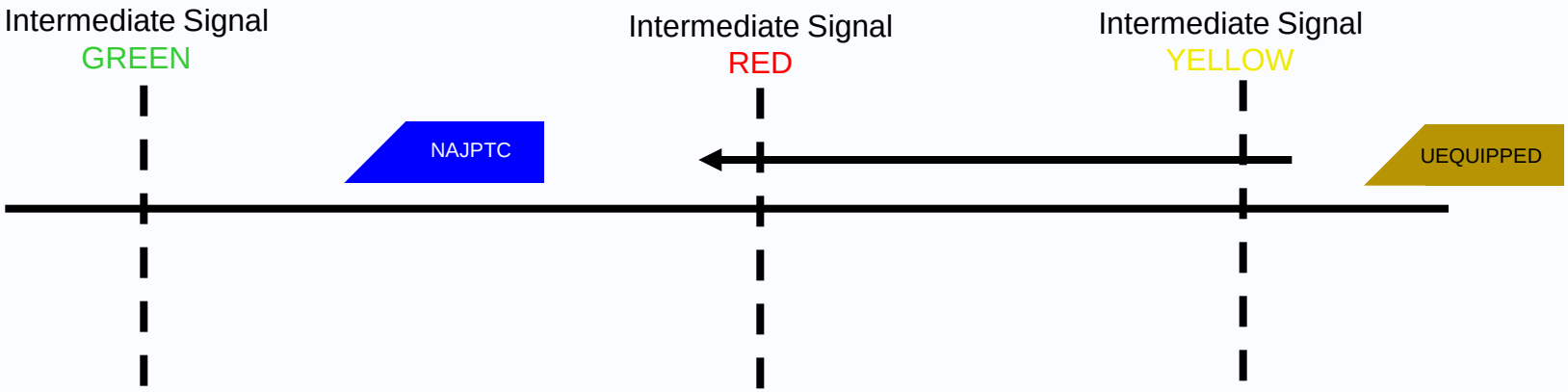


Section 2: Collision Between Two Active IDOT Corridor Trains: Head (Locomotive) with Rear or Side of Second Train

- Train rear-ends a stationary or slower moving train on main
- Train exiting uncontrolled siding in reverse. Collision on main with train traveling in same direction
- Train exiting uncontrolled siding. Collision on main with train traveling in same direction
- Train exiting uncontrolled siding, collides with side of train traveling in opposite direction.
- Train exiting controlled siding, collides with side of train traveling in opposite direction.
- Train exiting controlled siding. Collision with train traveling on main same direction

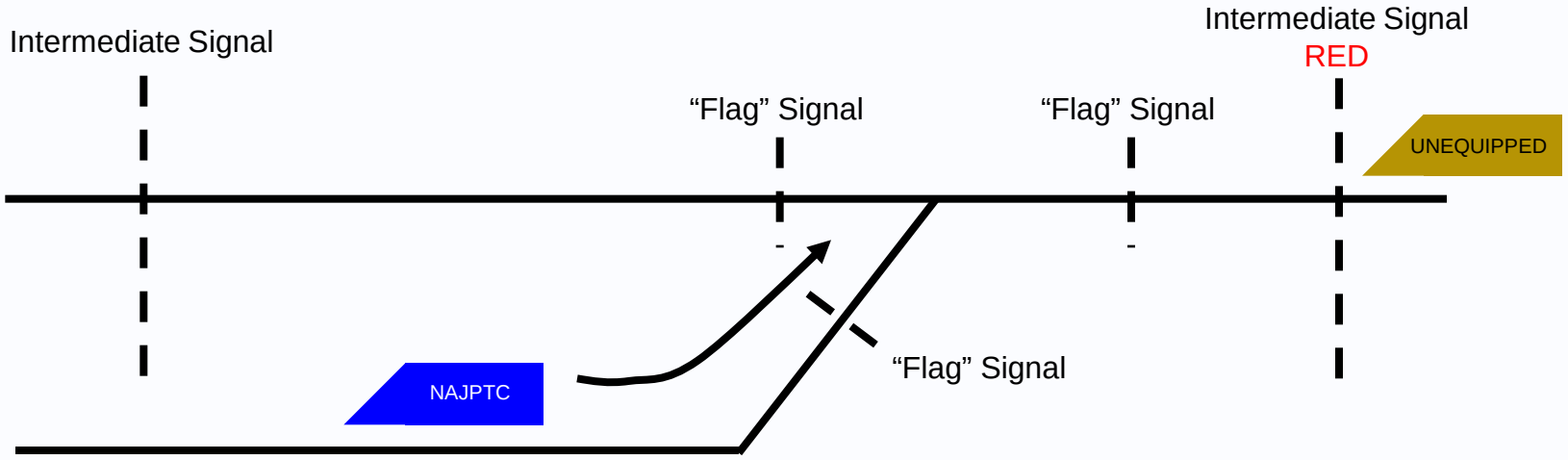
Accident Scenario: NAJPTC-Equipped Active Train Followed by NAJPTC-Unequipped Train on Main

- Accident Scenario: NAJPTC equipped train on main. Following unequipped train entering block (SPAD)
  - Cause: Crew ignores intermediate signal
  - Action: Following unequipped train passes RED Intermediate Signal on main. No warning possible
- Accident Type: Rear end collision. Locomotive of train on main strikes rear of train exiting siding
- NAJPTC Risk Effect : - None. However, it is rare for a freight train to rear-end a passenger train because passenger trains usually operate at higher speed.



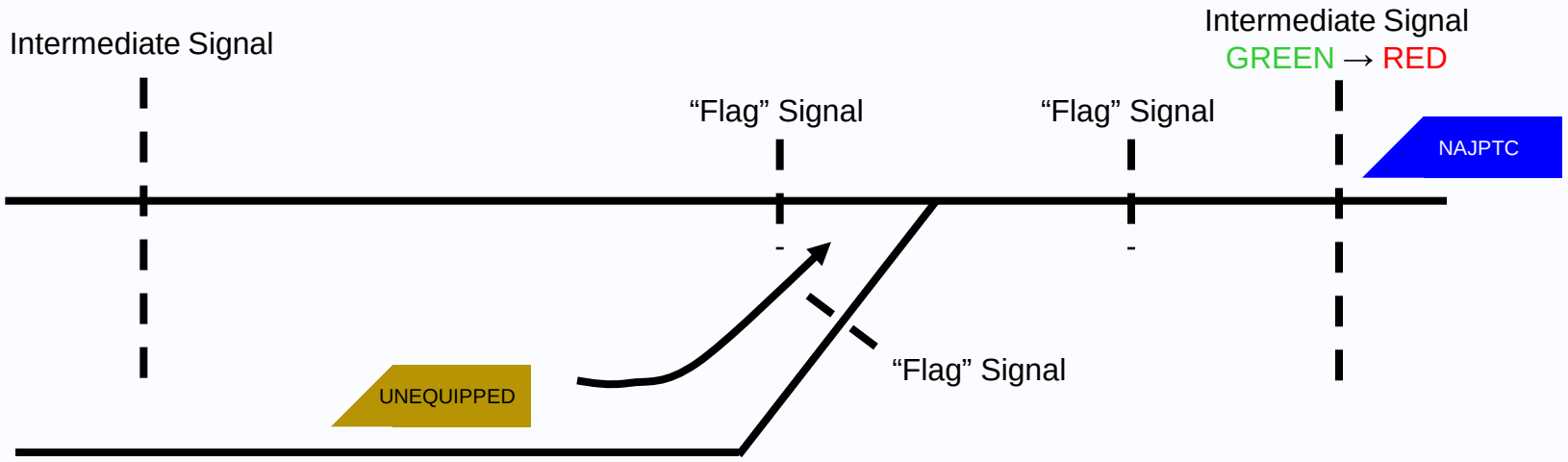
Accident Scenario: NAJPTC-Equipped Train on Uncontrolled Siding & NAJPTC-Unequipped Train on Main

- Accident Scenario: NAJPTC equipped train leaving siding (reverse move) & NAJPTC unequipped train entering block (SPAD)
  - Cause: Crew ignores signal
  - Action: NAJPTC unequipped passes RED Intermediate Signal on main; NAJPTC equipped train exiting siding
  - NAJPTC unequipped train on main: continues movement at current speed
  - NAJPTC equipped train entering main from siding: The train will be unaware of the approaching train
- Accident Type: Rear-end collision
- NAJPTC Risk effect: None, unequipped train cannot take preventative action.



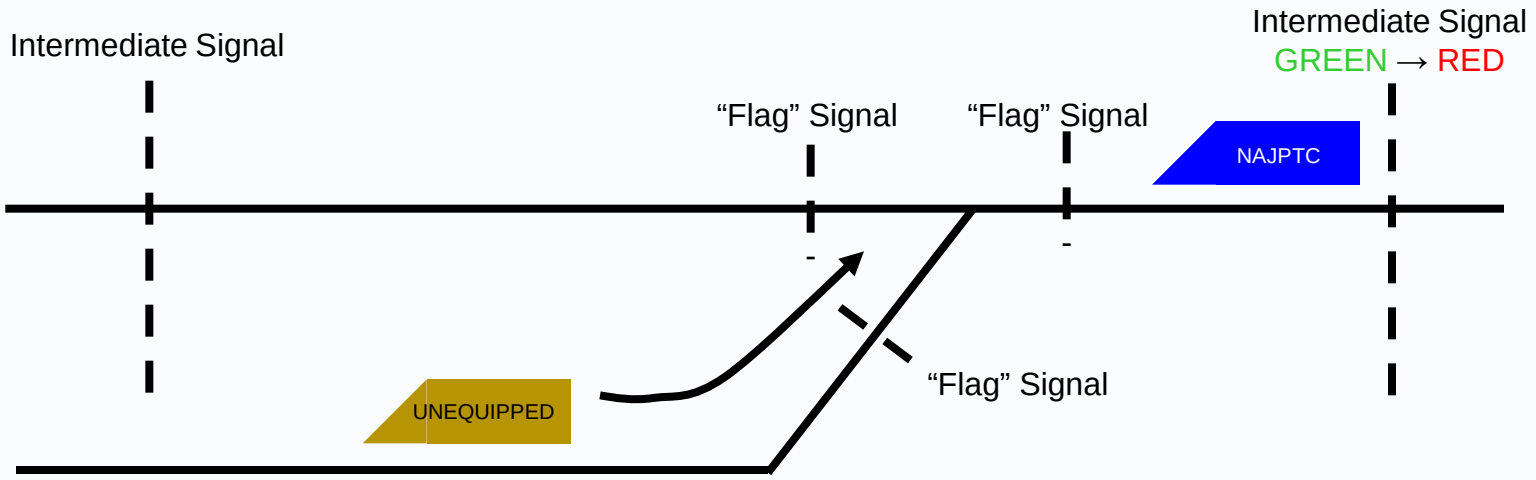
Accident Scenario: NAJPTC-Unequipped Train on Uncontrolled Siding & NAJPTC-Equipped Train on Main

- Accident Scenario: NAJPTC unequipped train leaving siding & NAJPTC equipped train entering block
  - Cause: Dispatcher misreads map or crew ignores signal
  - Action: NAJPTC unequipped train erroneously exits siding and enters main; NAJPTC equipped train passing Intermediate Signal
  - NAJPTC equipped train on main: Train will see Intermediate Signal change when exiting train reaches main track track-circuit, timeout results in potentially delayed enforcement
  - NAJPTC unequipped train entering main from siding: The train will be unaware of the approaching train
- Accident Type: Rear-end collision. Train on main strikes rear of train exiting siding



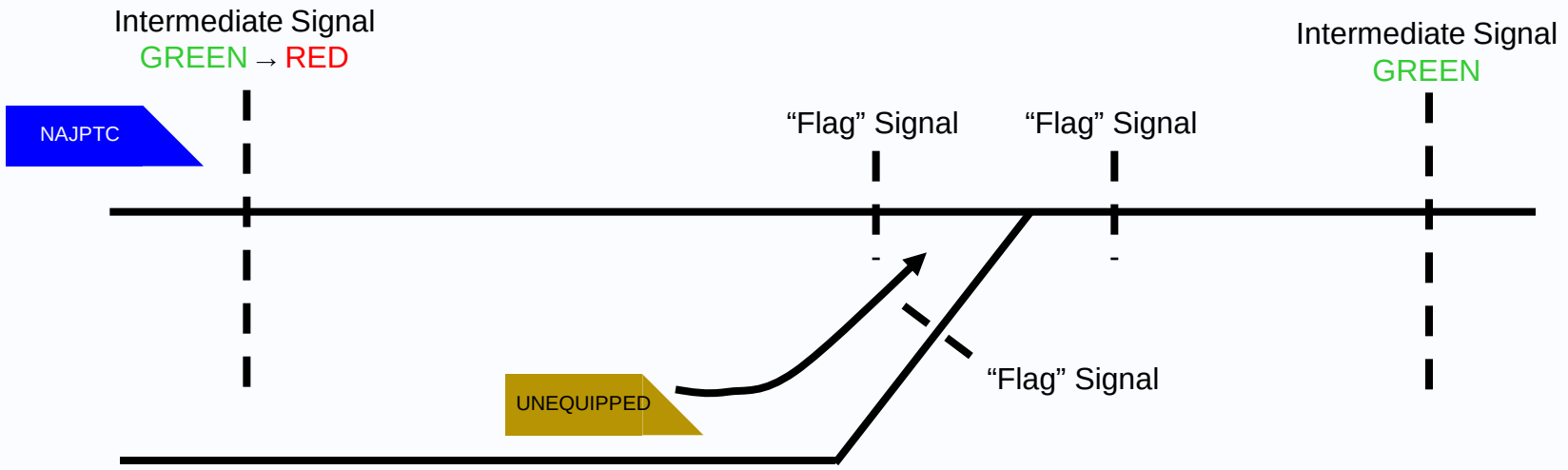
Accident Scenario: NAJPTC-Unequipped Train on Uncontrolled Siding & NAJPTC-Equipped Train on Main

- Accident Scenario: NAJPTC unequipped train leaving siding & NAJPTC equipped train in block
  - Cause: Dispatcher misreads map or crew ignores signal
  - Action: NAJPTC unequipped erroneously exits siding and enters main; NAJPTC equipped train has passed Intermediate Signal
  - NAJPTC equipped train on main: NAJPTC does not use coded track circuit, therefore design, not timeout, impacts safety; timeout has no effect, The train will be unaware of the encroaching train
  - NAJPTC unequipped train entering main line from siding: The train will be unaware of the approaching train
- Accident Type: Rear-end, side or raking collision. Train on main strikes train exiting from siding.
- NAJPTC Risk effect: NAJPTC train already occupying block and cannot receive a warning. No preventative effect



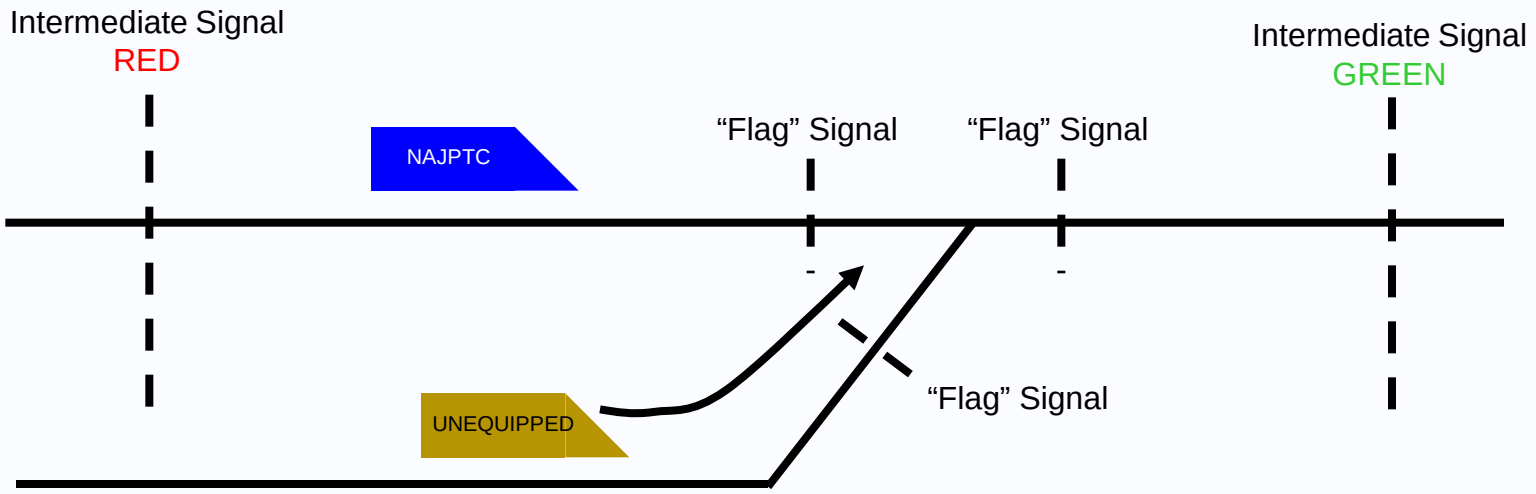
Accident Scenario: NAJPTC-Equipped Active Train on Main and Unequipped Train on Uncontrolled Siding

- Accident Scenario: Unequipped train leaving siding & NAJPTC equipped train approaching intermediate signal
  - Cause: Dispatcher misreads map or crew ignores signal
  - Action: Unequipped train erroneously exits siding and enters main; NAJPTC equipped train passed Intermediate Signal
  - NAJPTC equipped train on main: NAJPTC locomotive onboard equipment enforces braking to slow to stop train. Timeout will delay response
  - Unequipped train on siding: continues unaware of approaching equipped train
- Accident Type: Rear-end, side or raking collision. Train exiting siding strikes train or vise-versa depending on relative position and speed of trains
- ATC Risk Effect: Collision may be prevented or closing speed of collision reduced, depending on the position of the two trains relative to the collision point



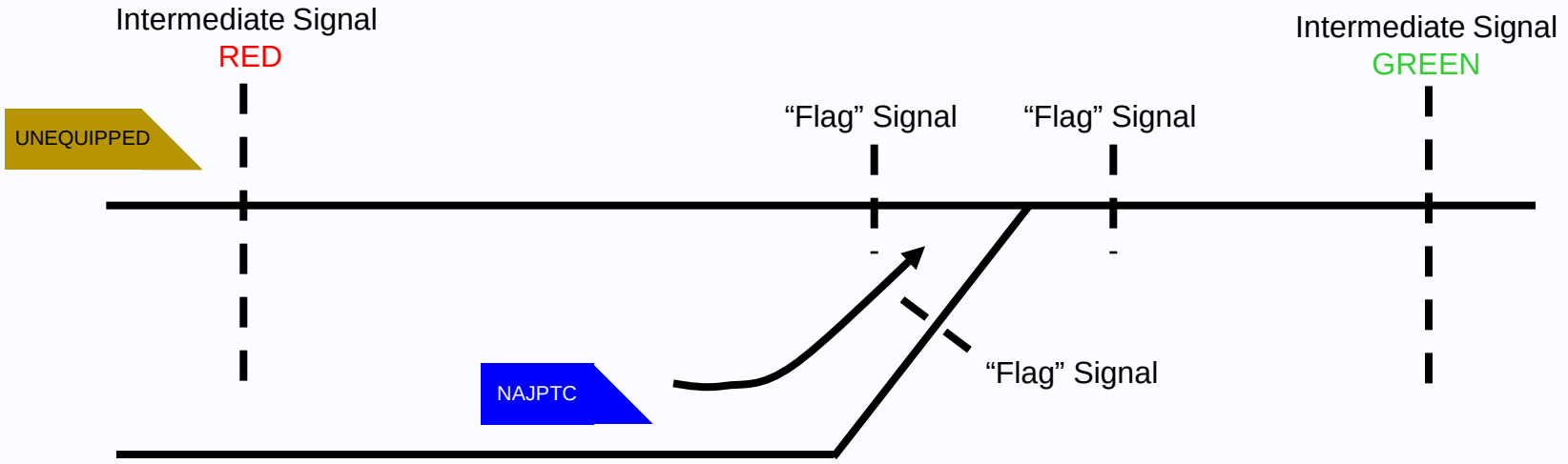
Accident Scenario: NAJPTC-Equipped Active Train on Main and Unequipped Train on Uncontrolled Siding

- Accident Scenario: NAJPTC Unequipped train leaving siding & NAJPTC equipped train in block
  - Cause: Dispatcher misreads map or crew ignores signal
  - Action: NAJPTC unequipped train erroneously exits siding and enters main; NAJPTC equipped train has passed Intermediate Signal
  - NAJPTC equipped train on main. No action, NAJPTC cannot detect second train in block
  - NAJPTC unequipped train on siding: continues unaware of approaching train
  - Accident Type: Rear, side or raking collision. Train exiting siding strikes train or vise-versa depending on relative position and speed of trains
- NAJPTC Risk Effect: None, NAJPTC cannot detect violation



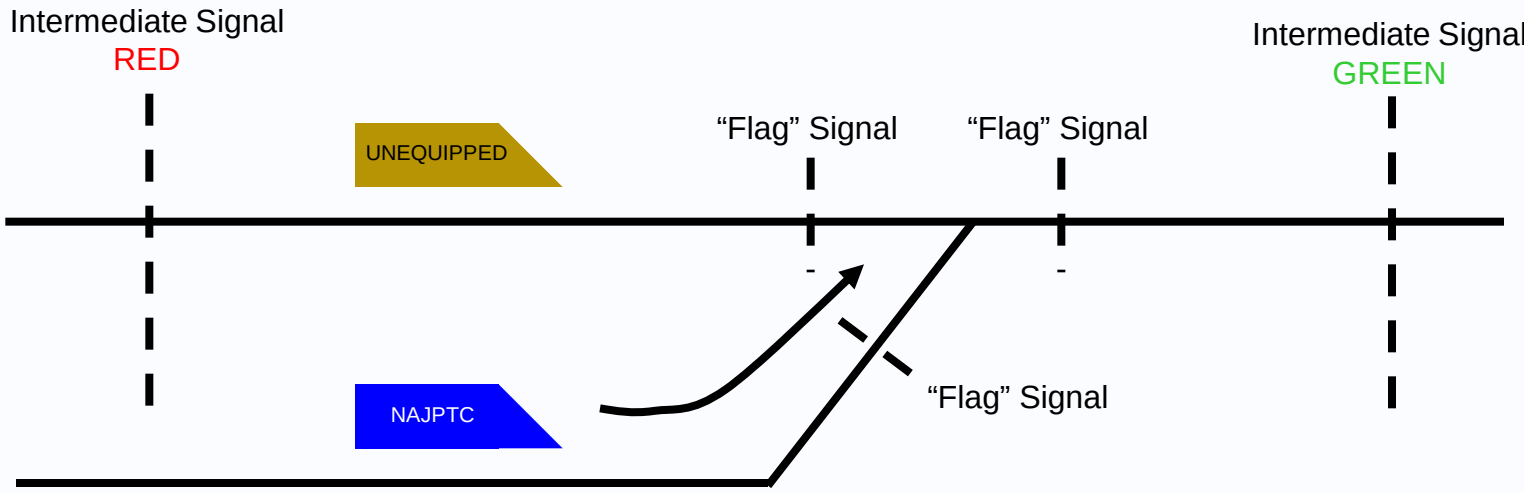
Accident Scenario: NAJPTC-Unequipped Active Train on Main and NAJPTC-Equipped Train on Uncontrolled Siding

- Accident Scenario: NAJPTC equipped train leaving siding & unequipped train approaching intermediate signal
  - Cause: Dispatcher misreads map or crew ignores signal
  - Action: Unequipped train erroneously passes intermediate signal
  - NAJPTC equipped train on siding: NAJPTC locomotive onboard equipment enforces braking to slow to stop train, provided it is still in siding. Timeout will delay response. If NAJPTC equipped train has left siding and occupies main line block, it will be unaware of violation and cannot avoid collision
  - Unequipped train on continues unaware of equipped train leaving siding
- Accident Type: Rear-end, side or raking collision. Train exiting siding strikes train or vise-versa depending on relative position and speed of trains
- ATC Risk Effect: Collision could be prevented only if NAJPTC-equipped train has not left siding. NAJPTC would not give authority for train to enter block occupied by another train



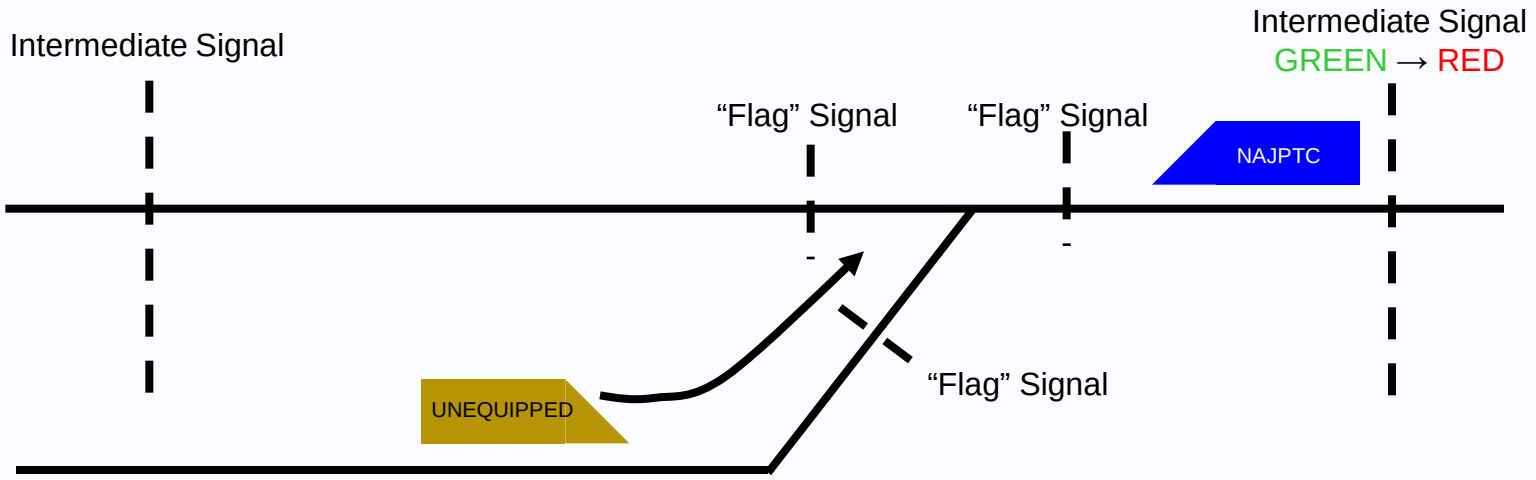
Accident Scenario: NAJPTC-Unequipped Active Train on Main and NAJPTC-Equipped Train on Uncontrolled Siding

- Accident Scenario: NAJPTC equipped train leaving siding & unequipped train in block
  - Cause: Dispatcher misreads map or crew ignores signal
  - Action: NAJPTC equipped train ready to exit siding and unequipped train has passed Intermediate Signal
  - NAJPTC Unequipped train on main. No action, unequipped train would continue at same speed
  - NAJPTC equipped train on siding: would not receive authority to leave siding
  - Accident Type: Rear, side or raking collision. Train exiting siding strikes train or vise-versa depending on relative position and speed of trains
- NAJPTC Risk Effect: Accident would be prevented. NAJPTC would not receive authority to enter block occupied by another train



Accident Scenario: NAJPTC-Unequipped Train on Uncontrolled Siding & NAJPTC-Equipped Train on Main

- Accident Scenario: NAJPTC unequipped train leaving siding & NAJPTC equipped train in block traveling in opposite direction
  - Cause: Dispatcher misreads map or crew ignores signal
  - Action: NAJPTC unequipped erroneously exits siding and enters main; NAJPTC equipped train has passed Intermediate Signal
  - NAJPTC equipped train on main: NAJPTC does not use coded track circuit, therefore design, not timeout, impacts safety; timeout has no effect, The train will be unaware of the encroaching train
  - NAJPTC unequipped train entering main line from siding: The train will be unaware of the approaching train
- Accident Type: Side or raking collision. Train exiting siding strikes train on main behind locomotive. See page E-14 for corresponding head-on collision scenario
- NAJPTC Risk Effect: None. Train exits siding after locomotive of train on main has passed

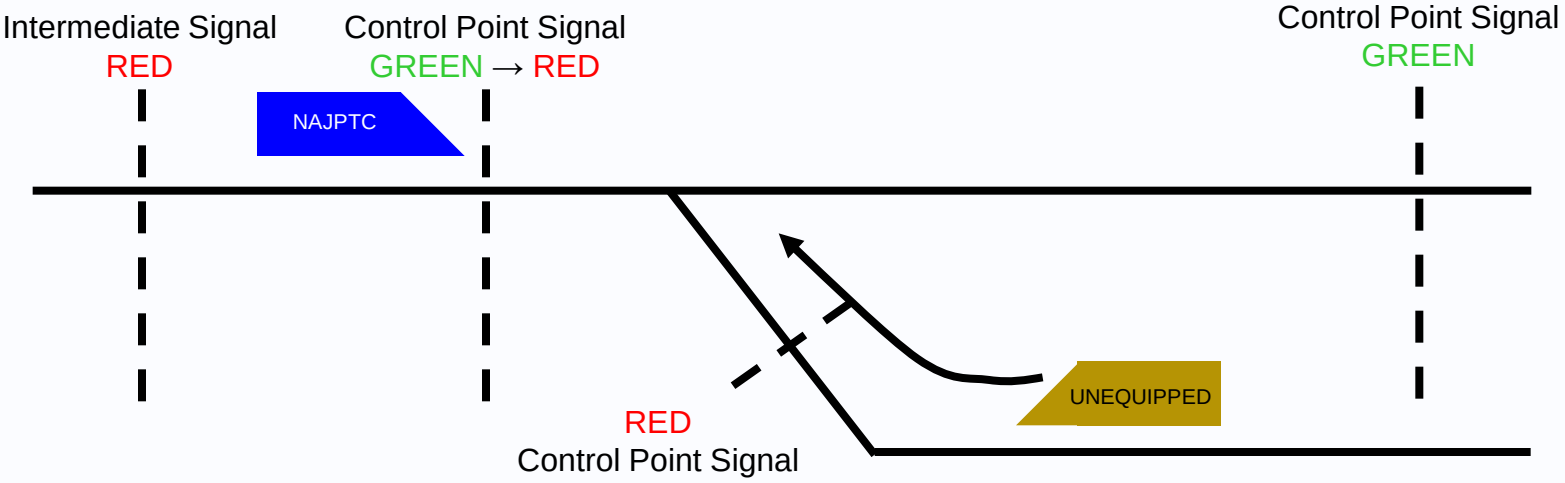


Accident Scenario: NAJPTC-Unequipped Train on Controlled (Passing) Siding & NAJPTC-Equipped Train on Main

- Accident Scenario: NAJPTC unequipped train erroneously leaving siding (SPAD); NAJPTC equipped train entering the Control Point block
  - Cause: Dispatcher misreads map or crew ignores signal
  - Action: NAJPTC unequipped train passes RED Control Point Signal and exits siding; NAJPTC equipped train on main between Intermediate & Control Point Signals
  - NAJPTC equipped train on main: NAJPTC System will detect the unequipped train when it shunts the main track, timeout results in potentially late enforcement
  - NAJPTC unequipped train entering main from siding: The train will be unaware of the approaching train on the main

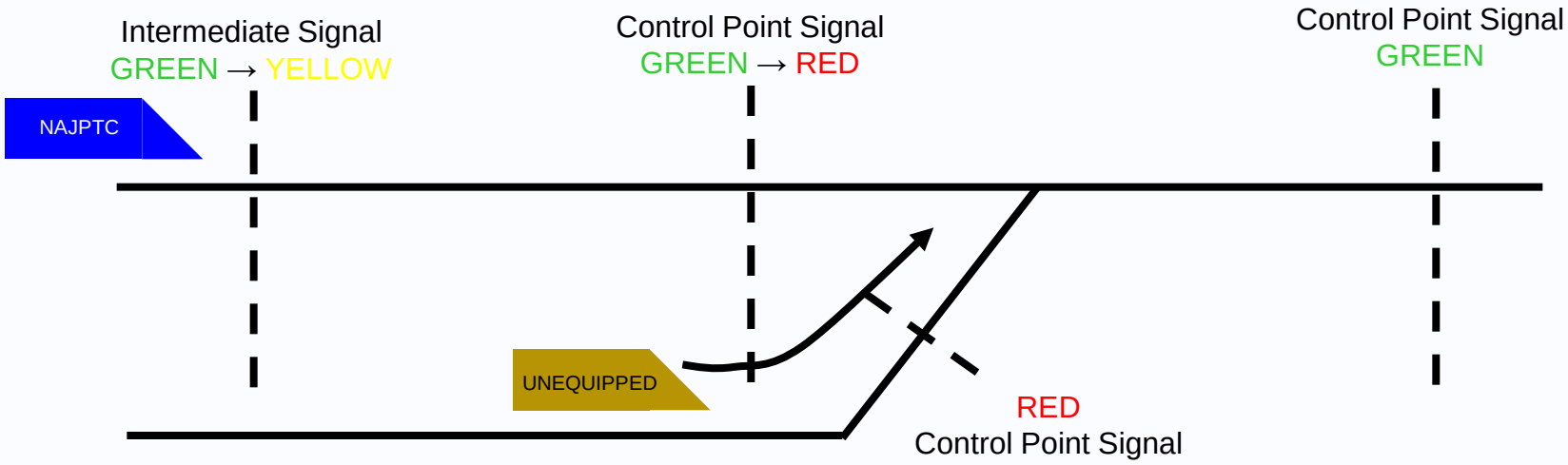
- Accident Type: Train exiting siding hits train on main behind locomotive. See also Section 1, page E-16 for corresponding head-on collision scenario

- NAJPTC risk effect: Limited – NAJPTC equipped train may not be able to slow or stop to prevent collision in spite of enforcement.



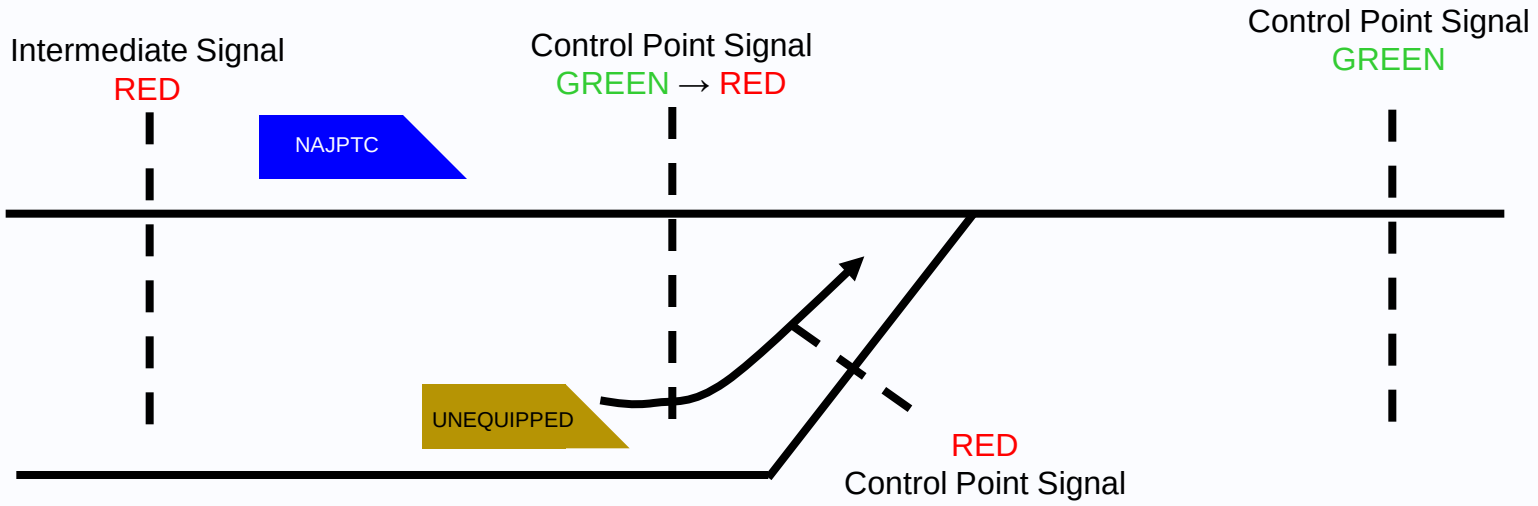
Accident Scenario: NAJPTC-Unequipped Train on Controlled (Passing) Siding & NAJPTC-Equipped Train on Main

- Accident Scenario: NAJPTC unequipped train erroneously leaving siding (SPAD); NAJPTC equipped train passing Intermediate Signal and approaching the Control Point
  - Cause: Dispatcher misreads map or crew ignores signal
  - Action: NAJPTC unequipped train passes RED Control Point Signal and exits siding; NAJPTC equipped train on main passes Intermediate Signal
  - NAJPTC equipped train on main: The NAJPTC system will detect the unequipped train once it shunts the tracks, timeout results in potentially late enforcement on the NAJPTC equipped train
  - NAJPTC unequipped train entering main from siding: The train will be unaware of the approaching train on the main.
- Accident Type: Rear-end; side or raking collision.
- NAJPTC Risk effect: NAJPTC equipped train on main could slow or stop before reaching collision point



Accident Scenario: NAJPTC-Unequipped Train on Controlled (Passing) Siding & NAJPTC-Equipped on Main

- Accident Scenario: NAJPTC unequipped train erroneously leaving siding (SPAD); NAJPTC equipped train entering the Control Point block
  - Cause: Dispatcher misreads map or crew ignores Control Point Signal
  - Action: NAJPTC unequipped train passes RED Control Point Signal and exits siding; NAJPTC equipped train on main between Intermediate & Control Point Signals
  - NAJPTC equipped train on main: The NAJPTC System will detect the unequipped train once it shunts the track, timeout results in potentially late enforcement on the NAJPTC equipped train
  - NAJPTC unequipped train entering main from siding: Once the Red Control Point Signal is passed the train will be unaware of the approaching train on the main
- Accident Type: Rear-end, side or raking collision
- NAJPTC Risk effect: NAJPTC equipped train on main could slow or stop before reaching collision point

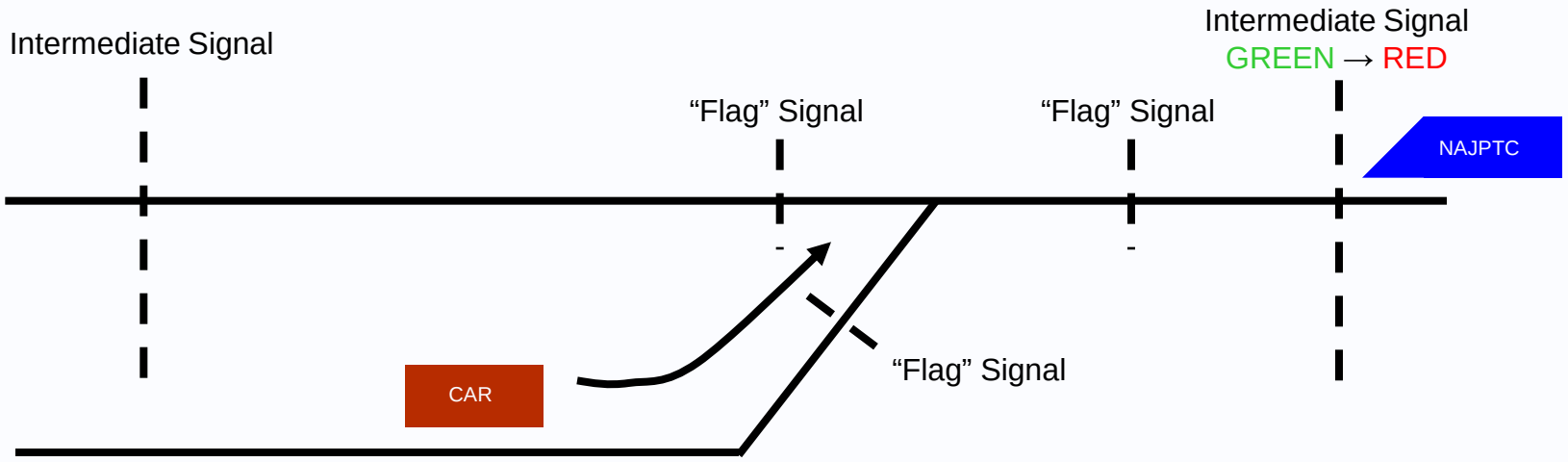


Section 3: Collision Between the Head (Locomotive) of an Active IDOT Test Corridor Train and an Intruding Rail Vehicle or Vehicle Lading

- Unsecured or mishandled rail vehicle rolling onto main track, or positioned “not in clear” at siding or industry track switch
  - Active train approaching signal block in which intrusion occurred
  - Active train in same block as intrusion
- Intrusions into clearance envelope of main track from adjacent track away from connecting turnout
  - Derailed vehicle on adjacent track
  - Shifted load on vehicle on adjacent track

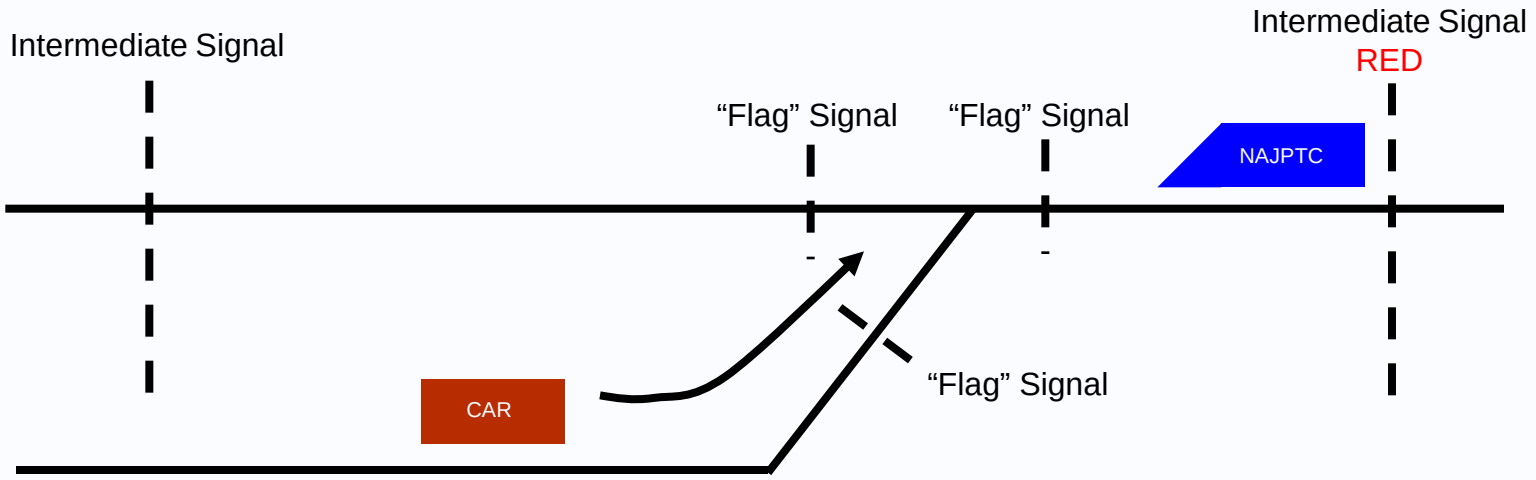
Accident Scenario: Equipment on Uncontrolled Siding & NAJPTC-Equipped Train on Main

- Accident Scenario: Car rolls from siding onto main (assume car shunts track circuit) & NAJPTC equipped train entering block
  - Cause: Car(s) not properly secured
  - Action: Car(s) erroneously exit siding and enter main; NAJPTC equipped train passing Intermediate signal
  - NAJPTC equipped train on main: NAJPTC System will detect the car, timeout results in potentially late enforcement
- Accident Type: Intrusion collision – locomotive of active train strikes car or cut of cars exiting siding
- NAJPTC risk effect: NAJPTC equipped train brakes, avoiding a collision or reducing collision speed



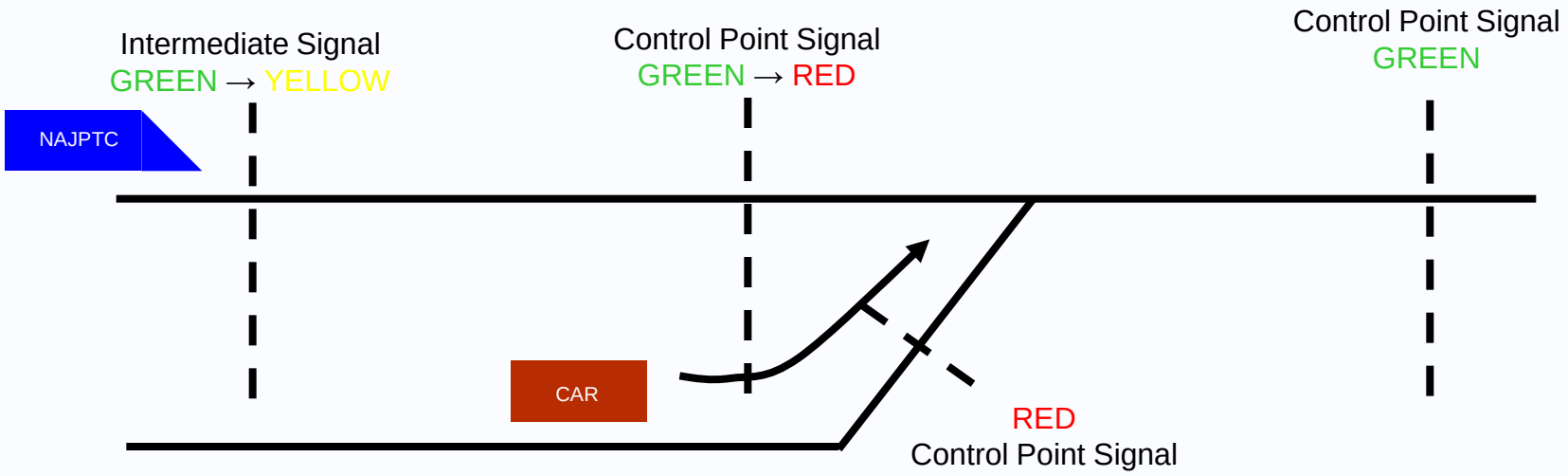
Accident Scenario: Equipment on Uncontrolled Siding & NAJPTC-Equipped Train on Main

- Accident Scenario: Car rolls from siding onto main (assume car shunts track circuit) & NAJPTC equipped train entering block
  - Cause: Car(s) not properly secured
  - Action: Car(s) erroneously exit siding and enter main; NAJPTC equipped train has passed the Intermediate Signal
  - NAJPTC equipped train on main: NAJPTC does not use coded track circuit, therefore design, not timeout, impacts safety; timeout has no effect, The train will be unaware of the encroaching train
- Accident Type: Intrusion collision – locomotive of active train strikes car or cut of cars exiting siding
- NAJPTC risk effect: None, NAJPTC cannot detect a second interruption to the track circuit in the same block.



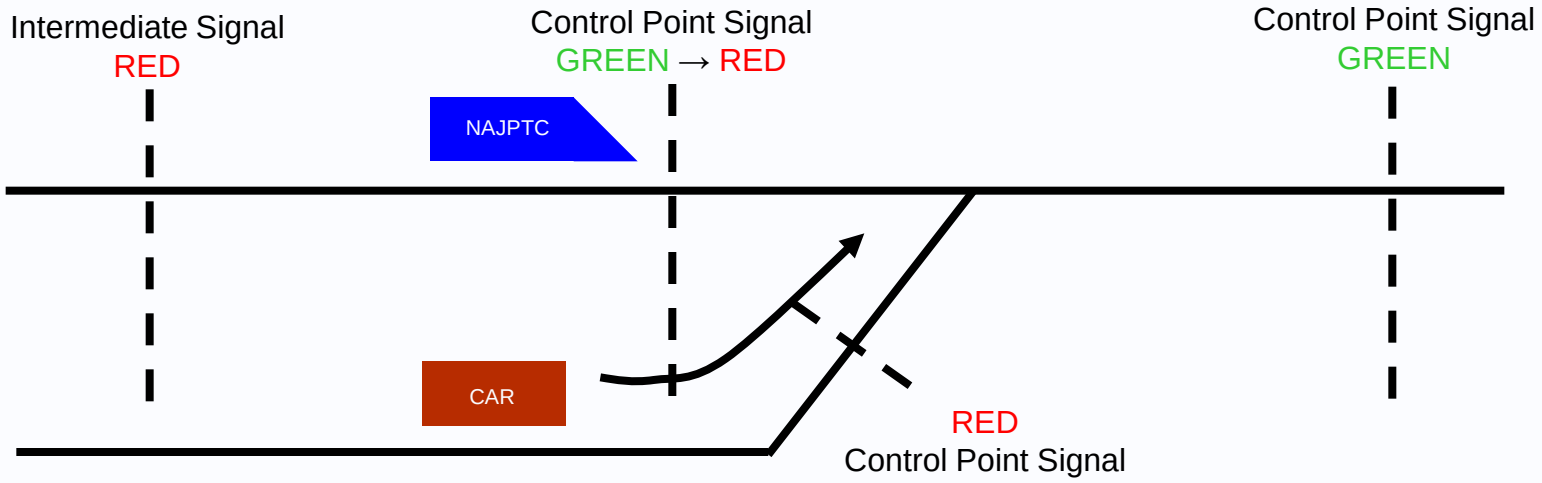
Accident Scenario: Equipment on Controlled Siding & NAJPTC-Equipped Train on Main

- Accident Scenario: Car rolls from siding onto main (assume car shunts track circuit) & NAJPTC equipped train entering block between Intermediate and Control Point Signal
  - Cause: Car not properly secured
  - Action: Cars erroneously exits siding and enters main; NAJPTC equipped train passing Intermediate Signal
  - NAJPTC equipped train on main: The NAJPTC System will detect the car when it shunts the main track, timeout results in potentially late enforcement
- Accident Type: Intrusion collision – locomotive of active train strikes car or cut of cars exiting siding
- NAJPTC risk effect: NAJPTC equipped train will detect intrusion and slow or stop before collision



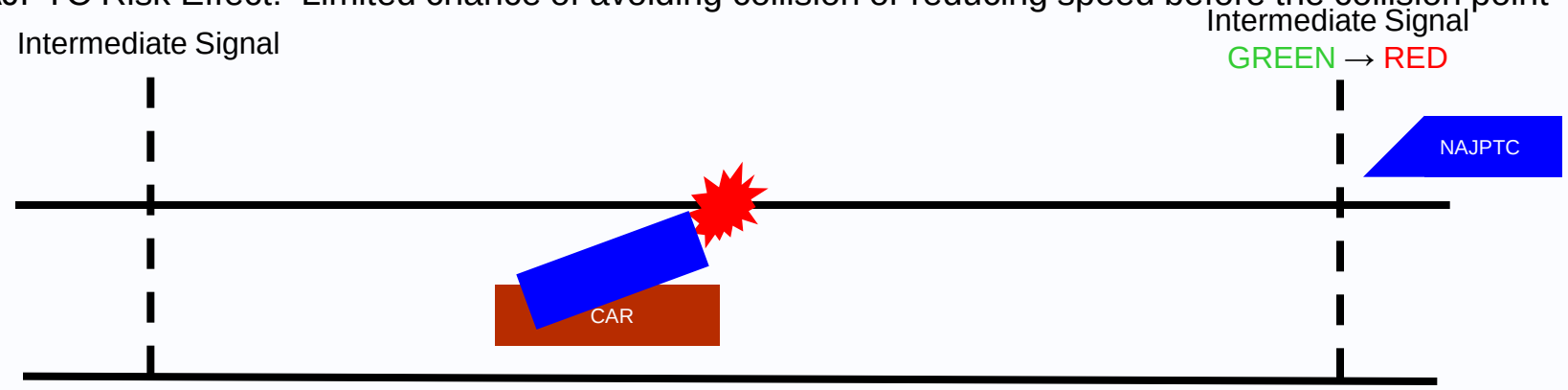
Accident Scenario: Equipment on Controlled Siding & NAJPTC-Equipped Train on Main

- Accident Scenario: Car rolls from siding onto main (assume car shunts track circuit) & NAJPTC equipped train entering block
  - Cause: Car(s) not properly secured
  - Action: Car(s) erroneously exit siding and enter main; NAJPTC equipped train passing Control Point Signal
  - NAJPTC equipped train on main: The NAJPTC system will detect the car when it shunts the main track, timeout will result in a delay in enforcement
- Accident Type: Intrusion collision – locomotive of active train strikes car or cut of cars exiting siding
- NAJPTC risk effect: Active train will receive stop command, NAJPTC will ensure braking to avoid collision or reduce collision speed



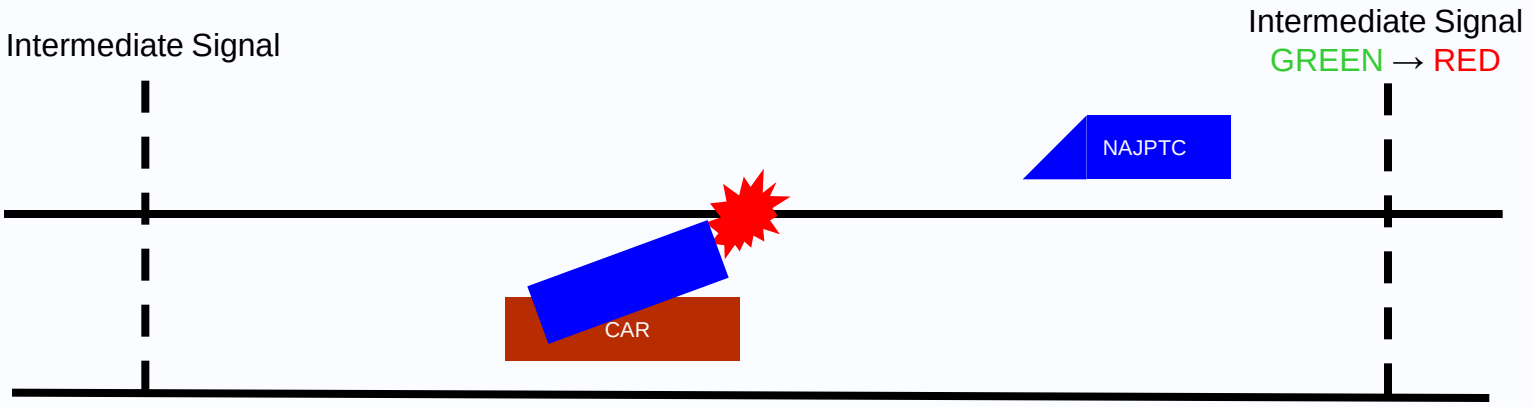
Accident Scenario: Car With Shifted Load on Adjacent Track & NAJPTC-Equipped Active Train on Main

- Accident Scenario: Shifted load on car on adjacent track fouls main track. ATC train approaching Intermediate signal at block entry
  - Cause: Shifted load for any reason
  - Action: Derailed shifted equipment fouls main track; NAJPTC equipped train passing Intermediate Signal
  - NAJPTC equipped train on main: IF shifted load shunts coded track circuit on main, NAJPTC locomotive will receive stop command and train will break whether or not Engineer responds. Timeout would delay response. Note: shifted load would have to fall and shunt track circuit to be detected, which is unlikely.
- Accident Type: Intrusion – main is fouled away from connecting switch
- NAJPTC Risk Effect: Limited chance of avoiding collision or reducing speed before the collision point



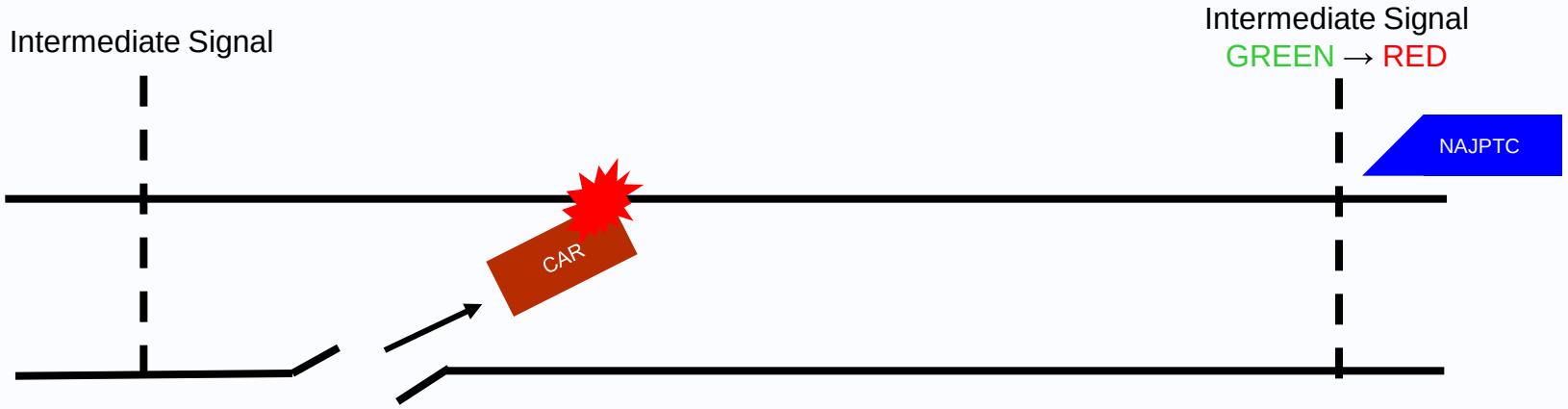
Accident Scenario: Car With Shifted Load on Adjacent Track & NAJPTC-Equipped Active Train on Main

- Accident Scenario: Shifted load on car on adjacent track fouls main track. ATC-equipped train in same block as intrusion
  - Cause: Shifted load for any reason
  - Action: Derailed car fouls main track; NAJPTC equipped train passing Intermediate Signal
  - NAJPTC equipped train on main: No effect – NAJPTC cannot detect track circuit interruption in the block occupied by the train. No separate intrusion detection system available
- Accident Type: Intrusion – main is fouled away from connecting switch
- NAJPTC Risk Effect: None – NAJPTC cannot detect track circuit interruption in the same block



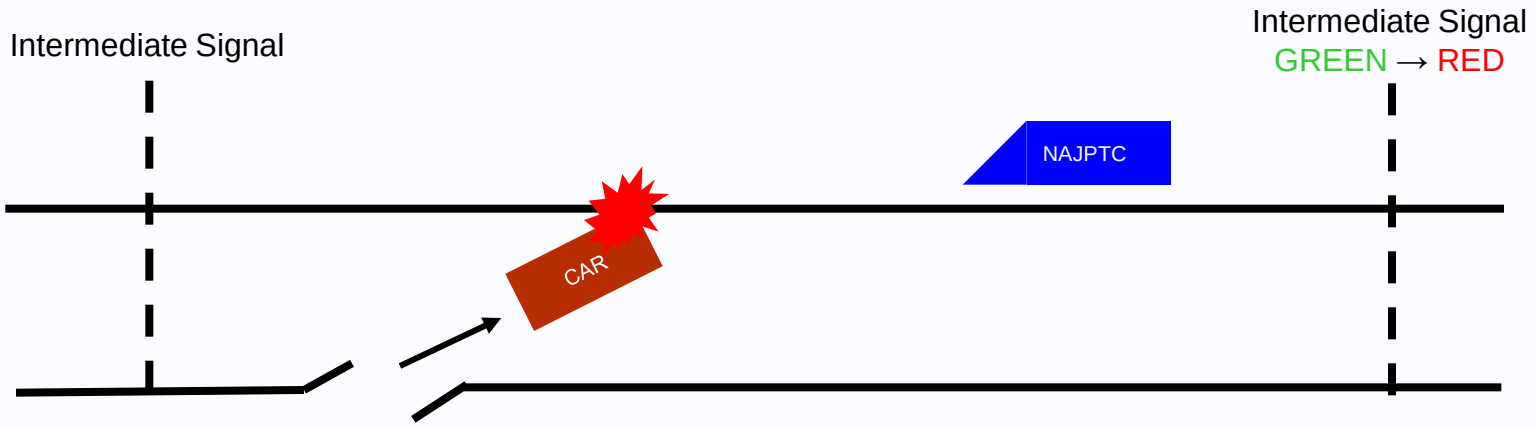
Accident Scenario: Derailed Car on Adjacent Track & NAJPTC-Equipped Active Train on Main

- Accident Scenario: Car or cars derail on adjacent track and foul main track. NAJPTC train approaching intermediate signal.
  - Cause: Derailment form any track or equipment defect or human error
  - Action: Derailed car(s) foul main track; NAJPTC equipped train approaching Intermediate Signal
  - NAJPTC equipped train on main: IF derailed car shunts track circuit on main, NAJPTC locomotive NAJPTC locomotive will receive stop command and train will break whether or not Engineer responds. Timeout would delay response.
  - Accident Type: Intrusion – main is fouled away from connecting switch
- NAJPTC Risk effect: Could prevent a collision or reduce NAJPTC-equipped train speed at the intrusion, IF derailed car shunts main track circuit



Accident Scenario: Derailed Car on Adjacent Track & NAJPTC-Equipped Active Train on Main

- Accident Scenario: Car or cars derail on adjacent track and foul main track. NAJPTC train in same block as intrusion.
  - Cause: Derailment form any track or equipment defect or human error
  - Action: Derailed car(s) foul main track; NAJPTC equipped train approaching Intermediate Signal
  - NAJPTC equipped train on main: No response, even IF derailed car shunts coded track circuit on main. NAJPTC locomotive cannot detect track circuit interruption in the block occupied by the train. No separate intrusion detection system available
  - Accident Type: Intrusion – main is fouled away from connecting switch
- NAJPTC Risk Effect: No effect NAJPTC cannot detect track circuit interruption in same block

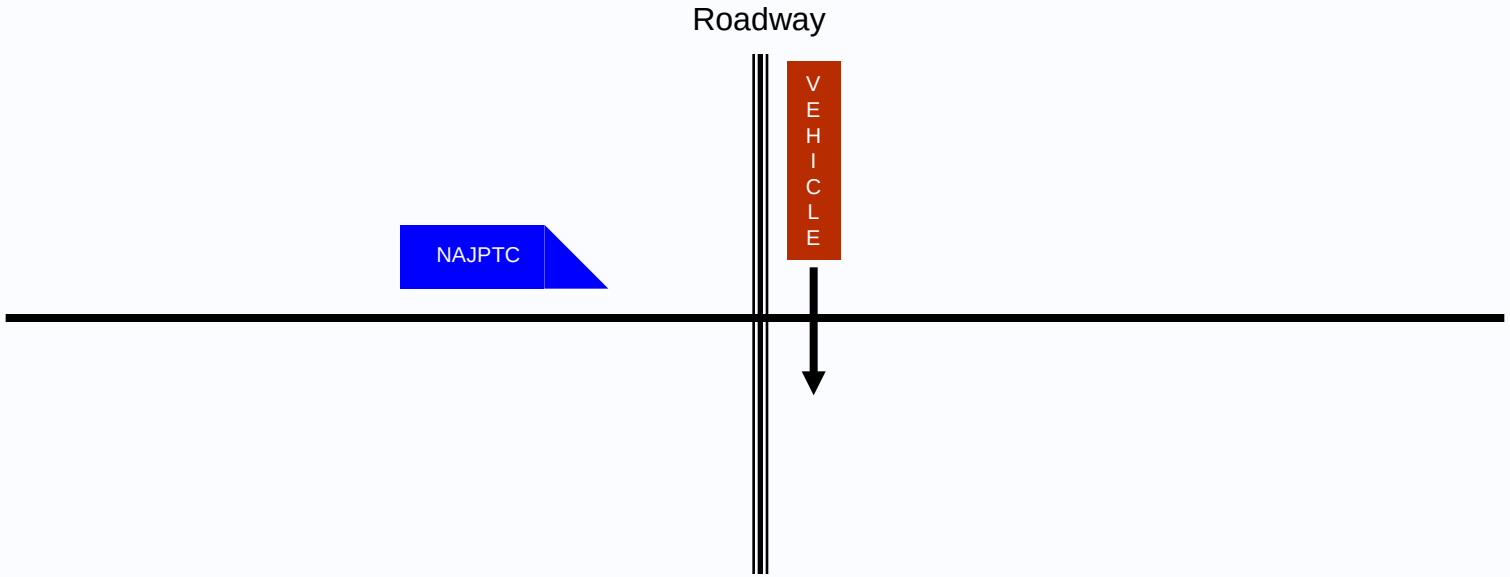


Section 4: Other Accident Types Involving a Single Active IDOT Test Corridor Train

- Collision with a highway vehicle at a grade crossing
- Collision with crossing train at a diamond crossing with another railroad
- Work zone intrusion or collision with work equipment (Form A)
- Over speed derailment at temporary (Form B) or permanent speed restriction
- Broken rail derailment

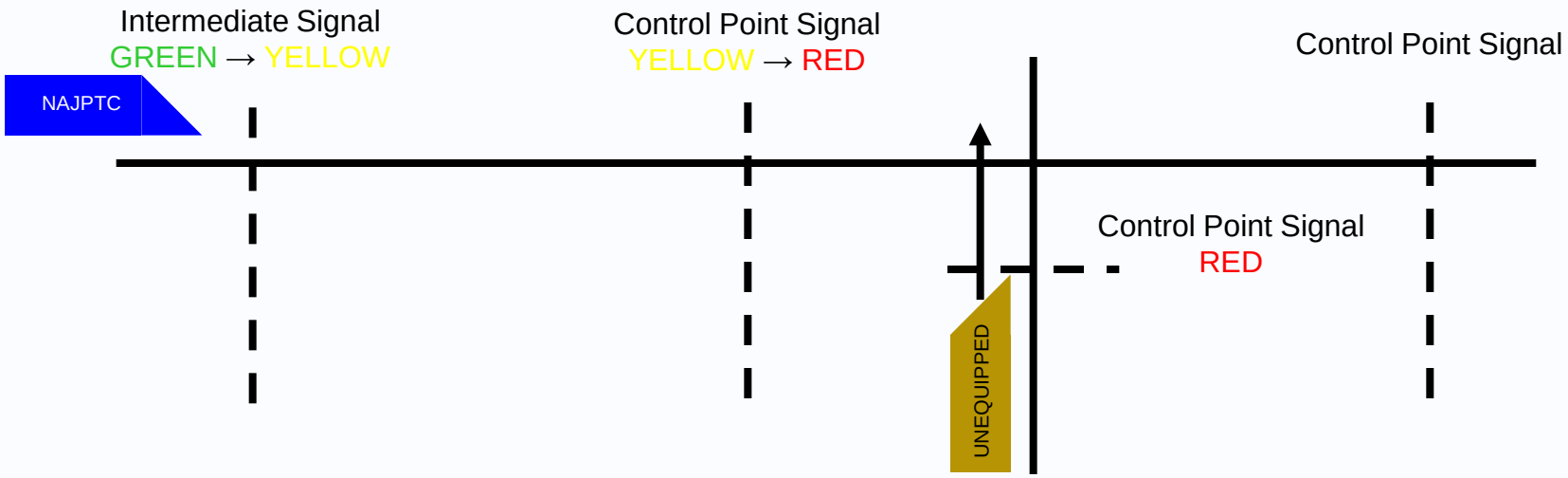
Accident Scenario: NAJPTC-Equipped Train at a Grade Crossing

- Accident Scenario: Vehicle crosses tracks in front of NAJPTC equipped train
  - Cause: Human error by highway vehicle driver
  - Action: Vehicle driver violates grade crossing
  - NAJPTC provides feedback monitoring to NAJPTC equipped train; radio based advanced activation required because track circuit based activation would not respond in time for 110 MPH operation (tells gate to activate & train slows); timeout results in potentially late enforcement
- Accident Type: Train to highway vehicle. Potential for derailment following grade crossing impact, especially with heavy truck
- NAJPTC risk effect: NAJPTC could cause train to slow in case of defective crossing warning system, preventing collision or reducing collision speed.



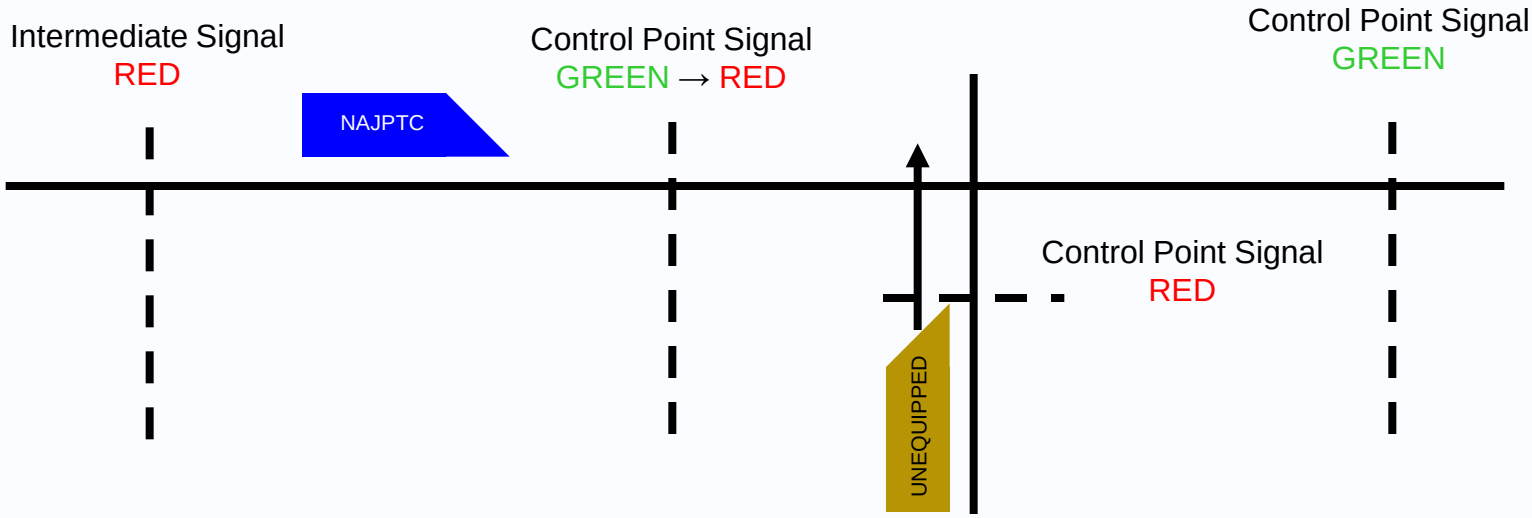
Accident Scenario: NAJPTC-Equipped & Unequipped Trains at a Diamond

- Accident Scenario: NAJPTC unequipped train erroneously enters diamond (SPAD)
  - Cause: Dispatcher misreads map or crew ignores Control Point Signal
  - Action: NAJPTC unequipped train passes RED Control Point Signal and enters diamond; NAJPTC equipped train on main passes Intermediate Signal
  - NAJPTC equipped train on main: NAJPTC System will detect the unequipped train, timeout results in potentially late enforcement
  - NAJPTC unequipped train on crossing track: The unequipped train will be unaware of the approaching train
- Accident Type: Side collision between locomotive of one train and car of the second train.
- NAJPTC risk effect: NAJPTC will prevent collision or reduce collision speed



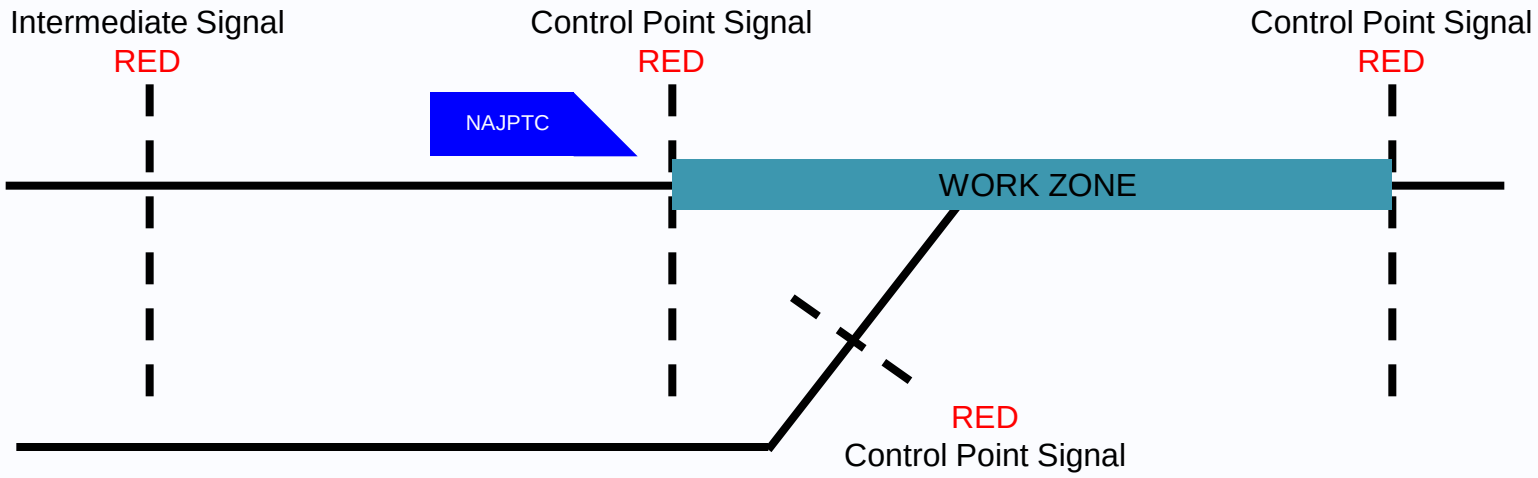
Accident Scenario: NAJPTC-Equipped & Unequipped Trains at a Diamond

- Accident Scenario: NAJPTC unequipped train erroneously enters Diamond (SPAD)
  - Cause: Dispatcher misreads map or crew ignores Control Point Signal
  - Action: NAJPTC unequipped train passes RED Control Point Signal; NAJPTC equipped train on main between Intermediate and Control Point Signals
  - NAJPTC equipped train on main: NAJPTC System will detect the unequipped train, timeout results in potentially late enforcement
  - NAJPTC unequipped train on crossing track: continues movement at current speed
- Accident Type: Side collision between the locomotive of one train and a car of the second train
- NAJPTC Risk effect: NAJPTC will cause active train to slow, preventing the collision or reducing collision speed.



Accident Scenario: Active NAJPTC-Equipped Train and Work Crew/Hi-Rail/Work Equipment

- Accident Scenario: Train contacts roadway worker(s) or hi-rail or work equipment, work zone protected by control point signal
  - Cause: Human error
  - Action: Train exceeds authority or work crew/equipment operating outside of authority
  - NAJPTC Case 1: Form B filed prior to train departure; authority limit downloaded to locomotive prior to departure from yard; train enforced at work zone limit
  - NAJPTC Case 2: Work zone created after train departure; dispatcher must wait for acknowledgement from NAJPTC onboard equipment prior to allowing work crew on track; train enforced at work zone limit. If very late notification, timeout could delay response to work zone limits
- Accident Type: Train to Work Crew/Hi-Rail/Work Equipment
- NAJPTC risk effect: Most work zone incursions will be prevented, may not prevent injury to work crew outside authority limits.

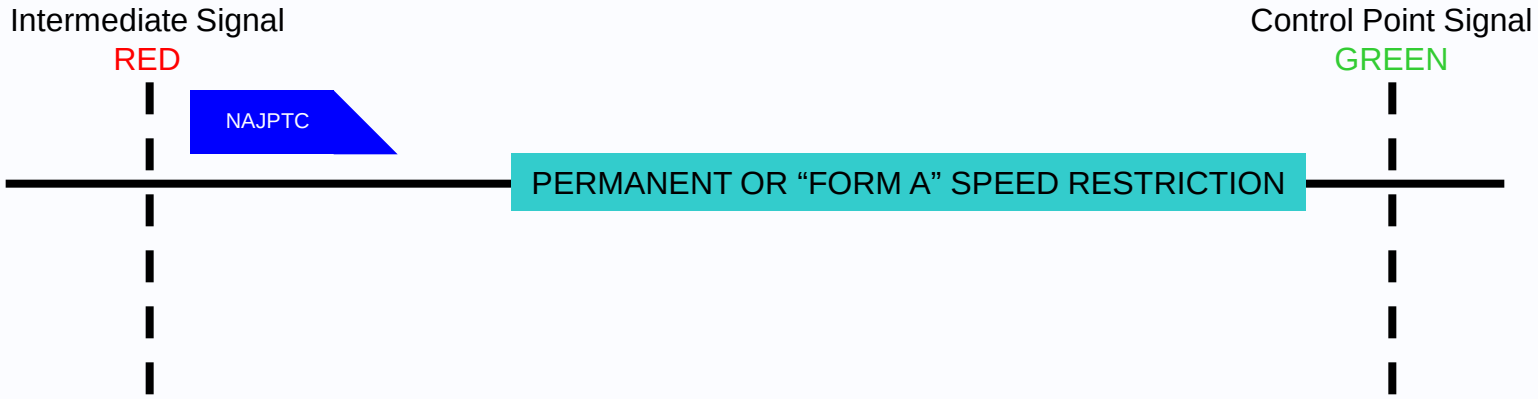


Accident Scenario: Active NAJPTC-Equipped Train and Work Crew/Hi-Rail/Work Equipment

- Accident Scenario: Train contacts roadway worker(s) or hi-rail or work equipment, work zone not protected by control point signal
  - Cause: Human error
  - Action: Train exceeds authority or work crew/equipment operating outside of authority
  - NAJPTC Case 1: Form B filed prior to train departure; authority limit downloaded to locomotive prior to departure from yard; train enforced at work zone limit
  - NAJPTC Case 2: Work zone created after train departure; dispatcher must wait for acknowledgement from NAJPTC onboard equipment prior to allowing work crew on track; train enforced at work zone limit. If very late notification, timeout could delay response to work zone limits
- Accident Type: Train to Work Crew/Hi-Rail/Work Equipment
- NAJPTC risk effect: Most work zone incursions will be prevented

Accident Scenario: NAJPTC-Equipped Train Derails Due To Overspeed

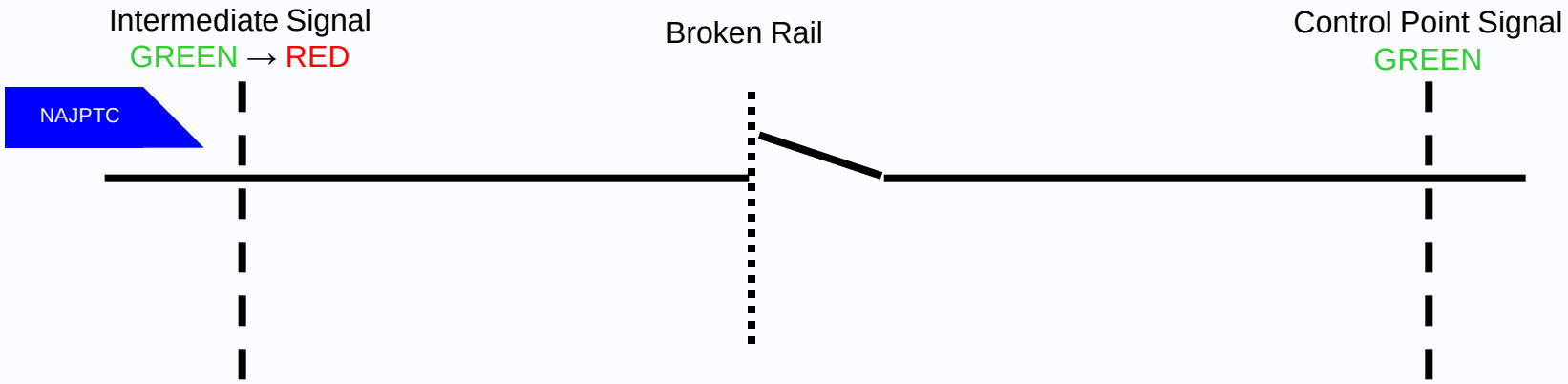
- Accident Scenario: NAJPTC equipped train derails due to overspeed
  - Cause: Dispatcher misreads map or crew ignores speed restriction
  - Action: NAJPTC equipped train ignores speed restriction (permanent or Form A) and accelerates or maintains current speed
  - NAJPTC Case 1: Form A filed prior to train departure; authority limit downloaded to locomotive prior to departure from yard; train enforced at speed zone limit
  - NAJPTC Case 2: Form A posted after train departure; timeout results in potentially late enforcement
- Accident Type: Overspeed Derailment
- NAJPTC risk effect: NAJPTC will prevent most over speed derailments



Accident Scenario: Active NAJPTC-Equipped Train Derails Due To Broken Rail (Complete Break, Interrupting Track Circuit)

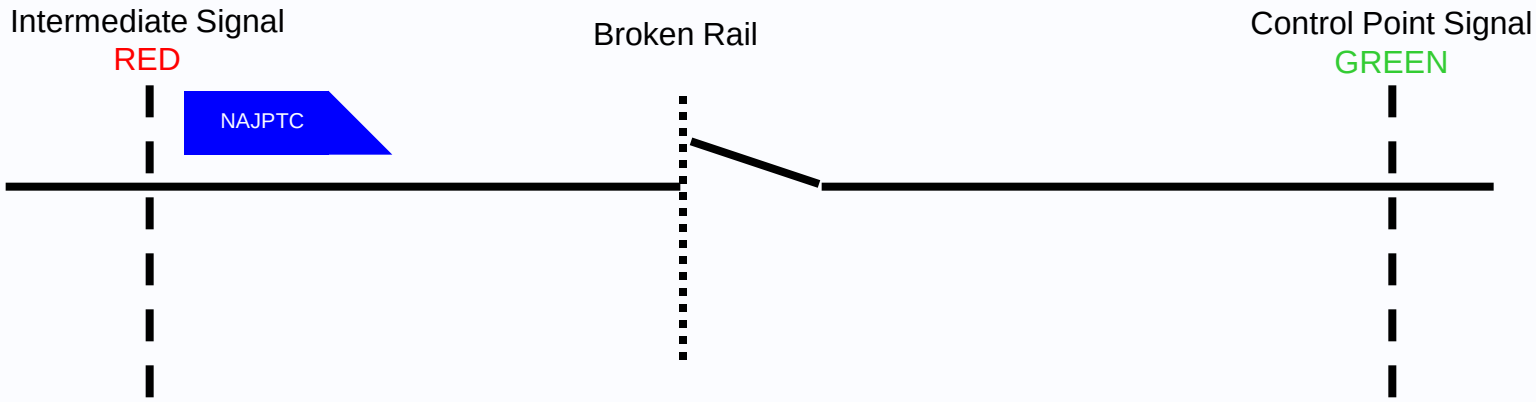
- Accident Scenario: NAJPTC equipped train derails due to broken rail. Train approaching intermediate signal
  - Cause: Broken rail in next signal block
  - Action: NAJPTC equipped train passes over broken rail and derails
  - NAJPTC equipped train on main: NAJPTC locomotive onboard equipment will receive a stop command, causing the train to slow regardless of whether Engineer response
  - Accident Type: Broken Rail Derailment

- NAJPTC Risk Effect: Train could slow or stop before reaching break, depending on break and train location relative to intermediate signal



Accident Scenario: Active NAJPTC-Equipped Train Derails Due To Broken Rail (Complete Break, Interrupting Track Circuit)

- Accident Scenario: NAJPTC equipped train derails due to broken rail. Train has passed intermediate signal and entered same block as break.
  - Cause: Broken rail in same signal block
  - Action: NAJPTC equipped train passes over broken rail and derails
  - NAJPTC equipped train on main: No response. NAJPTC cannot detect loss of track circuit in same block
- Accident Type: Broken Rail Derailment
- NAJPTC Risk Effect: None



PTC Optimum Communications Timeout Study: Accident Descriptions

Part III: Cab Signaling and Automatic Train Stop (ATS), without Speed Enforcement

Assumptions for Base Case: Automatic Cab Signal (ACS) with Automatic Train Stop

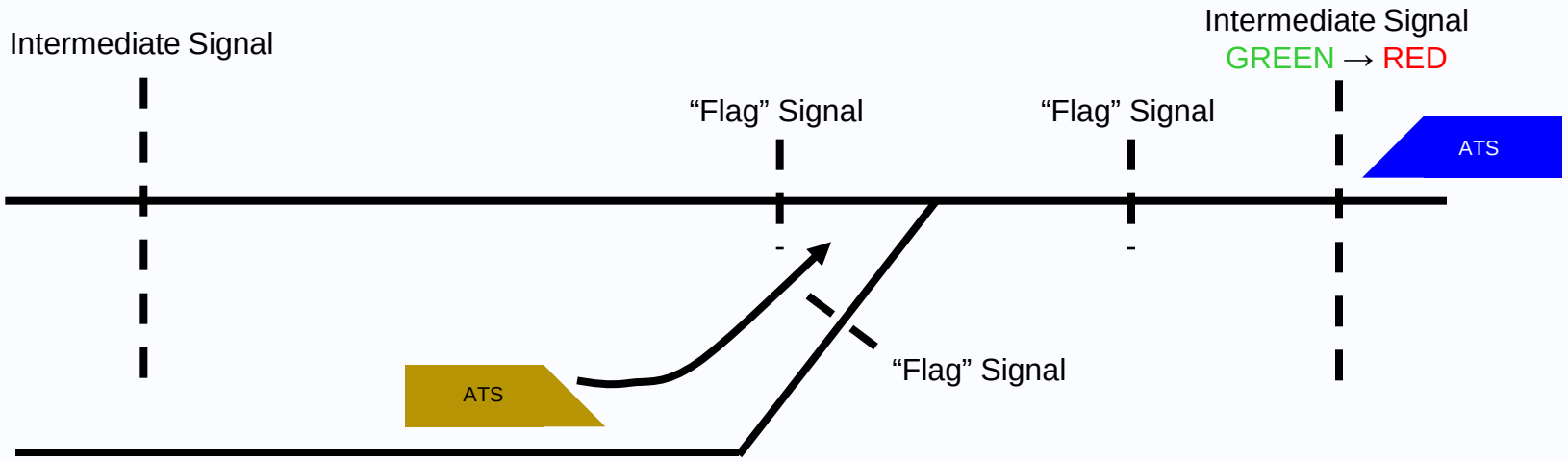
- Bi-directional signaling for all cases
- Route lock from control point to control point
- All except two passing sidings are track-circuited
- All IDOT test corridor passenger and freight trains headed by a locomotive are equipped with ACS and ATS
- Work trains are equipped with cab signal when headed by conventional locomotive. Self propelled work equipment units (e.g. tamping machine) are unequipped
- Cab signals use coded track circuits to provide detection and communicate information to an inductive pickup on the locomotive via a pulsed 60 Hz carrier injected into the rail
- Cab signal circuits are directional in that they can detect an interruption or shunt of the circuit ahead of an approaching train in the same signal block
- CTC track circuits provide detection to the wayside and control wayside signals, but do not communicate to the train
- All cab signal equipment operational and does not fail during operations over the route

Section 1: Head-On Collision Between Two Locomotives Heading Active IDOT Corridor Trains

- Collision between train leaving uncontrolled siding and train on main track
- Collision between train leaving controlled siding and train on main track.

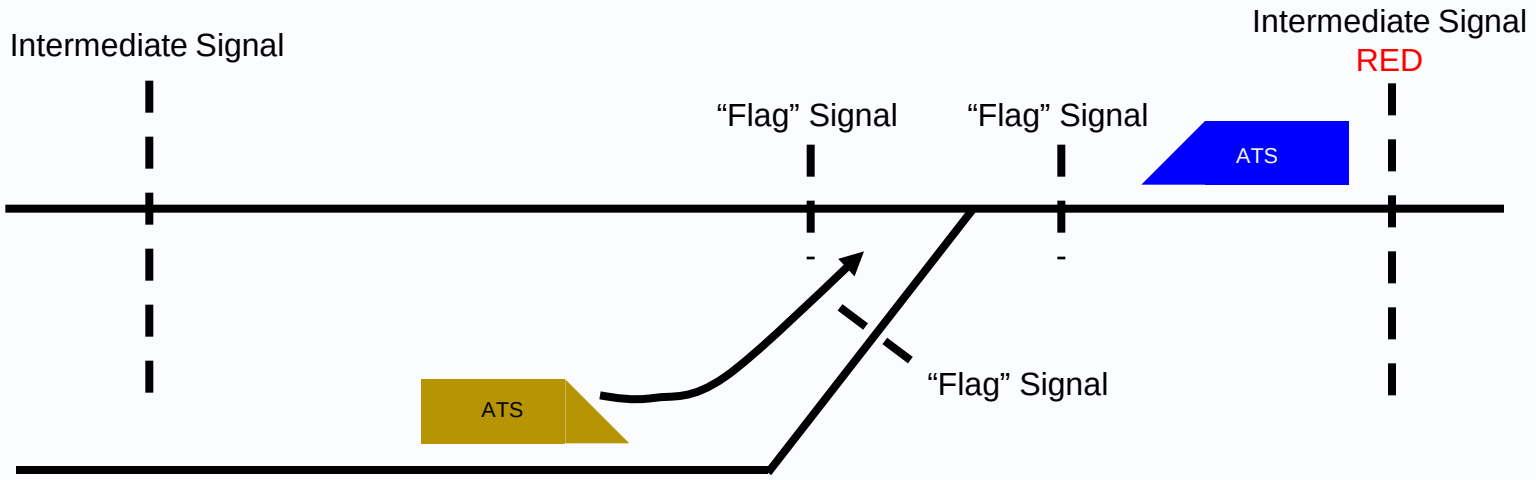
Accident Scenario: ACS/ATS-Equipped Active Trains on Uncontrolled Siding & Main

- Accident Scenario: ATS-equipped train leaving siding without authority, & ATS equipped train entering block
  - Cause: Dispatcher misreads map or crew ignores signal
  - Action: ATS equipped train erroneously exits siding and enters main; ATS equipped train passing Intermediate Signal
  - ATS equipped train on main: ATS locomotive onboard equipment provides an automatic train stop capability which requires the Engineer to acknowledge a downgrade in cab signal aspect within 8 seconds to prevent a penalty application, the absence of the carrier will continue to show a Restricting Aspect in the cab
  - ATS equipped train entering main from siding: The UP Cab Signal will continue to display a Restricting Aspect.
- Accident Type: Head-on collision between locomotives
- ACS/ATS risk effect: Could prevent some collisions or reduce collision speed



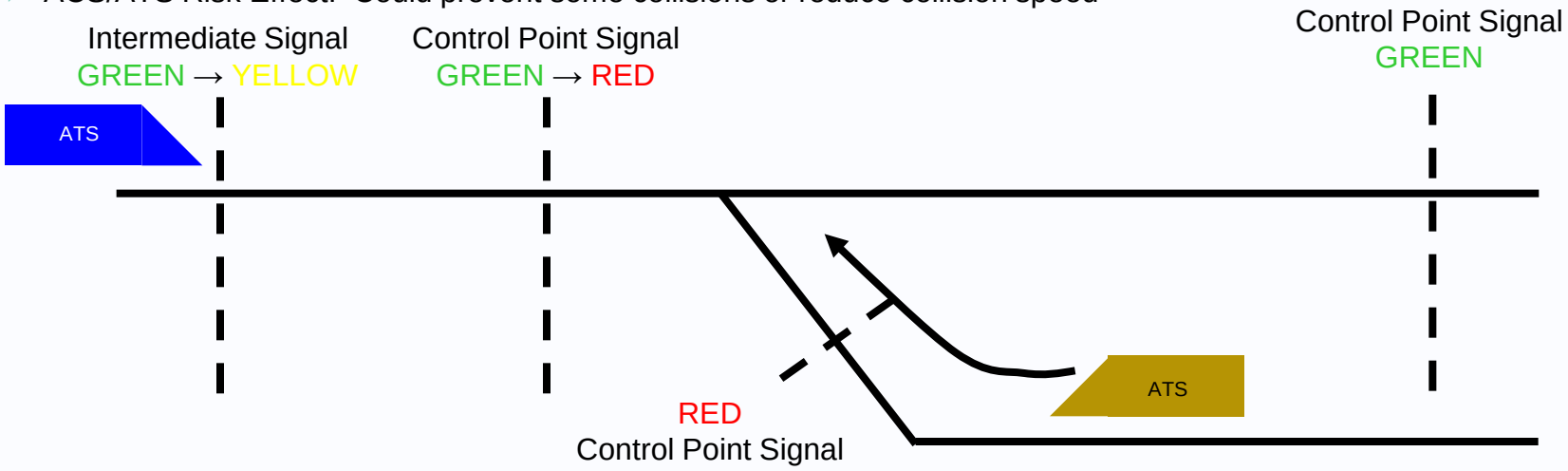
Accident Scenario: ACS/ATS-Equipped Active Trains on Uncontrolled Siding & Main

- Accident Scenario: ATS-equipped train leaving siding & ATS-equipped train in block
  - Cause: Dispatcher misreads map or crew ignores signal
  - Action: ATS equipped train erroneously exits siding and enters main; ATS equipped train passed Intermediate Signal
  - ATS equipped train on main: ATS locomotive onboard equipment provides an automatic train stop capability which requires the Engineer to acknowledge a downgrade in cab signal aspect within 8 seconds to prevent a penalty application.
  - ATS equipped train on siding: Upon entering main, loss of speed code results in a Restricting Aspect. ATS locomotive onboard equipment provides an automatic train stop capability which requires the Engineer to acknowledge a downgrade in cab signal aspect within 8 seconds to prevent a penalty application
- Accident Type: Head-on collision between locomotives. See also alternative scenario in Section 2, page E-62
- ACS/ATS Risk Effect: Could prevent a few collisions or reduce collision speed



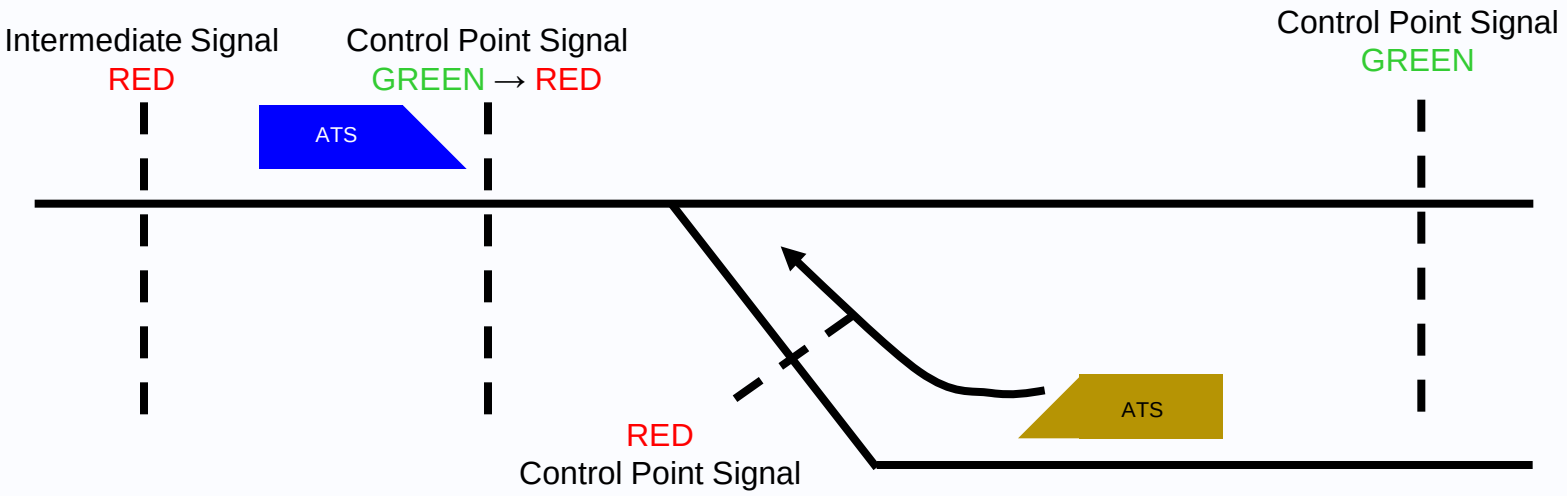
Accident Scenario: ACS/ATS-Equipped Active Trains on Controlled (Passing) Siding and Main

- Accident Scenario: ATS-equipped train erroneously leaving siding (SPAD); ATS-equipped train passing Intermediate Signal and approaching the Control Point
  - Cause: Dispatcher misreads map or crew ignores Control Point Signal
  - Action: ATS equipped train passes RED Control Point Signal and exits siding; ATS equipped train on main passes Intermediate Signal
  - ATS-equipped train on main: When the train from the siding shunts the main track, ATS will change from Clear to Approach and sound a warning the must be acknowledged to avoid penalty brake. When the train passes the Intermediate Signal, ATS will change from Approach to Restricting and sound an additional warning which must be acknowledged
  - ATS equipped train entering main from siding: ATS will display a continuous Restricting Aspect
- Accident Type: Head-on collision between locomotives.
- This and page E-10 scenarios probably the most common scenarios on this corridor. Almost all meets are at controlled sidings
- ACS/ATS Risk Effect: Could prevent some collisions or reduce collision speed



Accident Scenario: ACS/ATS-Equipped Active Trains on Controlled (Passing) Siding & Main

- Accident Scenario: ATS equipped train erroneously leaving siding (SPAD); ATS equipped train entering the Control Point block
  - Cause: Dispatcher misreads map or crew ignores signal
  - Action: ATS equipped train passes RED Control Point Signal and exits siding; ATS equipped train on main between Intermediate & Control Point Signals
  - ATS equipped train on main: When the train from the siding shunts the main track, ATS will change from Clear to Restricting and sound a warning the must be acknowledged to avoid penalty brake.
  - ATS equipped train on siding: ATS will display a continuous Restricting Aspect in the cab
- Accident Type: Head-on collision between locomotives. See also alternative scenario in Section 2, Page E-63
- ACS/ATS Risk Effect: Could reduce collision speed in some cases. Full prevention unlikely.

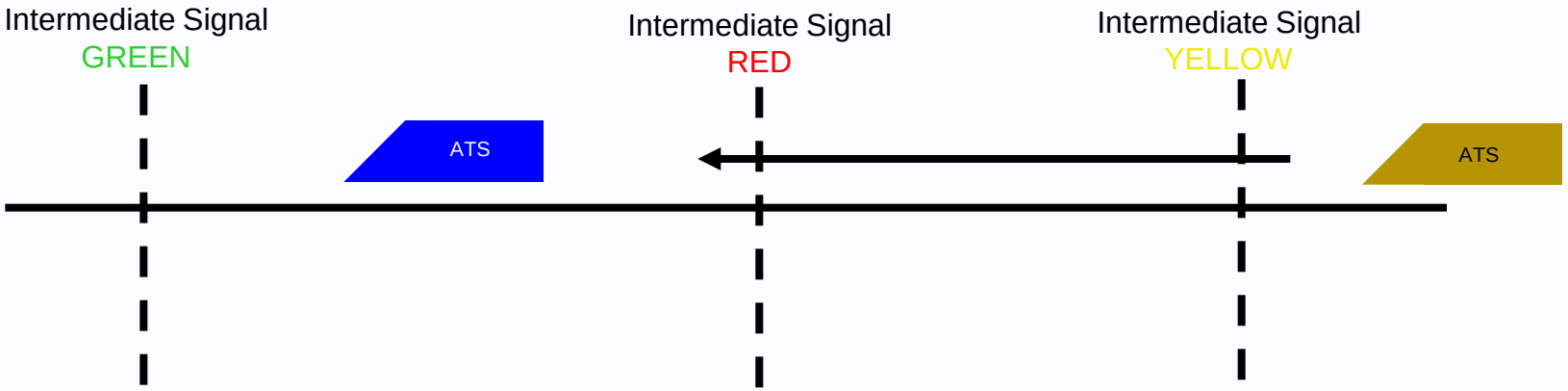


Section 2: Collision Between Two Active IDOT Corridor Trains: Head (Locomotive) with Rear or Side of Second Train

- Train rear-ends a stationary or slower moving train on main
- Train exiting uncontrolled siding in reverse. Collision on main with train traveling in same direction
- Train exiting uncontrolled siding. Collision on main with train traveling in same direction
- Train exiting uncontrolled siding, collides with side of train traveling in opposite direction.
- Train exiting controlled siding, collides with side of train traveling in opposite direction.
- Train exiting controlled siding. Collision with train traveling on main same direction

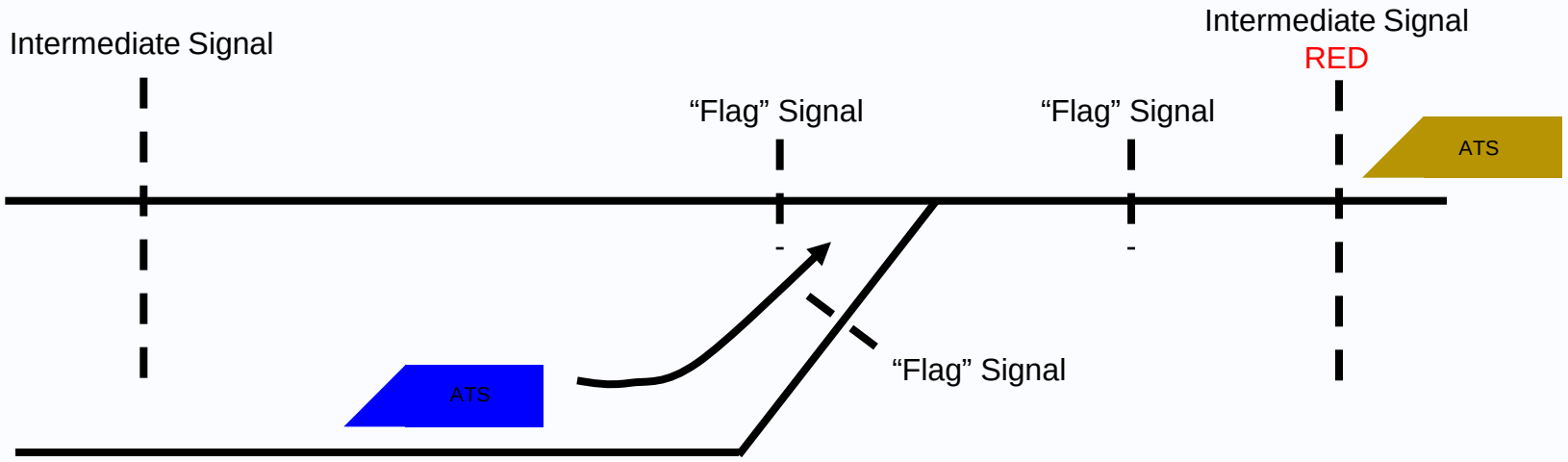
Accident Scenario: ACS/ATS-Equipped Active Trains Following One Another on Main

- Accident Scenario: Two ATS equipped trains on main. Following ATS-equipped train entering block (SPAD)
  - Cause: Crew ignores intermediate signal
  - Action: Following ATS equipped train passes RED Intermediate signal on main and rear-ends preceding train
  - Lead ATS equipped train: no change
  - Following ATS equipped train on main: ATS will sound an audible alert when the train passes the previous Intermediate Signal and show a downgraded signal aspect. Engineer must acknowledge warning or ATS applies a penalty brake.
- Accident Type: Rear end collision. Locomotive of train on main strikes rear of train exiting siding
- ACS/ATS Risk Effect : Reduces chance of SPAD. Following train could either stop or slow to reduce collision speed or prevent collision.



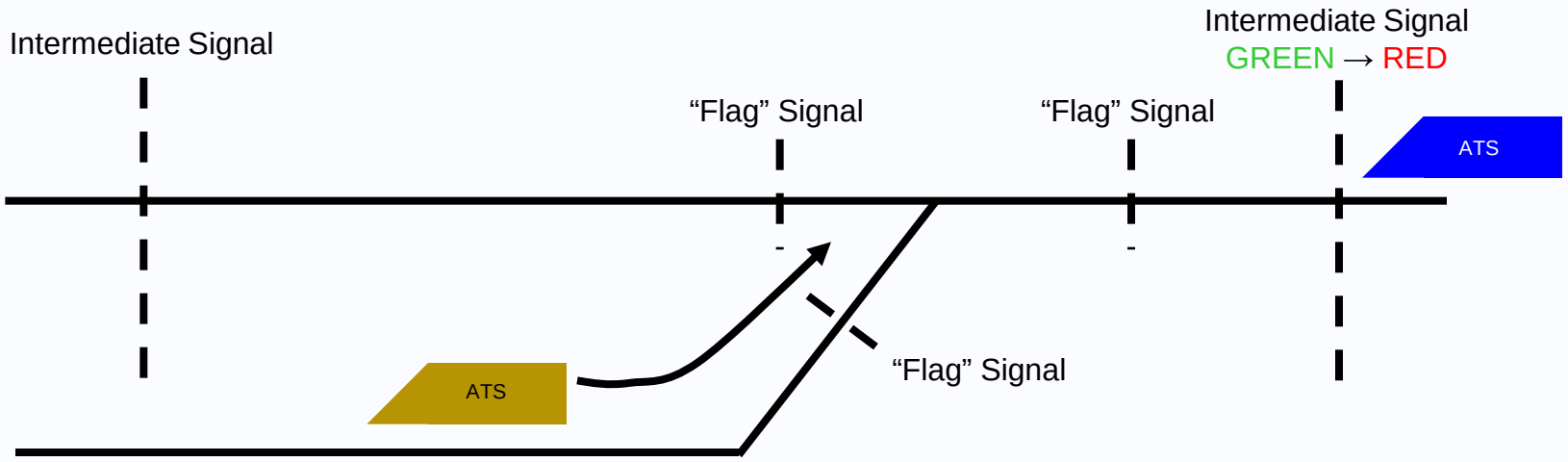
Accident Scenario: ACS/ATS-Equipped Active Trains on Uncontrolled Siding & Main

- Accident Scenario: ATS equipped train leaving siding (reverse move) & ATS equipped train entering block (SPAD)
  - Cause: Crew ignores intermediate signal
  - Action: ATS equipped train passes RED Intermediate Signal on main; ATS equipped train exiting siding
  - ATS equipped train on main: ATS will sound an auditable alert when the train passes the previous Intermediate Signal which the engineer must acknowledge within 8 seconds or ACS applies a penalty brake application. If engineer continues, the absence of the carrier continues to show a Restricting Aspect in the cab
  - ATS equipped train entering main from siding: The train will be unaware of the approaching train until locomotive reaches the main track
- Accident Type: Rear end collision. Locomotive of train on main strikes rear of train exiting siding
- ACS/ATS Risk Effect: In most cases ATS train on main will respond to warning and apply brakes. Could reduce collision speed and in some cases will prevent a collision



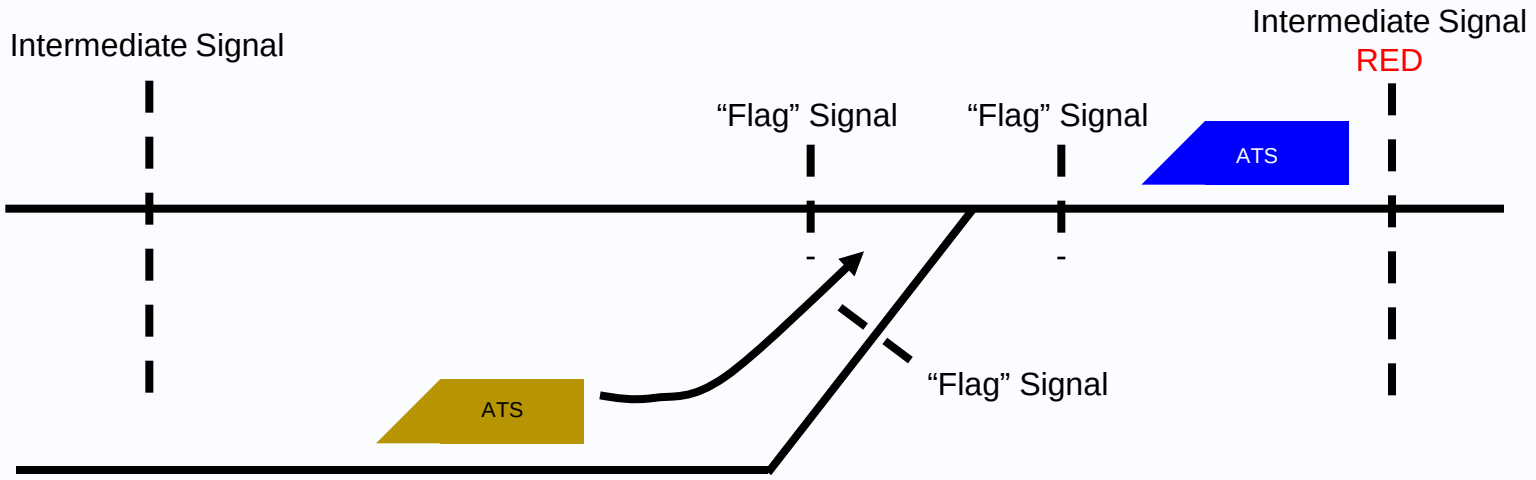
Accident Scenario: ACS/ATS-Equipped Active Trains on Uncontrolled Siding & Main

- Accident Scenario: ATS equipped train backing from siding & ATS equipped train entering block
  - Cause: Dispatcher misreads map or crew of train exiting siding ignores signal
  - Action: ATS equipped train erroneously exits siding and enters main; ATS equipped train passing Intermediate Signal
  - ACS equipped train on main: ATS locomotive onboard equipment provides an automatic train stop capability which requires the Engineer to acknowledge a downgrade in cab signal aspect within 8 seconds to prevent a penalty application, the absence of the carrier will continue to show a Restricting Aspect in the cab
  - ATS equipped train backing from siding: The train will be unaware of the approaching train
- Accident Type: rear-end collision. Train on main strikes rear of train exiting siding
- ACS/ATS Risk Effect: In most cases ACS train on main will respond to warning and apply brakes preventing a collision or reducing collision speed



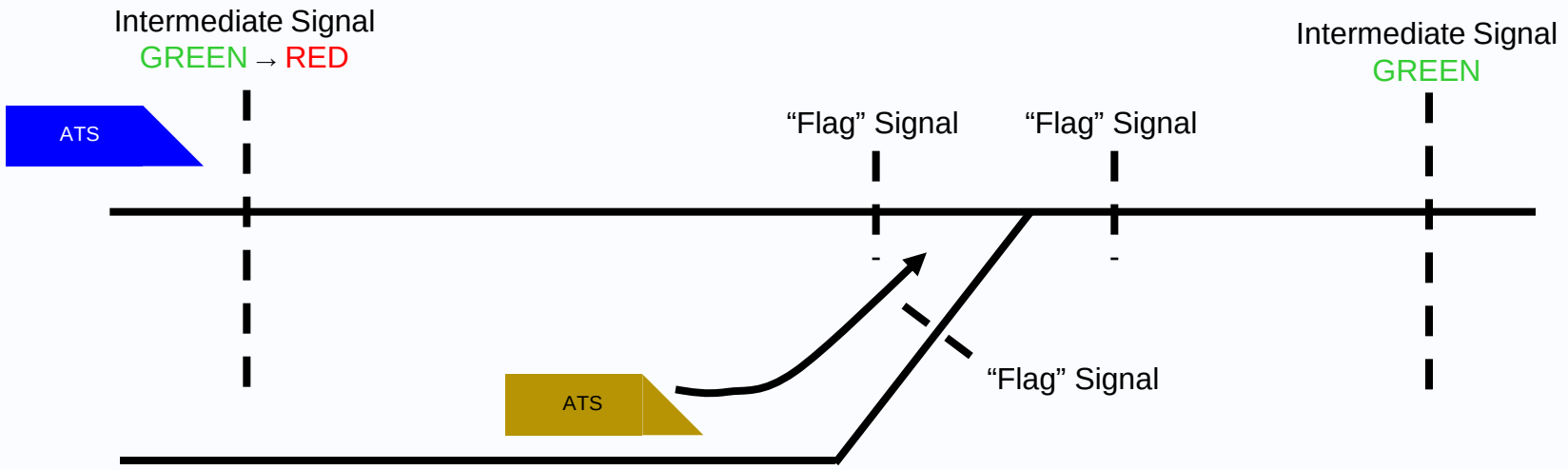
Accident Scenario: ACS/ATS-Equipped Active Trains on Uncontrolled Siding & Main

- Accident Scenario: ATS equipped train backing from siding & ATS equipped train in block
  - Cause: Dispatcher misreads map or crew ignores signal
  - Action: ATS equipped train erroneously exits siding and enters main; ATS equipped train has passed Intermediate Signal
  - ATS equipped train on main: ATS locomotive onboard equipment provides an automatic train stop capability which requires the Engineer to acknowledge a downgrade in cab signal aspect within 8 seconds to prevent a penalty application.
  - ATS equipped train on siding: The train will be unaware of the approaching train
- Accident Type: Rear-end, side or raking collision. Train on main strikes rear of train exiting siding, OR train on siding strikes side of train on main, behind the locomotive.
- ACS/ATS Risk effect: In most cases, ATS train on main will attempt to slow to reduce collision speed. Collision avoidance unlikely.



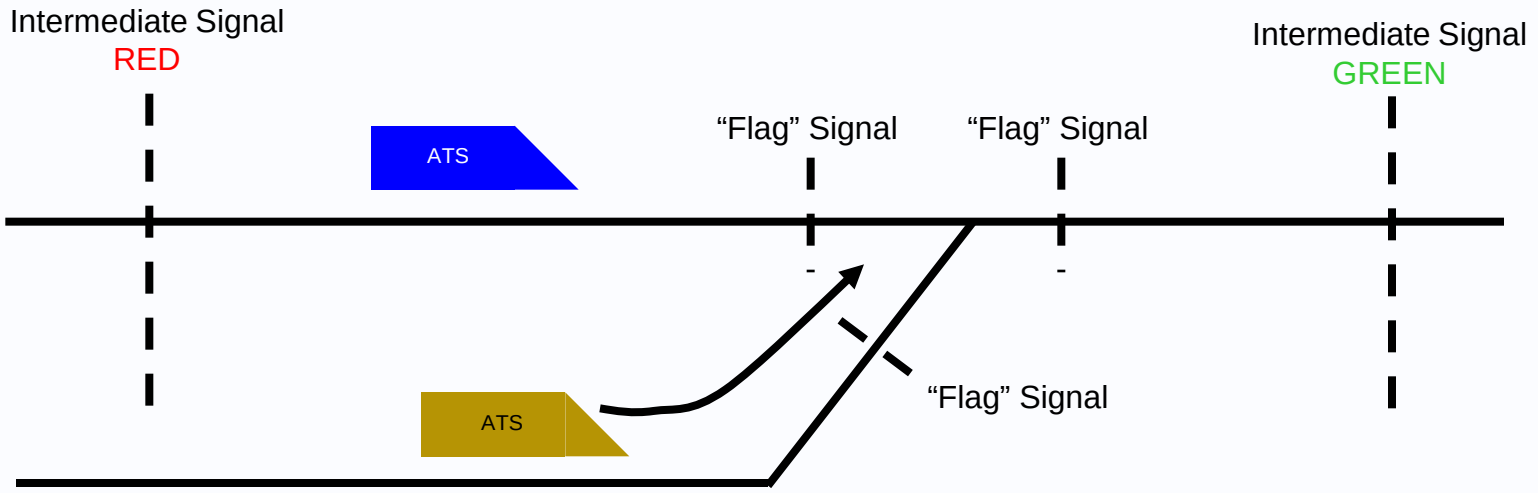
Accident Scenario: ACS/ATS-Equipped Active Trains on Uncontrolled Siding & Main

- Accident Scenario: ATS equipped train leaving siding & ATS equipped train approaching intermediate signal
  - Cause: Dispatcher misreads map or crew ignores signal
  - Action: ATS equipped train erroneously exits siding and enters main; ATS-equipped train passed Intermediate Signal
  - ATS equipped train on main: ATS locomotive onboard equipment requires the Engineer to acknowledge changed signal aspect within 8 seconds to prevent a penalty application.
  - ATS-equipped train on siding: Upon entering main, loss of speed code results in a Restricting Aspect. locomotive onboard equipment requires the Engineer to acknowledge warning within 8 seconds to prevent a penalty application
- Accident Type: Rear, side or raking collision. Train exiting siding strikes train or vise-versa depending on relative position and speed of trains
- ACS/ATS Risk Effect: Collision may be prevented or closing speed of collision reduced, depending on the position of the two trains relative to the collision point



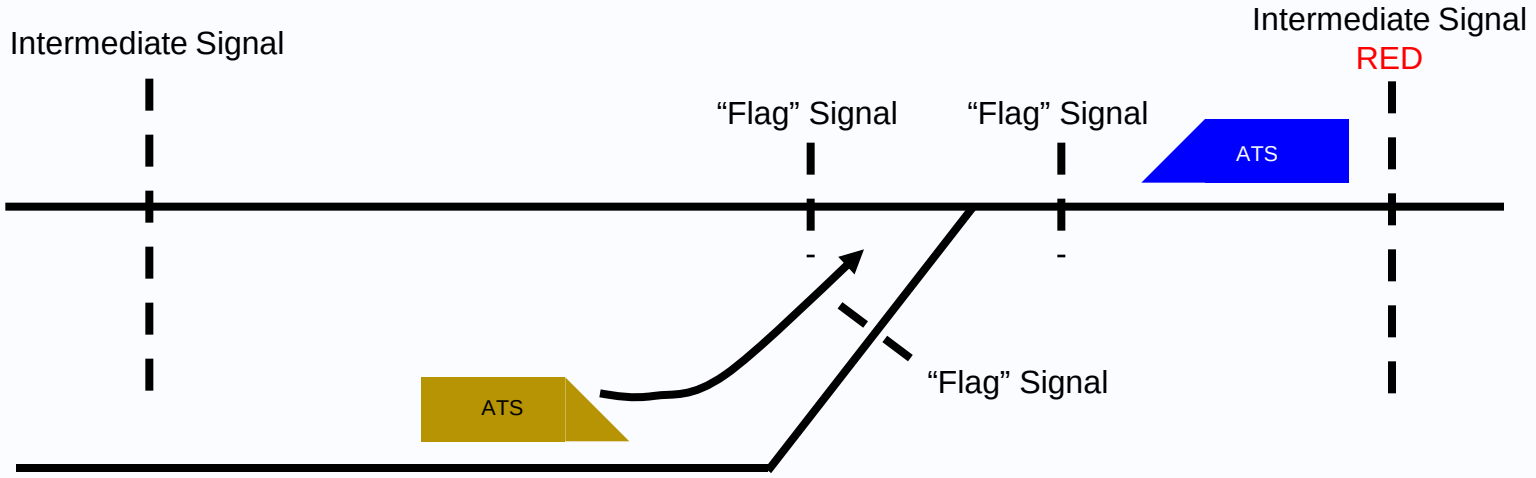
Accident Scenario: ACS/ATS-Equipped Active Trains on Uncontrolled Siding & Main

- Accident Scenario: ATS equipped train leaving siding & ATS equipped train in block
  - Cause: Dispatcher misreads map or crew ignores signal
  - Action: ATS equipped train erroneously exits siding and enters main; ATS-equipped train passed Intermediate Signal
  - ATS equipped train on main: ATS locomotive onboard equipment requires the Engineer to acknowledge restricting speed aspect within 8 seconds to prevent a penalty application.
  - ATS equipped train on siding: Upon entering main, loss of speed code results in a Restricting Aspect. ATS locomotive onboard equipment requires the Engineer to acknowledge aspect within 8 seconds to prevent a penalty application
- Accident Type: Rear, side or raking collision. Train exiting siding strikes train or vise-versa depending on relative position and speed of trains
- ACS/ATS Risk Effect: Collision may be prevented (unlikely) or closing speed of collision reduced, depending on the position of the two trains relative to the collision point



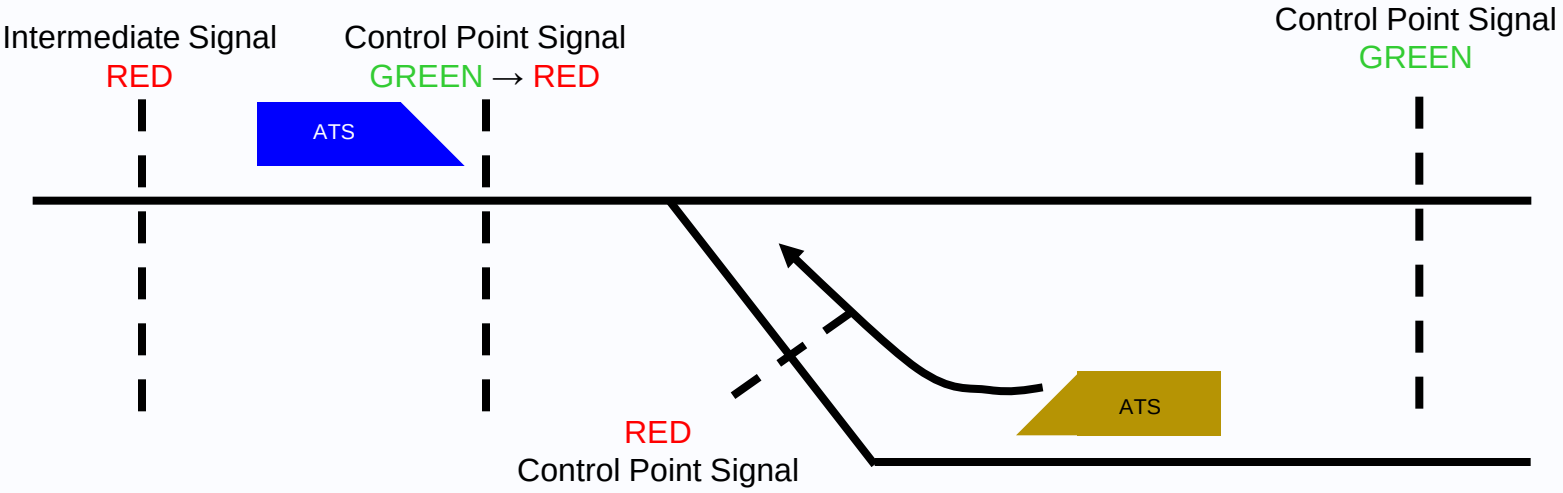
Accident Scenario: ACS/ATS-Equipped Active Trains on Uncontrolled Siding & Main

- Accident Scenario: ATS-equipped train leaving siding & ATS-equipped train in block
  - Cause: Dispatcher misreads map or crew ignores signal
  - Action: ATS-equipped train erroneously exits siding and enters main; ACS-equipped train passed Intermediate Signal
  - ATS-equipped train on main: ATS locomotive onboard equipment provides an automatic train stop capability which requires the Engineer to acknowledge a downgrade in cab signal aspect within 8 seconds to prevent a penalty application.
  - ATS-equipped train on siding: Upon entering main, loss of speed code results in a Restricting Aspect. ATS locomotive onboard equipment provides an automatic train stop capability which requires the Engineer to acknowledge a downgrade in cab signal aspect within 8 seconds to prevent a penalty application
- Accident Type: Side or raking collision. Train exiting siding strikes train on main behind locomotive. See also scenario variant in Section 1 Page E-53
- ACS/ATS Risk Effect: In most cases ATS will result in lowered collision speed, but unlikely to prevent collision



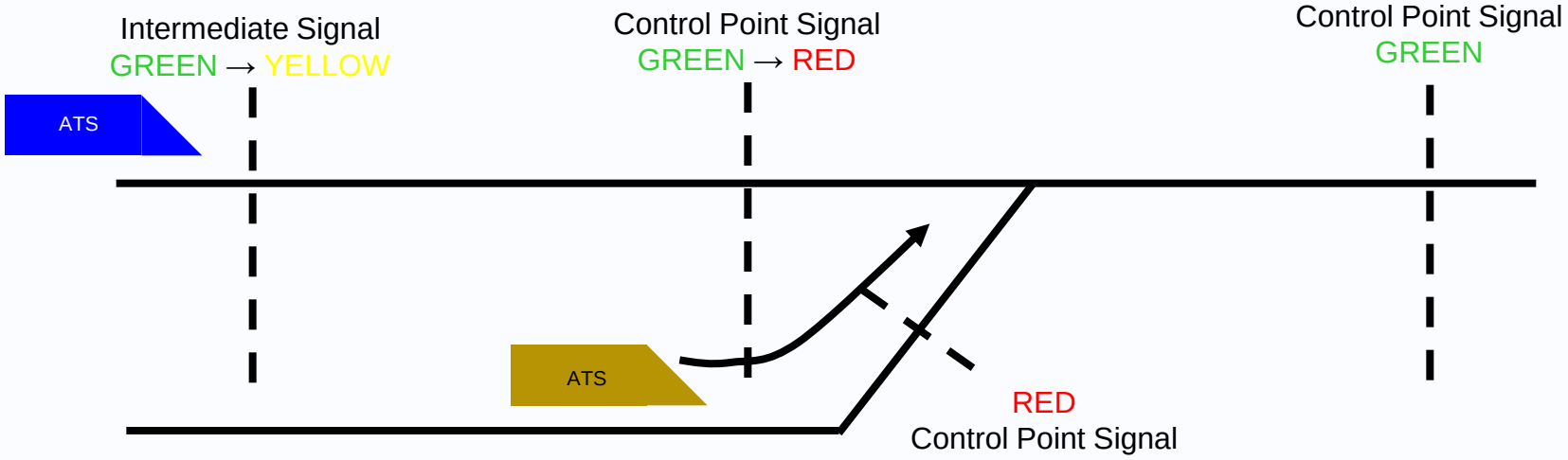
Accident Scenario: ACS/ATS-Equipped Active Trains on Controlled (Passing) Siding & Main

- Accident Scenario: ATS equipped train erroneously leaving siding (SPAD); ATS equipped train entering the Control Point block
  - Cause: Dispatcher misreads map or crew ignores signal
  - Action: ATS equipped train passes RED Control Point Signal and exits siding; ATS equipped train on main between Intermediate & Control Point Signals
  - ATS equipped train on main: When the train from the siding shunts the main track, ATS will change from Clear to Restricting and sound a warning the must be acknowledged to avoid penalty brake.
  - ATS equipped train on siding: ATS will display a continuous Restricting Aspect in the cab
- Accident Type: Side or raking collision. Locomotive of train exiting siding strikes train on main behind locomotive. See also alternative scenario in Section 1, Page E-55
- ACS/ATS Risk Effect: In most cases collision will be at reduced speed or will be prevented, depending on main track train location relative to siding switch.



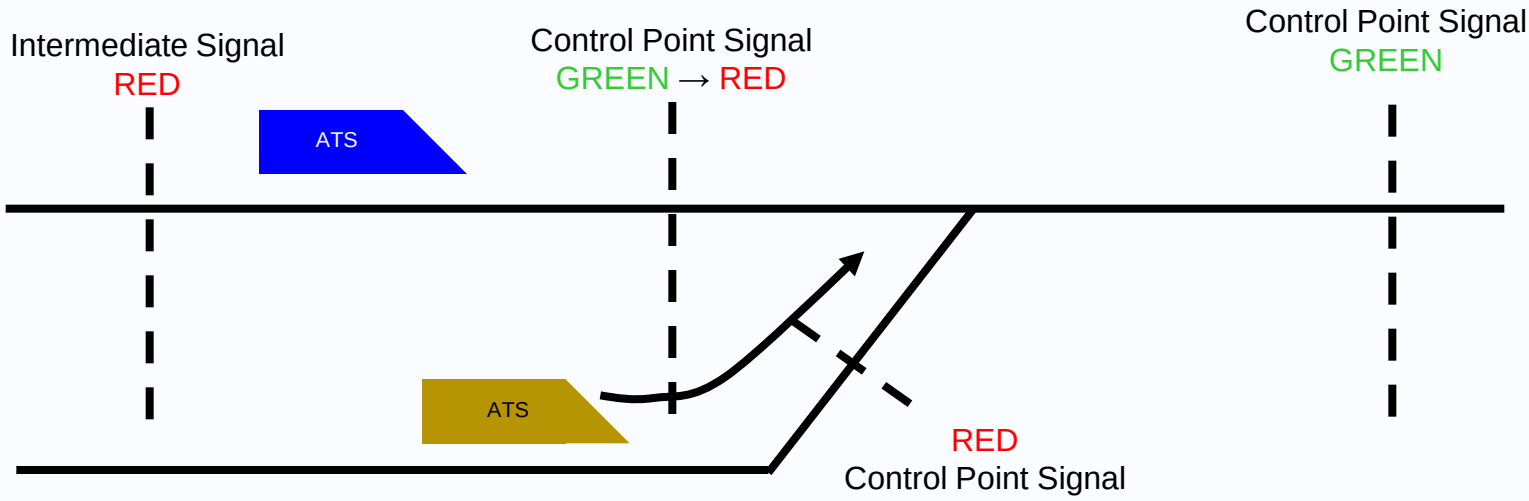
Accident Scenario: ACS/ATS-Equipped Active Trains on Controlled (Passing) Siding & Main

- Accident Scenario: ATS equipped train erroneously leaves siding (SPAD); ATS equipped train on main passing Intermediate Signal and approaching the Control Point
  - Cause: Dispatcher misreads map or crew ignores signal
  - Action: ATS equipped train passes RED Control Point Signal and exits siding; ATS equipped train on main has not passed the Intermediate Signal
  - ATS equipped train on main: When the train from the siding shunts the main track, ATS will change from Clear to Approach and sound a warning the must be acknowledged to avoid penalty brake. When the train passes the Intermediate Signal ATS will change from Approach to Restricting and sound an additional warning which must be acknowledged
  - ATS equipped train entering main from siding: Once the Control Point Signal is passed the train will be unaware of the approaching train on the main
- Accident Type: Rear-end, side or raking collision. Train on main strikes rear of train exiting siding OR either train strikes the other behind the locomotive
- ACS/ATS Risk Effect: In most cases ATS will prevent collision or reduce collision speed, depending on location of main track train relative to switch



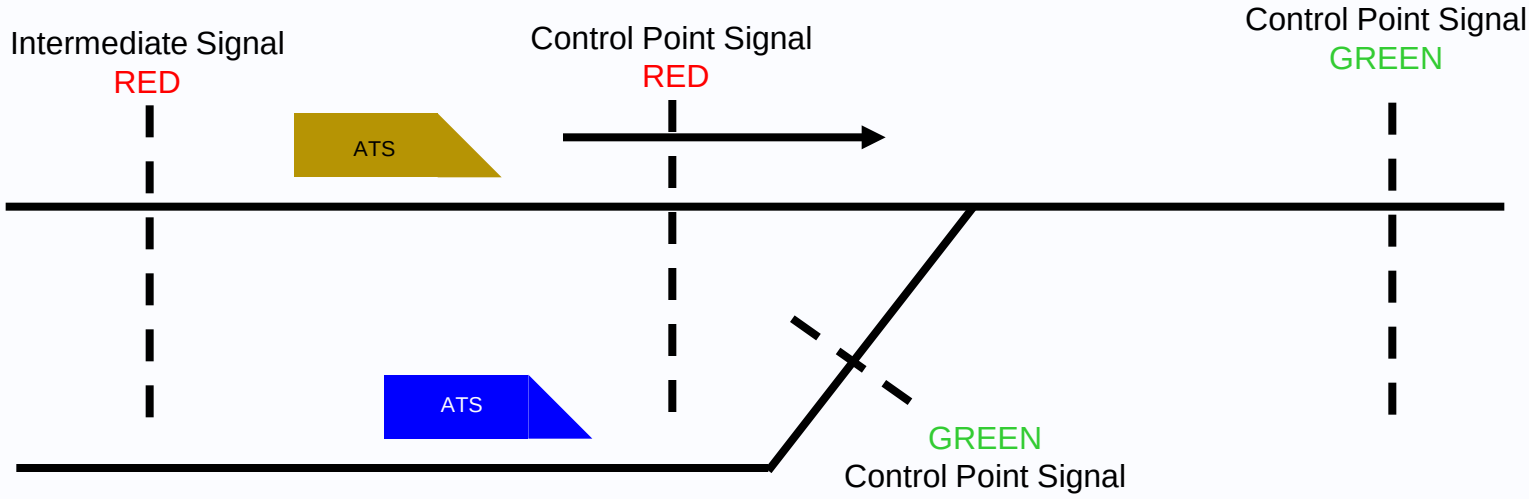
Accident Scenario: ACS/ATS-Equipped Active Trains on Controlled (Passing) Siding & Main

- Accident Scenario: ATS unequipped train erroneously leaving siding (SPAD); ATS equipped train entering the Control Point block
  - Cause: Dispatcher misreads map or crew ignores Control Point Signal
  - Action: ATS unequipped train passes RED Control Point Signal and exits siding; ATS equipped train on main between Intermediate & Control Point Signals
  - ATS-equipped train on main: When the train from the siding shunts the main track, ATS will change from Clear to Restricting and sound a warning the must be acknowledged to avoid penalty brake.
  - ATS-equipped train entering main from siding: Once the Control Point Signal is passed the train will be unaware of the approaching train on the main
- Accident Type: Rear-end, side or raking collision. Depending on relative train position, the train on the main could strike the rear of the train exiting the siding OR either train could strike the other behind the locomotive
- ACS/ATS Risk Effect: Will prevent collision or reduce collision speed in most cases, depending on location of the main track train relative to siding switch



Accident Scenario: ACS/ATS-Equipped Active Trains on Controlled (Passing) Siding & Main

- Accident Scenario: ATS-equipped active train on main ignores Control Point signal (SPAD); second ATS-equipped active train leaving siding
  - Cause: Dispatcher misreads map or crew ignores Control Point Signal
  - Action: ATS equipped train on main passes RED Control Point Signal; ATS equipped train correctly leaving siding under clear Control Point signal.
  - ATS equipped train on main: Engineer must initiate braking to reduce speed to restricting after passing Intermediate signal to avoid penalty braking.
  - ATS equipped train entering main from siding: No restriction
- Accident Type: Rear-end, side or raking collision. Depending on relative train position, the train on the main could strike the rear of the train exiting the siding OR either train could strike the other behind the locomotive
- ACS/ATS Risk Effect: Reduces chance that train on main will pass red control point signal; train on siding cannot slow to avoid collision or reduce collision speed until after train on main passes RED signal.

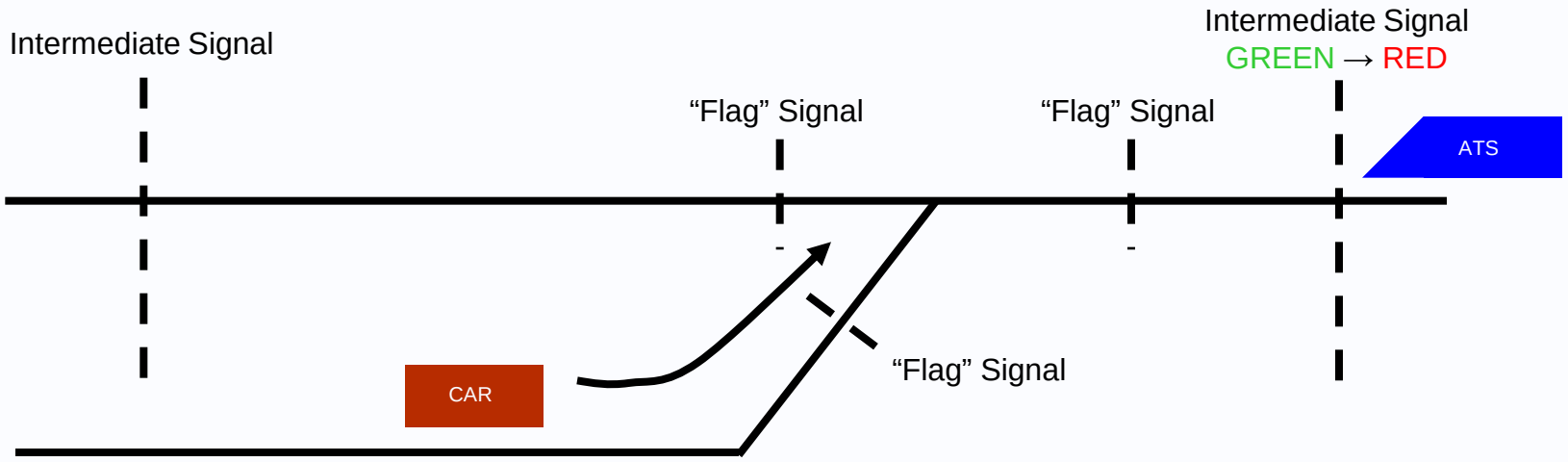


Section 3: Collision Between the Head (Locomotive) of an Active IDOT Test Corridor Train and an Intruding Rail Vehicle or Vehicle Lading

- Unsecured or mishandled rail vehicle rolling onto main track, or positioned “not in clear at siding or industry track switch
  - Active train approaching signal block in which intrusion occurred
  - Active train in same block as intrusion
- Intrusions into clearance envelope of main track from adjacent track away from connecting turnout
  - Derailed vehicle on adjacent track
  - Shifted load on vehicle on adjacent track

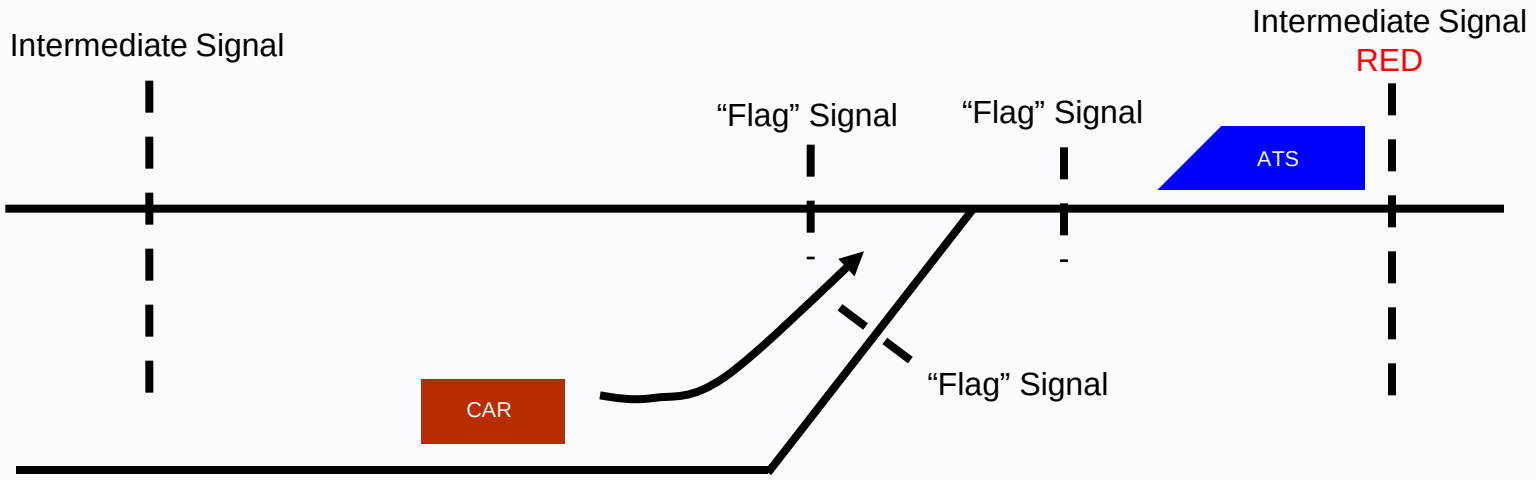
Accident Scenario: Cars on Uncontrolled Siding & ACS/ATS-Equipped Active Train on Main

- Accident Scenario: Car rolls from siding onto main (assume car shunts track circuit) & ATS-equipped train entering block
  - Cause: Car or cut of cars not properly secured, not positioned in clear or mishandled during switching operations
  - Action: Car erroneously exits siding and enters main; ATS-equipped train passing Intermediate Signal
  - ATS-equipped train on main: ATS locomotive onboard equipment provides an automatic train stop capability which requires the Engineer to acknowledge a downgrade in cab signal aspect within 8 seconds to prevent a penalty application
- Accident Type: Intrusion – locomotive of active train strikes car or cut of cars
- ACS/ATS Risk Effect: In most cases active train on main will respond to warning and start slowing to prevent collision or reduce collision speed



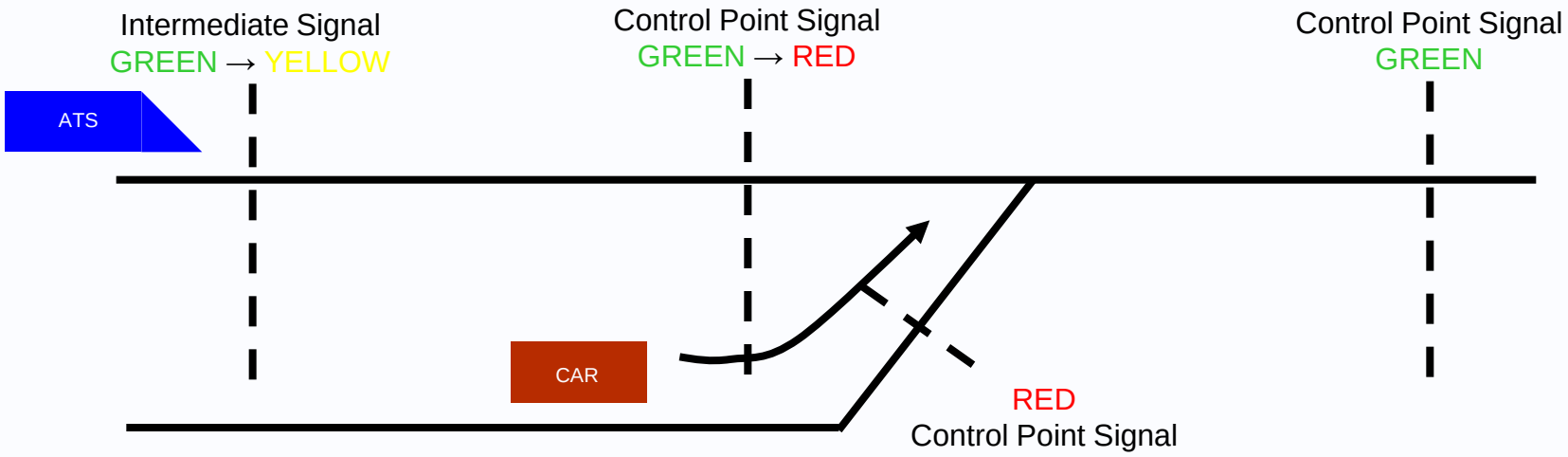
Accident Scenario: Equipment on Uncontrolled Siding & ACS/ATS-Equipped Train on Main

- Accident Scenario: Car rolls from siding (assume car shunts track circuit) & ATS-equipped train in block
  - Cause: Car or cut of cars not properly secured, not positioned in clear or mishandled during switching operations
  - Action: Car(s) erroneously exit siding and enters main; ATS-equipped train has passed the Intermediate Signal
  - ATS-equipped train on main: The loss of pulsed carrier results in a Restricting Aspect. ATS locomotive onboard equipment provides an automatic train stop capability which requires the Engineer to acknowledge a downgrade in cab signal aspect within 8 seconds to prevent a penalty application
- Accident Type: Intrusion – locomotive of active train strikes car or cut of cars
- ACS/ATS Risk Effect: In most cases, Engineer of active train will initiate braking to reduce collision speed or prevent collision, depending on speeds and location of train relative to switch



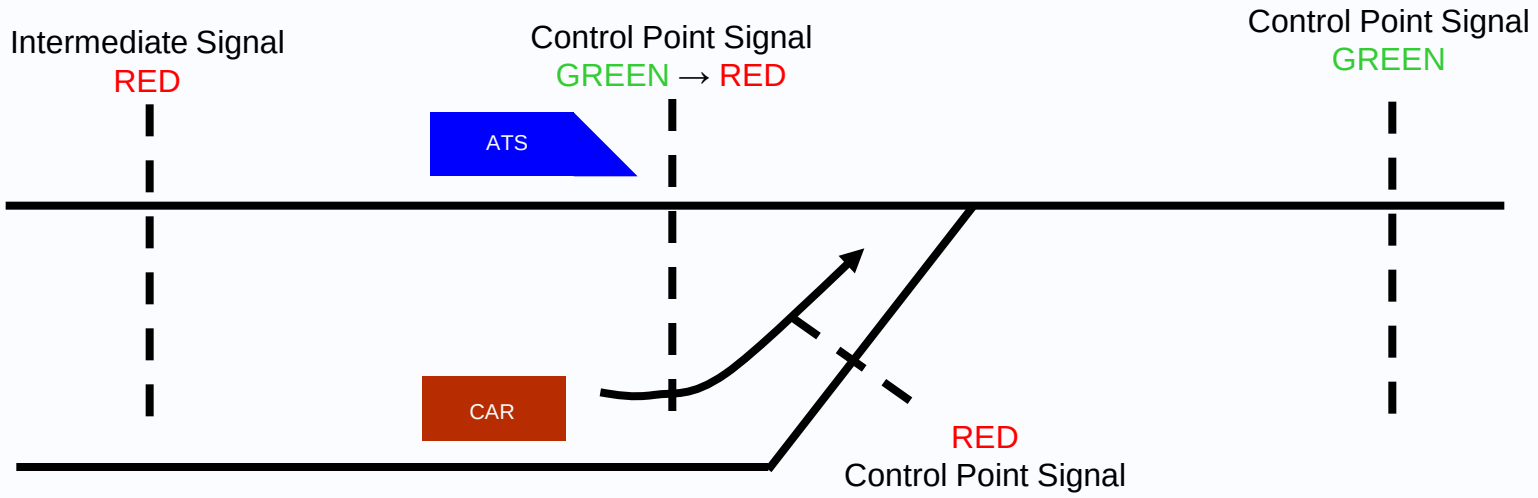
Accident Scenario: Equipment on Controlled Siding & ACS/ATS-Equipped Active Train on Main

- Accident Scenario: Car or cut of cars rolls from siding onto main (assume car shunts track circuit) & ATS equipped train entering block between Intermediate and Control Point Signal
  - Cause: Car not properly secured, or not parked in clear or mishandles during switching.
  - Action: Car erroneously exits siding and enters main; ATS equipped train passing Intermediate Signal
  - ATS equipped train on main: When the car from the siding shunts the main track, ATS will change from Clear to Approach and sound a warning the must be acknowledged to avoid penalty brake. When the train passes the Intermediate Signal, ATS will change from Approach to Restricting and sound an additional warning which must be acknowledged
- Accident Type: Intrusion collision: locomotive of active train strikes cars or cut of cars exiting siding
- ACS/ATS Risk Effect: In most cases Engineer of active train on main will initiate braking in response to warning to prevent collision or reduce collision speed.



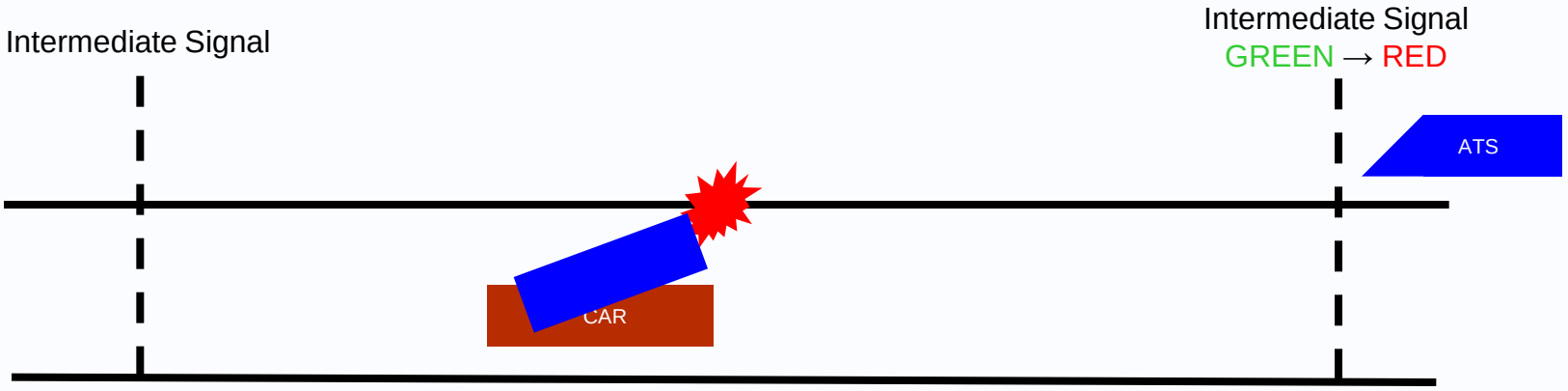
Accident Scenario: Equipment on Controlled Siding & ACS/ATS-Equipped Active Train on Main

- Accident Scenario: Car rolls from siding (assume car shunts track circuit) & ATS equipped train entering block
  - Cause: Car or cut of cars not properly secured
  - Action: Car erroneously exits siding and enters main; ATS-equipped train passing control Point Signal
  - ATS-equipped train on main: When the car from the siding shunts the main track, ATS will change from Clear to Restricting and sound a warning the must be acknowledged to avoid penalty brake.
- Accident Type: Intrusion collision: locomotive of active train strikes car or cut of cars
- ACS/ATS Risk Effect: In most cases Engineer of active train on main will initiate braking in response to warning to reduce collision speed or possible prevent collision



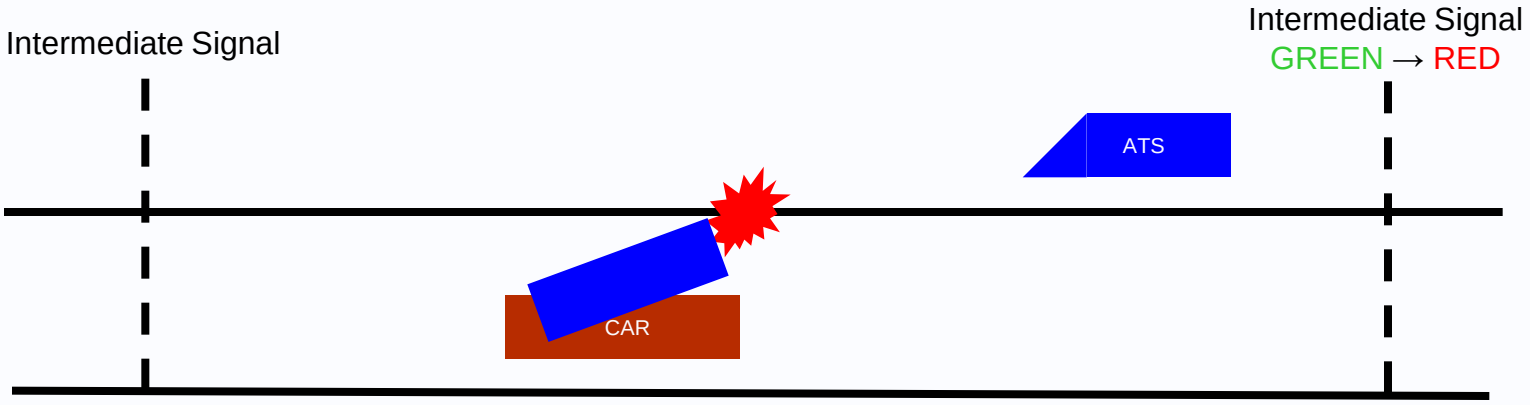
Accident Scenario: Car With Shifted Load on Adjacent Track & ACS/ATS-Equipped Active Train on Main

- Accident Scenario: Shifted load on car on adjacent track fouls main track
  - Cause: Shifted load for any reason
  - Action: Derailed car fouls main track; ATS equipped train passing Intermediate Signal
  - ATS-equipped train on main: IF derailed car shunts track circuit on main, ATS locomotive onboard equipment provides an automatic train stop capability which requires the Engineer to acknowledge a downgrade in cab signal aspect within 8 seconds to prevent a penalty application. Note: shifted load would have to fall and shunt track circuit to be detected, which is unlikely.
- Accident Type: Intrusion – main is fouled away from connecting switch
- ACS/ATS Risk Effect: Very limited chance of avoiding collision or reducing collision speed



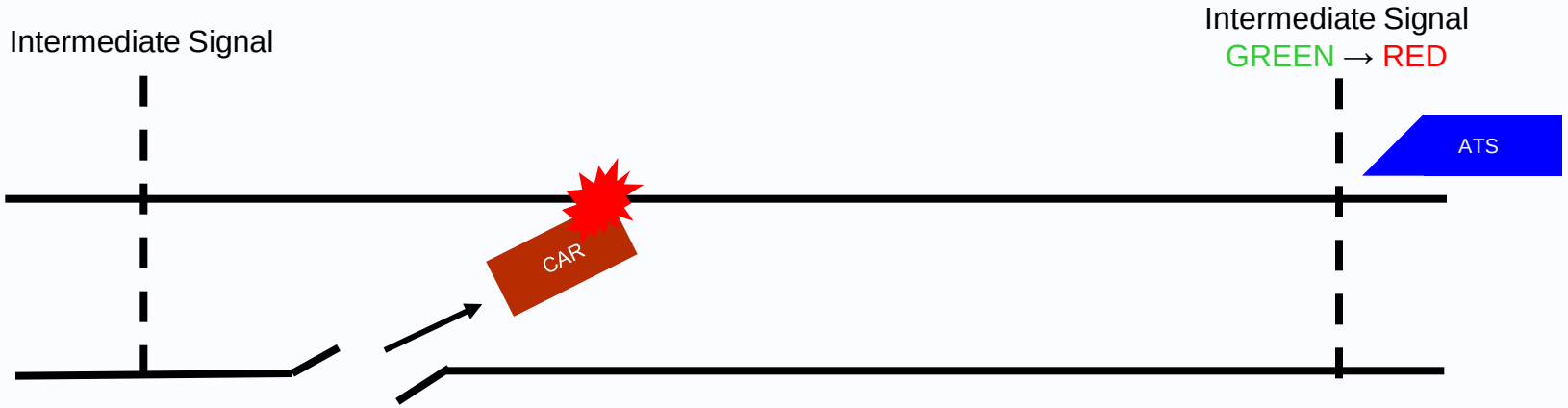
Accident Scenario: Car With Shifted Load on Adjacent Track & ACS/ATS-Equipped Active Train on Main

- Accident Scenario: Shifted load on car on adjacent track fouls main track. ATS Equipped train in same block as intrusion
  - Cause: Shifted load for any reason
  - Action: Derailed car fouls main track; ATS-equipped train passing Intermediate Signal
  - ATS-equipped train on main: IF shifted load shunts coded track circuit on main, ATS locomotive onboard equipment requires the Engineer to acknowledge restricting aspect (20 mph) within 8 seconds to prevent a penalty application. Note: shifted load would have to fall and shunt track circuit to be detected, which is unlikely.
- Accident Type: Intrusion – main is fouled away from connecting switch
- ACS/ATS Risk Effect: Very limited chance of avoiding collision or reducing collision speed



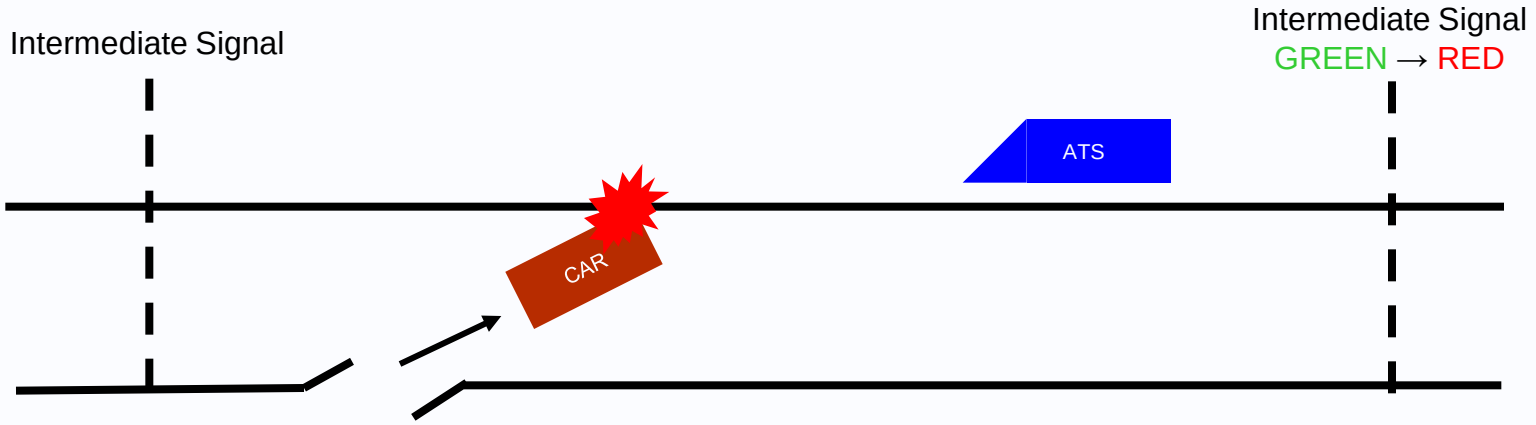
Accident Scenario: Derailed Car on Adjacent Track & ACS/ATS-Equipped Active Train on Main

- Accident Scenario: Car or cars derailed on adjacent track and fouls main track
  - Cause: Derailment form any track or equipment defect or human error
  - Action: Derailed car fouls main track; ATS-equipped train passing Intermediate Signal
  - ATS equipped train on main: IF derailed car shunts track circuit on main, ATS locomotive onboard equipment provides an automatic train stop capability which requires the Engineer to acknowledge a downgrade in cab signal aspect within 8 seconds to prevent a penalty application
- Accident Type: Intrusion – main is fouled away from connecting switch
- ACS/ATS Risk Effect: Could prevent a collision or reduce ACS-equipped train speed at the intrusion, IF derailed car shunts main track circuit



Accident Scenario: Derailed Car on Adjacent Track & ACS/ATS-Equipped Active Train on Main

- Accident Scenario: Car or cars derail on adjacent track and foul main track. ATS train in same block as intrusion.
  - Cause: Derailment form any track or equipment defect or human error
  - Action: Derailed car(s) foul main track; ATS-equipped train approaching Intermediate Signal
  - ATS-equipped train on main: IF derailed car shunts coded track circuit on main, ATS locomotive onboard equipment requires the Engineer to acknowledge restricted aspect within 8 seconds to prevent a penalty application
- Accident Type: Intrusion – main is fouled away from connecting switch
- ATC/ATS Risk Effect: Could prevent possibly a collision or reduce ATS-equipped train speed at the intrusion, depending on train location relative to intrusion AND IF derailed car shunts main track circuit

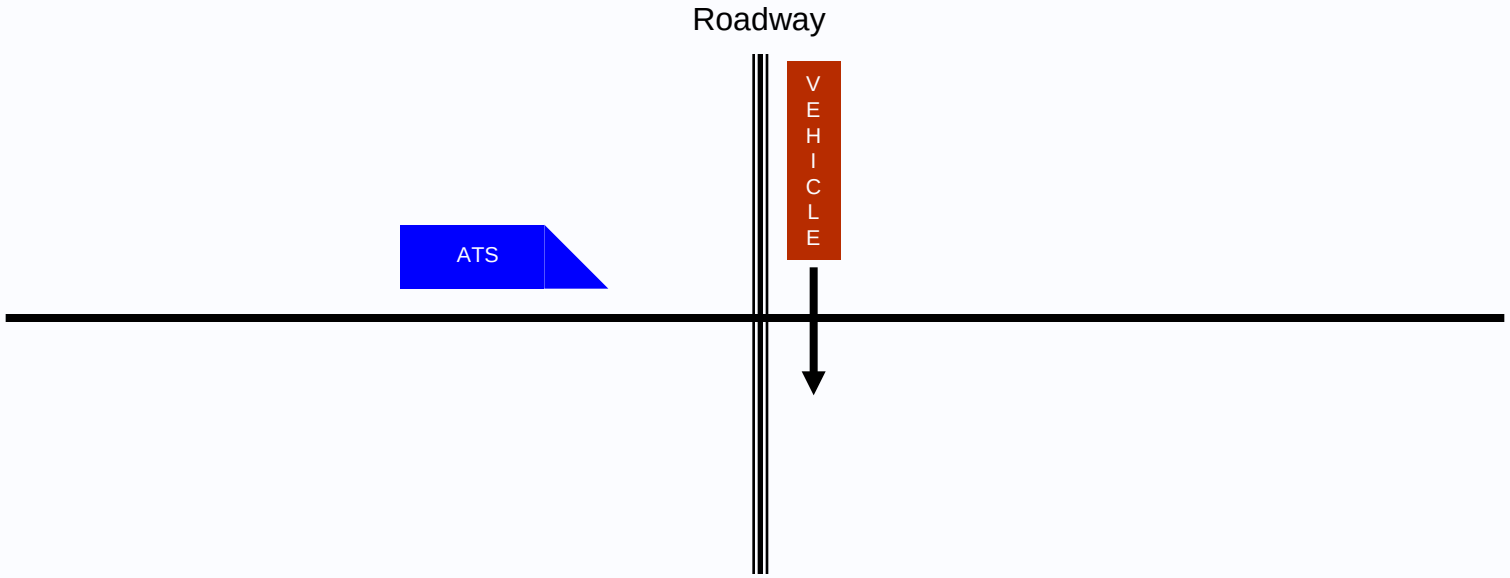


Section 4: Other Accident Types Involving a Single Active IDOT Test Corridor Train

- Collision with crossing train at a diamond crossing with another railroad
- Work zone intrusion or collision with work equipment (Form A)
- Over speed derailment at temporary (Form B) or permanent speed restriction
- Broken rail derailment

Accident Scenario: ACS/ATS-Equipped Active Train at a Grade Crossing

- Accident Scenario: Vehicle crosses tracks in front of ATS-equipped train
  - Cause: Human error by vehicle driver, or vehicle stalled on crossing, or defective crossing warning system
  - Action: Vehicle in path of train on crossing
  - ATS-equipped train has no grade crossing communications within cab that can alert locomotive to presence of vehicle
- Accident Type: Train to highway vehicle. Potential for derailment following grade crossing impact, especially with heavy trucks.
- ACS/ATS Risk Effect - None. ACS does not communicate with grade crossing systems

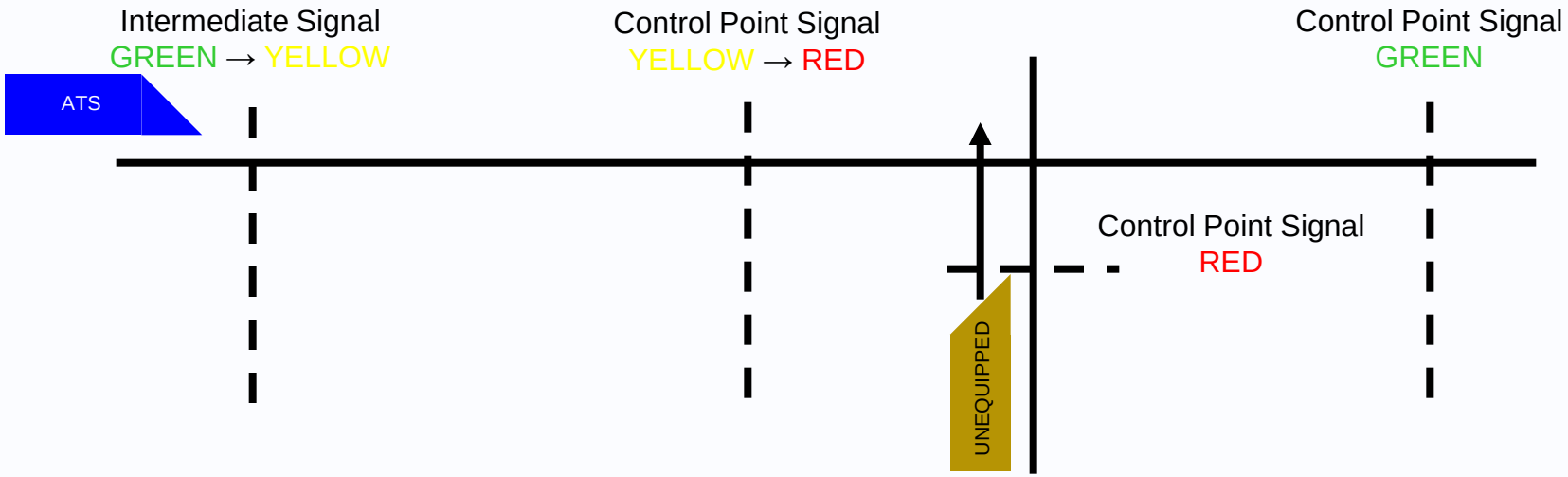


Accident Scenario: ACS/ATS-Equipped Active IDOT Corridor Train with Unequipped Train of Another Railroad at a Diamond

- Accident Scenario: Crossing un-equipped train erroneously enters diamond (SPAD)
  - Cause: Dispatcher misreads map or crew ignores Control Point Signal
  - Action: Un-equipped train passes RED Control Point Signal and enters diamond; ATS-equipped train on main passes Intermediate Signal
  - ACS equipped train on main: ACS locomotive onboard equipment provides an automatic train stop capability which requires the Engineer to acknowledge a downgrade in cab signal aspect within 8 seconds to prevent a penalty application
  - Un-equipped train on crossing track: No on-board display or capability to warn engineer or stop train.

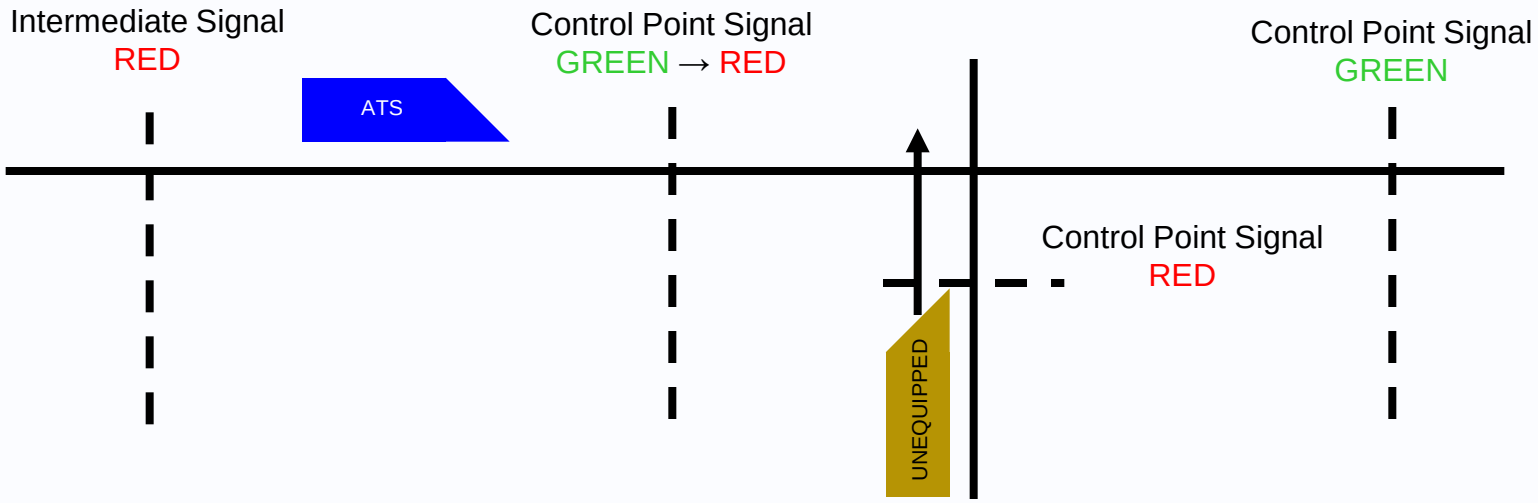
- Accident Type: : Side impact between locomotive of one train and car of crossing train.

- ACS/ATS Risk Effect: In many cases, ATS could prevent a collision or reduce collision speed



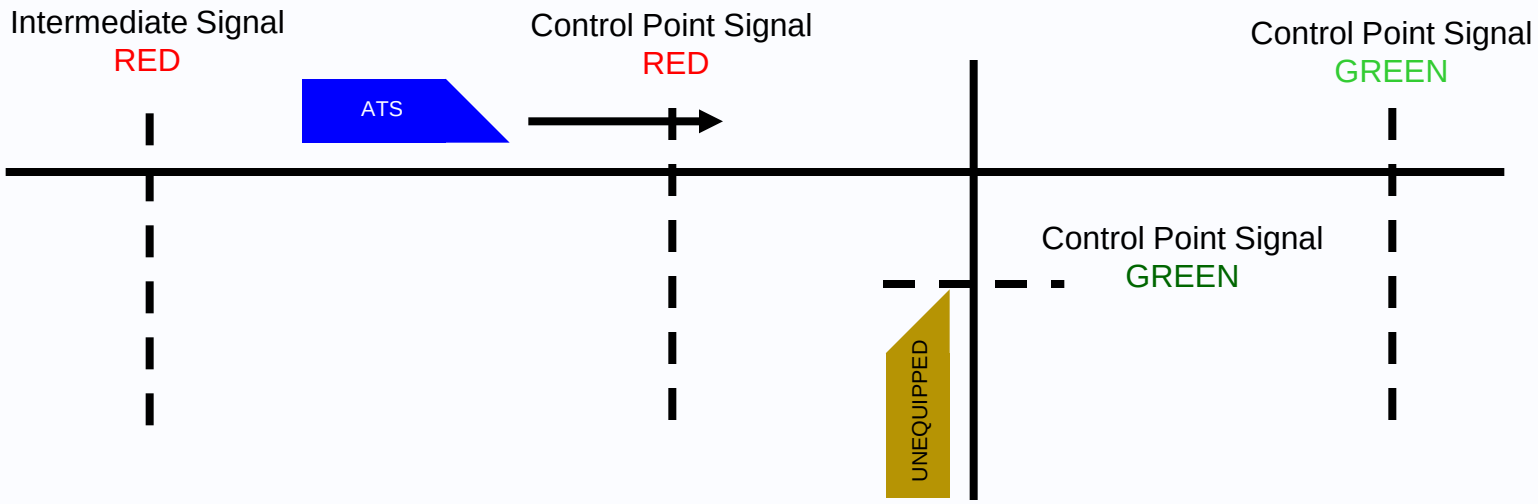
Accident Scenario: ACS/ATS-Equipped Active IDOT Corridor Train with Unequipped Train at a Diamond

- Accident Scenario: Un-equipped train erroneously enters Diamond (SPAD)
  - Cause: Dispatcher misreads map or crew ignores Control Point Signal
  - Action: Un-equipped train passes RED Control Point Signal; ATS equipped train on main between Intermediate and Control Point Signals
  - ATS equipped train on main: ATS locomotive onboard equipment provides an automatic train stop capability which requires the Engineer to acknowledge a downgrade in cab signal aspect within 8 seconds to prevent a penalty application
  - Un-equipped train on crossing track: No on-board display or capability to warn engineer or stop train.
- Accident Type: : Side impact between locomotive of one train and car of crossing train.
- ACS/ATS Risk Effect: In many cases ATS could reduce collision speed and might prevent a collision, depending on the location of ATS train relative to the diamond.



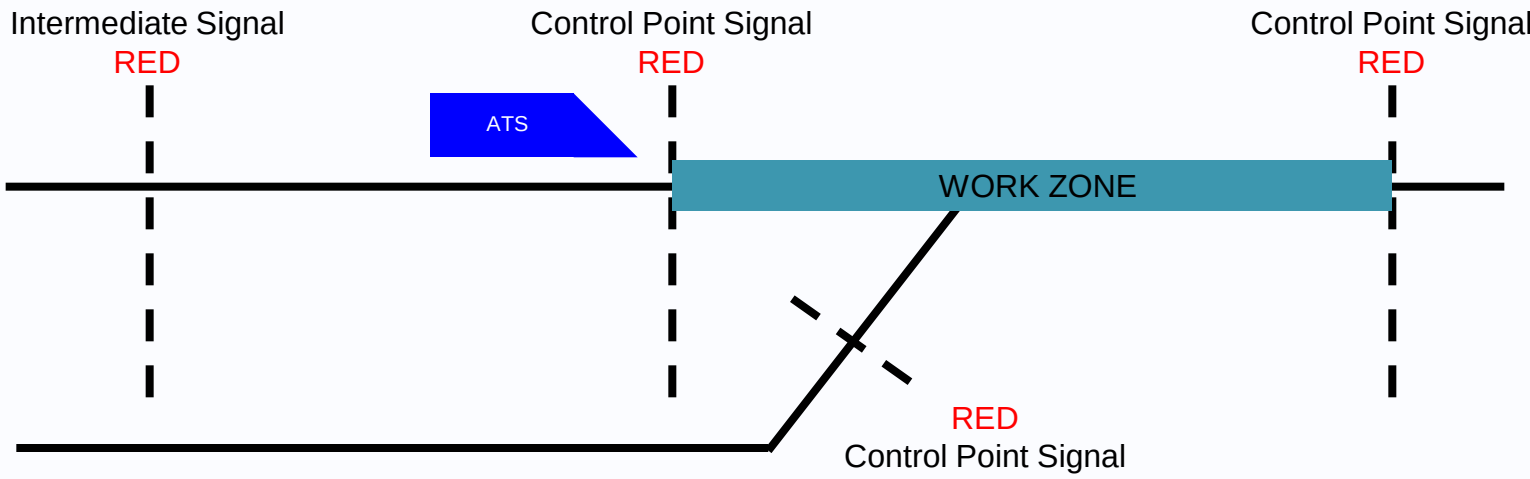
Accident Scenario: ACS/ATS-Equipped Active IDOT Corridor Train with Unequipped Train at a Diamond

- Accident Scenario: ATS equipped train erroneously enters Diamond (SPAD) when signals are cleared for crossing un-equipped train
  - Cause: Dispatcher misreads map or crew ignores Control Point Signal
  - Action: ATS equipped train on main passes RED Control Point Signal
  - ATS equipped train on main: ATS locomotive onboard equipment provides an automatic train stop capability which requires the Engineer to acknowledge a downgrade in cab signal aspect within 8 seconds to prevent a penalty application
  - Un-equipped train on crossing track: No on-board display or capability to warn engineer or stop train.
- Accident Type: Side impact between locomotive of one train and car of crossing train.
- ACS/ATS Risk Effect: ATS reduces the chance of a violation and may reduce collision speed in those collisions that are not prevented



Accident Scenario: Active ACS/ATS-Equipped Train and Work Crew/Hi-Rail/Work Equipment

- Accident Scenario: Train erroneously enters work zone and contacts roadway worker(s) or hi-rail or work equipment. Work zone equipment protected by control point signal
  - Cause: Human error
  - Action: Train exceeds authority or work crew/equipment operating outside of authority
  - ATS: ATS locomotive onboard equipment provides an automatic train stop capability which requires the Engineer to acknowledge a downgrade in cab signal aspect within 8 seconds to prevent a penalty application
- Accident Type: Train collides Work Crew/Hi-Rail/Work Equipment
- ACS/ATS Risk Effect: ATS can reduce the chance of a violation of the Control Point signal



Accident Scenario: Active ACS/ATS-Equipped Train and Work Crew/Hi-Rail/Work Equipment

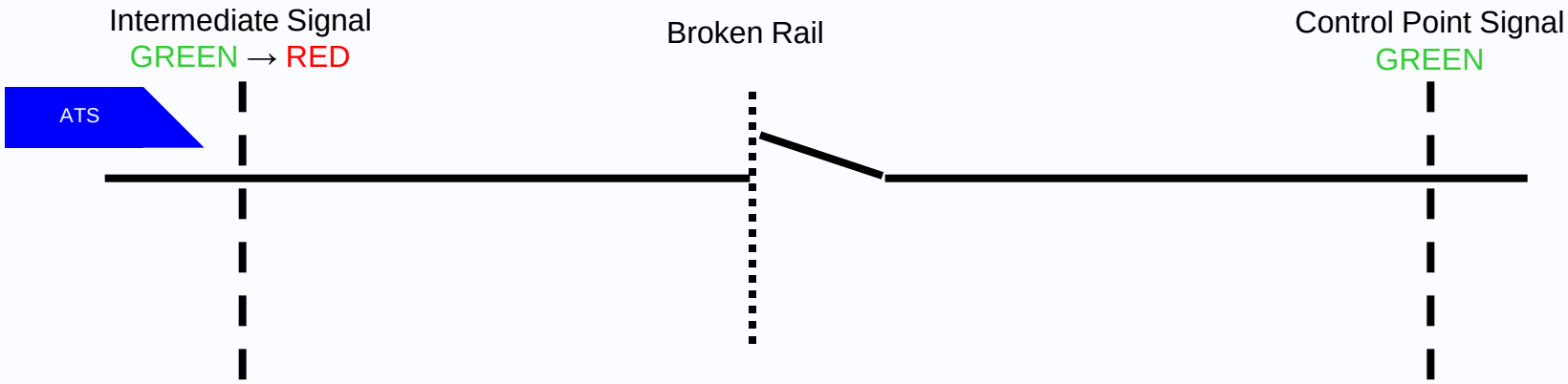
- Accident Scenario: Train contacts roadway worker(s) or hi-rail or work equipment not protected by control point signal
  - Cause: Human error
  - Action: Train exceeds authority or work crew/equipment operating outside of authority
  - ATS: ATS provides no work zone protection outside of Control Point Signals
- Accident Type: Train to Work Crew/Hi-Rail/Work Equipment
- ACS/ATS Risk Effect: None in this scenario

Accident Scenario: Active ACS/ATS-Equipped Train Derails Due To Overspeed

- Accident Scenario: ATS-equipped train derails due to overspeed
  - Cause: Dispatcher misreads map or crew ignores speed restriction
  - Action: ATS-equipped train ignores speed restriction (permanent or Form A) and accelerates or maintains current speed
  - ATS provides no speed enforcement at permanent or temporary speed restrictions
- Accident Type: Overspeed Derailment
- ACS/ATS Risk Effect: none in this scenario

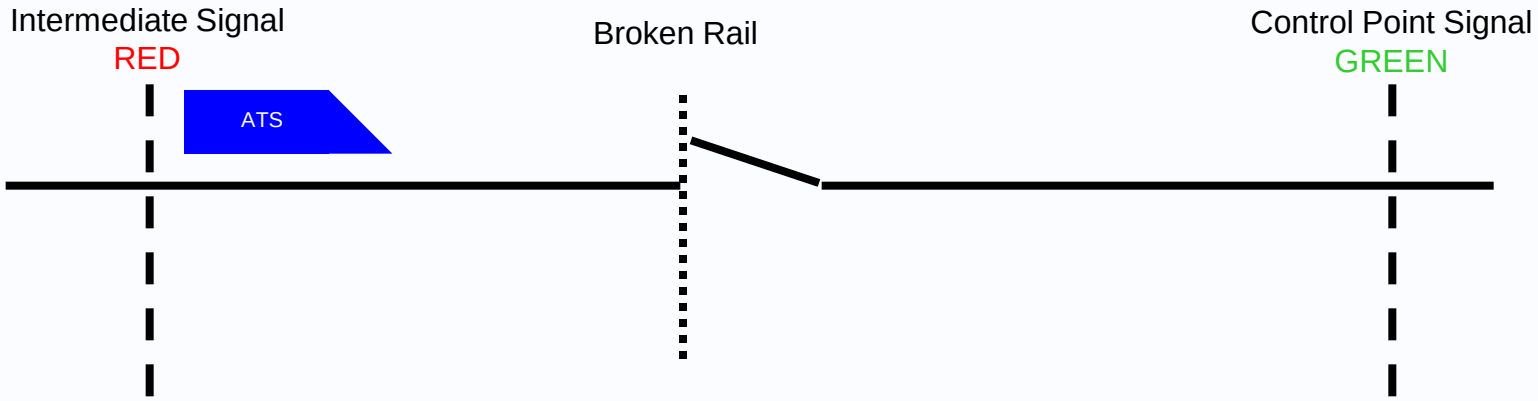
Accident Scenario: Active ACS/ATS-Equipped Train Derails Due To Broken Rail (Complete Break, Interrupting Track Circuit)

- Accident Scenario: ATS-equipped train derails due to broken rail. Train approaching intermediate signal
  - Cause: Broken rail in next signal block
  - Action: ATS-equipped train passes over broken rail and derails
  - ATS-equipped train on main: ATS locomotive onboard equipment provides an automatic train stop capability which requires the Engineer to acknowledge a downgrade in cab signal aspect within 8 seconds to prevent a penalty application
- Accident Type: Broken Rail Derailment
- ACS/ATS Risk Effect: In may cases train could slow or stop before break, depending on train location



Accident Scenario: Active ACS/ATS-Equipped Train Derails Due To Broken Rail (Complete Break, Interrupting Track Circuit)

- Accident Scenario: ATS-equipped train derails due to broken rail. Train has passed intermediate signal and entered same block as break.
  - Cause: Broken rail in same signal block
  - Action: ATS equipped train passes over broken rail and derails
  - ATS-equipped train on main: The loss of pulsed carrier results in a Restricting Aspect. ATS locomotive onboard equipment provides an automatic train stop capability which requires the Engineer to acknowledge a downgrade in cab signal aspect within 8 seconds to prevent a penalty application
- Accident Type: Broken Rail Derailment
- ACS/ATS Risk Effect: In many cases, the Engineer will apply the brakes in response to the warning and slow or stop the train before reaching the break.



PTC Optimum Communications Timeout Study: Accident Descriptions

Part IV: Cab Signaling with Automatic Train Control (ATC)

Assumptions for ATC Base Case

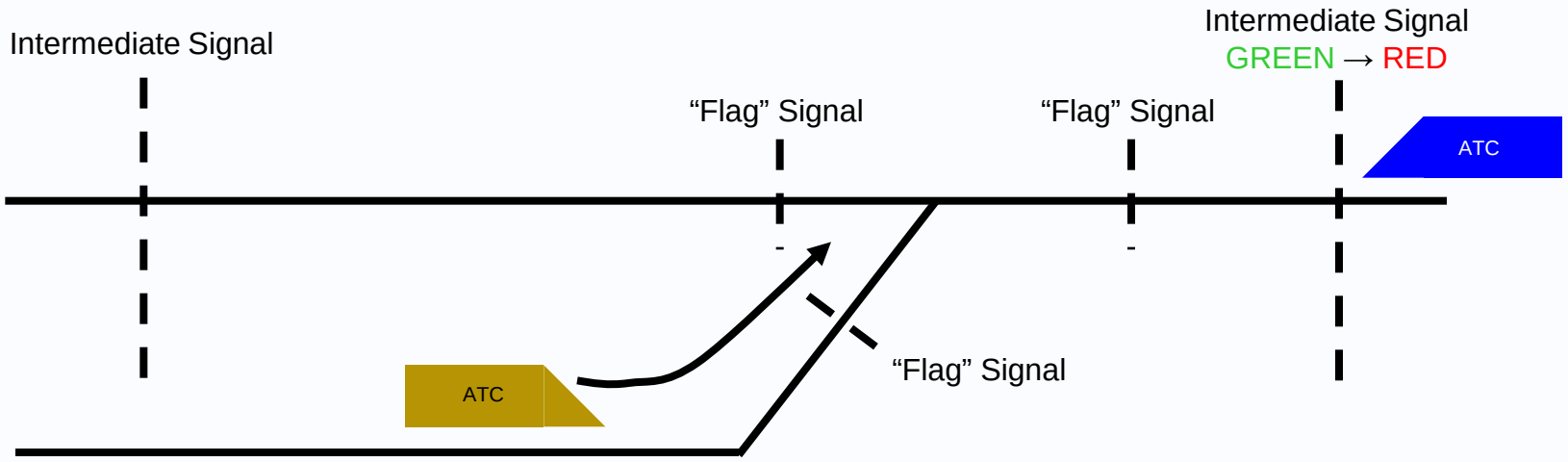
- Bi-directional signaling for all cases
- Route lock from control point to control point
- All except two passing sidings are track-circuited
- All IDOT test corridor passenger and freight trains headed by a locomotive are equipped with ATC
- Work trains are equipped with cab signal when headed by conventional locomotive. Self propelled work equipment units (e.g. tamping machine) are unequipped
- Cab signal coded track circuits provide detection and communicate information to an inductive pickup on the locomotive via a pulsed 60 Hz carrier injected into the rail
- On-board ATC equipment enforces braking to a speed corresponding to cab signal aspect. Lowest enforced speed is restricting (20 mph), when track circuit is shunted
- Cab signal circuits are directional in that they can detect an interruption or shunt of the circuit ahead of an approaching train in the same signal block
- CTC track circuits provide detection to the wayside and control wayside signals, but do not communicate to the train
- All cab signal equipment operational and does not fail during operations over the route

Section 1: Head-On Collision Between Two Locomotives Heading Active IDOT Corridor Trains

- Collision between train leaving uncontrolled siding and train on main track
- Collision between train leaving controlled siding and train on main track.

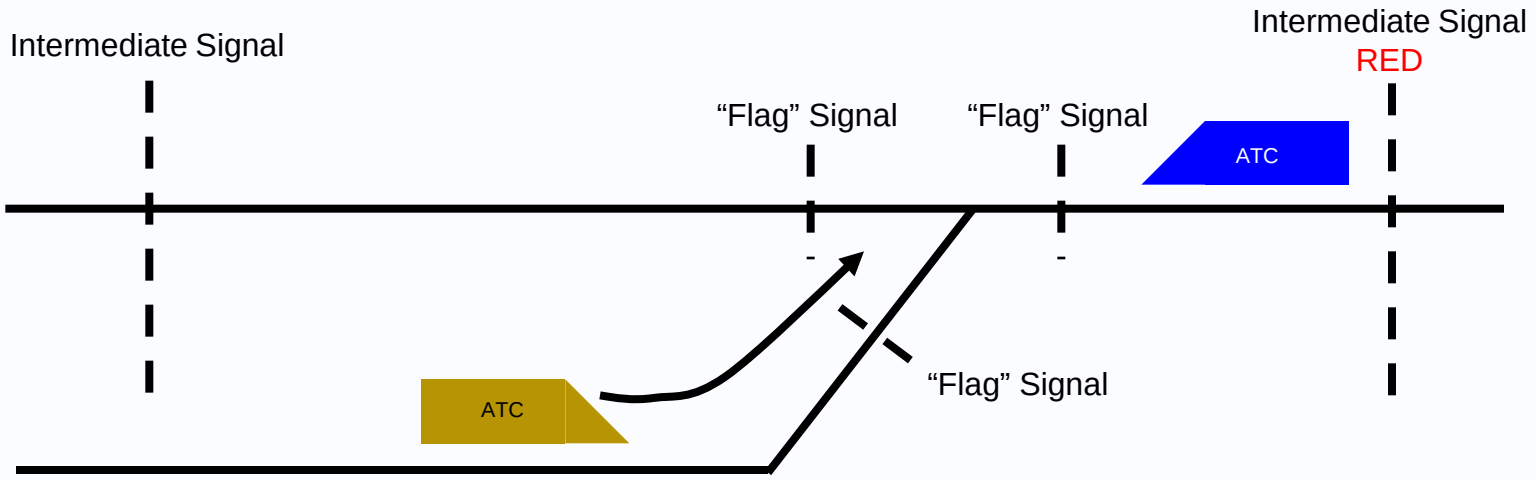
Accident Scenario: ATC-Equipped Active Trains on Uncontrolled Siding and Main

- Accident Scenario: ATC-equipped train leaving siding without authority, & ATC-equipped train entering block
  - Cause: Dispatcher misreads map or crew ignores signal
  - Action: ATC-equipped train erroneously exits siding and enters main; ATC-equipped train passing Intermediate Signal
  - ATC-equipped train on main: ATC locomotive onboard equipment requires the Engineer to initiate braking to reduce speed in compliance with cab signal aspect within 8 seconds to prevent a penalty application, the absence of the carrier will continue to show a Restricting Aspect in the cab
  - ATC-equipped train entering main from siding: ATC will continue to display a Restricting Aspect preventing speed exceeding restricting.
- Accident Type: Head-on collision between locomotives
- ATC Benefit: Collision will be prevented or collision speed reduced



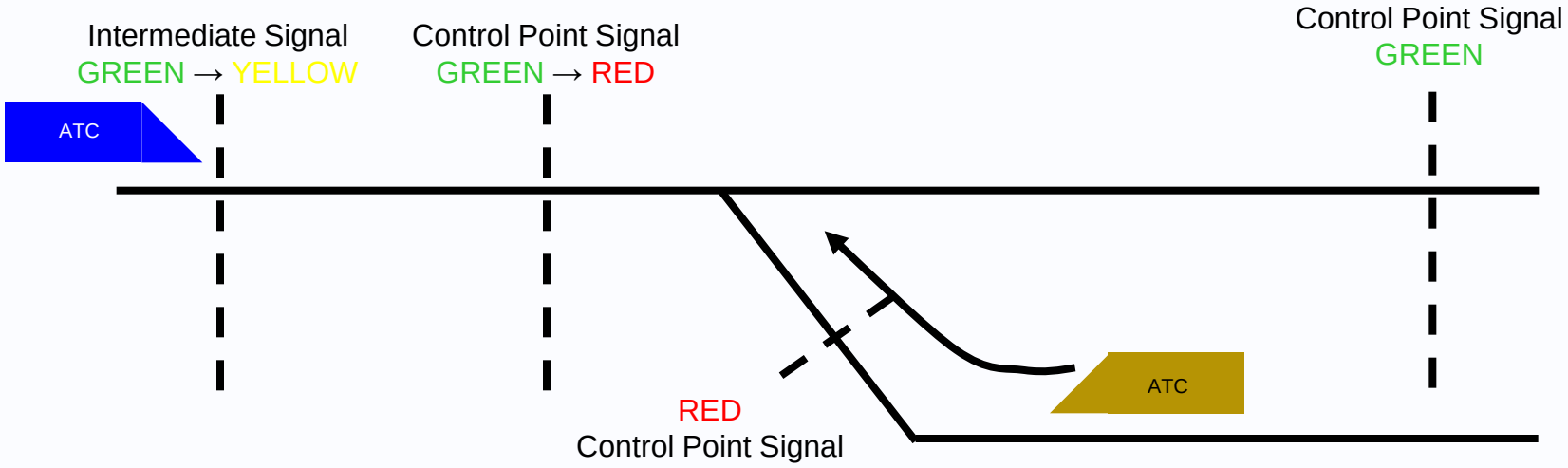
Accident Scenario: ATC-Equipped Active Trains on Uncontrolled Siding & Main

- Accident Scenario: ATC-equipped train leaving siding & ATC-equipped train in block
  - Cause: Dispatcher misreads map or crew ignores signal
  - Action: ATC-equipped train erroneously exits siding and enters main; ATC-equipped train passed Intermediate Signal
  - ATC-equipped train on main: ATC locomotive onboard equipment requires the Engineer initiate braking to restricted speed within 8 seconds to prevent a penalty application.
  - ATC-equipped train on siding: Upon entering main, loss of speed code results in a Restricting Aspect. ATC locomotive onboard equipment requires the Engineer to initiate braking to restricted speed within 8 seconds to prevent a penalty application
- Accident Type: Head-on collision between locomotives. See also alternative scenario in Section 2, page E-100
- ATC Risk Effect: Collision will be prevented or collision speed reduced



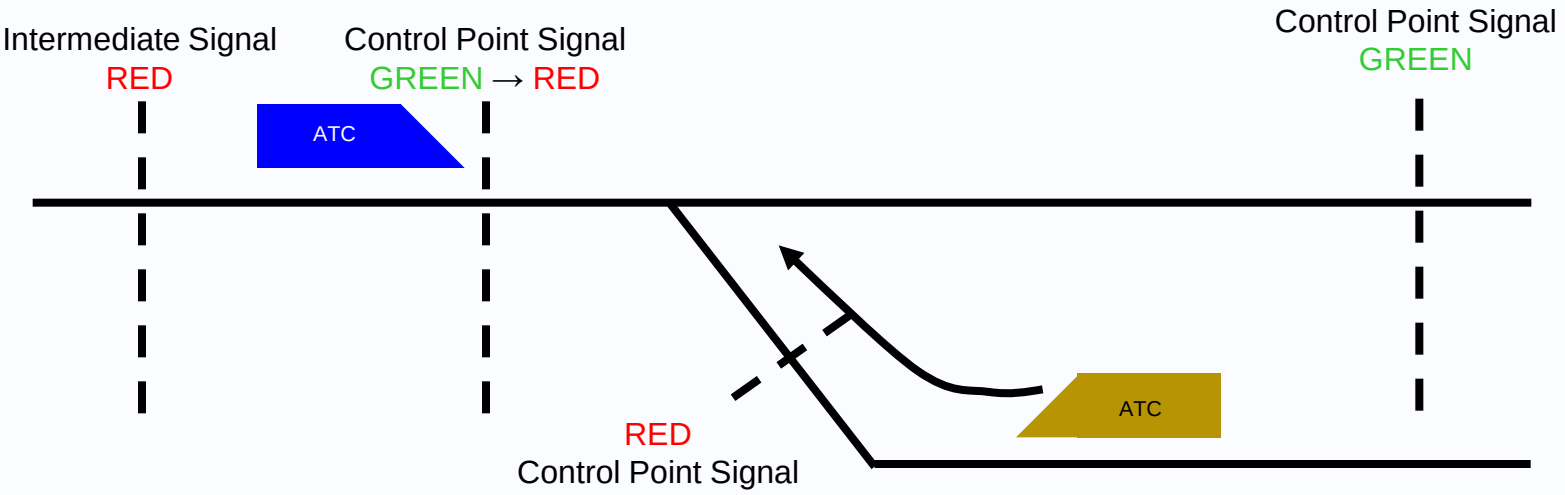
Accident Scenario: ATC-Equipped Active Trains on Controlled (Passing) Siding and Main

- Accident Scenario: ATC-equipped train erroneously leaving siding (SPAD); ATC-equipped train passing Intermediate Signal and approaching the Control Point
  - Cause: Dispatcher misreads map or crew ignores Control Point Signal
  - Action: ATC-equipped train passes RED Control Point Signal and exits siding; ATC-equipped train on main passes Intermediate Signal
  - ATC-equipped train on main: When the train from the siding shunts the main track, ATC will change from Clear to Approach. Engineer must initiate braking to reduce speed in accordance with signal aspect to avoid penalty brake. When the train passes the Intermediate Signal, ATC will change from Approach to Restricting, requiring further braking to restricting speed
  - ATC-equipped train entering main from siding: ATC will display a continuous Restricting Aspect
- Accident Type: Head-on collision between locomotives.
- This and page E-92 scenarios probably the most common scenarios on this corridor. Almost all meets are at controlled sidings
- ATC Risk Effect: Collision will be prevented or collision speed reduced



Accident Scenario: ATC-Equipped Active Trains on Controlled (Passing) Siding & Main

- Accident Scenario: ATC-equipped train erroneously leaving siding (SPAD); ATC-equipped train entering the Control Point block
  - Cause: Dispatcher misreads map or crew ignores signal
  - Action: ATC-equipped train passes RED Control Point Signal and exits siding; ATC-equipped train on main between Intermediate & Control Point Signals
  - ATC-equipped train on main: When the train from the siding shunts the main track, ATC will change from Clear to Restricting and Engineer must initiate braking to slow train to restricting speed to avoid penalty brake.
  - ATC-equipped train on siding: ATC will display a continuous Restricting Aspect in the cab, enforcing restricted speed
- Accident Type: Head-on collision between locomotives. See also alternative scenario in Section 2, Page E-101
- ATC Risk Effect: Collision will be prevented or collision speed reduced.

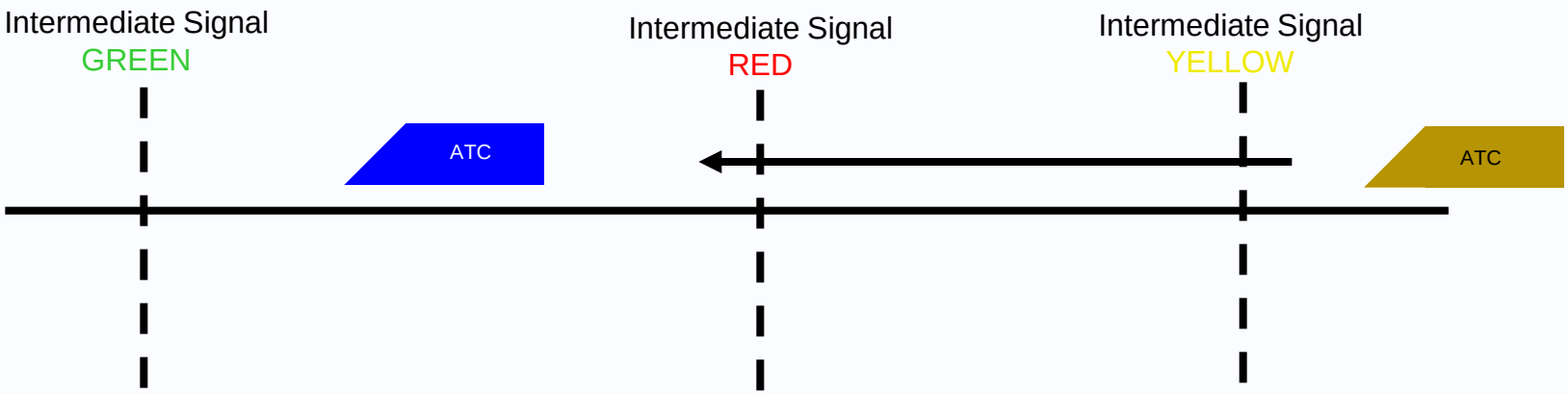


Section 2: Collision Between Two Active IDOT Corridor Trains: Head (Locomotive) with Rear or Side of Second Train

- Train rear-ends a stationary or slower moving train on main
- Train exiting uncontrolled siding in reverse. Collision on main with train traveling in same direction
- Train exiting uncontrolled siding. Collision on main with train traveling in same direction
- Train exiting uncontrolled siding, collides with side of train traveling in opposite direction.
- Train exiting controlled siding, collides with side of train traveling in opposite direction.
- Train exiting controlled siding. Collision with train traveling on main same direction

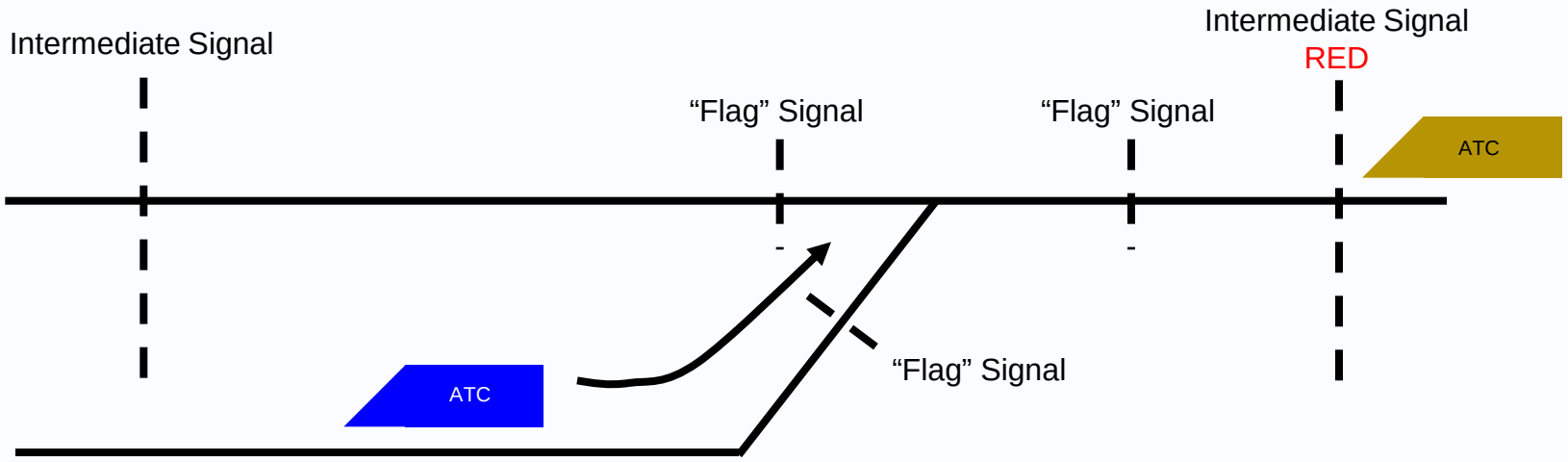
Accident Scenario: ATC-Equipped Active Trains Following One Another on Main

- Accident Scenario: Two ATC-equipped trains on main. Following ATC-equipped train entering block (SPAD)
  - Cause: Crew ignores intermediate signal
  - Action: Following ATC-equipped train passes RED Intermediate Signal on main; ATC-equipped train on main: ATC will sound an audible alert when the train passes the previous Intermediate Signal and show a downgraded signal aspect. Engineer must initiate braking or ATC applies a penalty brake.
- Accident Type: Rear end collision. Locomotive of train on main strikes rear of train exiting siding
- ATC Risk Effect : Reduces chance of SPAD. Following train either stops or slows to reduce collision speed or prevent collision. Cannot exceed restricting speed when entering same block as lead train.



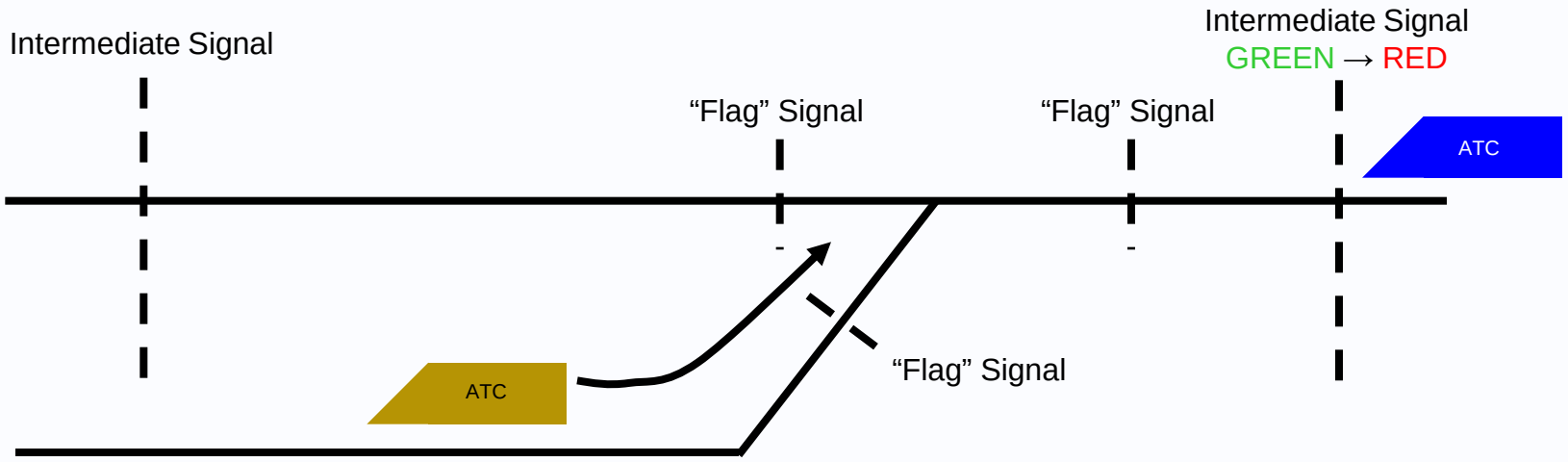
Accident Scenario: ATC-Equipped Active Trains on Uncontrolled Siding & Main

- Accident Scenario: ATC-equipped train leaving siding (reverse move) & ATC-equipped train entering block (SPAD)
  - Cause: Crew ignores intermediate signal
  - Action: ATC-equipped train passes RED Intermediate Signal on main; ATC-equipped train exiting siding
  - ATC-equipped train on main: ATC will sound an auditable alert when the train passes the previous Intermediate Signal and show a downgraded signal aspect. Engineer must initiate braking or ATC applies a penalty brake.
  - ATC-equipped train entering main from siding: The train will be unaware of the approaching train until locomotive reaches the main track
- Accident Type: Rear end collision. Locomotive of train on main strikes rear of train exiting siding
- ATC Risk Effect : Reduces chance of SPAD. Train on main either stops or slows to reduce collision speed or prevent collision. Train on siding limited to restricted speed.



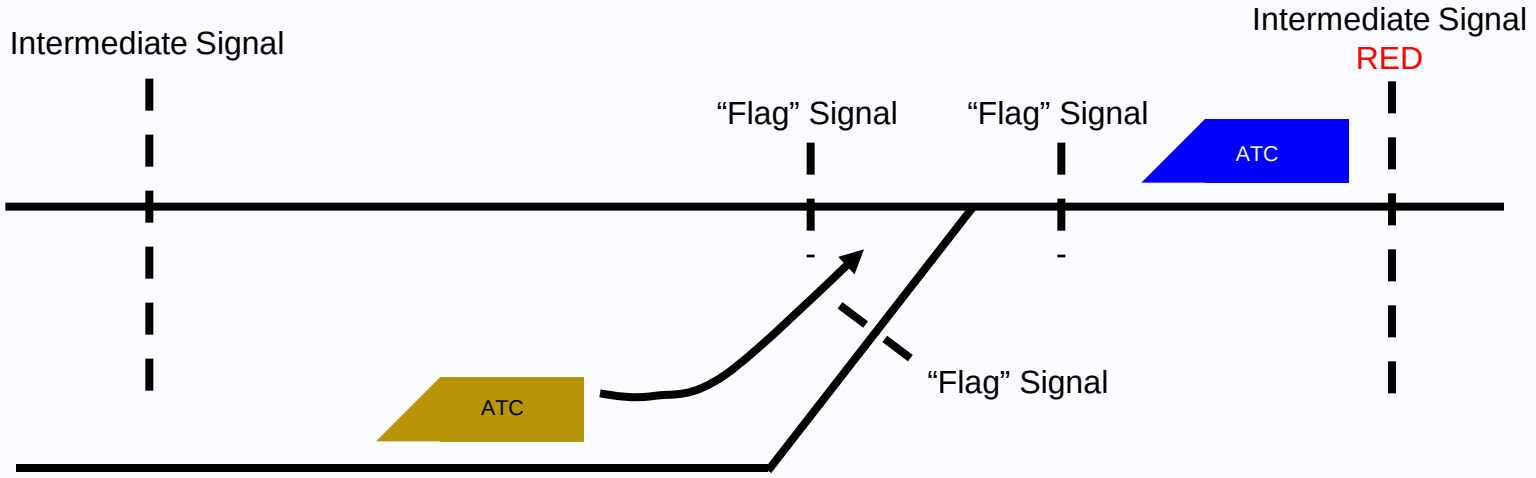
Accident Scenario: ATC-Equipped Active Trains on Uncontrolled Siding & Main

- Accident Scenario: ATC-equipped train backing from siding & ATC-equipped train entering block
  - Cause: Dispatcher misreads map or crew of train exiting siding ignores signal
  - Action: ATC-equipped train erroneously exits siding and enters main; ATC-equipped train passing Intermediate Signal
  - ATC-equipped train on main: ATC locomotive onboard equipment requires the Engineer to initiate braking in response to a downgrade in cab signal aspect within 8 seconds to prevent a penalty application. The absence of the carrier will continue to show a Restricting Aspect in the cab once the train has passed the intermediate signal
  - ATC-equipped train backing from siding: The train will be unaware of the approaching train
- Accident Type: rear-end collision. Train on main strikes rear of train exiting siding
- ATC Risk Effect: Train on main will slow to either prevent a collision or reduce collision speed.



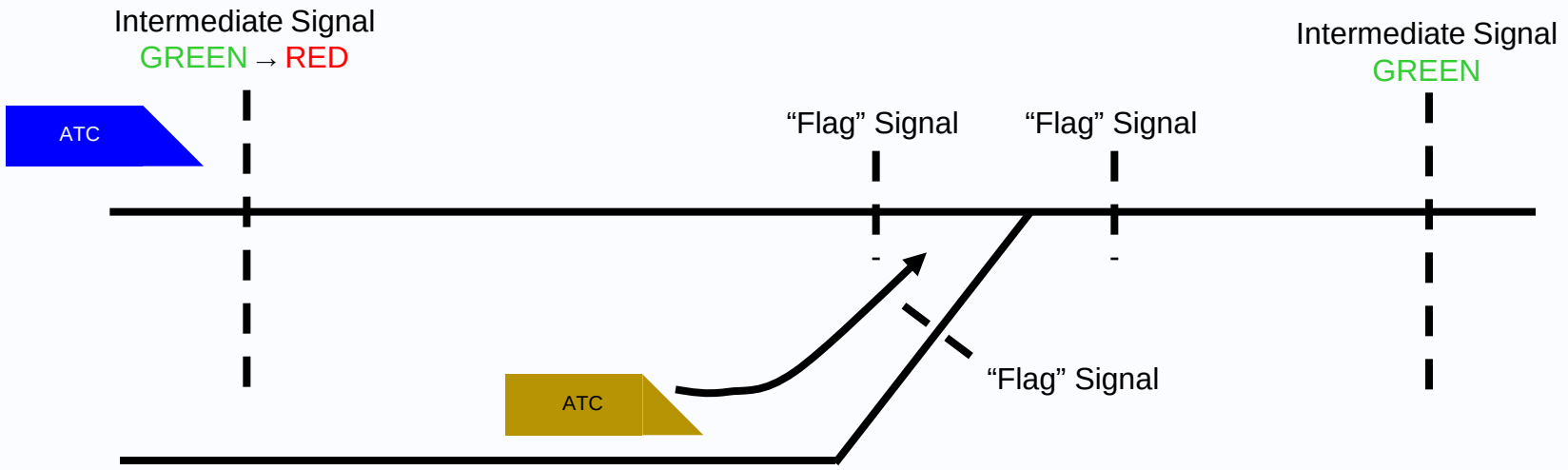
Accident Scenario: ATC-Equipped Active Trains on Uncontrolled Siding & Main

- Accident Scenario: ATC-equipped train reversing from siding & ATC-equipped train in block
  - Cause: Dispatcher misreads map or crew ignores signal
  - Action: ATC-equipped train erroneously exits siding and enters main; ATC-equipped train has passed Intermediate Signal
  - ATC-equipped train on main: ATC locomotive onboard equipment requires the Engineer to initiate braking to slow to restricted speed within 8 seconds to prevent a penalty application.
  - ATC-equipped train on siding: The train will be unaware of the approaching train
- Accident Type: Rear-end, side or raking collision. Train on main strikes rear of train exiting siding, OR train on siding strikes side of train on main, behind the locomotive.
- ATC Risk Effect: ATC train on main will slow to prevent a collision or reduce collision speed, depending on location relative to the switch



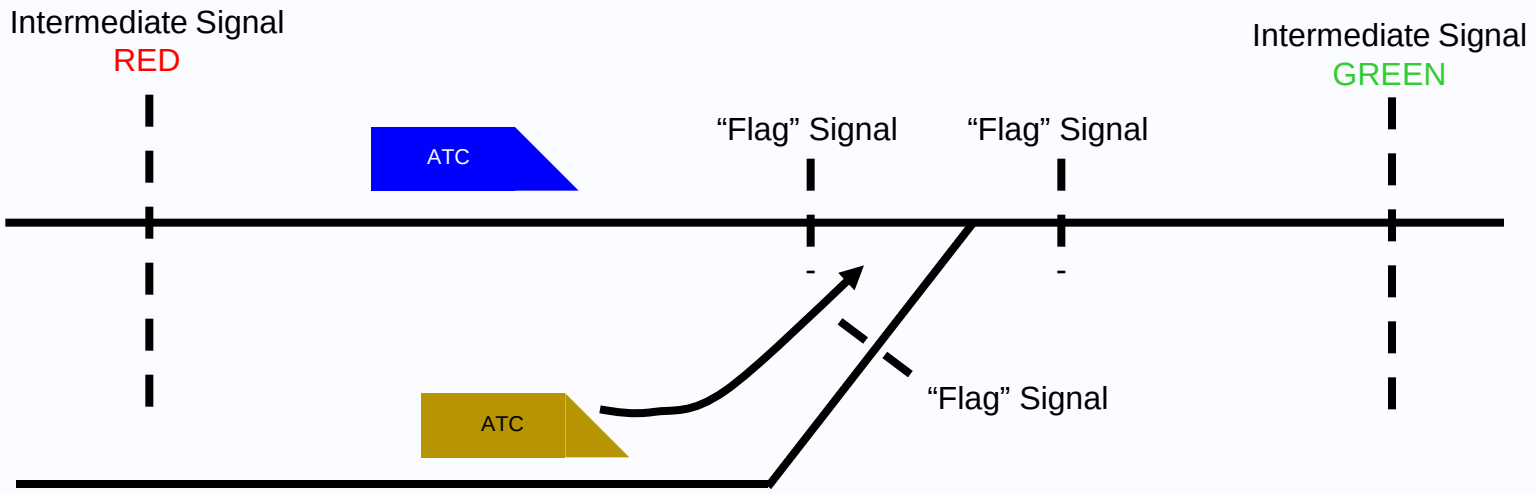
Accident Scenario: ATC-Equipped Active Trains on Uncontrolled Siding & Main

- Accident Scenario: ATC-equipped train leaving siding & ATC-equipped train approaching intermediate signal
  - Cause: Dispatcher misreads map or crew ignores signal
  - Action: ATC-equipped train erroneously exits siding and enters main; ATC-equipped train passed Intermediate Signal
  - ATC-equipped train on main: ATC locomotive onboard equipment requires the Engineer to initiate braking to slow to speed indicated by signal aspect within 8 seconds to prevent a penalty application.
  - ATC-equipped train on siding: Upon entering main, loss of speed code results in a Restricting Aspect. ATC locomotive onboard equipment requires the Engineer to initiate braking to slow to restricting speed within 8 seconds to prevent a penalty application
- Accident Type: Rear, side or raking collision. Train exiting siding strikes train or vise-versa depending on relative position and speed of trains
- ATC Risk Effect: Collision may be prevented or closing speed of collision reduced, depending on the position of the two trains relative to the collision point



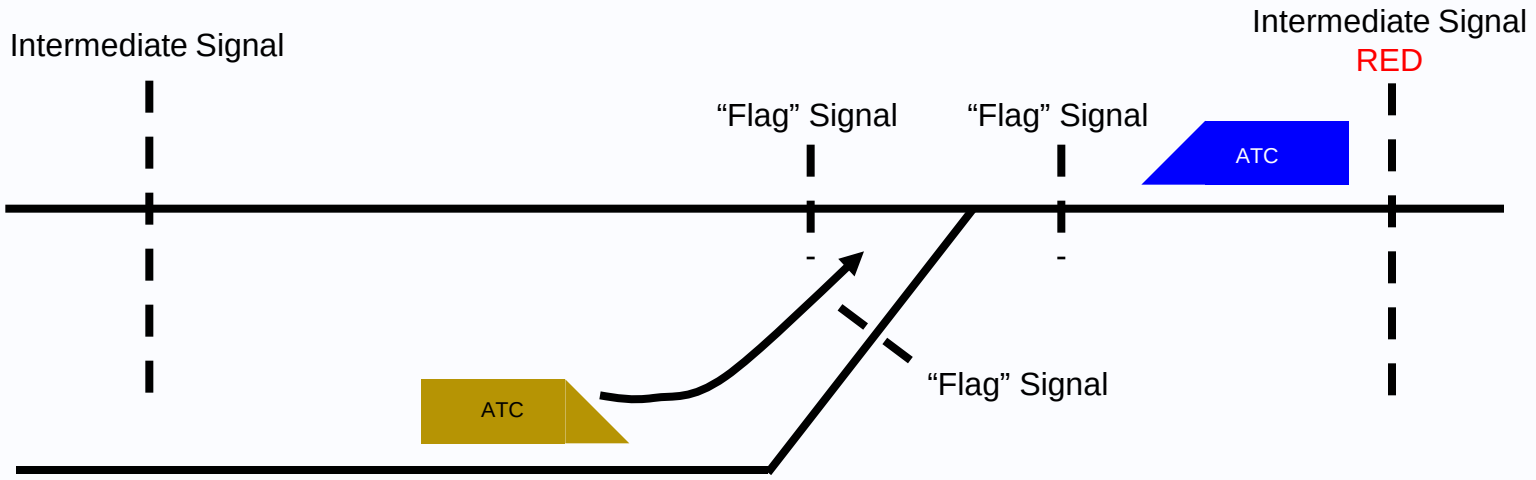
Accident Scenario: ATC-Equipped Active Trains on Uncontrolled Siding & Main

- Accident Scenario: ATC-equipped train leaving siding & ATC-equipped train in block
  - Cause: Dispatcher misreads map or crew ignores signal
  - Action: ATC-equipped train erroneously exits siding and enters main; ATC-equipped train passed Intermediate Signal
  - ATC-equipped train on main: ATC locomotive onboard equipment requires the Engineer to initiate braking to slow to restricting speed within 8 seconds to prevent a penalty application.
  - ATC-equipped train on siding: Upon entering main, loss of speed code results in a Restricting Aspect. ATC locomotive onboard equipment requires the Engineer to initiate braking to slow to restricting speed within 8 seconds to prevent a penalty application
- Accident Type: Rear, side or raking collision. Train exiting siding strikes train or vise-versa depending on relative position and speed of trains
- ATC Risk Effect: Collision may be prevented or closing speed of collision reduced, depending on the position of the two trains relative to the collision point



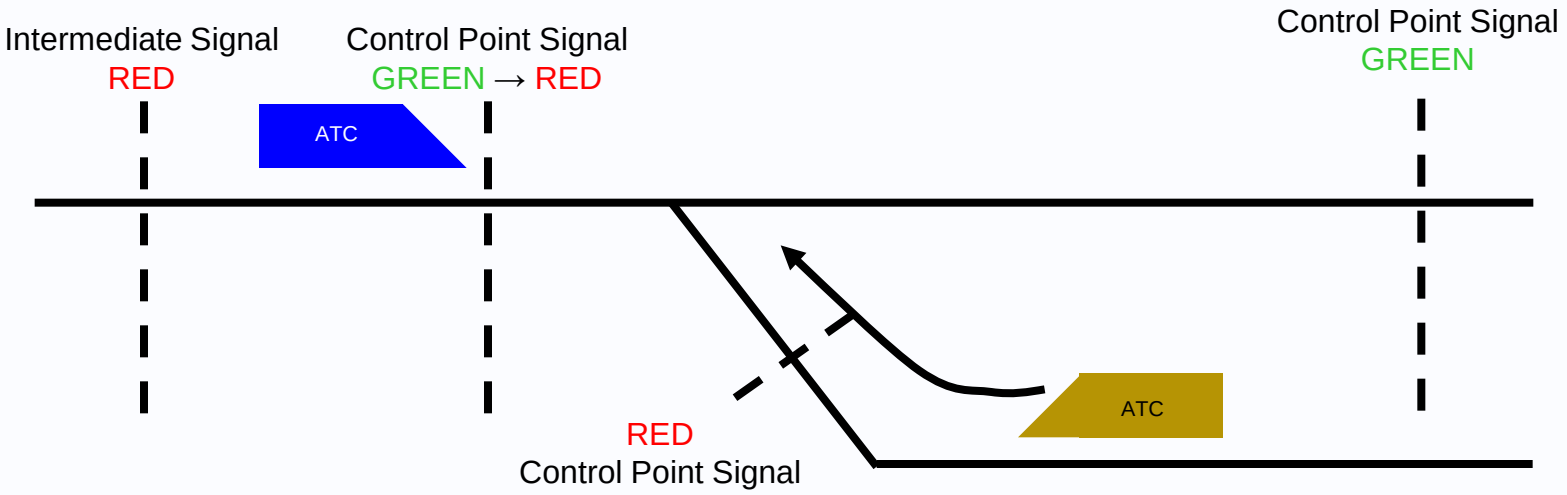
Accident Scenario: ATC-Equipped Active Trains on Uncontrolled Siding & Main

- Accident Scenario: ATC-equipped train leaving siding & ATC-equipped train in block
  - Cause: Dispatcher misreads map or crew ignores signal
  - Action: ATC-equipped train erroneously exits siding and enters main; ATC-equipped train passed Intermediate Signal
  - ATC-equipped train on main: ATC locomotive onboard equipment requires the Engineer to initiate braking to slow to restricting speed within 8 seconds to prevent a penalty application.
  - ATC-equipped train on siding: Upon entering main, loss of speed code results in a Restricting Aspect. ATC locomotive onboard equipment requires the Engineer to initiate braking to slow to restricting speed within 8 seconds to prevent a penalty application
- Accident Type: Side or raking collision. Train exiting siding strikes train on main behind locomotive. See also scenario variant in Section 1 Page E-90
- ATC Risk Effect: None, locomotive of train has already passed when train on siding reaches main.



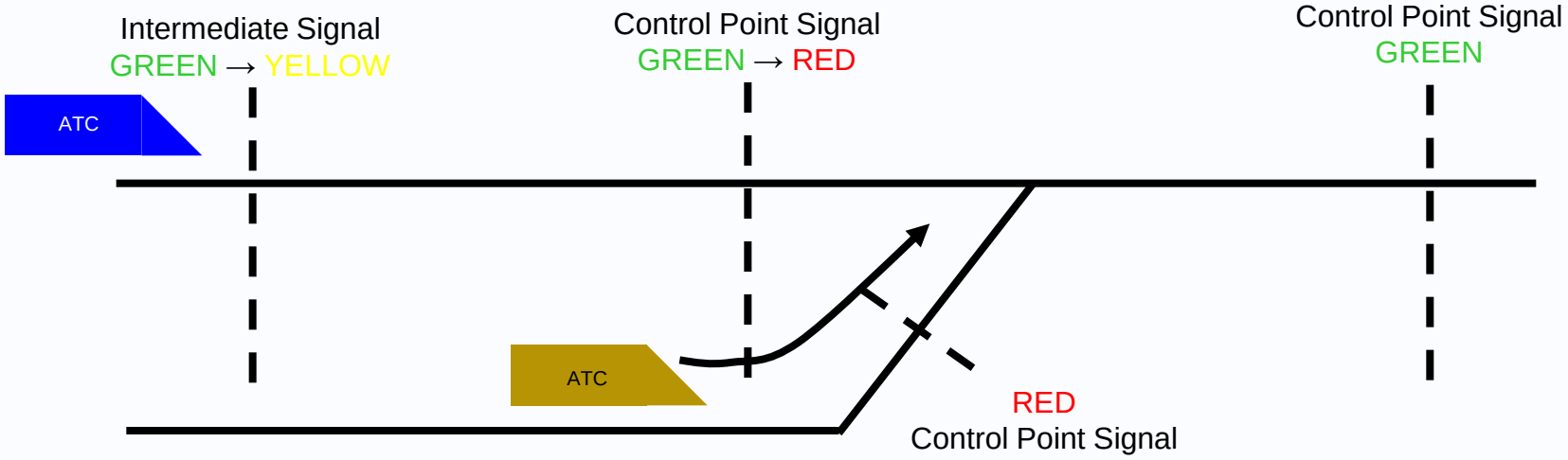
Accident Scenario: ATC-Equipped Active Trains on Controlled (Passing) Siding & Main

- Accident Scenario: ATC-equipped train erroneously leaving siding (SPAD); ACS equipped train entering the Control Point block
  - Cause: Dispatcher misreads map or crew ignores signal
  - Action: ATC-equipped train passes RED Control Point Signal and exits siding (max speed – restricting); ATC-equipped train on main between Intermediate & Control Point Signals
  - ATC-equipped train on main: When the train from the siding shunts the main track, ATC will change from Clear to Restricting. Engineer must initiate braking to reduce speed to restricting to avoid penalty brake.
  - ATC-equipped train on siding: ATC will be limited to Restricting speed
- Accident Type: Side or raking collision. Locomotive of train exiting siding strikes train on main behind locomotive. See also alternative scenario in Section 1, Page E-92
- ATC Risk Effect: Collision avoided or closing speed of collision reduced, depending on location of train on the main relative to collision point



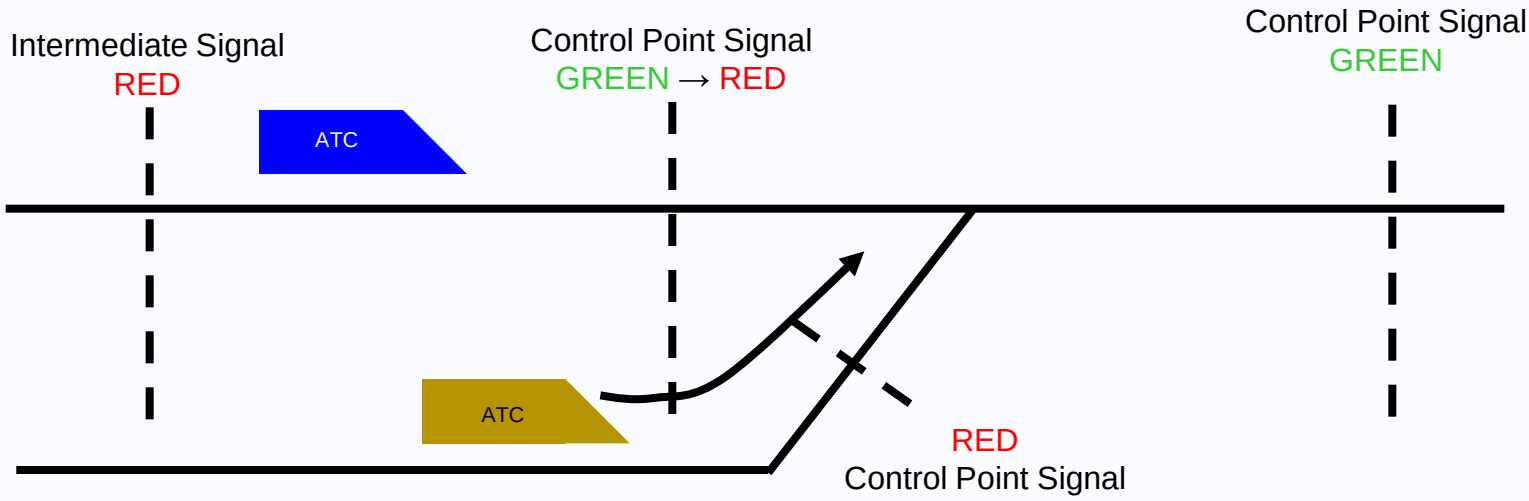
Accident Scenario: ATC-Equipped Active Trains on Controlled (Passing) Siding & Main

- Accident Scenario: ATC-equipped train erroneously leaves siding (SPAD); ATC-equipped train on main passing Intermediate Signal and approaching the Control Point
  - Cause: Dispatcher misreads map or crew ignores signal
  - Action: ATC-equipped train passes RED Control Point Signal (ATC does not enforce speed below restricting) and exits siding; ATC-equipped train on main has not passed the Intermediate Signal
  - ATC-equipped train on main: When the train from the siding shunts the main track, ATC will change from Clear to Approach and sound a warning the must be acknowledged to avoid penalty brake. When the train passes the Intermediate Signal ATC will change from Approach to Restricting and sound an additional warning which must be acknowledged
  - ATC-equipped train entering main from siding: Once the Control Point Signal is passed the train will be unaware of the approaching train on the main
- Accident Type: Rear-end, side or raking collision. Train on main strikes rear of train exiting siding OR either train strikes the other behind the locomotive
- ATC Risk Effect: Reduces chance that train on siding will pass red control point signal; train on main will slow to avoid collision or reduce collision speed



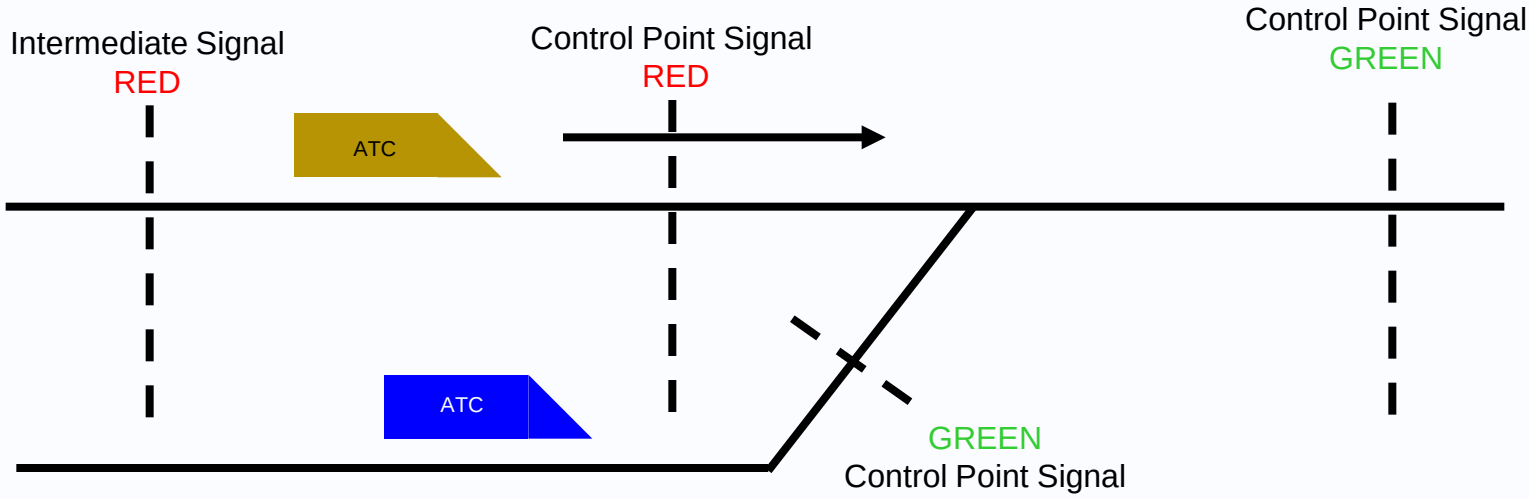
Accident Scenario: ATC-Equipped Active Trains on Controlled (Passing) Siding & Main

- Accident Scenario: ATC-equipped active train erroneously leaving siding (SPAD); second ATC-equipped active train approaching the Control Point signal
  - Cause: Dispatcher misreads map or crew ignores Control Point Signal
  - Action: ATC-equipped train passes RED Control Point Signal and exits siding; ATC-equipped train on main between Intermediate & Control Point Signals. (Note ATC does not enforce speeds below restricted speed 20 mph)
  - ATC-equipped train on main: When the train from the siding shunts the main track, ATC will change from Clear to Restricting/ Engineer must initiate braking to reduce speed to restricting to avoid penalty brake.
  - ATC-equipped train entering main from siding: Once the Control Point Signal is passed the train will be unaware of the approaching train on the main
- Accident Type: Rear-end, side or raking collision. Depending on relative train position, the train on the main could strike the rear of the train exiting the siding OR either train could strike the other behind the locomotive
- ATC Risk Effect: Reduces chance that train on siding will pass red control point signal; train on main will slow to avoid collision or reduce collision speed



Accident Scenario: ATC-Equipped Active Trains on Controlled (Passing) Siding & Main

- Accident Scenario: ATC-equipped active train on main ignores Control Point signal (SPAD); second ATC-equipped active train leaving siding
  - Cause: Dispatcher misreads map or crew ignores Control Point Signal
  - Action: ATC-equipped train on main passes RED Control Point Signal; ATC-equipped train correctly leaving siding under clear Control Point signal.
  - ATC-equipped train on main: Engineer must initiate braking to reduce speed to restricting after passing Intermediate signal to avoid penalty braking.
  - ATC-equipped train entering main from siding: No restriction
- Accident Type: Rear-end, side or raking collision. Depending on relative train position, the train on the main could strike the rear of the train exiting the siding OR either train could strike the other behind the locomotive
- ATC Risk Effect: Reduces chance that train on main will pass red control point signal; train on siding will not slow until train on main passes RED signal.

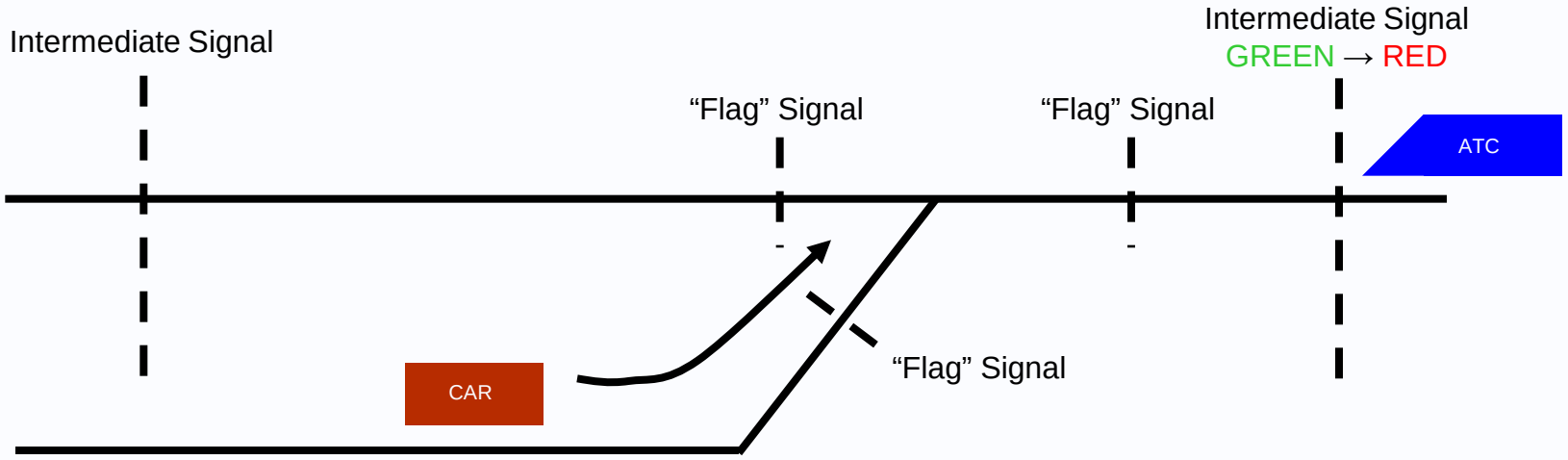


Section 3: Collision Between the Head (Locomotive) of an Active IDOT Test Corridor Train and an Intruding Rail Vehicle or Vehicle Lading

- Unsecured or mishandled rail vehicle rolling onto main track, or positioned “not in clear” at siding or industry track switch
  - Active train approaching signal block in which intrusion occurred
  - Active train in same block as intrusion
- Intrusions into clearance envelope of main track from adjacent track away from connecting turnout
  - Derailed vehicle on adjacent track
  - Shifted load on vehicle on adjacent track

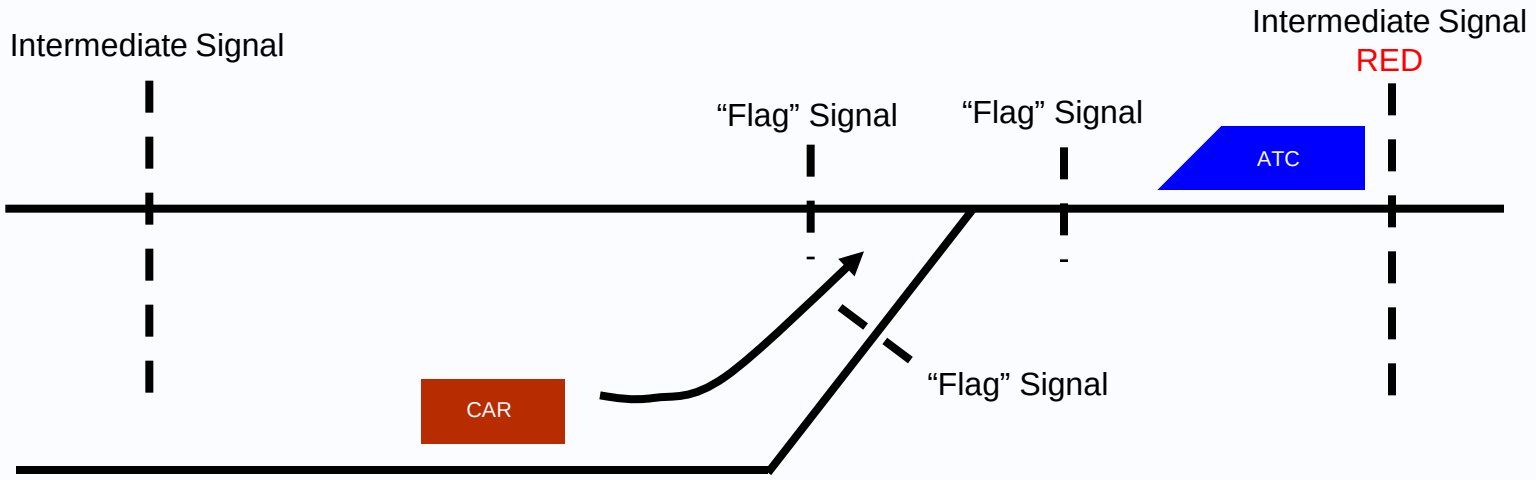
Accident Scenario: Cars on Uncontrolled Siding & ATC Equipped Active Train on Main

- Accident Scenario: Car rolls from siding onto main (assume car shunts track circuit) & ACS equipped train entering block
  - Cause: Car or cut of cars not properly secured, not positioned in clear or mishandled during switching operations
  - Action: Car erroneously exits siding and enters main; ATC-equipped train passing Intermediate Signal
  - ATC-equipped train on main: ATC locomotive onboard equipment will change to restricting, requiring the Engineer to initiate braking to reduce speed to restricted speed (20 mph) within 8 seconds to prevent a penalty application
- Accident Type: Intrusion – locomotive of active train strikes car or cut of cars
- ATC Risk Effect: ATC causes active train to brake, avoiding a collision or reducing collision speed, depending on location of train at time of intrusion.



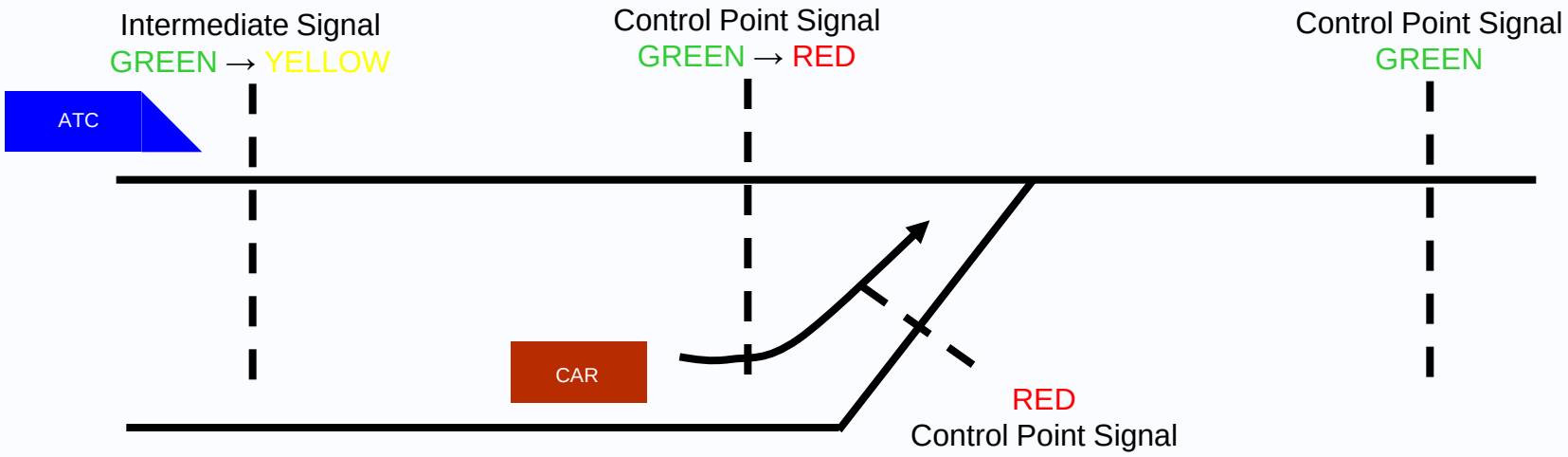
Accident Scenario: Equipment on Uncontrolled Siding & ATC-Equipped Train on Main

- Accident Scenario: Car rolls from siding (assume car shunts track circuit) & ATC-equipped train in block
  - Cause: Car or cut of cars not properly secured, not positioned in clear or mishandled during switching operations
  - Action: Car(s) erroneously exit siding and enters main; ATC-equipped train has passed the Intermediate Signal
  - ATC-equipped train on main: The loss of pulsed carrier results in a restricting aspect in the cab. Engineer must initiate braking to reduce speed to restricting within 8 seconds to prevent a penalty application
- Accident Type: Intrusion – locomotive of active train strikes car or cut of cars
- ATC Risk Effect: ATC causes active train to brake avoiding a collision or reducing collision speed, depending on location of train at time of intrusion.



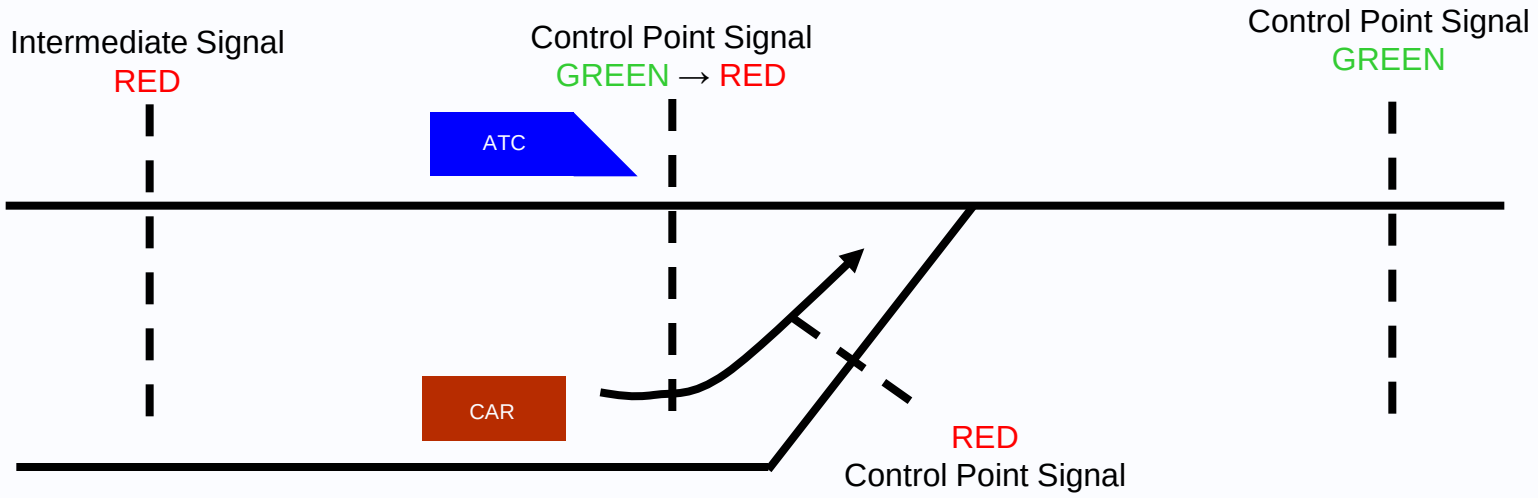
Accident Scenario: Equipment on Controlled Siding & ATC-Equipped Active Train on Main

- Accident Scenario: Car or cut of cars rolls from siding onto main (assume car shunts track circuit) & ATC-equipped train entering block between Intermediate and Control Point Signal
  - Cause: Car not properly secured, or not parked in clear or mishandled during switching.
  - Action: Car erroneously exits siding and enters main; ATC-equipped train passing Intermediate Signal
  - ATC-equipped train on main: When the car from the siding shunts the main track, Intermediate signal will change from Clear to Approach. On board ATC equipment requires Engineer to initiate braking to reduce speed to that required by changed aspect to avoid penalty brake application.
- Accident Type: Intrusion collision: locomotive of active train strikes cars or cut of cars exiting siding
- ATC Risk Effect: Train will brake, avoiding a collision or reducing collision speed



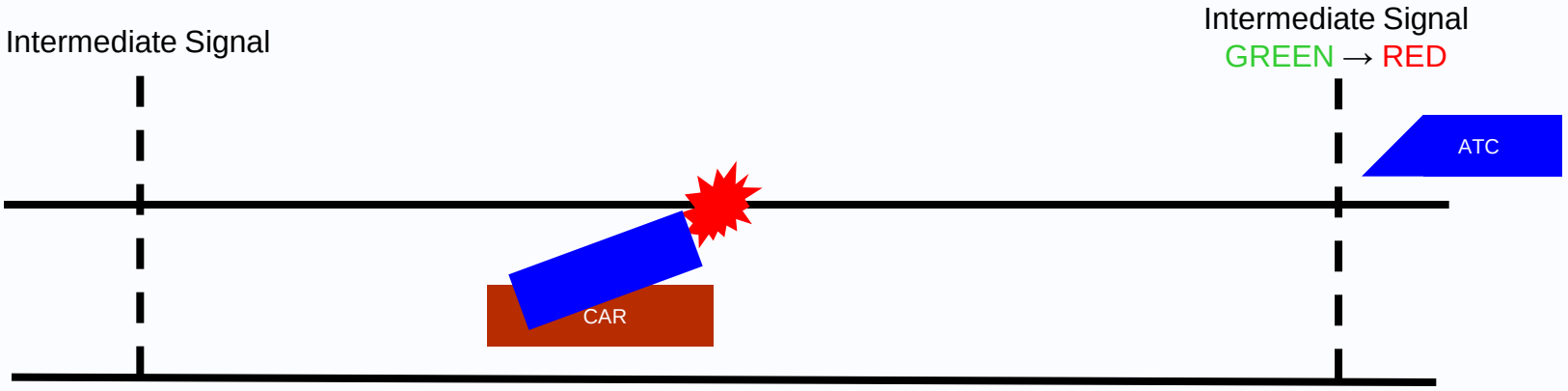
Accident Scenario: Equipment on Controlled Siding & ATC-Equipped Active Train on Main

- Accident Scenario: Car rolls from siding (assume car shunts track circuit) & ATC-equipped train entering block
  - Cause: Car or cut of cars not properly secured
  - Action: Car erroneously exits siding and enters main; ATC-equipped train passing control Point Signal
  - ATC-equipped train on main: When the car from the siding shunts the main track and the control point signal changes aspect, ATC on-board equipment requires the Engineer to initiate braking to reduce speed to restricting (20 mph) within 8 seconds to avoid penalty brake application..
- Accident Type: Intrusion collision: locomotive of active train strikes car or cut of cars
- ATC Risk Effect: Depending on location of train relative to intruding cars, ATC will help the train either avoid a collision or reduce collision speed.



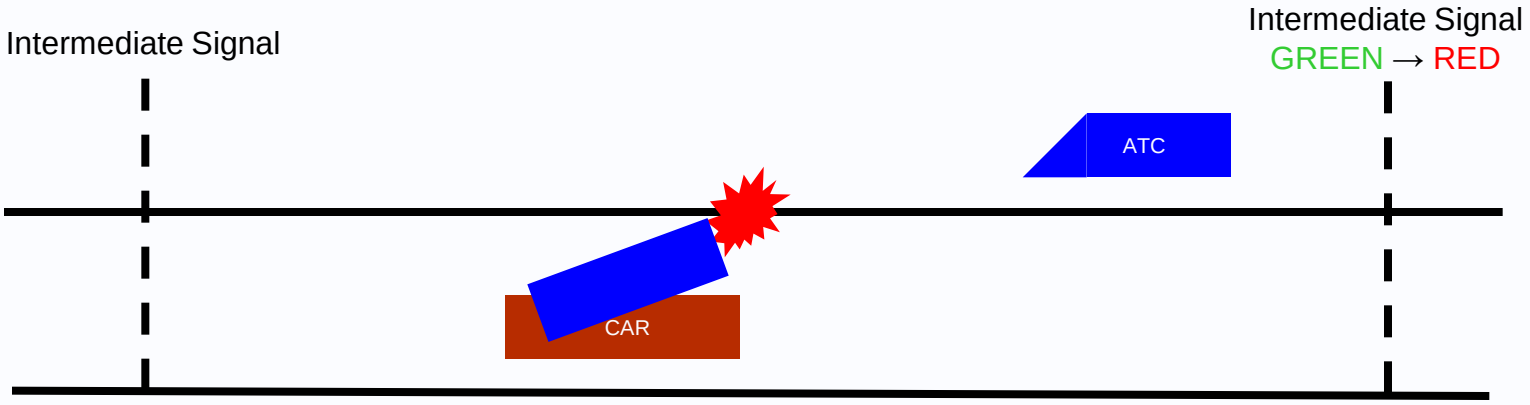
Accident Scenario: Car With Shifted Load on Adjacent Track & ATC-Equipped Active Train on Main

- Accident Scenario: Shifted load on car on adjacent track fouls main track. ATC train approaching Intermediate signal at block entry
  - Cause: Shifted load for any reason
  - Action: Derailed car fouls main track; ATC-equipped train passing Intermediate Signal
  - ATC-equipped train on main: IF shifted load shunts coded track circuit on main, ATC locomotive onboard equipment requires the Engineer to initiate braking to reduce speed to restricting aspect (20 mph) within 8 seconds to prevent a penalty application. Note: shifted load would have to fall and shunt track circuit to be detected, which is unlikely.
- Accident Type: Intrusion – main is fouled away from connecting switch
- ATC Risk Effect: Limited chance of avoiding collision or reducing speed before the collision point



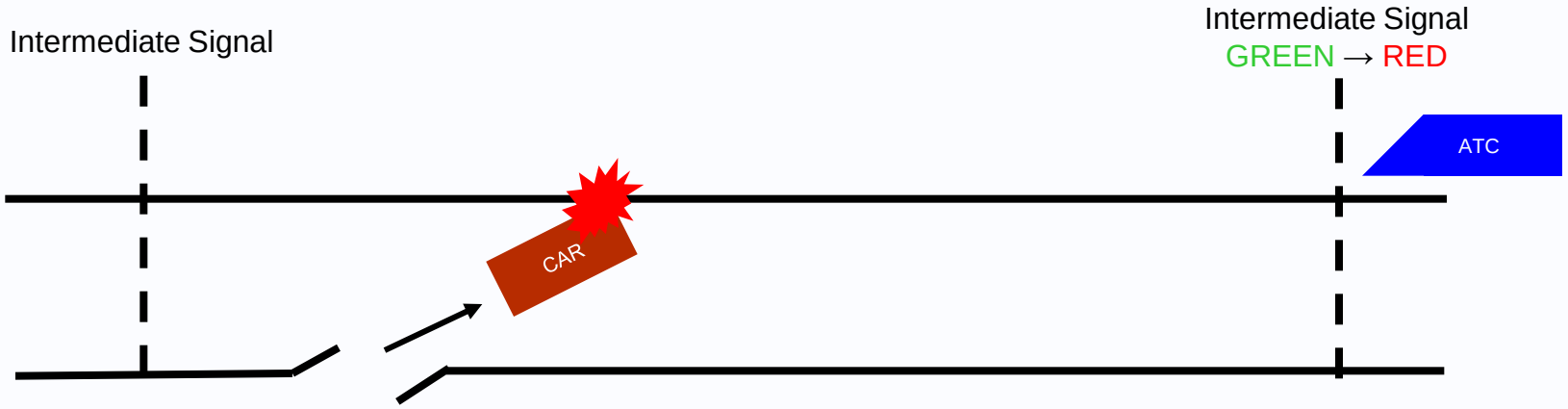
Accident Scenario: Car With Shifted Load on Adjacent Track & ATC-Equipped Active Train on Main

- Accident Scenario: Shifted load on car on adjacent track fouls main track. ATC-equipped train in same block as intrusion
  - Cause: Shifted load for any reason
  - Action: Derailed car fouls main track; ATC-equipped train passing Intermediate Signal
  - ATC-equipped train on main: IF shifted load shunts coded track circuit on main, ATC locomotive onboard equipment requires the Engineer to initiate braking to reduce speed to restricting (20 mph) within 8 seconds to prevent a penalty application. Note: shifted load would have to fall and shunt track circuit to be detected, which is unlikely.
- Accident Type: Intrusion – main is fouled away from connecting switch
- ATC Risk Effect: Very limited chance of avoiding collision or reducing collision speed



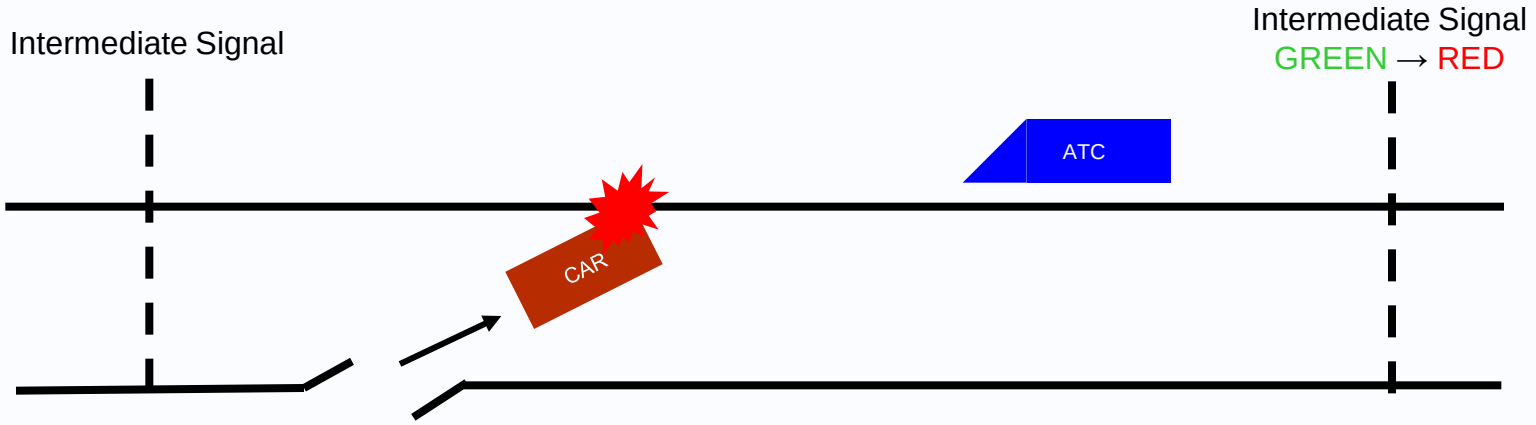
Accident Scenario: Derailed Car on Adjacent Track & ATC-Equipped Active Train on Main

- Accident Scenario: Car or cars derail on adjacent track and foul main track. ATC train approaching intermediate signal.
  - Cause: Derailment form any track or equipment defect or human error
  - Action: Derailed car(s) foul main track; ATC-equipped train approaching Intermediate Signal
  - ATC-equipped train on main: IF derailed car shunts coded track circuit on main, ATC locomotive onboard equipment requires the Engineer to initiate braking to reduce speed to that required by cab signal aspect within 8 seconds to prevent a penalty application
- Accident Type: Intrusion – main is fouled away from connecting switch
- ATC Risk effect: Could prevent a collision or reduce ATC-equipped train speed at the intrusion, IF derailed car shunts main track circuit



Accident Scenario: Derailed Car on Adjacent Track & ATC-Equipped Active Train on Main

- Accident Scenario: Car or cars derail on adjacent track and foul main track. ATC train in same block as intrusion.
  - Cause: Derailment form any track or equipment defect or human error
  - Action: Derailed car(s) foul main track; ATC-equipped train approaching Intermediate Signal
  - ATC-equipped train on main: IF derailed car shunts coded track circuit on main, ATC locomotive onboard equipment requires the Engineer to initiate braking to reduce speed to restricted within 8 seconds to prevent a penalty application
- Accident Type: Intrusion – main is fouled away from connecting switch
- ATC Risk Effect: Could prevent a collision or reduce ATC-equipped train speed at the intrusion, depending on train location relative to intrusion AND IF derailed car shunts main track circuit

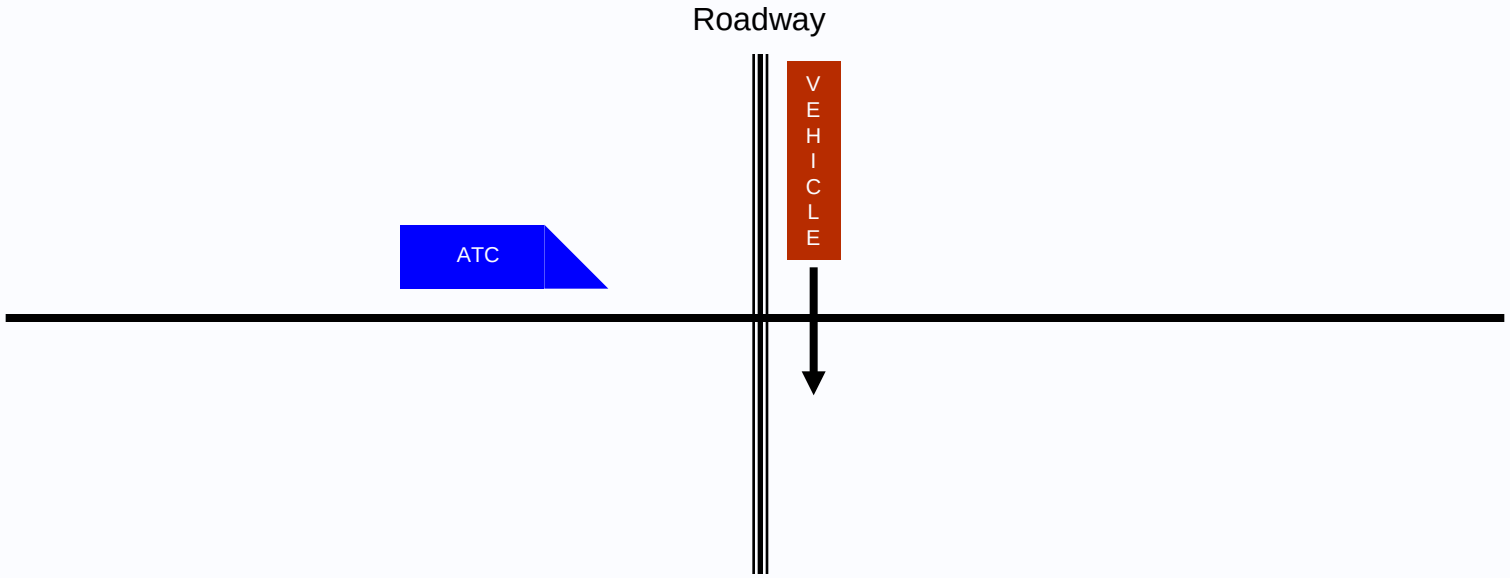


Section 4: Other Accident Types Involving a Single Active IDOT Test Corridor Train

- Collision with a highway vehicle at a grade crossing
- Collision with crossing train at a diamond crossing with another railroad
- Work zone intrusion or collision with work equipment (Form A)
- Over speed derailment at temporary (Form B) or permanent speed restriction
- Broken rail derailment

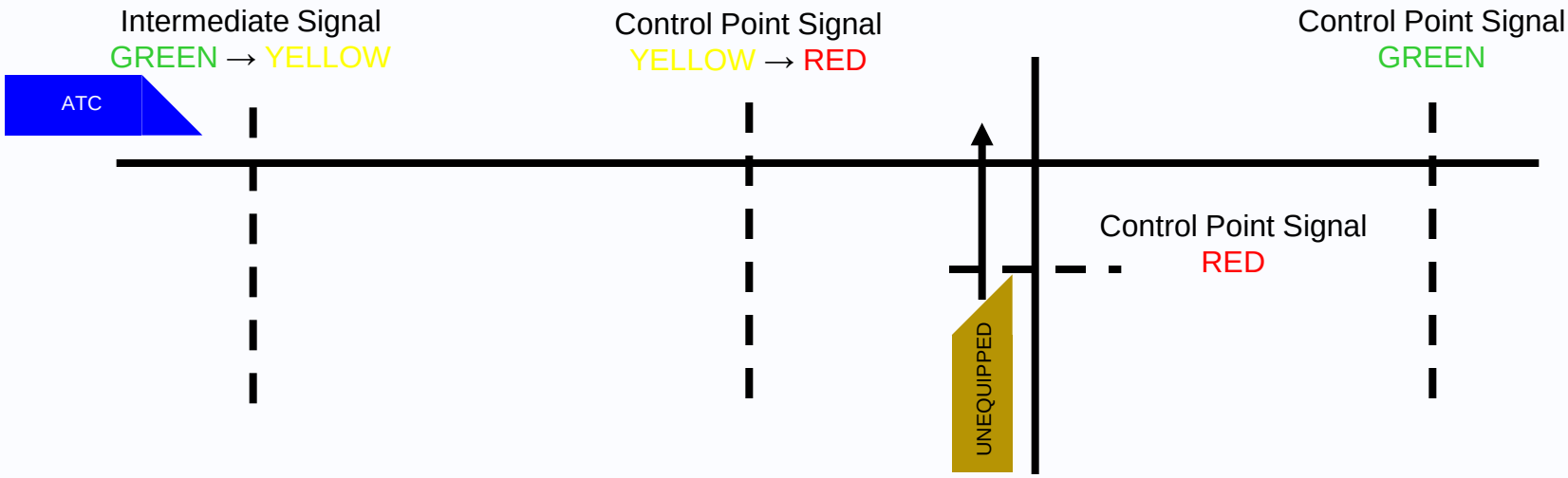
Accident Scenario: ATC-Equipped Active Train at a Grade Crossing

- Accident Scenario: Vehicle crosses tracks in front of ATC-equipped train
  - Cause: Human error by vehicle driver, or vehicle stalled on crossing, or defective crossing warning system
  - Action: Vehicle in path of train on crossing
  - ATC equipped train has no grade crossing communications within cab that can alert locomotive to presence of vehicle
- Accident Type: Train to highway vehicle. Potential for derailment following grade crossing impact, especially with heavy trucks.
- ATC Risk Effect: None. ATC does not communicate with grade crossing warning systems



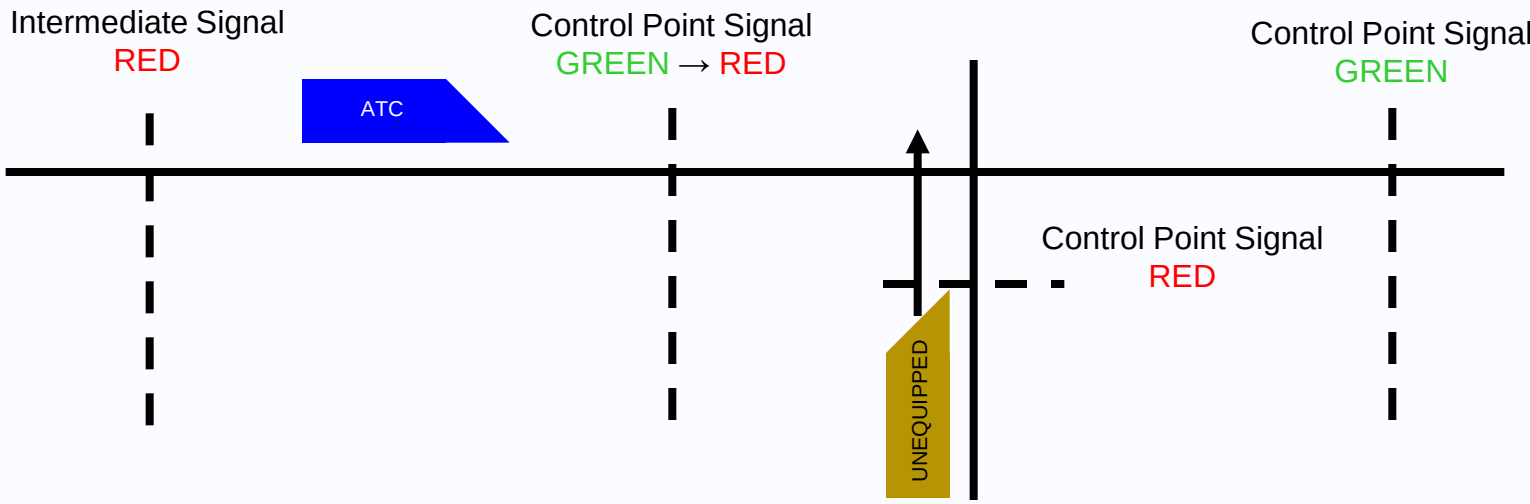
Accident Scenario: ATC-Equipped Active IDOT Corridor Train with Unequipped Train of Another Railroad at a Diamond

- Accident Scenario: Crossing un-equipped train erroneously enters diamond (SPAD)
  - Cause: Dispatcher misreads map or crew ignores Control Point Signal
  - Action: Un-equipped train passes RED Control Point Signal and enters diamond; ATC-equipped train on main passes Intermediate Signal
  - ATC-equipped train on main: ATC locomotive onboard equipment requires the Engineer to initiate braking to reduce speed to correct level for signal indication within 8 seconds to prevent a penalty application
  - Un-equipped train on crossing track: No on-board display or capability to warn engineer or stop train.
- Accident Type: : Side impact between locomotive of one train and car of crossing train.
- ATC Risk Effect: ATC could prevent or reduce the speed of a collision.



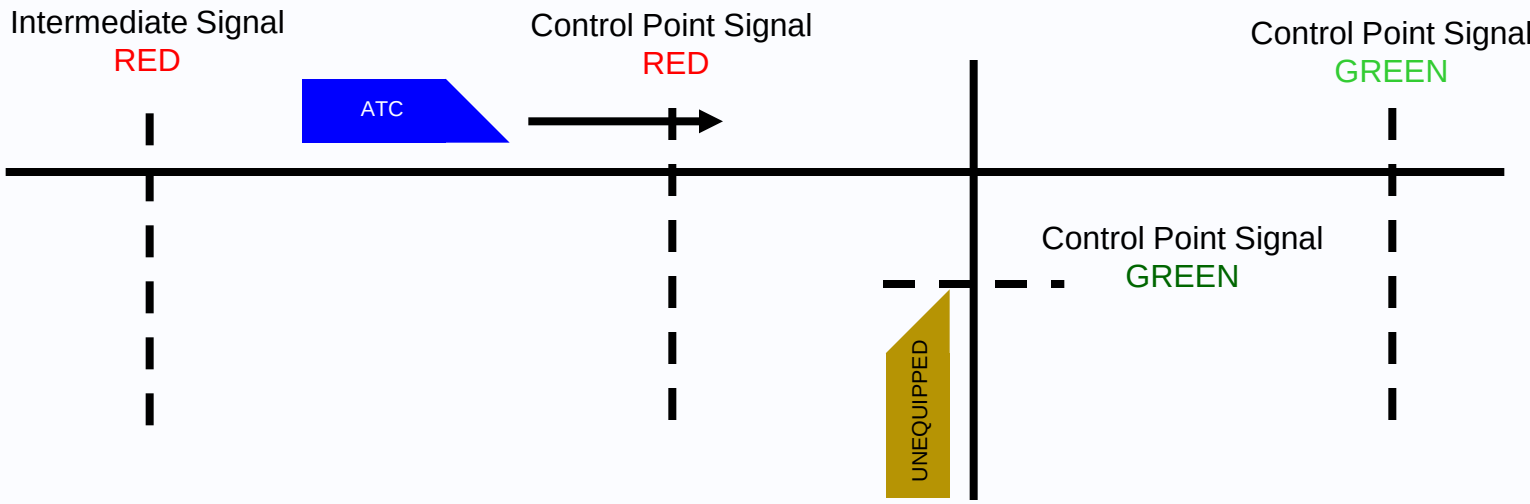
Accident Scenario: ATC-Equipped Active IDOT Corridor Train with Unequipped Train on Another Railroad at a Diamond

- Accident Scenario: Un-equipped train erroneously enters Diamond (SPAD)
  - Cause: Dispatcher misreads map or crew ignores Control Point Signal
  - Action: Un-equipped train passes RED Control Point Signal; ATC-equipped train on main between Intermediate and Control Point Signals
  - ATC-equipped train on main: Crossing train interrupts coded track circuit on main, leading to restricting aspect in cab. ATC locomotive onboard equipment provides an automatic speed enforcement capability which requires the Engineer to initiate braking within 8 seconds to prevent a penalty application
  - Un-equipped train on crossing track: No on-board display or capability to warn engineer or stop train.
- Accident Type: : Side impact between locomotive of one train and car of crossing train.
- ATC Risk Effect: ATC could prevent or reduce the speed of a collision, depending on ATC train location relative to the crossing at the time of the violation



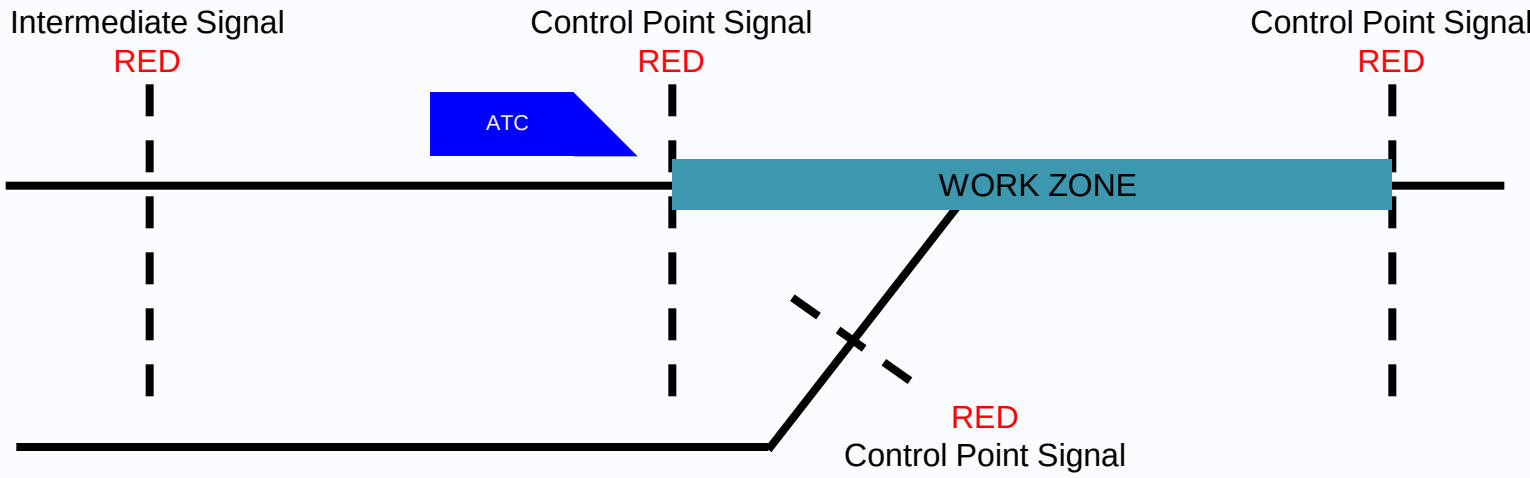
Accident Scenario: ATC-Equipped Active IDOT Corridor Train with Unequipped Train on Another Railroad at a Diamond

- Accident Scenario: ATC-equipped train erroneously enters Diamond (SPAD) when signals are cleared for crossing un-equipped train
  - Cause: Dispatcher misreads map or crew ignores Control Point Signal
  - Action: ATC-equipped train on main passes RED Control Point Signal
  - ATC-equipped train on main: ATC locomotive onboard equipment enforces a reduction in speed to restricting (20 mph). Engineer has to respond with braking in response to a downgrade in cab signal aspect within 8 seconds to prevent a penalty application
  - Un-equipped train on crossing track: No on-board display or capability to warn engineer or stop train.
- Accident Type: Side impact between locomotive of one train and car of crossing train.
- ATC Risk Effect: ATC will prevent most collisions . Collision speed will be reduced on those collisions ATC does not prevent.



Accident Scenario: Active ATC-Equipped Train and Work Crew/Hi-Rail/Work Equipment

- Accident Scenario: Train erroneously enters work zone and contacts roadway worker(s) or hi-rail or work equipment. Work zone equipment protected by a control point signal
  - Cause: Human error
  - Action: Train exceeds authority or work crew/equipment operating outside of authority
  - ATC: ATC locomotive onboard equipment provides an automatic train stop capability which requires the Engineer to initiate braking in response to a downgrade in cab signal aspect within 8 seconds to prevent a penalty application
- Accident Type: Train collides Work Crew/Hi-Rail/Work Equipment
- ATC Risk Effect: ATC can reduce the likelihood or speed of a collision with work crews or equipment if the equipment or work site is protected by a control point signal



Accident Scenario: Active ATC-Equipped Train and Work Crew/Hi-Rail/Work Equipment

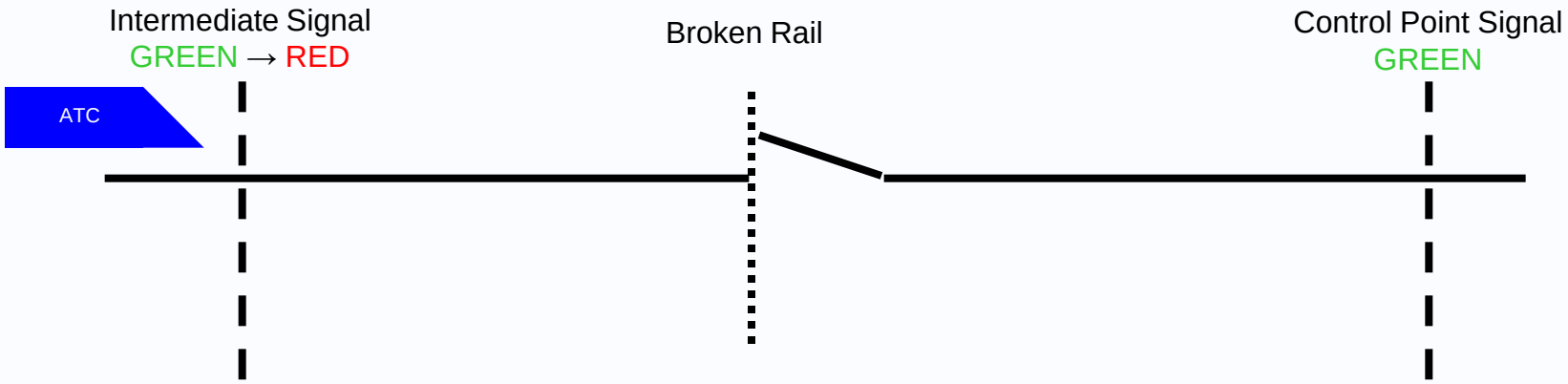
- Accident Scenario: Train contacts roadway worker(s) or hi-rail or work equipment not protected by control point signal
  - Cause: Human error
  - Action: Train exceeds authority or work crew/equipment operating outside of authority
  - ATC: ATC provides no work zone protection outside of Control Point Signals
- Accident Type: Train to Work Crew/Hi-Rail/Work Equipment
- ATC Risk Effect: None in this scenario

Accident Scenario: Active ATC-Equipped Train Derails Due To Overspeed

- Accident Scenario: ATC-equipped train derails due to overspeed
  - Cause: Dispatcher misreads map or crew ignores speed restriction
  - Action: ATC-equipped train ignores speed restriction (permanent or Form A) and accelerates or maintains current speed
  - ATC provides no speed enforcement at permanent or temporary speed restrictions
- Accident Type: Overspeed Derailment
- ATC Risk Effect: None in this scenario

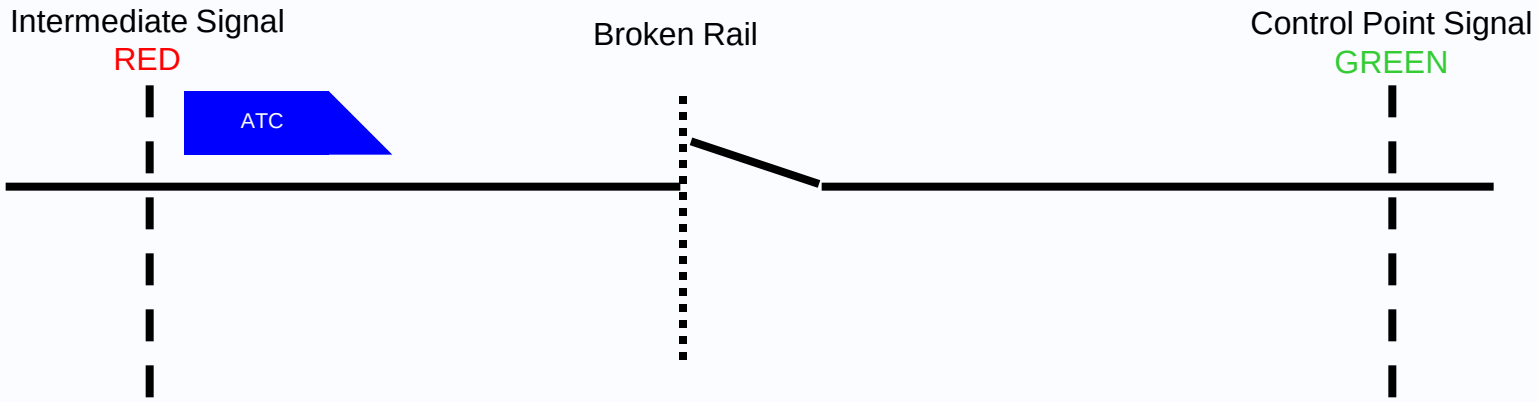
Accident Scenario: Active ATC-Equipped Train Derails Due To Broken Rail (Complete Break, Interrupting Track Circuit)

- Accident Scenario: ATC-equipped train derails due to broken rail. Train approaching intermediate signal
  - Cause: Broken rail in next signal block
  - Action: ATC-equipped train passes over broken rail and derails
  - ATC-equipped train on main: ATC locomotive onboard equipment provides a speed enforcement capability requiring the Engineer to initiate service braking to reduce speed to that required by the signal aspect within 8 seconds to prevent a penalty application
- Accident Type: Broken Rail Derailment
- ATC Risk Effect: Train could slow or stop before reaching break, depending on break and train location relative to intermediate signal



Accident Scenario: Active ATC-Equipped Train Derails Due To Broken Rail (Complete Break, Interrupting Track Circuit)

- Accident Scenario: ATC-equipped train derails due to broken rail. Train has passed intermediate signal and entered same block as break.
  - Cause: Broken rail in same signal block
  - Action: ATC-equipped train passes over broken rail and derails
  - ATC-equipped train on main: The loss of pulsed carrier of the track circuit results in a Restricting Aspect. ATC locomotive onboard equipment requires service brake application to reduce speed to restricting (20 mph). If sufficient braking effort is not initiated within 8 seconds, a penalty brake application will be initiated.
- Accident Type: Broken Rail Derailment
- ATC Risk Effect: Train could slow or stop before break, depending on the location of the break relative to train position.



Appendix F: Model Inputs – Sources and Analyses

F.1 Introduction

This appendix describes the sources of the numerical inputs to the risk models (contained on the inputs worksheet for each analysis case) and the analyses used to derive the numerical values. In some cases, the analyses are discussed and described elsewhere in this report or its appendices, in which case the appropriate reference is given, together with the specific source of the input numbers. How the input values change between analysis cases is also described.

The structure of the appendix is to group inputs by general subject area, generally in the order in which they are tabulated on the Model Inputs Worksheet. The information provided for each type of input is a definition of the input—what it refers to and the units used for numerical values, and then the data sources used for the inputs and details of any analysis required.

F.2 Route, Train, and Traffic Data

F.2.1 Braking and Miscellaneous Inputs

These inputs are given in Tables IN-1 and IN-1b on the Inputs worksheet. The braking formula coefficients in Table IN-1a are taken from material provided by Booz Allen Hamilton (BAH) and are further detailed in Section A.2 of Appendix A. The coefficients are held constant for all analysis cases.

The values for NAJPTC timeout and latency are provided by the FRA for the PTC system as currently configured. A range of reduced timeout and latency values will be entered for analyses of the impact of radio communications improvements, as selected by the analyst in consultation with FRA. For cab signal with ATS analysis cases, latency is set at 3 seconds, and there is no separate timeout operating state.

Table IN-1b contains inputs concerned with the calculation of collision risk when an equipped train is in Zone C.

- Sight distance is the distance over which the engineer can see the next signal and can respond to a changes signal aspect, even if the response of the PTC system is delayed due to latency or timeout.
- Probability refers to the chance that the equipped train will be located in Zone C at the time of a signal violation by an unequipped train versus being located in Zones A1, A2, or B.
- PTC risk increment in Zone C. This value is the increased risk that an engineer will fail to respond to the changed signal indication due to a PTC "complacency effect."
- Danger length is the distance over which an engineer may fail to respond to a more restrictive signal in the absence of a response by the PTC system. Danger length is usually identical to the sight distance, above.

The Zone C analysis is explained in further detail in Section A.3 of Appendix A.

F.2.2 Traffic Volume and Mix

Traffic data model inputs are contained in Table IN-1c on the inputs worksheet. All traffic data were derived from Table 9 in a risk assessment base case report prepared by the University of Virginia (UVA).[1] Actual traffic on the corridor varies by location, day of the week and location along the corridor, as follows:

- Passenger trains: Three round trips/day daily throughout the year;
- Local freight trains:
  - Five round trips/week between Bloomington and Mazonia, and
  - Three round trips/week between Bloomington and Ridgely;

[1] University of Virginia, "IDOT Base Case Risk Assessment Results," Revision 04, February 7, 2005.

- Through freight trains: Three round trips/week between Bloomington and Ridgely;
- Unscheduled grain trains: Total of five round trips per week in the non-summer months on random days -
  - Three between Bunge and Ridgely;
  - Two between Bloomington and Ridgely.

Seventy-five percent of the local freight trains are PTC-equipped and all other freight trains are unequipped. To avoid having to do separate risk calculations for each day of the week, average traffic levels expressed as one-way trips/day were used in the model, and are documented in Table IN-1c on the Inputs worksheet. The table indicates traffic levels (daily one-way trips) for the three Sub-corridors:

- "Joliet" between Mazonia and MP 88.3 (the nearest block signal to the Bunge grain siding);
- "Bloomington" Sub-corridor, between MPs 88.3 (Bunge) and MP 124.9 (north end of Bloomington yard);
- "Springfield" Sub-corridor, between MP 124.9 and MP 181 at Ridgely, the south end of the IDOT test corridor.

Note that no seasonal grain trains operate in the Joliet Sub-corridor, thus traffic does not vary by season. This means that only one risk calculation is needed for this corridor rather than the separate summer and rest of year calculations required for the Bloomington and Springfield Sub-corridors. The specific traffic data used in the model are given in Table F.1.

Table F.1. Average Trains per Day for Each Season and Sub-Corridor

Train Type	One-Way Trips					
	Joliet Sub-corridor		Bloomington Sub-corridor		Springfield Sub-corridor	
	Summer	Rest of Year	Summer	Rest of Year	Summer	Rest of Year
Passenger	6.00	6.00	6.00	6.00	6.00	6.00
Equipped freight	1.07	1.07	1.07	1.07	0.86	0.86
Unequipped freight	0.36	0.36	0.36	1.21	0.87	2.30
Operating days	91	274	91	274	91	274

The final item of information in the inputs worksheet Table IN.1c is the parameters from which to calculate the occupancy of passenger trains, the average number of seats or berths on the trains and the average load factor or occupancy. Seating and berth capacity of the trains depends on the numbers and types of cars in the consists. Two of the trains are short-haul corridor services with five cars, four coaches and one food service car. The third train is the long haul "Texas Eagle" with four coach cars, two sleeping cars, and two food service cars. The capacity of Amtrak cars varies widely from about 20 for a sleeping car up to about 80 for coach cars used in short-haul services. Seats in food service cars are usually reserved for use by passengers only when eating, but at busy times may be occupied by passengers for their complete journey. Taking all this into account and assuming that the short haul trains have 80-seat coaches and the Texas Eagle has 60-seat long haul coaches, the capacity of both trains is in the range between 320 and 360 passengers; a figure of 340 is used in the model. Load factor or occupancy is estimated at 0.6 or 60 percent, a typical value for Amtrak service, which is based on data supplied by Amtrak for a previous ICF project.

F.2.3 Track and Route Data

Track and route data comprise all the information concerning line segment and Sub-corridors, and train speeds in the test corridor. These data are held constant for all analysis cases, and are contained in Tables 2a, 2b, and 2c on the inputs worksheet.

Each of these tables contains the following information, all of which is taken from the detailed listing of track information prepared by BAH, as detailed in Appendix D, supplemented by a review of current track charts for the IDOT test corridor, which is also provided in Appendix D.

Sub-Corridors

Separate analyses are performed for each sub-corridor of the IDOT test corridor, as a function of traffic level and mix. Traffic data (one-way trips/day) for each Sub-corridor were given in Table IN-1c and the boundaries of the Sub-corridors are given in Section F.2.2. Each of Tables IN-2a, 2b, and 2c give segment data for a Sub-corridor.

Segment Data

Segment boundaries (milepost locations) are located at each block boundary or interlocking signal and were derived from the detailed route data listings in Appendix D. Segment locations (beginning and end points) are given to the nearest 1/100th of a mile in that listing.

Segment type was taken directly from track layout information on the track charts. As described in Section A.1.3 of Appendix A, all segments (signal blocks) have been designated as one of five categories, as follows:

- Monitored (track-circuited) siding,
- Unmonitored Siding (siding track not track circuited),
- CP Adjacent (M) – a single track segment immediately before or after a monitored siding,
- CP Adjacent (U) – a single track segment immediately before or after an unmonitored siding, and
- Plain track: all other single track segments.

No double track occurs on the corridor except at passing sidings. The rationale for distinguishing between segment types is that collision type and risk vary by segment type.

Posted speeds are taken from the track charts for freight trains and for conventional (non-high-speed) passenger trains. The listing provided in Appendix D supplied posted speeds applicable to high-speed trains, with an overall limit of 110 mph.

Representative speeds are the analyst's estimate of typical operating speeds in a segment, taking into account braking and acceleration zones before and after a restricted speed points. Section A.2.2 of Appendix A discussed the approach to estimating representative speeds. Two representative speeds are for high speed trains in the NAJPTC case. The "regular" representative speed is used for all braking distance and collision risk calculations and the reduced speed for only collision consequences in collisions with unequipped trains. This allows the model to take account of the operating rule that restricts high speed train speed when in the vicinity of an unequipped freight train.

The tables also contain information about the presence of industrial sidings and passenger stations in each segment. These data are for reference only and are not used in the present version of the model. In particular, passenger train speeds are representative of a nonstop run through the test corridor and do not reflect braking and acceleration zones before and after passenger station stops.

F.2.4 Grade Crossing Data

Tables IN-3a, 3b, 3c, and 3d provide grade crossing data for model input. The first three of these give grade crossing counts for each Sub-corridor, by train representative speed when passing over the crossing and by crossing type. Three types are used to characterize crossings:

- Crossings at a public highway equipped with at least gates, flashing lights, and a bell;
- Crossings at a public highway that lack one or more of the key crossing warning systems (gates, lights, or bell); and
- All private crossings for accessing a farm or industrial facility.

Separate listings are provided for each train type: conventional passenger, high-speed passenger and freight. The listings also provide a count of the number of diamonds in each Sub-corridor. Diamond data are for reference only and are not used in the calculations, which depend on data on the location of diamond segments and segments adjacent to diamonds given in Tables 2a, 2b, and 2c.

Crossing counts are taken from information on the track charts, using the segment-by-segment speeds from Tables IN-2a, 2b, and 2c as the source of representative speeds. Crossing location and warning systems were derived primarily from the track charts, which appear to be more up-to-date than the listings prepared by BAH. Almost all public crossings are equipped with active warning systems.

Table IN-3d provides crossing collision frequencies and consequences by train type, crossing type, and representative speed. Crossing collision frequencies have the units of collisions per million crossing passes and are for crossing collisions reportable as train accidents and derived from FRA-reportable train accidents. These are accidents that cause damage to railroad property exceeding the train accident reporting threshold. No attempt was made to calculate crossing collision frequencies for all grade crossing accidents, defined by FRA as any event where a train strikes a highway user, irrespective of damage or the number and types of casualties. The frequency of all rail-highway grade crossing accidents would be much higher than that for those reportable such as train accidents. Passenger frequencies and consequences were calculated from a 15-year database of passenger accidents developed for a past ICF project and adjusted to reflect current nationwide crossing collision frequencies. Frequencies for freight trains were derived directly from FRA train accident data. No attempt was made to analyze local grade crossing collision frequencies on this corridor.

Crossing collision consequences for passenger trains were also derived from the same previous ICF analysis. The consequences are for railroad employees and contractors and passenger train occupants. No attempt has been made to estimate and include in the analysis casualties among highway vehicle occupants, pedestrians, and bystanders.

F.3 Reference Case Accident Consequences

Table IN-4 contains listings of accident consequences for all accident scenarios other than collisions with a highway vehicle at a grade crossing, discussed in Section F.2.4. These include head-on and rear end/side collisions, collisions with freight equipment or freight lading intruding onto the main running track, derailments due to overspeed or a broken rail and track worker casualties involving a violation of a work zone. Separate tables are provided for freight and passenger trains, given the very different exposure to casualties and property damage between passenger and freight trains.

F.3.1 Passenger Train Consequence Data

Train-to-Train Collisions

The passenger train data are derived from an analysis of a 15-year database of train accidents involving passenger trains, derived from the FRA accident database. The information on casualties in accidents and accident frequencies were taken from a previous analysis of the same database. This previous analysis did not call for an analysis of property damage costs, thus a cost analysis, using the same source, was carried out for this project.

Casualty estimates from the previous project results were adjusted for differences in representative speeds to give the results shown in Table F.2. The analysis assumes that casualties are proportional to speed squared, and the differentials between the accidents with the different colliding vehicles are largely derived from the extensive collision modeling carried out in FRA and Volpe Center passenger car and locomotive crashworthiness research.

Table F.2. Casualties per Accident in Passenger Trains in Train-to-Train Collisions

Accident Scenario	Representative Speed 40 mph		Representative Speed 60 mph		Representative Speed 79 mph		Representative Speed 105 mph	
	Injuries	Fatalities	Injuries	Fatalities	Injuries	Fatalities	Injuries	Fatalities
P Loco → Loco	0.083	0.0020	0.139	0.0049	0.240	0.0085	0.425	0.0150
P Loco → P Car	0.034	0.0010	0.056	0.0026	0.097	0.0045	0.171	0.0080
P Loco → F Car	0.034	0.0010	0.056	0.0026	0.097	0.0045	0.171	0.0080
P Car →Loco	0.166	0.0050	0.275	0.0119	0.476	0.0206	0.841	0.0364

Note: Figures are for estimated fraction of train occupants that become casualties in the first train listed in the accident scenario column.

Damage estimates were calculated from collisions consequences in a 15-year database for train accidents involving passenger trains. Differentials between representative speeds were calculated as for casualties, assuming damage is proportional to speed squared. The results are given in Table F.3.

Table F.3. Damage Measured in Dollars per Accident for Passenger Trains in Train-to-train Collisions

Accident Scenario	Representative Speed 40 mph	Representative Speed 60 mph	Representative Speed 79 mph	Representative Speed 105 mph
P Loco → Loco	$502,000	$1,142,000	$1,976,000	$3,495,000
P Loco → P Car	$251,000	$571,000	$988,000	$1,747,000
P Loco → F Car	$251,000	$571,000	$988,000	$1,747,000
P Car → Loco	$1,005,000	$2,284,000	$3,951,000	$6,989,000

Note: Figures are for estimated damage cost for the first train listed in the accident scenario column.

Passenger Train Intrusion Collisions

The next step was to derive corresponding estimates for intrusion collisions from rollout events and from other forms of intrusion from an adjacent track, such as derailed vehicles and shifted loads. The result was that rollout events (from switching misjudgments or improperly secured vehicles on an adjacent track) results in casualties and costs per passenger train involved of 15 percent of a train-to-train collision, and other intrusions result in casualties and costs of 30 percent of train-to-train collisions. The direction of this difference is surprising, but seems to be due to collision speeds in rollout accidents being consistently lower that for the other intrusion collisions. The figures are given in Table F.4a and F.4b.

Table F.4a. Casualties per Accident in Passenger Trains in Intrusion Collisions

Accident Scenario	Representative Speed 40 mph		Representative Speed 60 mph		Representative Speed 79 mph		Representative Speed 105 mph	
	Injuries	Fatalities	Injuries	Fatalities	Injuries	Fatalities	Injuries	Fatalities
Rollout intrusion	0.019	0.0005	0.031	0.0011	0.054	0.0019	0.096	0.0034
Other intrusions	0.038	0.0009	0.063	0.0022	0.108	0.0038	0.191	0.0068

Note: Figures are for estimated fraction of passenger train occupants that become casualties.

Table F.4b. Damage Measured in Dollars per Accident for Passenger Trains in Intrusion Collisions

Accident Scenario	Representative Speed 40 mph	Representative Speed 60 mph	Representative Speed 79 mph	Representative Speed 105 mph
Rollout intrusion	$113,000	$257,000	$445,000	$786,000
Other intrusions	$226,000	$514,000	$889,000	$1,573,000

Note: Figures are for estimated total damage cost for the collision scenario.

Passenger Train Derailment Accidents

Estimated of casualties in derailment accidents (overspeed or broken rails) are available from the previous study, and the 15-year passenger train accident database was used to obtain accident cost estimates in the same way as for collisions. The results are shown in Tables F.5a and F.5b.

Table F.5a. Casualties per Accident in Passenger Trains in Derailments

Accident Scenario	Representative Speed 40 mph		Representative Speed 60 mph		Representative Speed 79 mph		Representative Speed 105 mph	
	Injuries	Fatalities	Injuries	Fatalities	Injuries	Fatalities	Injuries	Fatalities
Overspeed and broken rail derailments	0.044	0.0004	0.140	0.00186	0.210	0.00338	0.280	0.0045

Note: Figures are for estimated fraction of passenger train occupants that become casualties.

Table F.5b. Damage Measured in Dollars per Accident for Passenger Trains in Overspeed and Broken Rail Derailments

Accident Scenario	Representative Speed 40 mph	Representative Speed 60 mph	Representative Speed 79 mph	Representative Speed 105 mph
Overspeed and Broken Rail Derailments	$ 667,000	$ 1,500,000	$ 2,600,000	$ 4,594,000

Note: Figures are for estimated total damage cost for the collision scenario.

It is worth noting that the consequence values for derailment accidents are driven by a small number of very serious accidents. Although the average cost of all intercity passenger trains outside the Northeast Corridor (NEC) is approximately $600,000, about 70 percent of this total is

accounted for just 17 accidents having a reported cost over $1 million. The bulk of the remainder seem to be minor low speed accidents. The causes of the serious accidents break down as follows:

- Rail failure—4,
- Buckled track—2,
- Overspeed—4 (3 due to excessive speed through turnouts and crossovers),
- Roadbed and structure failures—5, and
- Vandalism (tampering with track work)—2.

Although only 15 out of 90 derailments are overspeed and broken rail derailments, they have much higher than average consequences because they predominately take place at higher speeds. This bias is reflected in the figures given in Tables F.5a and F.5b above.

F.3.2 Freight Train Consequence Data

The freight train data is derived from previous analyses of FRA accident data and reviews of data contained in annual FRA accident/incident bulletins. The resulting estimates for damage and casualties are given in Tables F.6a and F.6b.

Table F.6a. Casualties per Freight Train involved in Train Accidents

Accident Scenario	Representative Speed 25 mph		Representative Speed 40 mph		Representative Speed 50 mph	
	Injuries	Fatalities	Injuries	Fatalities	Injuries	Fatalities
F Loco → Loco	0.43	0.043	1.0	0.11	1.0	0.17
F Loco → Car	0.35	0.035	0.9	0.09	1.0	0.14
F Car → Loco	0	0	0	0	0	0
Rollout intrusion	0.088	0.009	0.225	0.023	0.352	0.035
Other intrusion	0.088	0.009	0.225	0.023	0.350	0.035
Overspeed and broken rail derailments	0.056	0.0056	0.144	0.0144	0.225	0.0225

Table F.6b. Damage Measured in Dollars per Freight Train Involved in Train Accidents

Accident Scenario	Representative Speed 25 mph	Representative Speed 40 mph	Representative Speed 50 mph
F Loco → Loco	$105,000	$270,000	$422,000
F Loco → Car	$88,000	$225,000	$352,000
F Car → Loco	$44,000	$112,000	$176,000
Rollout intrusion	$11,000	$28,000	$44,000
Other intrusion	$11,000	$28,000	$44,000
Overspeed and broken rail derailments	$150,000	$375,000	$586,000

Note: Figures are for estimated damage cost for the first train listed in the accident scenario column.

Estimates for rollout and other intrusions follow the same logic as for passenger trains, but little information exists to support a significant difference in consequences between the two categories of intrusion. Values of 25 percent of train-to-train collisions were assumed. Estimates for the derailment accidents are simply based on the accident data. It is noteworthy that freight train derailment accidents tend to be more costly than collisions because more vehicles are derailed and damaged.

F.3.3 Adjusted Consequence Inputs for Sensitivity Analysis

For most analysis cases, the assumption was that accident consequences were unaffected by the train control system or timeout and latency values. However, consideration of the NEC ATC analysis cases suggested that the speed control feature of ATC would tend to reduce collision speeds, and thus the average consequences of accidents in those situations where accidents could not be prevented. This effect may be more pronounced with ATC than with PTC or ATS, thus shifting the results of comparisons between the train control systems.

The treatment of accident consequence data on the Model Inputs Worksheets was modified to allow the analyst to adjust consequences in these sensitivity case versions of the model. The changes involved the addition of three new tables to perform the following calculations:

- Table IN-7, which contains reference case consequence inputs formerly provided in Table IN-4.
- Table IN-7A, which contains consequences adjustment factors for each accident scenario and representative speed for both passenger and freight trains.
- Table IN-8, which contains adjusted consequence inputs. This Table has exactly the same layout as Tables IN-4 and IN-7. Each entry is obtained by multiplying reference case consequences from Table IN-7 by the corresponding adjustment factors from Table IN-7A. A single adjustment factor is used for all types of consequence—injuries, fatalities, and property damage.

- Then, Table IN-4 is modified to copy the modified consequence values from Table IN-8, thus replacing the original reference case consequences in this table with adjusted values. The rest of the model continues to use Table IN-4 as the consequences look-up table, thus incorporating reduced consequences into the analysis.

Estimates of the adjusted consequence factors for PTC were based on the calculations of reduced consequence zones on segment definition and prevention worksheets in the model, specifically the results in Tables 1.6a through 1.6f., using an estimate of a 60 percent reduction in consequences for the fraction of accidents for which consequences could be reduced. The data also guided the estimates for the ATS and ATC reduced severity analysis cases, supported by qualitative judgments as to:

a) The fraction of accidents that were not prevented, but severity was reduced, and

b) The fraction of accidents that were not prevented and severity was not reduced.

F.4 Reference Case Accident Frequencies

Accident frequencies are given in Table IN-5a for collision accidents and Table IN-5c for other relevant accident types. All frequencies are for the Reference Case (conventional CTC and passenger train operation at up to 79 mph), before the implementation of PTC or any other train control system. In the different versions of the model, these collisions and accident frequencies are modified by accident preventability factors to give estimated frequencies after implementation of the different train control systems.

F.4.1 Base Train-to-Train Collision Accident Frequency

This subcategory includes head-on collisions, rear-end collisions and side collisions at junctions or the turnouts at the end of a passing siding. Collisions with individual cars or cuts of cars that have rolled out onto the main track from a siding or industrial track, or collisions with shifted loads or derailed vehicles intruding from an adjacent track are considered intrusion collisions, and analyzed separately and addressed separately in the model as are collisions at diamond crossings.

Analyses of historical FRA accident data performed in several earlier studies have concluded that the overall collision frequency on mainline freight railroads in the United States predominantly equipped with ABS or CTC wayside signaling or better is between 0.035 and 0.045 collisions per million train-miles. These railroads have a mixture of double and single track and a small fraction of lines equipped with cab signaling or an ATS system. The average traffic density on these routes is estimated to be about 25–30 trains/day.

The IDOT test corridor differs from the average route from which this data were derived by being all single track and having a traffic density of about 8 trains/day, all of which operate in the 16 hours during which passenger traffic is using the line. A series of adjustments were applied to the overall U.S. average rate to arrive at an estimate of CTC reference rates to be used in the IDOT risk model, as follows:

- A multiplier of 1.5 for an all-single-track line, derived from the analysis of an estimate of the mix of single and multitrack territory represented in the source data, and a analysis of accident risks by Martland et al.[2]
- A multiplier of 0.5 to adjust for an approximately halving of traffic density. Analysis based on simulations of rail operations suggest that collision rate varies linearly with traffic density, assuming collision frequency is a direct function of the number of pass and meet events.
- A multiplier of 1.2 to account for the portion of route equipped with some form of train control covered by the source data.
- A multiplier of 0.8 to adjust for the portion of intrusion collisions (mainly raking collisions) among the source data.

[2] "Risk and Train Control: A Framework for Analysis" Carl D. Martland, Ying Zhu, Youssef Lahrech and Joseph M. Sussman. Transportation Research Record 1742, 2001.

The result for train-to-train collision accident frequency on the IDOT test corridor for the reference case of CTC train control is: $0.040 \times 1.5 \times 0.5 \times 1.2 \times 0.8 = 0.0288$.

Given the uncertainty as to the correct value the multipliers used and the possible effects of local conditions (which can include signal positioning, local terrain, the training and experience of train crews, local practices regarding crew assignments and rest periods, the types of train operated and familiarity of train crews and dispatchers with the line), a base train-to-train collision frequency of 0.03 collisions per million train-miles has been used in the model. In reality, collision frequency could vary anywhere between 0.02 and 0.04 collisions per million train-miles, depending on local conditions.

F.4.2 Distribution of Collision Accidents by Segment Type and between Head-On, Rear End, and Side Collisions

The model requires estimates of the distribution of collision accidents between trains operating on the same track by train pairs in the collision and between head-on and rear/side collisions. These data are entered in Tables IN-5b and 5d.

Table IN-5d contains collision distributions by train pair in the collision and by season and sub-corridor for the reference case. These collision distributions are a function of the traffic mix and schedules in each sub-corridor and season, and are estimated as described in Section F.4.3 below. The data developed in Section F.4.3 for the PTC analysis case are transferred directly to Table IN-5d. Since all trains are equipped in the cab signal and ATC analysis cases, the data are simply revised by adding the one train equipped and no train equipped values to the corresponding "both trains equipped" values. Train schedules and thus collision probabilities in the reference case are held constant for all analysis cases.

Since collision accident consequences vary according to whether the colliding vehicles are locomotives, freight cars or passenger cars, it is necessary to estimate the distribution of collision accidents by types of colliding vehicle. In this model, the distribution by segment type is also required. These estimates were developed partly from historical accident data and partly from a review of the pattern of operations on the IDOT test corridor as displayed in string charts. Two points about these estimates should be noted:

- The resulting estimates are a function of the specific traffic operating on the IDOT test corridor. The estimates will have to be adjusted if traffic or train schedules change.
- The estimates are for the reference case of CTC operation. Estimates of accident preventability for each accident type, segment type, et cetera are calculated and applied in the model.

Accident frequency varies by segment type. A review of collision accidents on single track on freight railroads contained in the detailed accident descriptions yielded the following:

1. In siding—one head-on;
2. At siding entry/exit switches—one side;

3. On single track near siding—five head-on (all caused by one train passing a stop signal and running through the exit switch of a siding); and
4. On single track, segment type uncertain—one rear-end.

The results from this review are only indicative—given the very small sample. A more extensive review of FRA data combined with information from track charts and railroad timetables would be required, but this would be beyond the scope of this effort. This information was interpreted as shown in the Table F.7 to estimate collision accident frequency by segment type, assuming an overall average frequency of 0.029 collisions/million train-miles:

Table F.7. Collision Frequency by Segment Type

Segment Type	Percent Segments	Percent Collisions	Accident Frequency Ratio	Adjusted Collision Frequency
CP adjacent	35	65	1.86	0.054
Siding	20	25	1.20	0.035
Plain track	45	10	0.22	0.006

The collision frequencies were further adjusted to reflect the difference between monitored and unmonitored sidings. Unmonitored sidings are not track circuited and thus the CTC system will not be able to detect the presence of a train in the siding. This means a slightly greater chance of a collision occurs at an unmonitored siding than at a monitored siding. No readily available data exists to quantify this effect, so a judgmental estimate was applied to yield a final set of collision frequencies as shown in Table F.8.

Table F.8. Final Reference Case Collision Frequencies

Segment Type	Collision Frequency (Collisions per Million Train-Miles)
Siding (monitored)	0.030
Siding (unmonitored)	0.040
CP adjacent (monitored)	0.005
CP adjacent (unmonitored)	0.060
Plain track	0.006

The split between head-on and side/rear-end collisions is also based on this information, combined with the following considerations derived from the traffic pattern on the IDOT test corridor:

- Almost all "encounters" (meets and passes between trains) occur at passes of a pair of trains traveling in the opposite direction. This means far more head-on than rear-end collisions will occur. Rear end collisions are only possible when trains are traveling well off schedule.
- In a rear-end collision between a freight and a passenger train, it is usually the passenger train that rear-ends the freight, because of the speed differential.
- In a rear-end collision between two freight trains, equal numbers of trains are where a loco hits a freight car and the freight car is hit by a locomotive.
- The primary scenario for side collisions is at the entry/exit switch of a passing siding, where one train has not fully entered the siding (or unwisely backed up as happened in one of the accidents included in the detailed descriptions).

The resulting set of head-on and rear-end/side probabilities used in the analysis are given in Table F.9.

Table F.9. Probability of Head-on, Rear-End and Side Collisions

Segment Type	Passenger to Passenger		Passenger to Freight			Freight to Freight	
	Head-on	Rear/side	Head-on	Rear/side P into F	Rear/side F into P	Head-on	Rear/side
CP adjacent	0.9	0.1	0.8	0.15	0.05	0.75	0.25
Siding	0.5	0.5	0.5	0.4	0.1	0.5	0.5
Plain track	0.8	0.2	0.7	0.25	0.05		

F.4.3 Reference Case Collision Distributions by Train Type

This section provides details of the calculations of the distribution of collisions by train pair that are briefly described in Section F.4.2 and listed in Table IN-5d of the Inputs worksheet. Each collision is assumed to involve two trains and the challenge is to estimate how these collisions are distributed among the possible pairs of trains that could be involved. The collision distributions are a function of the traffic mix and schedules in each Sub-corridor and season, and are estimated as described in this section The data developed for the PTC analysis case are transferred directly to Table IN-5d. Because all trains are equipped in the cab signal and ATC analysis cases, the data are simply revised by adding the one train equipped and no train equipped values to the corresponding "both trains equipped values. Train schedules and thus collision probabilities in the reference case are held constant for all analysis cases.

Two distinct methods were used to estimate the train type distribution:

- The random approach where collision exposure is a function of the mix of train with no consideration of specific train schedules. This approach is appropriate when information is

lacking on specific schedules or all or most trains are unscheduled or subject to substantial schedule uncertainty; and

- The deterministic approach where string charts of the train schedule are used to count the passes and meets between trains to yield collision exposure data. This approach is appropriate where a detailed schedule or string charts are available, and trains are expected to adhere reasonably closely to their schedules.

This section explains the alternative methods and how they have been applied to provide input data for the model. Examples of each approach are provided together with the method used to combine the two to provide best estimates for model inputs.

A comparison between the two approaches to estimating collision probability has been carried out using the average traffic mix over the whole corridor and for the "rest of year" traffic mix. Too few meets and passes are within one Sub-corridor for a meaningful comparison between the methods to be made. Collision probability estimates for the Sub-corridors are made using only the random approach with adjustments informed by the results for the comparison for the whole corridor. The following paragraphs describe the two methods. All traffic data is taken from the data in Section F.2.2, Table F.1.

The Random Approach (Whole Corridor, Rest of Year)

By assuming a random traffic pattern and lacking detailed simulations, the relative chance of a train of each type being involved in a collision with a train of the same or a different type is a function of the numbers of trains in the traffic mix, as given by the relationship:

[Fraction of trains of a given type] ×
[Fraction of other trains of the same or another type operating on the line]

The calculation is repeated for each pairing of train types, to give the following results:

Passenger with another passenger:	6/8.1 × 5/7.1 = 0.522
Passenger with an equipped freight	6/8.1 × 0.87/7.1 = 0.091
Passenger with an unequipped freight	6/8.1 × 1.23/7.1 = 0.128
Equipped freight with a passenger	0.87/8.1× 6/7.1 = 0.091
Equipped freight with another equipped freight:	0.87/8.1 × 0/7.1 = 0
Equipped freight with an unequipped freight:	0.87/8.1 × 1.23/7.1 = 0.019
Unequipped freight with a passenger:	1.23/8.1 × 6/7.1 = 0.128
Unequipped freight with an equipped freight:	1.23/8.1 ×0.87/7.1 = 0.019
Unequipped freight with another unequipped freight	1.23/8.1 × 0.23/7.1 = 0.005
TOTAL	1.000

From this, the relative chance of a collision accident involving the different pairings of trains is as follows:

Passenger to passenger:	0.522
Passenger to equipped freight and vice-versa:	0.182
Passenger to unequipped freight and vice-versa:	0.256
Equipped freight to equipped freight:	None
Equipped freight to unequipped freight and vice-versa:	0.038
Unequipped freight to unequipped freight:	0.005

The Deterministic Approach (Whole Corridor, Rest of Year)

This approach is used with specific string charts illustrating expected operations on the corridor for the whole corridor and "rest of year" traffic. An example of the string charts is shown in Figures F.1a and F.1b, taken from the UVA analysis of PTC safety cited in Reference 1.

The trains on the string charts were identified as passenger, equipped freight (the local freight trains and unequipped freight) (the long-haul freight and grain trains), and the meets and passes shown on the string charts were counted. This exercise gave the following results, averaged over a full week's operations:

Passenger to passenger:	0.67
Passenger to equipped freight and vice-versa:	0.18
Passenger to unequipped freight and vice-versa:	0.11
Equipped freight to equipped freight:	0.00
Equipped freight to unequipped freight and vice-versa:	0.00
Unequipped freight to unequipped freight:	0.05

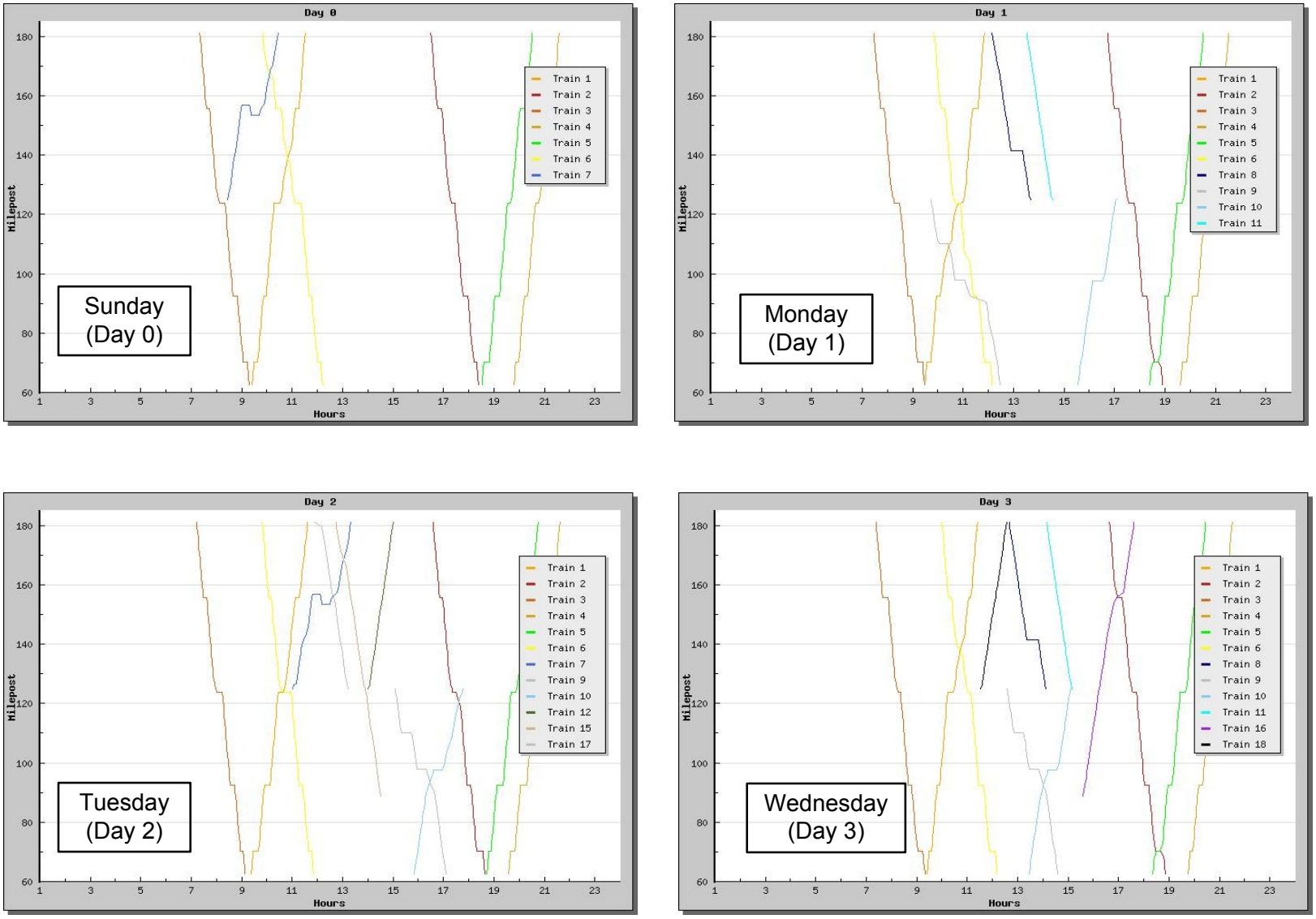
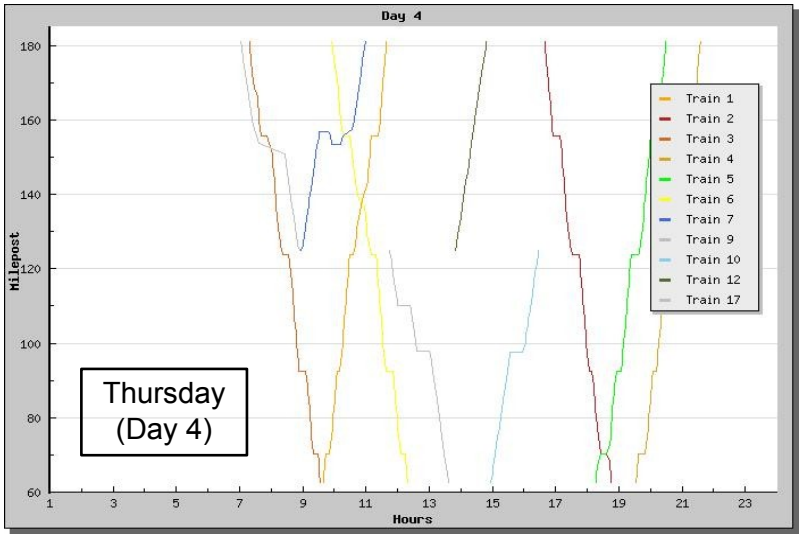
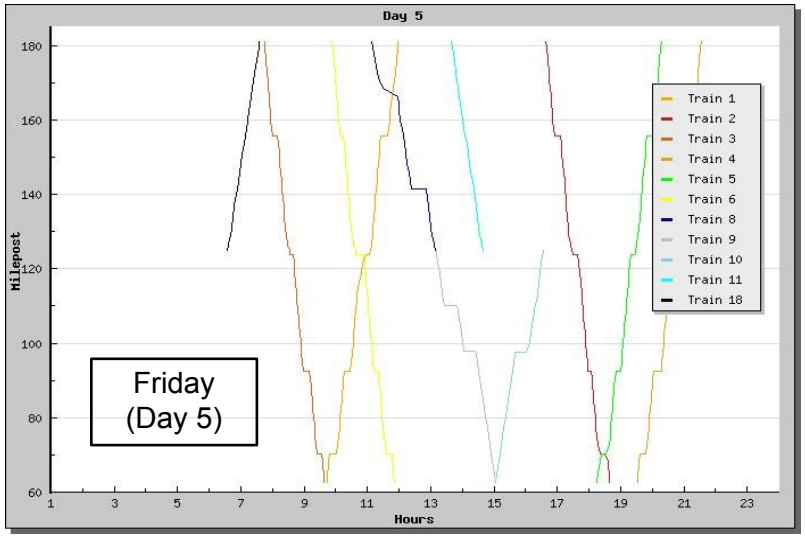


Figure F.1a. String Charts, Winter Week Sunday–Wednesday





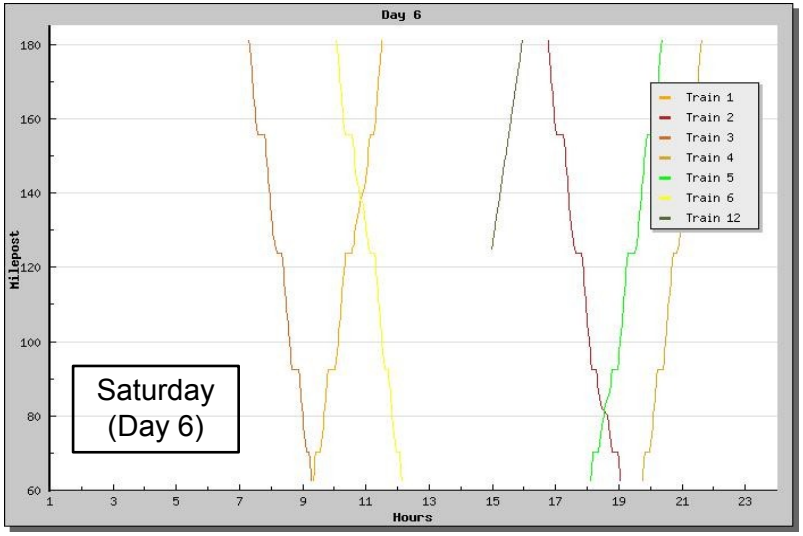


Figure F.1b. String Charts, Winter Week Thursday–Saturday

Comparison between Approaches

These results suggest that the actual train scheduling in the corridor tends to reduce the potential for conflicts between passenger and freight trains—primarily between passenger trains and unequipped freight trains. This is because the through freight trains are scheduled in the principal gaps between passenger train movements along the IDOT test corridor. However, the through freight trains are those most subject to schedule uncertainty, so the real conflict probabilities on the corridor will be somewhere between the two approaches. This recognizes that schedule variability is likely but not to the extent of producing a completely random traffic pattern.

On the basis of this argument, a reasonable estimate would be the mean of the results from the two approaches, as follows:

Passenger to passenger:	0.60
Passenger to equipped freight and vice-versa:	0.18
Passenger to unequipped freight and vice-versa:	0.18
Equipped freight to equipped freight:	0.00
Equipped freight to unequipped freight and vice-versa:	0.02
Unequipped freight to unequipped freight:	0.02

On the distribution between head-on and rear/side collisions, the string charts show that almost every encounter between trains is a "meet" with the two trains traveling in opposite directions. Overtaking "passes" are almost nonexistent because of the large spacing between trains traveling in the same direction. Thus, head-on collisions will be much more common than read-end collisions. However, even at meets at a passing siding, a possibility of a side collision exists, where a train attempts to exit the siding when the train approaching from the opposite direction has not fully entered the siding.

Where passenger trains and freight trains move at markedly different speed, rear-end collisions between passenger and freight trains are almost always involve a passenger train rear-ending a freight train.

Estimates for Sub-corridors and Seasons

Because it is not practical to compare the two methods for individual Sub-corridors and seasons, the approach is to use the random method and then make judgmental adjustments informed by the results of the comparison described above. The adjustments generally increase the probability of collisions between two passenger trains and reduce the probability of collisions between passenger and freight trains. The results are shown in the Tables F.10a and F.10b for the unadjusted and adjusted probabilities.

Table F.10a. Unadjusted Collision Probabilities from Random Calculation

Sub-corridor	Season	Collision Probabilities by Types of Train*					
		P-P	P-EF	P-UF	EF-EF	EF-UF	UF-UF
Joliet	Summer	0.63	0.27	0.09	0	0.02	0
	Rest of year	0.63	0.27	0.09	0	0.02	0
Bloomington	Summer	0.63	0.27	0.09	0	0.02	0
	Rest of year	0.50	0.21	0.24	0	0.04	0
Springfield	Summer	0.75	0.19	0.06	0	0.01	0
	Rest of year	0.50	0.13	0.33	0	0.03	0.02

*P = passenger, EF = equipped freight, UF = unequipped freight

Table F.10b. Adjusted Collision Probabilities from Random Calculation

Sub-corridor	Season	Collision Probabilities by Types of Train*					
		P-P	P-EF	P-UF	EF-EF	EF-UF	UF-UF
Joliet	Summer	0.71	0.22	0.07	0	0	0
	Rest of year	0.71	0.22	0.07	0	0	0
Bloomington	Summer	0.77	0.22	0.07	0	0	0
	Rest of year	0.60	0.16	0.16	0	0.08	0
Springfield	Summer	0.80	0.15	0.05	0	0	0
	Rest of year	0.62	0.12	0.18	0	0.05	0.03

*P = passenger, EF =- equipped freight, UF = unequipped freight

The figures in Table F.10b are transferred to Table IN-5d of the Inputs worksheet.

F.4.4 Intrusion Collision Frequencies

Intrusion collisions, a catch-all category, include poorly secured or mishandled rail vehicles rolling on to or fouling the main line at a turnout, as well as intrusions by derailed vehicles and shifted loads.

Intrusions, due to shifted loads or a derailment on an adjacent track, are rarely detectable by track circuits and cannot be prevented or mitigated by PTC in the absence of an intrusion detection system. They are usually classified on FRA accident reports as raking or obstruction collisions.

Rollout events differ from the derailed vehicle or shifted load intrusions in that they will be detected by track circuits or switch position monitors and possibly mitigated or prevented by the signaling or train control system. Rollout events are usually classified by FRA as head-on, side or rear-end collision. It is usually necessary to review the narrative on the accident reports to determine if a collision was between two trains operating under the control of the train crew and dispatcher or an unintended intrusion from a connecting track.

Intrusion accidents have been analyzed with regard to both frequency and consequences in their relationship to train-to-train collisions. The frequency of both train-to-train collisions is a direct function of traffic levels and the level of railroad activity generally. Estimated collision frequencies for passenger and freight trains are given in Table F.11.

Table F.11: Frequencies for Rollout and Intrusion Collisions

Train Type	Collision Type	Fraction of Train-Train Collisions	Frequency (Collisions per Million Train-Miles)
Passenger	Rollout	0.3	0.0086
	Other intrusion	0.5	0.0144
Freight	Rollout	0.5	0.0144
	Other intrusion	0.3	0.0086

These estimates were derived from the 15-year database of passenger train accidents and from a 5-year database of accidents on Class I freight railroads. Compared with passenger trains, freight trains appear to have rather more rollout collisions, mainly because some of these accidents occur during en-route switching. The fewer other intrusion accidents seemingly because the lower speeds and greater robustness of freight equipment. The same accidents occur, but more fall below the reporting threshold.

F.4.5 Diamond Collision Frequencies

Estimating a collision rate for diamond accidents presents a problem for the analyst, given the scarcity of historic accident data and the lack of information on traffic and train speeds on rail lines crossing the IDOT test corridor at diamond crossings. To try to minimize the uncertainties, two different approaches to estimating collision frequency (collisions per million IDOT test corridor train passes) were attempted, as described below.

From historic accident data: A review of the FRA database for the years 1995–2002 (6 years) yielded a probable six diamond collisions on main track, three of which were in Illinois. This suggests that Illinois is uniquely exposed to diamond crossing collision risk, probably because of the unique intersection of north-to-south and east-to-west rail routes in the State and the flat terrain. It is unlikely that individual diamond crossings in the State are uniquely risky. The number of train-miles operated in Illinois can be roughly estimated from the fraction of national railroad route miles in Illinois (5.15 percent) and the national average total annual train-miles (508 million, including non-Class I railroads). This gives 26.0 million train-miles/year and 208 train-miles over 8 years. Then, the frequency calculation goes as follows:

- Crossings spaced every 40 miles (as in the IDOT test corridor);
- Number of crossing passes over 8 years, 208/40 = 5.2 million;
- Number of collisions, three, over 8 years; and
- Collision frequency, 3/5.2 or 0.58/million crossing passes.

By analogy with other collision accidents: The cause of diamond crossing collisions is predominantly failure to observe the interlocking signals controlling movement through the crossing, very similar to the cause of the majority of other collision accidents. Therefore, the frequency of diamond crossing accidents (for example per million encounters with crossing trains) is likely to be similar to the corresponding frequency of collisions between meeting or passing trains at sidings. The frequency calculation goes as follows:

- Approximately two and one-half encounters/day are on the IDOT test corridor and with approximately eight one-way trips or 936 train-miles/day, giving an encounter frequency of once every 374 miles.
- Average collision frequency on the IDOT test corridor is estimated to be 0.06 trains in collisions/million train-miles, based on historic data, which translates to $.06 \times 374 = 22.44$ trains in collisions per million encounters.
- A corresponding encounter at a diamond is when a train approaches the diamond on both lines at the same time and a collision would result if one train fails to observe the signals protecting the diamond.
- The probability of this double approach is obtained by multiplying the fractions of total time that trains on each route will occupy the crossing. If 8 trains/16 hours are on the IDOT test corridor, an average of 15 trains/16 hours on the crossing route and each train occupies the crossing for 5 minutes, this probability is:

$$[(5 \times 8)/(16 \times 60)] \times [(5 \times 15)/(16 \times 60)] = 0.0417 \times 0.0781 = 0.00326$$

- The collision frequency at a diamond is then given by $22.44 \times 0.00326 = 0.073$ IDOT test corridor trains in collisions per million crossing passes.

Clearly, a 8:1 discrepancy exists between the two approaches, although it would be easy to reduce this to the order of 2:1 by making different traffic assumptions and assuming that the run of three collisions in Illinois over 8 years is unique and greatly exaggerates the long-term average. The result also suggests that the risk collisions at diamonds is somehow higher than at other points of potential conflict. For the model, a figure between extremes of 0.15 has been selected. This value will be used throughout the analysis and is unlikely to have a significant influence on the differential between the different train control systems.

F.4.6 Frequencies for Other Accident Types

Accident frequencies are required for the two types of derailment accident of interest—broken rails, overspeed and for casualties due to work zone intrusions.

Broken Rail Derailments

The estimated frequencies for broken rail derailment taken from previous analyses FRA accident data are given below:

Passenger: 0.0167/million train-miles and
Freight: 0.0556/million train-miles.

The passenger frequency was for passenger trains operating on freight railroads. Passenger train derailments frequencies are substantially lower than that for freight trains due to the combined effect of higher axle loads and the higher number of load cycles imposed on the track by freight trains.

Overspeed Derailments

The estimated frequencies, obtained directly from the databases for overspeed derailments are:

Passenger: 0.0110/million train-miles and
Freight: 0.0160/million train-miles.

The IDOT test corridor has few permanent speed restrictions due to curves, and overspeed derailments in the corridor may be less that the frequencies derived from national data. However, the majority of derailments seem to be because of a failure to observe speed limits when passing through turnouts, such as at a crossover or entry to a passing siding, so the reduction in accidents on the IDOT test corridor may not be significant. The national figures will be used for the initial model runs.

Work Zone Intrusions

The number of on-track workers killed by moving equipment while performing track and infrastructure maintenance (including signal maintainers) is about five individuals per year and having approximately 10 times as many injuries. Not all these events occurred in a formally designated work zone or involved the operation of on-track maintenance or inspection equipment, or where an active train violated a work zone. Some maintenance-of-way worker casualties are a result of the person failing to keep clear of trains operating correctly on an active track. Note that these do not include casualties or damage in collisions between on-track maintenance equipment and active trains, which are captured in the analysis of collisions in the model.

To provide an estimate of the benefits of enforcement of work zones, the analysis will assume that approximately half of these fatalities are potentially preventable by PTC, but not by cab signals and ATC.

The casualty frequency for on-track workers is the number of casualties divided by aggregate mainline train-miles operated as follows:

Fatalities: 5/600 = 0.0083/million train-miles and
Injuries: 50/600 = 0.083/million train-miles.

These values are assumed to apply to 50 mph for freight trains and 40 mph for quieter passenger trains and are adjusted up or down in proportion to speed. The logic for speed sensitivity is that lower speeds give the worker more time to escape from the approaching train, rather than any assumption that accidents at lower speeds are less injurious.

The results are given in Table F.12 below

Table F.12. Estimated Casualty Frequencies for On-Track Worker Casualties

Train Type	Representative Speed (mph)	Frequency per Million Train-Miles	
		Fatalities	Injuries
Passenger	40	0.0083	0.083
	60	0.0124	0.124
	79	0.0163	0.163
	105	0.0218	0.218
Freight	25	0.0042	0.042
	40	0.0066	0.066
	50	0.0083	0.083

F.5 Preventability Estimates

In this analysis, *preventability* is defined as the fraction of accidents that would have occurred with the reference case system (CTC with block and interlocking signals) that are prevented by the specific train control systems analyzed in this case NAJPTC cab signals with ATS or NEC cab signals with ATC. In the case of collision accidents, the preventability factor is applied to the guilty train that failed to observe a wayside signal or operating authority. All other accident scenarios only involve one active train. Preventability is simply applied to the reference case accident frequency to obtain an adjusted frequency for the train control system being analyzed.

The analysis and considerations, used to derive preventability estimates, are described in the following paragraphs, which include a discussion of the effects of varying latency and timeout for the NAJPTC system. Note that the effects of timeout and latency on train-to-train collision frequency are analyzed on Worksheet 1 and explained in Appendix A.

F.5.1 Collision Preventability

Calculation of preventability estimates for train-to-train collisions that typically involve two active trains are somewhat more complex than for other accident scenarios, which involve a single active train. All train-to-train collisions involve a guilty train, which failed to observe signals and/or operating authorities, and an innocent train that made no such errors Preventability factors are applied to the guilty train, if equipped with the train control system, and to an innocent train only in reference to calculations as to whether actions by the innocent train can prevent or mitigate a collision. In reference case head-on collision accidents and in head-to-side, where trains of different types are involved in a collision, each train is assumed to be guilty 50 percent of the time. In the case of rear-end collisions between a passenger train and a freight train, reference case guilt is weighted to the passenger train, because passenger trains are generally moving faster that freight trains.

The following paragraphs discuss how preventability factors were developed for train-to-train collisions.

NAJPTC System

When functioning normally, the NAJPTC system will prevent almost all collision accidents where an equipped train could have failed to observe signals or operating authorities. Situations, where PTC might not prevent a collision, are:

- Where a fault outside the NAJPTC system prevents the expected response from the train, for example a fault in the brake system or unusually slick rail.
- An undetected fault in the NAJPTC system itself, so that it fails to deliver the correct message to the train. This scenario could include a fault that results in a false all clear (expected to be very rare) or perhaps more likely an error in reference data on which the system relies, such a track map data, braking profiles and the like.
- A fault in the conventional signal and communications systems on which the NAJPTC system relies for some of its input data, especially the location of unequipped trains.

- In collisions with self-propelled on-rail inspection or maintenance equipment that does not shunt track circuits. If the equipment is also not PTC-equipped, the system has no way of recognizing its location except by manual entry by the dispatcher. Such accidents are included among train-to-train collision accidents, unless the equipment is located in a designated work zone.
- Lower speed collisions in yard or station areas where implementation of full NAJPTC functions are impractical (for example where it would enforce a stop before a train had fully entered a terminal track).

These considerations specifically exclude two situations where NAJPTC cannot prevent an accident and that are considered elsewhere in the model:

- Where the NAJPTC and thus a train's response to a specific hazardous situation is delayed by latency or timeout. This situation is analyzed in detail on Worksheet 1 of the model.
- Where NAJPTC has been isolated and is not in service. The train will be operating under a fall-back operating state, which is presumed to be CTC. Because the fall-back operating state is common to all control systems and presumed to apply to the same fraction of train-miles operated in all analysis cases, it is not analyzed in these versions of the model.

Very little data exists on which to base the preventability estimate for a PTC-equipped train. Experience with the ATC system on the NEC suggests that almost all accidents are because of events that the ATC system could not prevent, given its functional capabilities and limitations at the time and location of the accident. For this analysis preventability for the normal operating state was set at 90 percent or 0.9, which means that PTC would prevent 90 percent of failures to observe signals and authorities leading to a collision that would have occurred with the reference case CTC system. This is believed to be a conservative estimate. The true preventability probably lies between 90 and 95 percent. To explore the effects of uncertainty in estimating preventability, risk model runs were carried out with preventability at 88 percent for a low bound and 94 percent for a high bound. Collisions that are not prevented will be covered by one of the situations described above.

Union Pacific Cab Signal and ATS System

The UP cab signal and ATS system provides an in-cab warning whenever the train enters a signal block under a more restrictive signal aspect. The system is directional in that the signal aspect is conveyed by coded track circuits to the train from the signal the train is approaching. If another train or an obstruction interrupts the track circuit between the signal and the approaching train, the equipped train will immediately receive the most restrictive aspect. However, once acknowledged, the UP system does not enforce signal aspect speeds or a stop before reaching a signal at danger. This means that a train equipped with the cab signal/ATS system will prevent fewer accidents and will have a lower preventability factor than one with the NAJPTC system.

In an analysis of accidents with and without the cab signal, the ATS system on the UP was used to estimate the preventability factors. By using 6 recent years' worth of FRA accident data, the number of train-to-train collision accidents on lines with and without cab signals/ATS was compared with the number of derailment accidents on the same line. The analysis was confined

to train accidents on mainline tracks of FRA Class 3 or better and with ABS or better signaling. Accidents on lower-class tracks, yard, and industrial track and on dark territory were not included. The rationale was that the occurrence of derailment accidents would be an indicator of traffic volume on the lines, and would be unaffected by the presence or absence of cab signals/ATS. The results of the comparison are given in Table F.13.

Table F.13: Comparison of Collision and Derailment Accidents on Union Pacific

Accident Type	CTC and ABS	Cab Signal with ATS
Train-to-train collisions	33	2
Derailments	497	83

The results for CTC and ABS territory show 15.1 derailments for each collision. If this ratio is applied to cab signal/ATS territory, the result suggests that 5.51 collisions with CTC and ABS would have been on the same territory. Thus, ATS has reduced collisions from 5.51 to 2, implying a preventability of 63 percent. A check of the accident reports for the two collisions with cab signals confirmed that both were genuine collisions with operational ATS. In both cases, the ATS warning was acknowledged but the crew failed to observe restricted speed operating rules and failed to stop at the next signal.

Obviously, this result is indicative rather than conclusive, and ideally, the analysis should be extended to a larger sample. Given the uncertainty because of the very small sample, risk model runs were performed with preventability values between 60 and 80 percent. A model run at 90 percent was also carried out to show the comparison between NAJPTC and cab signals/ATS, if the assumption is made that no difference occurs between the two systems in their effectiveness in preventing collisions.

NEC Cab Signals with ATC

The NEC cab signal and ATC system first provide an in-cab warning whenever a train enters a signal block under a more restrictive signal aspect. If the engineer does not initiate braking to reduce speed down to that corresponding to the approaching signal aspect, a penalty brake application will be initiated. ATC continues to monitor both speed and brake setting to ensure that braking effort is increased up to normal service braking, and the brake is not released until speed is reduced to that corresponding to the approaching signal aspect. The brake may also be released if the signal clears to allow a speed higher than current speed. ATC does not enforce speeds below restricted speed (20 mph), This allows a train to approach a stop signal rather than being forced to stop before reaching the signal.

Until the Chase, MD, collision in 1987, where a freight locomotive consist passed a red interlocking signal and entered a track occupied by an approaching passenger train traveling at high speed, freight train were only equipped with cab signals and not speed control. After this accident, freight trains were required to be fitted with a version of speed control called the

Locomotive Speed Limiter (LSL) that enforced braking at graduated braking rates designed to minimize risk of damaging longitudinal shocks during service or penalty braking.

The analysis assumes that all freight and passenger trains will be equipped with ATC on the IDOT test corridor, including LSL or an equivalent on freight trains.

Preventability estimates for train-to-train collisions with ATC were derived from an analysis of the collision history on the NEC. This analysis showed that main line passenger train collisions on the NEC away from major passenger terminals are very rare. A review of FRA accident data for the NEC over the period 1986 to 2000 identified about five passenger trains in train-to-train collisions outside of large passenger stations. Some ambiguity about this number occurs because it can be a judgment call as to whether the accident occurred in a terminal area (where conflicting movements are common), whether or not the accident was a rollout event, and for the earlier period up to about 1990, whether the accident would have happened at all if the freight train involved had been equipped with full ATC instead of just cab signals. Speed control was required on all freight trains after the Chase, MD, collision in 1987.

Assuming five trains in collisions over 15 years and average annual train-miles of 15.5 million gives a frequency of trains in collisions of 0.0215 trains in collisions per million train-miles. This is achieved with a traffic density on each main track of approximately 55 trains/day in passenger train operating hours. Using the same calculations as that in Section F4.1 and changing the traffic density multiplier from 0.5 to 2.2 gives a frequency of 0.127 collisions per million train-miles for the NEC operated with CTC and at conventional speed. Thus the preventability can be calculated as [1 – 0.0215/0.127] or 0.83.

As with the ATS preventability analysis, obviously numerous potential sources of error are in this calculation given the small sample and the sweeping assumptions used. However the results are credible. ATC is clearly highly effective at preventing main line collision accidents, and can be expected to show substantial improvement over ATS but not reach the performance of NAJPTC with its enforcement down to an absolute stop. A base estimate for train-to-train collision preventability for ATC of 0.85 was used in the model, with high and low values of 0.8 and 0.9 for the sensitivity analysis.

Preventability values applying to an equipped train for NAJPTC, cab signal with ATS and cab signal with ATC analysis cases are entered into Table IN-6b on the Inputs Worksheets for the corresponding risk analysis model.

F.5.2 Preventability for Other Accident Scenarios

Preventability values for all other accident scenarios are entered into Table IN-6a of the Inputs Worksheet. The derivation of the individual preventability values are described for each accident scenario and described in the following paragraphs.

Intrusion Collisions

Two types of intrusion collisions occur for which preventability values are required:

- Rollout events, where a car or cars rollout onto the active main line at a connecting switch (usually from an industry or yard track) into the path of an approaching train. The cars may have been poorly secured or mishandled during switching, and any derails positioned to guard against such events may not have been set or were ineffective. Rollout events are usually detectable by the main line track circuits, and preventability depends on the location of the rollout event relative to the approaching train, the type of track circuit, and timeout and latency. The response of the train control systems will be:
  - *NAJPTC in a normal operating state*: The intrusion will be detected by the track circuit only if the equipped train has not entered the signal block in which the rollout occurred. The event would also be detected by a switch position monitor if so equipped. If detected, PTC will send a zero speed message to the train and prevention then depends on the location of the equipped train relative to the rollout event.
  - *NAJPTC in timeout*: Preventability is a function of whether the event can be detected by PTC (as for the normal operating state, and timeout. For the higher timeout values, comparable to or greater than the time taken by a passenger train to travel through a signal block, PTC in timeout is unable to prevent an accident. For lower timeout values, preventability increases as timeout reduces.
  - *Cab signal and ATS*: Because of the directional feature of coded track circuits, any intrusion ahead of an approaching train will interrupt the track circuit and cause a warning and a restricted speed aspect to be displayed in the cab, even after the equipped train has entered the block in which the intrusion occurred. Preventability depends on the ability of the train to stop in the distance between the train the train's position at the time of the rollout event and the location of the event. Preventability values with cab signals and ATS will generally be greater than with PTC.
  - *Cab signal and ATC*: ATC uses the same directional coded track circuits as ATS. If the track circuit is interrupted by a rollout intrusion, a restricted speed aspect will be shown in the cab and ATC will enforce braking down to restricted speed.
- Intrusions unrelated to connecting switches, caused by shifted loads on or derailments of vehicles on an adjacent track These events are rarely detectable by track circuits, and only a few can be prevented by either PTC or cab signal/ATS systems. The possibility of prevention depends on whether the derailed vehicle or shifted load interrupts the track circuit, triggering a warning or stop command to be transmitted to the train. Alternatively, an alert train crew responsible for the derailed vehicles may have had time to apply a shunt to the active track to warn approaching trains of the obstruction. If the track circuit is interrupted, then the logic applied to estimating preventability is the same as for rollout events as described above.

The central estimate for preventability for rollout intrusions for the NAJPTC system was derived from the values for preventability derived from the calculations on Worksheet 1 for preventability for a collision involving an unequipped train violating a block or signal. Typical Worksheet 1 values were reduced to account for the fact that the rollout events can take place

anywhere in a signal block., instead of at the entry point to the block. PTC also adds an increment of preventability when the equipped train is in the block before rollout location. The equipped train will receive a zero speed command at the time of the violation. An unequipped train will only become aware of the problem when the crew sees the block signal controlling entry to the block where the violation is located.

On the basis of these arguments, preventability was estimated to be 30 percent (0.3) for NAJPTC in the normal operating state and with latency at 10 seconds. Preventability was estimated to be zero with 120 seconds timeout, implying no improvement over an unequipped train responding to wayside signal indications. Preventability for other intrusion collisions, not associated with a connecting switch, was estimated to be much lower, at 5 percent (0.05) for NAJPTC in a normal operating state with latency at 10 seconds. Very little readily available information exists from which to base this estimate of the fraction of other intrusion events that interrupt track circuits and thus could potentially be PTC preventable. This is an attempt at a very rough estimate simply based on the perception that the value will be much lower that for rollout events.

Preventability estimates for other latency and timeout values were interpolated between the limits for PTC in its normal and timeout operating states to give the values shown in Table F.14.

Table F.14. NAJPTC Intrusion Collision Preventability Estimates

Latency or Timeout	Value (seconds)	Preventability Values	
		Rollout Intrusions	Other Intrusions
Latency	5	0.32	0.054
	10	0.30	0.050
	20	0.26	0.043
Timeout	20	0.26	0.043
	60	0.10	0.015
	120 and above	0.00	0.000

As stated above, ATS and ATC will both be more effective in preventing intrusion collisions because of its quicker response and the ability to respond when the approaching train is in the same block as the intrusion. For rollout intrusions the improvement may be limited because the intrusion may be detected by PTC via a switch position monitor, leading to an estimate of 35 percent, corresponding to the basic cab signal analysis case for which preventability for train-to-train collisions is set at 70 percent. For other intrusion collisions, the improvement over NAJPTC will be greater because these are always undetectable by PTC after the equipped train has entered the same block as the intrusion. A preventability of 0.10 was estimated for cab signals/ATS for other (nonrollout) intrusions. The corresponding estimates for ATC are 0.43 for rollout intrusions and 0.12 for other intrusions, reflecting the greater likelihood of a response to the restricted speed warning with speed enforcement.

Given the uncertainty of preventability estimates for both ATS and ATC, analysis model runs were carried out with high and low values of preventability. In doing this, intrusion collision preventability estimates were adjusted in proportion to corresponding variations in train-to-train collision preventability. The final preventability estimates for train-to-train and intrusion collisions are shown in Tables F.15a and b for ATS and ATC respectively.

Table F.15a. Cab Signal with ATS Intrusion Collision Preventability Estimates

Train-to-Train Collision	Rollout Intrusions	Other Intrusions
0.60	0.30	0.09
0.70	0.35	0.10
0.80	0.40	0.11

Table F.15b. Cab Signal with ATC Intrusion Collision Preventability Estimates

Train-to-Train Collision	Rollout Intrusions	Other Intrusions
0.80	0.40	0.11
0.85	0.43	0.12
0.90	0.45	0.12

Overspeed Derailments

The NAJPTC system will enforce all types of speed limits, including permanent and temporary slow orders, speed limits when taking the diverging track at a turnout, posted speed limits, and the maximum speed for a specific type of train. Except for the kinds of failure described under the discussion of train-to-train collisions, NAJPTC will always enforce speed limits and the preventability will be comparable to that for equipped trains in train-to-train collisions. Timeout and latency will have only a limited effect on preventability value, since the speed limits will normally be entered or transmitted to the on-board PTC installation well before the train reaches the speed-limited location. Few instances will occur where the speed limit data are transmitted to the train shortly before the train reaches the point at which the limit applies, and thus where latency or timeout could affect preventability. Preventability for trains equipped with NAJPTC will be high, comparable to for train-to-train collisions, and has been conservatively estimated at 80 percent. With NAJPTC in timeout of 120 seconds, preventability was conservatively estimated at 50 percent. Preventability values for other latency and timeout values was estimated by interpolating between these limits, but not reducing preventability further with timeout exceeding 120 seconds as shown in Table F.16. At 120-second timeout, the assumption is that no possibility of preventing overspeed events where data are transmitted shortly before reaching the speed-limited location, but all other limits will be enforced regardless if timeout.

Table F.16. NAJPTC Overspeed Derailment Preventability Estimates

Latency or Timeout	Value (seconds)	Overspeed Derailment Preventability
Latency	5	0.82
	10	0.80
	20	0.76
Timeout	20	0.76
	60	0.60
	120 and above	0.50

Preventability is zero for cab signal cases, since that system does not enforce civil speed limits or temporary slow orders.

Broken Rail Derailments

A broken rail, which results in a total break, will interrupt track circuits and be detected by both PTC and the cab signal/ATS system. In the case of NAJPTC, the break will interrupt the conventional track circuit and indicate that the signal block with the break is occupied. If the approaching train has not entered the signal block containing the break, then the train will receive a zero speed command before entering the block. If a PTC-equipped train is already occupying the block containing the break at the time of the break, then the break will not be detected and an accident cannot be prevented or mitigated.

Again, little information exists from which to base a preventability estimate for rail failure accidents. The most helpful comes from an effort conducted for the FRA's Rail Safety Advisory Committee's PTC subcommittee in which a panel of experts reviewed accident descriptions to identify PTC-preventable accidents. Of those identified, about 17 percent were rail failures, mostly designated as "maybe" preventable. Possibly, half of these would actually be preventable. Knowing accident frequencies and preventability values for the other types of PTC-preventable accidents and the frequency for rail-flaw accidents it is possible to work backwards to a very rough estimate that four percent of rail-flaw accidents would be PTC-preventable with PTC in the normal operating state. This estimate was adjusted up and down to reflect the effects of timeout and latency as shown in Table F.17. By assuming that with 120-second latency, NAJPTC would be unable to respond to a broken rail any more effectively than a conventional track circuit and block signals.

Table F.17. NAJPTC Broken Rail Derailment Preventability Estimates

Latency or Timeout	Value (seconds)	Broken Rail Derailment Preventability
Latency	5	0.043
	10	0.040
	20	0.034
Timeout	20	0.034
	60	0.013
	120 and above	0.000

The cab signal/ATS and cab signal/ATC systems are potentially more effective against these kinds of rail failure derailments. Directionally coded track circuits will detect the break and cause a restricted speed aspect to be transmitted to the on-board system, even after the equipped train has entered the signal block containing the break. However, in many cases, the equipped train will be too close to the break to avoid an accident. Therefore, preventability for broken rail derailments was estimated to be 0.06, a 50 percent increase over the equivalent value for the NAJPTC system, for the basic cab signal analysis case for which preventability for train-to-train collisions is set at 70 percent. In addition, preventability for broken rail derailments as with train-train collisions will be affected by the level of compliance with restricted speed cab signal indications after acknowledging the warning. To capture this effect, broken rail derailment preventability values were adjusted to parallel corresponding variations in train-to-train collision preventability as shown in Tables F.18a and F.18b for ATS and ATC, respectively. As for intrusion collisions, high and low bound are shown for broken rail preventability estimates as well as a central estimate corresponding to 70 percent preventability for ATS train-to-train collisions and 85 percent preventability for ATC train-to-train collisions.

Table F.18a. Cab Signal with ATS Broken Rail Derailment Preventability Estimates

Train-to-Train Collision	Broken Rail Derailment
0.60	0.05
0.70	0.06
0.80	0.07

Table F.18b. Cab Signal with ATC Broken Rail Derailment Preventability Estimates

Train-to-Train Collision	Broken Rail Derailment
0.80	0.07
0.85	0.08
0.90	0.08

Work Zone Violations

The NAJPTC system possesses the capability of enforcing work zone restrictions, as described in Section F.4.6. This capability will prevent a train entering a designated work zone. It will not prevent work zone and track work accidents having other causes, for example:

- On-track maintenance or inspection work not protected by a designated work zone,
- On-track crews failing to keep within the designated zone, and
- Communications mix-ups or errors leading to a mismatch between the actual location of the on-track crew and the location communicated to the PTC system. An error of this type with conventional signaling and voice communications recently caused two track worker fatalities in the Boston area due to confusion over which of two tracks were occupied by the work zone.

Latency and timeout are unlikely to have a significant effect on the preventability of work zone violations. Work zone data are communicated to the train either at the start of the trip or en route. In either case, the data are likely to be communicated well before the train nears the location of the work zone. Thus, communications delays cannot—in most cases—affect the train's response to a work zone requirement.

Resources did not permit a detailed analysis of work zone injuries and fatalities. A simple scan of readily available descriptions of casualties to on-track workers on main tracks suggested that 50 percent of these would be prevented by PTC in a normal operating state with a latency of 10 seconds. This estimate was reduced to a very conservative 25 percent for timeout of 120 seconds. In general, communications delays will have a limited effect on preventability, because work zone details are generally downloaded to the train at the start of the trip and only a few will be communicated shortly before the train reaches the zone. Preventability for other latency and timeout values are shown in Table F.19.

Table F.19. NAJPTC Work Zone Violation Preventability Estimates

Latency or Timeout	Value (seconds)	Work Zone Violation Preventability
Latency	5	0.500
	10	0.500
	20	0.465
Timeout	20	0.465
	60	0.330
	120 and above	0.250

Preventability is zero for the cab signal/ATS and cab signal/ATC systems, which do not have the capability to store and enforce work zone restrictions.

Grade Crossing Collisions

The NAJPTC system interacts with active rail/highway grade crossing warning systems in two ways:

- As a passenger train approaches the crossing at speeds exceeding 79 mph, the NAJPTC system transmits train speed and location to the crossing system, enabling the crossing warning system to activate and provide highway traffic with a consistent time between activating the warning systems and the passage of the train over the crossing, irrespective of train speed. This feature avoids the need to replace previously installed conventional constant warning time systems designed for speeds up to 79 mph. NAJPTC does not add a safety capability in this case; it is a substitute for a more cumbersome alternative.
- If the crossing fails to acknowledge receipt of PTC-based warning system activation message or fails to activate crossing warning systems, then a failure message is transmitted to the train. On receipt of the failure message the train must reduce speed as much as possible before reaching the crossing. Since the crossing warning system cycle is usually initiated only 25 to 30 seconds before the train reached the crossings it will not normally be possible to stop. However, the speed reduction will reduce the likelihood or consequences of a collision. Timeout and latency will reduce the effectiveness of PTC to prevent crossing collisions by delaying the exchange of messages between the crossing systems and the trains. Preventability will be zero for higher values of timeout, which exceed 60 seconds.

In the case of preexisting crossing warning system failures, PTC will enforce the requirement to stop before moving over the crossing with flagger protection.

The starting point for estimating grade crossing collision preventability is the fraction of crossing collisions where warning systems failure was a factor. From FRA data, this is estimated to be about 10 percent. A more timely notification to the train of the failure could potentially prevent a collision at the crossing or reduce collision severity to below the FRA reporting threshold for a train accident. An estimate of a four-percent reduction in crossing collisions reportable as train

accidents was used for PTC in the normal operating stare. In the timeout operating state, preventability is assumed to be zero because the system would be unable to respond in any way before the train had traveled between the point of first contact with the crossing and the crossing itself. Interpolation between estimated for normal and timeout operating states was used to obtain estimates for other timeout and latency values.

The resulting preventability estimates (for both passenger and freight trains) are summarized in Table F.20.

Table F.20. NAJPTC Grade Crossing Collision Preventability Estimates

Latency or Timeout	Value (seconds)	Grade Crossing Collision Preventability
Latency	5	0.043
	10	0.040
	20	0.034
Timeout	20	0.034
	60	0.013
	120 and above	0.000

The cab signal/ATS and cab signal/ATC systems do not communicate with grade crossing warning systems in any way, thus preventability is zero.

Final Note

The preventability estimates for many of the accident scenarios other than train-to-train collisions are necessarily approximate. Although a more indepth analysis of each scenario is technically possible, leading to better supported estimates, this could not be done within the time and budget available for this effort. A more indepth analysis would be warranted if:

- The analysis is to be used as part of a formal submission to FRA for safety acceptance of the NAJPTC system, or
- The preventability performance of the NAJPTC system in these other accident scenarios is critical to showing that this system is equivalent to or better than the base case system, cab signals with ATS and cab signals with ATC.

Despite the approximate nature of the analyses, the analysis is thought to present a fair picture of the relative safety performance of the two systems analyzed.

Appendix G: Model Calculations

Table R1a: Full Year, PTC Normal, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00360	0.20937	0.00800	9112	54058
	Intrusion Collisions	0.01054	0.29310	0.01041	12560	73109
	Diamond Collisions	0.00025	0.00219	0.00007	77	491
	Overspeed	0.00118	0.06034	0.00097	4972	13916
	Broken Rail	0.00858	0.43531	0.00700	35869	100392
	Work Zone Violation	0.00000	0.05563	0.00556	0	22253
	Grade Crossing Collisions	0.57238	1.84557	0.02739	178897	445626
	Total, All Scenarios	0.59651	2.90151	0.05940	241487	709844
Freight	Train-Train Collisions	0.00097	0.00103	0.00010	274	686
	Intrusion Collisions	0.00248	0.00077	0.00008	97	406
	Diamond Collisions	0.00146	0.00052	0.00005	199	406
	Overspeed	0.00082	0.00026	0.00003	448	550
	Broken Rail	0.00688	0.00212	0.00021	3723	4572
	Work Zone Violation	0.00000	0.00637	0.00064	0	2549
	Grade Crossing Collisions	0.04669	0.01659	0.00085	3319	7537
	Total, All Scenarios	0.05930	0.02766	0.00196	8060	16706
Total Passenger + Freight		**0.65581**	**2.92917**	**0.06136**	**249547**	**726550**

Table R2a: Summer, PTC Normal, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions Intrusion Collisions Diamond Collisions Overspeed Broken Rail Work Zone Violation Grade Crossing Collisions Total, All Scenarios					
Freight	Train-Train Collisions Intrusion Collisions Diamond Collisions Overspeed Broken Rail Work Zone Violation Grade Crossing Collisions Total, All Scenarios					
Total Passenger + Freight						

Table R3a: All Year, PTC Normal, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)

Passenger	Train-Train Collisions	0.00360	0.20937	0.00800	9112	54058
	Intrusion Collisions	0.01054	0.29310	0.01041	12560	73109
	Diamond Collisions	0.00025	0.00219	0.00007	77	491
	Overspeed	0.00118	0.06034	0.00097	4972	13916
	Broken Rail	0.00858	0.43531	0.00700	35869	100392
	Work Zone Violation	0.00000	0.05563	0.00556	0	22253
	Grade Crossing Collisions	0.57238	1.84557	0.02739	178897	445626
	Total, All Scenarios	0.59651	2.90151	0.05940	241487	709844
Freight	Train-Train Collisions	0.00097	0.00103	0.00010	274	686
	Intrusion Collisions	0.00248	0.00077	0.00008	97	406
	Diamond Collisions	0.00146	0.00052	0.00005	199	406
	Overspeed	0.00082	0.00026	0.00003	448	550
	Broken Rail	0.00688	0.00212	0.00021	3723	4572
	Work Zone Violation	0.00000	0.00637	0.00064	0	2549
	Grade Crossing Collisions	0.04669	0.01659	0.00085	3319	7537
	Total, All Scenarios	0.05930	0.02766	0.00196	8060	16706
Total Passenger + Freight		0.65581	2.92917	0.06136	249547	726550

Table R4a: Full Year, PTC Timeout, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00038	0.00001	16	98

	Intrusion Collisions	0.00002	0.00050	0.00002	21	124
	Diamond Collisions	0.00000	0.00001	0.00000	0	2
	Overspeed	0.00000	0.00022	0.00000	18	51
	Broken Rail	0.00001	0.00067	0.00001	56	155
	Work Zone Violation	0.00000	0.00012	0.00001	0	49
	Grade Crossing Collisions	0.00088	0.00283	0.00004	274	683
	Total, All Scenarios	0.00092	0.00473	0.00010	386	1162
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	1	1
	Intrusion Collisions	0.00000	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00000	0.00000	1	1
	Broken Rail	0.00001	0.00000	0.00000	6	7
	Work Zone Violation	0.00000	0.00001	0.00000	0	5
	Grade Crossing Collisions	0.00007	0.00003	0.00000	5	11
	Total, All Scenarios	0.00009	0.00005	0.00000	13	28
Total Passenger + Freight		**0.00101**	**0.00478**	**0.00010**	**399**	**1190**

Table R5a: Summer, PTC Timeout, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					

	Total, All Scenarios					
Freight	Train-Train Collisions Intrusion Collisions Diamond Collisions Overspeed Broken Rail Work Zone Violation Grade Crossing Collisions Total, All Scenarios					
Total Passenger + Freight						

Table R6a: All Year, PTC Timeout, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00038	0.00001	16	98
	Intrusion Collisions	0.00002	0.00050	0.00002	21	124
	Diamond Collisions	0.00000	0.00001	0.00000	0	2
	Overspeed	0.00000	0.00022	0.00000	18	51
	Broken Rail	0.00001	0.00067	0.00001	56	155
	Work Zone Violation	0.00000	0.00012	0.00001	0	49
	Grade Crossing Collisions	0.00088	0.00283	0.00004	274	683
	Total, All Scenarios	0.00092	0.00473	0.00010	386	1162
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	1	1
	Intrusion Collisions	0.00000	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00000	0.00000	1	1

	Broken Rail	0.00001	0.00000	0.00000	6	7
	Work Zone Violation	0.00000	0.00001	0.00000	0	5
	Grade Crossing Collisions	0.00007	0.00003	0.00000	5	11
	Total, All Scenarios	0.00009	0.00005	0.00000	13	28
bbb **Total Passenger + Freight**		0.00101	0.00478	0.00010	399	1190

Table R7a: totals: All Year, All Operating States, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00360	0.20975	0.00802	9128	54156
	Intrusion Collisions	0.01056	0.29360	0.01043	12582	73233
	Diamond Collisions	0.00025	0.00220	0.00007	77	492
	Overspeed	0.00118	0.06056	0.00097	4990	13967
	Broken Rail	0.00859	0.43598	0.00701	35924	100548
	Work Zone Violation	0.00000	0.05576	0.00558	0	22302
	Grade Crossing Collisions	0.57325	1.84840	0.02743	179171	446309
	Total, All Scenarios	0.59743	2.90624	0.05950	241873	711006
Freight	Train-Train Collisions	0.00097	0.00103	0.00010	275	688
	Intrusion Collisions	0.00248	0.00077	0.00008	97	407
	Diamond Collisions	0.00146	0.00052	0.00005	200	407
	Overspeed	0.00082	0.00026	0.00003	449	551
	Broken Rail	0.00689	0.00213	0.00021	3729	4579
	Work Zone Violation	0.00000	0.00638	0.00064	0	2554
	Grade Crossing Collisions	0.04676	0.01662	0.00085	3324	7549

Total, All Scenarios	0.05939	0.02771	0.00196	8073	16734
Total Passenger + Freight	0.65682	2.93394	0.06147	249946	727740

Results Summary: Basic PTC Case, Timeout 120 seconds, Lat

PTC Normal Oper

Table R1b: Rest of Year, PTC Normal, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00471	0.24335	0.00923	10473	62506
	Intrusion Collisions	0.01122	0.29495	0.01047	12570	73487
	Diamond Collisions	0.00023	0.00199	0.00006	70	446
	Overspeed	0.00125	0.06146	0.00099	4976	14078
	Broken Rail	0.00913	0.44338	0.00711	35898	101563
	Work Zone Violation	0.00000	0.05716	0.00572	0	22865
	Grade Crossing Collisions	0.53522	1.49510	0.02223	144911	361115
	Total, All Scenarios	0.56176	2.59739	0.05581	208899	636061
Freight	Train-Train Collisions	0.00342	0.00328	0.00033	881	2192
	Intrusion Collisions	0.00449	0.00135	0.00014	170	711
	Diamond Collisions	0.00125	0.00044	0.00004	170	346
	Overspeed	0.00216	0.00063	0.00006	1129	1381
	Broken Rail	0.01180	0.00341	0.00034	6100	7466
	Work Zone Violation	0.00000	0.01286	0.00129	0	5142
	Grade Crossing Collisions	0.07402	0.02323	0.00119	4622	10513
	Total, All Scenarios	0.09716	0.04520	0.00339	13071	27752
Total Passenger + Freight		**0.65892**	**2.64259**	**0.05919**	**221970**	**663812**

Table R2b: Summer, PTC Normal, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00134	0.07268	0.00276	3134	18695
	Intrusion Collisions	0.00373	0.09796	0.00348	4175	24406
	Diamond Collisions	0.00007	0.00059	0.00002	21	133
	Overspeed	0.00042	0.02041	0.00033	1653	4675
	Broken Rail	0.00303	0.14725	0.00236	11922	33731
	Work Zone Violation	0.00000	0.01898	0.00190	0	7594
	Grade Crossing Collisions	0.17776	0.49655	0.00738	48127	119932
	Total, All Scenarios	0.18633	0.85443	0.01823	69032	209167
Freight	Train-Train Collisions	0.00035	0.00035	0.00003	93	232
	Intrusion Collisions	0.00088	0.00026	0.00003	33	137
	Diamond Collisions	0.00037	0.00013	0.00001	51	103
	Overspeed	0.00029	0.00008	0.00001	151	185
	Broken Rail	0.00243	0.00070	0.00007	1256	1537
	Work Zone Violation	0.00000	0.00219	0.00020	0	824
	Grade Crossing Collisions	0.01524	0.00478	0.00024	952	2165
	Total, All Scenarios	0.01957	0.00850	0.00060	2535	5184
Total Passenger + Freight		0.20590	0.86293	0.01883	71568	214351

Table R3b: All Year, PTC Normal, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)

Passenger	Train-Train Collisions	0.00605	0.31602	0.01200	13608	81201
	Intrusion Collisions	0.01494	0.39291	0.01395	16745	97893
	Diamond Collisions	0.00029	0.00258	0.00008	90	579
	Overspeed	0.00167	0.08187	0.00131	6629	18753
	Broken Rail	0.01216	0.59064	0.00947	47821	135294
	Work Zone Violation	0.00000	0.07615	0.00761	0	30459
	Grade Crossing Collisions	0.71298	1.99165	0.02961	193039	481047
	Total, All Scenarios	0.74809	3.45182	0.07404	277931	845227
Freight	Train-Train Collisions	0.00378	0.00362	0.00036	974	2424
	Intrusion Collisions	0.00537	0.00161	0.00016	202	848
	Diamond Collisions	0.00163	0.00057	0.00006	221	449
	Overspeed	0.00245	0.00072	0.00007	1280	1566
	Broken Rail	0.01423	0.00412	0.00041	7356	9003
	Work Zone Violation	0.00000	0.01505	0.00149	0	5967
	Grade Crossing Collisions	0.08927	0.02802	0.00143	5574	12678
	Total, All Scenarios	0.11673	0.05370	0.00399	15607	32936
Total Passenger + Freight		0.86483	3.50552	0.07802	293538	878163

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Table R4b: Rest of Year, PTC Timeout, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00045	0.00002	19	116

	Intrusion Collisions	0.00002	0.00050	0.00002	21	125
	Diamond Collisions	0.00000	0.00001	0.00000	0	2
	Overspeed	0.00000	0.00023	0.00000	18	52
	Broken Rail	0.00001	0.00069	0.00001	56	157
	Work Zone Violation	0.00000	0.00013	0.00001	0	50
	Grade Crossing Collisions	0.00082	0.00229	0.00003	222	553
	Total, All Scenarios	0.00087	0.00429	0.00010	337	1055
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	2	5
	Intrusion Collisions	0.00001	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00000	0.00000	2	2
	Broken Rail	0.00002	0.00001	0.00000	9	11
	Work Zone Violation	0.00000	0.00002	0.00000	0	9
	Grade Crossing Collisions	0.00011	0.00003	0.00000	7	16
	Total, All Scenarios	0.00015	0.00007	0.00001	21	45
Total Passenger + Freight		**0**	**0**	**0**	**358**	**1100**

Table R5b: Summer, PTC Timeout, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00013	0.00001	5.7	34.0
	Intrusion Collisions	0.00001	0.00017	0.00001	7.1	41.4
	Diamond Collisions	0.00000	0.00000	0.00000	0.1	0.4
	Overspeed	0.00000	0.00008	0.00000	6.1	17.2
	Broken Rail	0.00000	0.00023	0.00000	18.5	52.2
	Work Zone Violation	0.00000	0.00004	0.00000	0.0	16.8
	Grade Crossing Collisions	0.00027	0.00076	0.00001	73.7	183.8

	Total, All Scenarios	0.00029	0.00141	0.00003	111.1	345.8
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0.2	0.5
	Intrusion Collisions	0.00000	0.00000	0.00000	0.1	0.3
	Diamond Collisions	0.00000	0.00000	0.00000	0.1	0.2
	Overspeed	0.00000	0.00000	0.00000	0.3	0.4
	Broken Rail	0.00000	0.00000	0.00000	1.9	2.4
	Work Zone Violation	0.00000	0.00000	0.00000	0.0	1.0
	Grade Crossing Collisions	0.00004	0.00001	0.00000	2.3	5.2
	Total, All Scenarios	0.00004	0.00002	0.00000	4.9	10.0
Total Passenger + Freight		0.00033	0.00142	0.00003	116.1	355.7

Table R6b: All Year, PTC Timeout, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00058	0.00002	25	150
	Intrusion Collisions	0.00003	0.00067	0.00002	28	166
	Diamond Collisions	0.00000	0.00001	0.00000	0	2
	Overspeed	0.00001	0.00030	0.00000	24	69
	Broken Rail	0.00002	0.00091	0.00001	74	209
	Work Zone Violation	0.00000	0.00017	0.00002	0	67
	Grade Crossing Collisions	0.00109	0.00305	0.00005	296	737
	Total, All Scenarios	0.00115	0.00569	0.00013	448	1400
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	2	5
	Intrusion Collisions	0.00001	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	1	1
	Overspeed	0.00000	0.00000	0.00000	2	3

	Broken Rail	0.00002	0.00001	0.00000	11	14
	Work Zone Violation	0.00000	0.00003	0.00000	0	10
	Grade Crossing Collisions	0.00015	0.00005	0.00000	9	21
	Total, All Scenarios	0.00019	0.00009	0.00001	26	55
Total Passenger + Freight		0.00135	0.00579	0.00013	474	1456

PTC Totals, All Operatir

Table R7b: Totals: All Year, All Operating States, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00606	0.31661	0.01202	13633	81351
	Intrusion Collisions	0.01497	0.39358	0.01398	16773	98059
	Diamond Collisions	0.00029	0.00259	0.00008	91	581
	Overspeed	0.00167	0.08217	0.00132	6653	18822
	Broken Rail	0.01218	0.59155	0.00948	47895	135503
	Work Zone Violation	0.00000	0.07632	0.00763	0	30526
	Grade Crossing Collisions	0.71407	1.99470	0.02966	193335	481784
	Total, All Scenarios	0.74925	3.45751	0.07417	278379	846628
Freight	Train-Train Collisions	0.00379	0.00363	0.00036	976	2429
	Intrusion Collisions	0.00538	0.00161	0.00016	203	850
	Diamond Collisions	0.00163	0.00057	0.00006	222	450
	Overspeed	0.00246	0.00072	0.00007	1282	1569
	Broken Rail	0.01426	0.00412	0.00041	7367	9017
	Work Zone Violation	0.00000	0.01507	0.00149	0	5976
	Grade Crossing Collisions	0.08942	0.02806	0.00144	5583	12699

Total, All Scenarios	0.11692	0.05379	0.00399	15632	32991
Total Passenger + Freight	0.86617	3.51131	0.07816	294011	879619

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Table R1c: Rest of Year, PTC Normal, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00708	0.35839	0.01356	15321	91837
	Intrusion Collisions	0.01724	0.42338	0.01502	18056	105443
	Diamond Collisions	0.00049	0.00436	0.00013	153	979
	Overspeed	0.00193	0.09127	0.00146	7148	20669
	Broken Rail	0.01403	0.65848	0.01056	51572	149112
	Work Zone Violation	0.00000	0.08482	0.00848	0	33929
	Grade Crossing Collisions	0.48582	1.41481	0.02100	137215	341700
	Total, All Scenarios	0.52660	3.03552	0.07022	229465	743667
Freight		0.00000	0.00000	0.00000	0	0
	Train-Train Collisions	0.00642	0.00661	0.00066	1767	4412
	Intrusion Collisions	0.01001	0.00322	0.00032	405	1695
	Diamond Collisions	0.00280	0.00098	0.00010	381	774
	Overspeed	0.00577	0.00190	0.00019	3207	3967
	Broken Rail	0.02535	0.00827	0.00083	13948	17257
	Work Zone Violation	0.00000	0.03192	0.00319	0	12769
	Grade Crossing Collisions	0.09676	0.03675	0.00188	7335	16651
	Total, All Scenarios	0.14711	0.08966	0.00717	27043	57526
Total Passenger + Freight		0.67371	3.12518	0.07739	256509	801193

Table R2c: Summer, PTC Normal, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00183	0.10014	0.00380	4294	25719
	Intrusion Collisions	0.00573	0.14061	0.00499	5997	35019
	Diamond Collisions	0.00014	0.00122	0.00004	43	274
	Overspeed	0.00064	0.03031	0.00049	2374	6864
	Broken Rail	0.00466	0.21869	0.00351	17128	49522
	Work Zone Violation	0.00000	0.02817	0.00282	0	11269
	Grade Crossing Collisions	0.16135	0.46988	0.00697	45571	113484
	Total, All Scenarios	0.17435	0.98903	0.02261	75407	242152
Freight	Train-Train Collisions	0.00034	0.00035	0.00004	94	234
	Intrusion Collisions	0.00173	0.00055	0.00006	69	290
	Diamond Collisions	0.00079	0.00028	0.00003	107	217
	Overspeed	0.00081	0.00027	0.00003	449	555
	Broken Rail	0.00457	0.00149	0.00015	2513	3109
	Work Zone Violation	0.00000	0.00505	0.00050	0	2019
	Grade Crossing Collisions	0.01743	0.00662	0.00034	1322	3000
	Total, All Scenarios	0.02566	0.01461	0.00114	4554	9426
Total Passenger + Freight		0.20001	1.00364	0.02375	79961	251577

Table R3c: All Year, PTC Normal, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)

Passenger	Train-Train Collisions	0.00891	0.45853	0.01736	19616	117555
	Intrusion Collisions	0.02297	0.56399	0.02000	24053	140462
	Diamond Collisions	0.00063	0.00559	0.00017	196	1253
	Overspeed	0.00257	0.12159	0.00195	9523	27533
	Broken Rail	0.01869	0.87718	0.01407	68700	198634
	Work Zone Violation	0.00000	0.11299	0.01130	0	45198
	Grade Crossing Collisions	0.64717	1.88469	0.02798	182786	455184
	Total, All Scenarios	0.70094	4.02455	0.09283	304873	985819
Freight	Train-Train Collisions	0.00675	0.00696	0.00070	1861	4647
	Intrusion Collisions	0.01174	0.00378	0.00038	475	1986
	Diamond Collisions	0.00359	0.00126	0.00013	488	991
	Overspeed	0.00658	0.00217	0.00022	3656	4523
	Broken Rail	0.02992	0.00976	0.00098	16461	20366
	Work Zone Violation	0.00000	0.03697	0.00370	0	14789
	Grade Crossing Collisions	0.11419	0.04337	0.00222	8657	19651
	Total, All Scenarios	0.17277	0.10427	0.00831	31597	66951
Total Passenger + Freight		0.87371	4.12882	0.10114	336470	1052770

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Table R4c: Rest of Year, PTC Timeout, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00054	0.00002	23	139

	Intrusion Collisions	0.00003	0.00072	0.00003	31	179
	Diamond Collisions	0.00000	0.00001	0.00000	0	3
	Overspeed	0.00001	0.00034	0.00001	26	76
	Broken Rail	0.00002	0.00102	0.00002	80	231
	Work Zone Violation	0.00000	0.00019	0.00002	0	75
	Grade Crossing Collisions	0.00074	0.00217	0.00003	210	524
	Total, All Scenarios	0	0	0	370	1226
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	4	9
	Intrusion Collisions	0.00002	0.00001	0.00000	1	3
	Diamond Collisions	0.00001	0.00000	0.00000	1	2
	Overspeed	0.00001	0.00000	0.00000	5	6
	Broken Rail	0.00004	0.00001	0.00000	21	26
	Work Zone Violation	0.00000	0.00005	0.00001	0	20
	Grade Crossing Collisions	0.00014	0.00005	0.00000	11	25
	Total, All Scenarios	0	0	0	42	91
Total Passenger + Freight		**0**	**0**	**0**	**413**	**1316**

Table R5c: Summer, PTC Timeout, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00018	0.00001	7.8	46.5
	Intrusion Collisions	0.00001	0.00024	0.00001	10.2	59.3
	Diamond Collisions	0.00000	0.00000	0.00000	0.1	0.9
	Overspeed	0.00000	0.00011	0.00000	8.7	25.2
	Broken Rail	0.00001	0.00034	0.00001	26.5	76.6
	Work Zone Violation	0.00000	0.00006	0.00000	0.0	18.9
	Grade Crossing Collisions	0.00025	0.00072	0.00001	69.8	173.9

	Total, All Scenarios	0.00027	0.00166	0.00004	123.1	401.4
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0.2	0.5
	Intrusion Collisions	0.00000	0.00000	0.00000	0.1	0.5
	Diamond Collisions	0.00000	0.00000	0.00000	0.2	0.5
	Overspeed	0.00000	0.00000	0.00000	0.8	1.0
	Broken Rail	0.00001	0.00000	0.00000	3.8	4.7
	Work Zone Violation	0.00000	0.00001	0.00000	0.0	3.5
	Grade Crossing Collisions	0.00003	0.00001	0.00000	2.0	4.5
	Total, All Scenarios	0.00004	0.00002	0.00000	7.1	15.1
Total Passenger + Freight		**0.00031**	**0.00168**	**0.00004**	**130.3**	**416.6**

Table R6c: All Year, PTC Timeout, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00072	0.00003	31	185
	Intrusion Collisions	0.00004	0.00096	0.00003	41	238
	Diamond Collisions	0.00000	0.00002	0.00000	1	4
	Overspeed	0.00001	0.00045	0.00001	35	101
	Broken Rail	0.00003	0.00136	0.00002	106	307
	Work Zone Violation	0.00000	0.00025	0.00002	0	94
	Grade Crossing Collisions	0.00099	0.00289	0.00004	280	697
	Total, All Scenarios	0.00108	0.00664	0.00016	494	1627
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	4	9
	Intrusion Collisions	0.00002	0.00001	0.00000	1	3
	Diamond Collisions	0.00001	0.00000	0.00000	1	2
	Overspeed	0.00001	0.00000	0.00000	6	7

	Broken Rail	0.00004	0.00001	0.00000	25	31
	Work Zone Violation	0.00000	0.00006	0.00001	0	24
	Grade Crossing Collisions	0.00017	0.00006	0.00000	13	29
	Total, All Scenarios	0.00026	0.00016	0.00001	49	106
Total Passenger + Freight		0.00134	0.00680	0.00017	543	1733

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Table R7c: Totals: All Year, All Operating States, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00893	0.45926	0.01739	19647	117740
	Intrusion Collisions	0.02301	0.56494	0.02004	24094	140700
	Diamond Collisions	0.00064	0.00560	0.00017	196	1257
	Overspeed	0.00257	0.12203	0.00196	9558	27634
	Broken Rail	0.01872	0.87853	0.01409	68806	198942
	Work Zone Violation	0.00000	0.11324	0.01132	0	45292
	Grade Crossing Collisions	0.64816	1.88757	0.02802	183066	455881
	Total, All Scenarios	0.70203	4.03119	0.09299	305366	987446
Freight	Train-Train Collisions	0.00677	0.00698	0.00070	1865	4656
	Intrusion Collisions	0.01176	0.00378	0.00038	475	1989
	Diamond Collisions	0.00360	0.00126	0.00013	489	993
	Overspeed	0.00659	0.00217	0.00022	3662	4530
	Broken Rail	0.02997	0.00978	0.00098	16486	20397
	Work Zone Violation	0.00000	0.03703	0.00370	0	14812
	Grade Crossing Collisions	0.11436	0.04343	0.00222	8669	19680

Total, All Scenarios	0.17303	0.10443	0.00832	31646	67057
Total Passenger + Freight	0.87506	4.13562	0.10131	337012	1054503

Table R1d: Rest of Year, PTC Normal, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01539	0.81111	0.03079	34907	208401
	Intrusion Collisions	0.03900	1.01143	0.03590	43187	252038
	Diamond Collisions	0.00097	0.00854	0.00025	299	1916
	Overspeed	0.00436	0.21307	0.00342	17096	48662
	Broken Rail	0.03174	1.53717	0.02467	123339	351067
	Work Zone Violation	0.00000	0.19762	0.01976	0	79048
	Grade Crossing Collisions	1.59342	4.75548	0.07062	461023	1148441
	Total, All Scenarios	1.68487	8.53442	0.18543	679851	2089572
Freight	Train-Train Collisions	0.01081	0.01092	0.00109	2923	7290
	Intrusion Collisions	0.01698	0.00535	0.00054	672	2813
	Diamond Collisions	0.00552	0.00194	0.00019	750	1526
	Overspeed	0.00875	0.00279	0.00028	4783	5899
	Broken Rail	0.04403	0.01381	0.00138	23771	29295
	Work Zone Violation	0.00000	0.05115	0.00512	0	20460
	Grade Crossing Collisions	0.21747	0.07657	0.00392	15276	34701
	Total, All Scenarios	0.30356	0.16253	0.01252	48175	101984
Total Passenger + Freight		**1.98843**	**8.69694**	**0.19795**	**728025**	**2191556**

Table R2d: Summer, PTC Normal, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00317	0.17282	0.00657	7429	44414
	Intrusion Collisions	0.00945	0.23857	0.00847	10172	59425
	Diamond Collisions	0.00021	0.00182	0.00005	64	407
	Overspeed	0.00106	0.05072	0.00081	4027	11540
	Broken Rail	0.00769	0.36595	0.00587	29050	83253
	Work Zone Violation	0.00000	0.04716	0.00472	0	18862
	Grade Crossing Collisions	0.33910	0.96643	0.01436	93699	233417
	Total, All Scenarios	0.36068	1.84346	0.04084	144440	451319
Freight	Train-Train Collisions	0.00069	0.00070	0.00007	187	466
	Intrusion Collisions	0.00261	0.00081	0.00008	102	428
	Diamond Collisions	0.00116	0.00041	0.00004	158	320
	Overspeed	0.00110	0.00035	0.00004	600	740
	Broken Rail	0.00700	0.00219	0.00022	3769	4647
	Work Zone Violation	0.00000	0.00724	0.00071	0	2844
	Grade Crossing Collisions	0.03268	0.01141	0.00058	2273	5165
	Total, All Scenarios	0.04523	0.02311	0.00174	7089	14610
Total Passenger + Freight		**0.40591**	**1.86657**	**0.04258**	**151529**	**465928**

Table R3d: All Year, PTC Normal, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)

Passenger	Train-Train Collisions	0.01856	0.98392	0.03736	42335	252814
	Intrusion Collisions	0.04845	1.25000	0.04437	53358	311464
	Diamond Collisions	0.00117	0.01036	0.00031	363	2323
	Overspeed	0.00541	0.26379	0.00423	21123	60202
	Broken Rail	0.03943	1.90312	0.03054	152389	434320
	Work Zone Violation	0.00000	0.24478	0.02448	0	97910
	Grade Crossing Collisions	1.93252	5.72191	0.08498	554721	1381857
	Total, All Scenarios	2.04555	10.37788	0.22627	824290	2540891
Freight	Train-Train Collisions	0.01151	0.01162	0.00116	3109	7757
	Intrusion Collisions	0.01959	0.00616	0.00062	774	3240
	Diamond Collisions	0.00668	0.00234	0.00023	908	1846
	Overspeed	0.00985	0.00314	0.00031	5383	6639
	Broken Rail	0.05103	0.01600	0.00160	27541	33942
	Work Zone Violation	0.00000	0.05839	0.00582	0	23304
	Grade Crossing Collisions	0.25014	0.08798	0.00451	17549	39866
	Total, All Scenarios	0.34880	0.18563	0.01426	55264	116593
Total Passenger + Freight		**2.39435**	**10.56351**	**0.24053**	**879554**	**2657484**

Table R4d: Rest of Year, PTC Timeout, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00002	0.00137	0.00005	59	352

	Intrusion Collisions	0.00007	0.00171	0.00006	73	427
	Diamond Collisions	0.00000	0.00003	0.00000	1	7
	Overspeed	0.00002	0.00078	0.00001	63	179
	Broken Rail	0.00005	0.00238	0.00004	191	543
	Work Zone Violation	0.00000	0.00044	0.00004	0	174
	Grade Crossing Collisions	0.00244	0.00729	0.00011	706	1760
	Total, All Scenarios	0.00260	0.01400	0.00032	1093	3442
Freight	Train-Train Collisions	0.00002	0.00002	0.00000	6	15
	Intrusion Collisions	0.00003	0.00001	0.00000	1	5
	Diamond Collisions	0.00001	0.00000	0.00000	2	3
	Overspeed	0.00002	0.00000	0.00000	8	10
	Broken Rail	0.00007	0.00002	0.00000	36	44
	Work Zone Violation	0.00000	0.00008	0.00001	0	34
	Grade Crossing Collisions	0.00033	0.00011	0.00001	23	52
	Total, All Scenarios	0.00046	0.00026	0.00002	76	163
Total Passenger + Freight		**0.00306**	**0.01426**	**0.00034**	**1169**	**3606**

Table R2d: Summer, PTC Timeout, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00031	0.00001	13	81
	Intrusion Collisions	0.00002	0.00040	0.00001	17	101
	Diamond Collisions	0.00000	0.00001	0.00000	0	1
	Overspeed	0.00000	0.00019	0.00000	15	42
	Broken Rail	0.00001	0.00057	0.00001	45	129
	Work Zone Violation	0.00000	0.00010	0.00001	0	36
	Grade Crossing Collisions	0.00052	0.00148	0.00002	144	358

	Total, All Scenarios	0.00056	0.00306	0.00007	234	747
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0	1
	Intrusion Collisions	0.00000	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00000	0.00000	1	1
	Broken Rail	0.00001	0.00000	0.00000	6	7
	Work Zone Violation	0.00000	0.00001	0.00000	0	4
	Grade Crossing Collisions	0.00006	0.00002	0.00000	4	10
	Total, All Scenarios	0.00008	0.00004	0.00000	12	25
Total Passenger + Freight		**0.00064**	**0.00310**	**0.00007**	**246**	**772**

Table R6d: All Year, PTC timeout, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00003	0.00169	0.00006	72	433
	Intrusion Collisions	0.00008	0.00212	0.00008	90	528
	Diamond Collisions	0.00000	0.00004	0.00000	1	8
	Overspeed	0.00002	0.00097	0.00002	78	221
	Broken Rail	0.00006	0.00295	0.00005	236	672
	Work Zone Violation	0.00000	0.00054	0.00005	0	210
	Grade Crossing Collisions	0.00296	0.00877	0.00013	850	2117
	Total, All Scenarios	0.00315	0.01706	0.00039	1328	4189
Freight	Train-Train Collisions	0.00002	0.00002	0.00000	6	16
	Intrusion Collisions	0.00003	0.00001	0.00000	1	5
	Diamond Collisions	0.00001	0.00001	0.00000	2	4
	Overspeed	0.00002	0.00001	0.00000	9	12

	Broken Rail	0.00008	0.00002	0.00000	42	51
	Work Zone Violation	0.00000	0.00010	0.00001	0	38
	Grade Crossing Collisions	0.00039	0.00014	0.00001	27	62
	Total, All Scenarios	0.00055	0.00030	0.00002	88	188
Total Passenger + Freight		**0.00370**	**0.01737**	**0.00041**	**1416**	**4378**

Table R7d: Grand Total: All Year, All Operating States, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01859	0.98561	0.03743	42408	253247
	Intrusion Collisions	0.04854	1.25212	0.04444	53449	311991
	Diamond Collisions	0.00118	0.01039	0.00031	364	2331
	Overspeed	0.00543	0.26476	0.00425	21201	60423
	Broken Rail	0.03949	1.90606	0.03059	152625	434992
	Work Zone Violation	0.00000	0.24532	0.02453	0	98120
	Grade Crossing Collisions	1.93548	5.73068	0.08511	555571	1383975
	Total, All Scenarios	2.04870	10.39494	0.22666	825618	2545080
Freight	Train-Train Collisions	0.01153	0.01164	0.00116	3116	7773
	Intrusion Collisions	0.01962	0.00617	0.00062	775	3245
	Diamond Collisions	0.00669	0.00235	0.00023	910	1850
	Overspeed	0.00987	0.00315	0.00031	5392	6650
	Broken Rail	0.05111	0.01603	0.00160	27582	33993
	Work Zone Violation	0.00000	0.05849	0.00583	0	23342
	Grade Crossing Collisions	0.25053	0.08811	0.00451	17576	39928

Total, All Scenarios	0.34934	0.18593	0.01428	55351	116782
Total Passenger + Freight	**2.39805**	**10.58087**	**0.24094**	**880969**	**2661862**

Contents of Results Summaries Worksheets

System	Number	Worksheet Title	Analysis Case
IDOT PTC System	1	PTC Basic TO120	Basic PTC Case: Timeout 120 secs, Latency 10 secs.
	2	PTC TO240	PTC Case, Timeout 240 secs, Latency 10 secs
	3	PTC TO360	PTC Case, Timeout 360 secs, Latency 10 secs
	4	PTC TO60	PTC Case, Timeout 60 secs, Latency 10 secs.
	5	PTC TO20	PTC Case Timeout 20 secs, Latency 10 secs
	6	PTC Lat 20	PTC Case Timeout 120 secs, Latency 20 secs
	7	PTC Lat 5	PTC Case Timeout 120 secs, Latency 5 secs
	8	PTC Basic 88%	PTC Case with Preventability Reduced from 90% to 88 %
	9	PTC Basic 94%	PTC Case with Preventability Increased from 90 to 94%
	10	PTC Basic Red. Sev'ty	Basic PTC Case with Reduced Severity of Consequences
Cab Signals + ATS	11	ATS Basic, 70%	Basic Case: Cab Signal and ATS, 70% Preventability
	12	ATS 80%	Cab Signal and ATS, 80% Preventability
	13	ATS 60%	Cab Signal and ATS, 60% Preventability
	14	ATS Basic 70% Red. Sev'ty	Basic ATS case with reduced severity of consequences
Northeast Corridor ATC	15	NEC-ATC Basic 85%	Basic NEC-ATC Case with 85% Preventability
	16	NEC-ATC 80%	NEC-ATC with 80% Preventability
	17	NEC-ATC 90%	NEC-ATC with 90% Preventability
	18	NEC Basic 85% Red. Sev'ty	Basic NEC-ATC Case with Reduced Severity of Consequences
CTC Reference Case	19	CTC Ref	CTC Reference Case

Worksheet 1
Basic PTC Case: Timeout 120 seconds
Latency 10 seconds

Results Summary: Basic PTC Case, Timeout 120 seconds, Latency 10 seconds

PTC Normal Operating State

Table R1a: Full Year, PTC Normal, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00360	0.25533	0.00976	11112	65925
	Intrusion Collisions	0.01054	0.30191	0.02070	12910	75191
	Diamond Collisions	0.00015	0.00167	0.00009	93	588
	Overspeed	0.00118	0.00056	0.00007	4972	13646
	Broken Rail	0.00808	0.43970	0.00707	36231	101406
	Work Zone Violation	0.00000	0.00563	0.00000	0	22253
	Grade Crossing Collisions	0.57228	1.84557	0.02799	178697	445626
	Total, All Scenarios	0.59651	2.96057	0.06154	244217	724870
Freight	Train-Train Collisions	0.00097	0.00126	0.00013	335	827
	Intrusion Collisions	0.00368	0.00581	0.00006	102	627
	Diamond Collisions	0.00146	0.00063	0.00006	243	495
	Overspeed	0.00082	0.00026	0.00003	448	550
	Broken Rail	0.00688	0.00214	0.00021	3761	4619
	Work Zone Violation	0.00000	0.00637	0.00004	0	2584
	Grade Crossing Collisions	0.04669	0.01659	0.00085	3319	7537
	Total, All Scenarios	0.05936	0.02889	0.00200	8207	17312
Total Passenger + Freight		**0.65587**	**2.98861**	**0.06354**	**252424**	**742091**

Table R1b: Rest of Year, PTC Normal, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00671	0.29676	0.01136	12772	76227
	Intrusion Collisions	0.01122	0.30163	0.02077	12902	75544
	Diamond Collisions	0.00021	0.00243	0.00007	85	544
	Overspeed	0.00125	0.00148	0.00008	4976	14078
	Broken Rail	0.00913	0.44786	0.00718	36261	102569
	Work Zone Violation	0.00000	0.00716	0.00000	0	22663
	Grade Crossing Collisions	0.53520	1.49610	0.02223	144961	361115
	Total, All Scenarios	0.56174	2.66339	0.05601	211927	652960
Freight	Train-Train Collisions	0.00342	0.00400	0.00040	1074	2673
	Intrusion Collisions	0.00449	0.00145	0.00030	176	738
	Diamond Collisions	0.00135	0.00054	0.00005	208	423
	Overspeed	0.00216	0.00069	0.00008	1129	1381
	Broken Rail	0.01180	0.00345	0.00034	6162	7541
	Work Zone Violation	0.00000	0.01286	0.00009	0	5142
	Grade Crossing Collisions	0.07402	0.02323	0.00119	4622	10513
	Total, All Scenarios	0.09714	0.04631	0.00246	13375	29411
Total Passenger + Freight		**0.65892**	**2.71009**	**0.06169**	**225297**	**681373**

Table R1c: Rest of Year, PTC Normal, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00708	0.43706	0.01632	16685	111966
	Intrusion Collisions	0.01724	0.42522	0.01034	18561	108393
	Diamond Collisions	0.00049	0.00532	0.00016	186	1194
	Overspeed	0.00193	0.00127	0.00012	7148	20068
	Broken Rail	0.01403	0.68513	0.01097	52060	155618
	Work Zone Violation	0.00000	0.00482	0.00000	0	20663
	Grade Crossing Collisions	0.48582	1.41481	0.02100	137215	341700
	Total, All Scenarios	0.52656	3.12300	0.07253	232880	768491
Freight	Train-Train Collisions	0.00642	0.00806	0.00081	2155	5381
	Intrusion Collisions	0.01001	0.00322	0.00030	417	1746
	Diamond Collisions	0.00290	0.00130	0.00012	464	944
	Overspeed	0.00577	0.00190	0.00019	2037	2667
	Broken Rail	0.02535	0.00830	0.00084	14089	17421
	Work Zone Violation	0.00000	0.01192	0.00019	0	12769
	Grade Crossing Collisions	0.09676	0.03075	0.00168	7335	16651
	Total, All Scenarios	0.14721	0.06153	0.00739	27498	58999
Total Passenger + Freight		**0.67371**	**3.22516**	**0.08111**	**261556**	**827389**

Table R1d: Rest of Year, PTC Normal, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01536	0.96915	0.03701	42569	254147
	Intrusion Collisions	0.03900	1.03075	0.03991	44395	259092
	Diamond Collisions	0.00087	0.01042	0.00033	365	2236
	Overspeed	0.00436	0.00332	0.00031	17096	48662
	Broken Rail	0.03174	1.52270	0.02492	124585	354613
	Work Zone Violation	0.00000	0.01762	0.00000	0	79248
	Grade Crossing Collisions	1.59342	4.75548	0.07062	481023	1148441
	Total, All Scenarios	1.68465	8.75931	0.19255	690010	2144938
Freight	Train-Train Collisions	0.01681	0.01332	0.00133	3564	8890
	Intrusion Collisions	0.01698	0.00553	0.00055	695	2911
	Diamond Collisions	0.00552	0.00236	0.00024	915	1861
	Overspeed	0.00975	0.00279	0.00028	4783	5699
	Broken Rail	0.04410	0.01295	0.00130	24012	29591
	Work Zone Violation	0.00000	0.05115	0.00012	0	20460
	Grade Crossing Collisions	0.21747	0.07657	0.00362	15276	34701
	Total, All Scenarios	0.30059	0.16581	0.01260	49284	104181
Total Passenger + Freight		**1.98843**	**8.92386**	**0.20633**	**739277**	**2250652**

PTC Timeout Operating State

Table R2a: Summer, PTC Normal, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Freight	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Total Passenger + Freight						

There are no seasonal traffic variations on the Joliet Sub-corridor. Therefore only one risk calculation is needed: for the full year, and there is no separate summer calculation

Table R2b: Summer, PTC Normal, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00134	0.08863	0.00337	3822	22799
	Intrusion Collisions	0.00372	0.10678	0.00734	4292	25986
	Diamond Collisions	0.00007	0.00072	0.00002	25	162
	Overspeed	0.00042	0.00041	0.00003	1653	4675
	Broken Rail	0.00303	0.14674	0.00238	13043	34572
	Work Zone Violation	0.00000	0.01898	0.00030	0	7594
	Grade Crossing Collisions	0.17776	0.49655	0.00738	48127	119932
	Total, All Scenarios	0.18632	0.87421	0.01898	69962	214324
Freight	Train-Train Collisions	0.00035	0.00042	0.00004	113	283
	Intrusion Collisions	0.00068	0.00019	0.00003	34	144
	Diamond Collisions	0.00027	0.00016	0.00002	62	126
	Overspeed	0.00041	0.00008	0.00001	151	185
	Broken Rail	0.00243	0.00071	0.00007	1269	1552
	Work Zone Violation	0.00000	0.00219	0.00003	0	874
	Grade Crossing Collisions	0.01524	0.00478	0.00024	952	2165
	Total, All Scenarios	0.01901	0.00886	0.00041	2581	5330
Total Passenger + Freight		**0.20500**	**0.88237**	**0.01957**	**72544**	**219604**

Table R2c: Summer, PTC Normal, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00183	0.12212	0.00444	5237	31364
	Intrusion Collisions	0.00573	0.14455	0.00533	6165	35999
	Diamond Collisions	0.00014	0.00149	0.00004	52	335
	Overspeed	0.00064	0.00031	0.00004	2274	6864
	Broken Rail	0.00466	0.22090	0.00364	17301	50023
	Work Zone Violation	0.00000	0.03817	0.00062	0	15269
	Grade Crossing Collisions	0.16135	0.46988	0.00697	45171	113484
	Total, All Scenarios	0.17438	0.81742	0.02091	76706	249339
Freight	Train-Train Collisions	0.00034	0.00043	0.00004	115	286
	Intrusion Collisions	0.00173	0.00057	0.00008	72	302
	Diamond Collisions	0.00079	0.00034	0.00003	130	265
	Overspeed	0.00081	0.00027	0.00003	449	555
	Broken Rail	0.00457	0.00151	0.00015	2538	3141
	Work Zone Violation	0.00000	0.00555	0.00008	0	2219
	Grade Crossing Collisions	0.01743	0.00662	0.00036	1322	3000
	Total, All Scenarios	0.02558	0.01478	0.00110	4626	9568
Total Passenger + Freight		**0.20001**	**1.03221**	**0.02479**	**81326**	**258905**

Table R2d: Summer, PTC Normal, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00317	0.21075	0.00801	9060	54163
	Intrusion Collisions	0.00945	0.24525	0.00970	10454	61989
	Diamond Collisions	0.00021	0.00221	0.00007	78	497
	Overspeed	0.00106	0.00072	0.00061	4027	11540
	Broken Rail	0.00769	0.36964	0.00592	29344	84594
	Work Zone Violation	0.00000	0.04716	0.00072	0	18862
	Grade Crossing Collisions	0.33910	0.96643	0.01436	93699	233417
	Total, All Scenarios	0.36099	1.69231	0.04259	146682	463561
Freight	Train-Train Collisions	0.00069	0.00085	0.00009	228	569
	Intrusion Collisions	0.00241	0.00085	0.00008	100	448
	Diamond Collisions	0.00116	0.00050	0.00005	192	390
	Overspeed	0.00132	0.00035	0.00004	600	740
	Broken Rail	0.00700	0.00222	0.00022	3807	4694
	Work Zone Violation	0.00000	0.00734	0.00070	0	2844
	Grade Crossing Collisions	0.03208	0.01141	0.00058	2273	5165
	Total, All Scenarios	0.04522	0.02340	0.00177	7203	14849
Total Passenger + Freight		**0.40591**	**1.91558**	**0.04436**	**153869**	**478409**

Table R3a: All Year, PTC Normal, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00360	0.25533	0.00976	11112	65925
	Intrusion Collisions	0.01054	0.30191	0.02070	12910	75191
	Diamond Collisions	0.00015	0.00167	0.00009	93	588
	Overspeed	0.00118	0.00056	0.00007	4972	13646
	Broken Rail	0.00808	0.43970	0.00707	36231	101406
	Work Zone Violation	0.00000	0.00563	0.00000	0	22253
	Grade Crossing Collisions	0.57228	1.84557	0.02799	178697	445626
	Total, All Scenarios	0.59651	2.96057	0.06154	244217	724870
Freight	Train-Train Collisions	0.00097	0.00126	0.00013	335	827
	Intrusion Collisions	0.00368	0.00581	0.00006	102	627
	Diamond Collisions	0.00146	0.00063	0.00006	243	495
	Overspeed	0.00082	0.00026	0.00003	448	550
	Broken Rail	0.00688	0.00214	0.00021	3761	4619
	Work Zone Violation	0.00000	0.00637	0.00004	0	2584
	Grade Crossing Collisions	0.04669	0.01659	0.00085	3319	7537
	Total, All Scenarios	0.05936	0.02889	0.00200	8207	17312
Total Passenger + Freight		**0.65587**	**2.98861**	**0.06354**	**252424**	**742091**

Table R3b: All Year, PTC Normal, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00805	0.38539	0.01463	16595	99026
	Intrusion Collisions	0.01494	0.40301	0.02144	17213	100919
	Diamond Collisions	0.00029	0.00315	0.00009	110	707
	Overspeed	0.00167	0.00189	0.00011	6029	18753
	Broken Rail	0.01216	0.59460	0.00957	49304	136966
	Work Zone Violation	0.00000	0.02614	0.00039	0	30416
	Grade Crossing Collisions	0.71296	1.99165	0.02961	192039	491047
	Total, All Scenarios	0.74810	3.53610	0.07711	281688	877286
Freight	Train-Train Collisions	0.00378	0.00442	0.00044	1187	2956
	Intrusion Collisions	0.00527	0.00162	0.00037	210	882
	Diamond Collisions	0.00163	0.00070	0.00007	270	548
	Overspeed	0.00273	0.00097	0.00010	1280	1568
	Broken Rail	0.01423	0.00416	0.00042	7430	9094
	Work Zone Violation	0.00000	0.01503	0.00049	0	5962
	Grade Crossing Collisions	0.08907	0.02802	0.00143	5574	12678
	Total, All Scenarios	0.11672	0.05427	0.00459	19951	33816
Total Passenger + Freight		**0.86483**	**3.59045**	**0.08136**	**287641**	**900977**

Table R3c: All Year, PTC Normal, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00891	0.55916	0.02117	21922	143360
	Intrusion Collisions	0.02297	0.57979	0.01568	24726	144392
	Diamond Collisions	0.00063	0.00681	0.00020	239	1528
	Overspeed	0.00257	0.12158	0.00156	9523	27332
	Broken Rail	0.01869	0.88604	0.01415	69384	205641
	Work Zone Violation	0.00000	0.11296	0.00182	0	35458
	Grade Crossing Collisions	0.64717	1.88469	0.02798	182786	455184
	Total, All Scenarios	0.70094	4.15109	0.09373	310581	1017902
Freight	Train-Train Collisions	0.00675	0.00849	0.00085	2270	5657
	Intrusion Collisions	0.01174	0.00388	0.00109	690	2948
	Diamond Collisions	0.00359	0.00152	0.00015	595	1236
	Overspeed	0.00658	0.00232	0.00024	3616	4523
	Broken Rail	0.02962	0.00987	0.00098	16828	20572
	Work Zone Violation	0.00000	0.03370	0.00109	0	14798
	Grade Crossing Collisions	0.11419	0.04337	0.00222	8657	19651
	Total, All Scenarios	0.17277	0.10629	0.00661	32294	69457
Total Passenger + Freight		**0.87371**	**4.25737**	**0.10039**	**342882**	**1088260**

Table R3d: All Year, PTC Normal, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01856	1.16991	0.04504	51628	308210
	Intrusion Collisions	0.04819	1.28500	0.04561	54851	320180
	Diamond Collisions	0.00117	0.01263	0.00038	442	2833
	Overspeed	0.00543	0.00379	0.00035	21123	60320
	Broken Rail	0.03943	1.92234	0.03085	153829	438707
	Work Zone Violation	0.00000	0.04478	0.00072	0	97910
	Grade Crossing Collisions	1.93252	5.72191	0.08498	574721	1381857
	Total, All Scenarios	2.04532	10.65929	0.20906	856595	2613016
Freight	Train-Train Collisions	0.01151	0.01417	0.00142	3792	9419
	Intrusion Collisions	0.01858	0.00638	0.00117	802	3357
	Diamond Collisions	0.00668	0.00286	0.00028	1107	2251
	Overspeed	0.01314	0.00384	0.00039	5983	6638
	Broken Rail	0.05102	0.01616	0.00162	27819	34285
	Work Zone Violation	0.00000	0.05839	0.00162	0	23364
	Grade Crossing Collisions	0.25214	0.08798	0.00451	17549	39866
	Total, All Scenarios	0.34896	0.18869	0.01450	56451	119361
Total Passenger + Freight		**2.39435**	**10.83944**	**0.25068**	**893145**	**2720561**

PTC Timeout Operating State

Table R4a: Full Year, PTC Timeout, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00038	0.00001	16	98
	Intrusion Collisions	0.00002	0.00050	0.00002	21	124
	Diamond Collisions	0.00000	0.00000	0.00000	0	2
	Overspeed	0.00000	0.00022	0.00001	18	51
	Broken Rail	0.00001	0.00057	0.00001	55	163
	Work Zone Violation	0.00000	0.00012	0.00001	0	49
	Grade Crossing Collisions	0.00086	0.00283	0.00041	256	663
	Total, All Scenarios	0.00090	0.00467	0.00051	386	1162
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	1	1
	Intrusion Collisions	0.00000	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00000	0.00000	1	1
	Broken Rail	0.00000	0.00001	0.00000	7	7
	Work Zone Violation	0.00000	0.00001	0.00000	0	5
	Grade Crossing Collisions	0.00007	0.00003	0.00000	5	11
	Total, All Scenarios	0.00008	0.00005	0.00000	13	28
Total Passenger + Freight		**0.00101**	**0.00478**	**0.00053**	**399**	**1190**

Table R4b: Rest of Year, PTC Timeout, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00045	0.00002	19	116
	Intrusion Collisions	0.00002	0.00052	0.00002	21	125
	Diamond Collisions	0.00000	0.00003	0.00000	0	2
	Overspeed	0.00000	0.00023	0.00000	18	52
	Broken Rail	0.00001	0.00062	0.00001	56	167
	Work Zone Violation	0.00000	0.00013	0.00001	0	50
	Grade Crossing Collisions	0.00090	0.00297	0.00043	222	553
	Total, All Scenarios	0.00097	0.00493	0.00052	337	1055
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	2	5
	Intrusion Collisions	0.00001	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00000	0.00000	2	2
	Broken Rail	0.00001	0.00001	0.00000	9	11
	Work Zone Violation	0.00000	0.00002	0.00000	0	9
	Grade Crossing Collisions	0.00001	0.00002	0.00000	7	16
	Total, All Scenarios	0.00003	0.00005	0.00001	21	45
Total Passenger + Freight		**0.00101**	**0.00436**	**0.00010**	**358**	**1100**

Table R4c: Rest of Year, PTC Timeout, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00054	0.00002	23	139
	Intrusion Collisions	0.00003	0.00072	0.00003	31	179
	Diamond Collisions	0.00000	0.00001	0.00000	0	3
	Overspeed	0.00001	0.00034	0.00001	26	76
	Broken Rail	0.00002	0.00102	0.00002	90	271
	Work Zone Violation	0.00000	0.00019	0.00002	0	75
	Grade Crossing Collisions	0.00074	0.00217	0.00033	210	524
	Total, All Scenarios	0	0	0	370	1228
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	4	9
	Intrusion Collisions	0.00002	0.00001	0.00000	1	3
	Diamond Collisions	0.00001	0.00000	0.00000	1	2
	Overspeed	0.00001	0.00000	0.00000	5	6
	Broken Rail	0.00003	0.00001	0.00000	11	26
	Work Zone Violation	0.00000	0.00005	0.00001	0	20
	Grade Crossing Collisions	0.00014	0.00005	0.00000	11	25
	Total, All Scenarios	0.00032	0.00014	0.00000	42	91
Total Passenger + Freight		**0.00104**	**0.00512**	**0.00033**	**413**	**1316**

Table R4d: Rest of Year, PTC Timeout, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00002	0.00137	0.00005	59	352
	Intrusion Collisions	0.00007	0.00171	0.00006	73	427
	Diamond Collisions	0.00000	0.00003	0.00000	1	7
	Overspeed	0.00002	0.00078	0.00003	63	176
	Broken Rail	0.00004	0.00238	0.00004	191	563
	Work Zone Violation	0.00000	0.00044	0.00004	0	174
	Grade Crossing Collisions	0.00244	0.00729	0.00110	706	1760
	Total, All Scenarios	0.00259	0.01406	0.00033	1099	3442
Freight	Train-Train Collisions	0.00002	0.00002	0.00000	6	15
	Intrusion Collisions	0.00003	0.00001	0.00000	1	5
	Diamond Collisions	0.00001	0.00000	0.00000	2	3
	Overspeed	0.00002	0.00000	0.00000	8	10
	Broken Rail	0.00007	0.00002	0.00000	26	64
	Work Zone Violation	0.00000	0.00008	0.00001	0	34
	Grade Crossing Collisions	0.00032	0.00011	0.00001	23	52
	Total, All Scenarios	0.00094	0.00028	0.00002	76	182
Total Passenger + Freight		**0.00306**	**0.01436**	**0.00034**	**1169**	**3606**

PTC Timeout Operating State

Table R5a: Summer, PTC Timeout, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Freight	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Total Passenger + Freight						

There are no seasonal traffic variations on the Joliet Sub-corridor. Therefore only one risk calculation is needed: for the full year, and there is no separate summer calculation

Table R5b: Summer, PTC Timeout, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00013	0.00001	5.7	34.0
	Intrusion Collisions	0.00001	0.00017	0.00001	7.1	41.4
	Diamond Collisions	0.00000	0.00000	0.00000	0.1	0.4
	Overspeed	0.00000	0.00006	0.00000	6.1	17.2
	Broken Rail	0.00000	0.00020	0.00000	16.5	52.2
	Work Zone Violation	0.00000	0.00004	0.00000	0.0	16.8
	Grade Crossing Collisions	0.00021	0.00100	0.00008	45.5	183.8
	Total, All Scenarios	0.00021	0.00141	0.00011	131.1	345.8
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0.2	0.5
	Intrusion Collisions	0.00000	0.00000	0.00000	0.1	0.3
	Diamond Collisions	0.00000	0.00000	0.00000	0.1	0.2
	Overspeed	0.00000	0.00000	0.00000	0.3	0.4
	Broken Rail	0.00000	0.00000	0.00000	1.9	2.4
	Work Zone Violation	0.00000	0.00000	0.00000	0.0	1.0
	Grade Crossing Collisions	0.00001	0.00001	0.00000	2.3	5.2
	Total, All Scenarios	0.00001	0.00001	0.00000	4.9	10.0
Total Passenger + Freight		**0.00023**	**0.00142**	**0.00003**	**136.1**	**355.7**

Table R5c: Summer, PTC Timeout, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00018	0.00001	7.8	46.5
	Intrusion Collisions	0.00001	0.00024	0.00001	10.2	59.3
	Diamond Collisions	0.00000	0.00000	0.00000	0.1	0.9
	Overspeed	0.00000	0.00011	0.00000	8.7	25.2
	Broken Rail	0.00001	0.00028	0.00001	23.6	76.6
	Work Zone Violation	0.00000	0.00006	0.00000	0.0	18.9
	Grade Crossing Collisions	0.00035	0.00072	0.00011	69.8	173.9
	Total, All Scenarios	0.00037	0.00158	0.00009	123.1	401.4
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0.2	0.5
	Intrusion Collisions	0.00000	0.00000	0.00000	0.1	0.5
	Diamond Collisions	0.00000	0.00000	0.00000	0.1	0.5
	Overspeed	0.00000	0.00000	0.00000	0.8	1.0
	Broken Rail	0.00001	0.00000	0.00000	3.8	4.7
	Work Zone Violation	0.00000	0.00001	0.00000	0.0	3.5
	Grade Crossing Collisions	0.00003	0.00001	0.00000	2.0	4.5
	Total, All Scenarios	0.00009	0.00002	0.00000	7.1	15.1
Total Passenger + Freight		**0.00031**	**0.00160**	**0.00009**	**130.3**	**416.6**

Table R5d: Summer, PTC Timeout, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00031	0.00001	13	81
	Intrusion Collisions	0.00002	0.00040	0.00001	17	101
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00019	0.00000	15	42
	Broken Rail	0.00001	0.00057	0.00001	45	128
	Work Zone Violation	0.00000	0.00010	0.00001	0	36
	Grade Crossing Collisions	0.00052	0.00148	0.00020	144	358
	Total, All Scenarios	0.00059	0.00305	0.00027	234	747
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0	1
	Intrusion Collisions	0.00000	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00000	0.00000	1	1
	Broken Rail	0.00001	0.00000	0.00000	6	7
	Work Zone Violation	0.00000	0.00001	0.00000	0	4
	Grade Crossing Collisions	0.00006	0.00002	0.00000	4	10
	Total, All Scenarios	0.00009	0.00003	0.00000	12	25
Total Passenger + Freight		**0.00064**	**0.00310**	**0.00027**	**246**	**772**

Table R5a: Summer, PTC Timeout, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00038	0.00001	16	98
	Intrusion Collisions

Worksheet 3:
PTC Case, Timeout 360 seconds
Latency 10 seconds.

Results Summary: PTC Case, Timeout 360 seconds, Latency 10 seconds

PTC Normal Operating State

Table R1a: Full Year, PTC Normal, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00359	0.25458	0.00973	11079	65731
	Intrusion Collisions	0.01051	0.30042	0.01067	12874	74934
	Diamond Collisions	0.00025	0.00266	0.00008	93	596
	Overspeed	0.00117	0.06016	0.00097	4957	13875
	Broken Rail	0.00855	0.43841	0.00705	36125	101108
	Work Zone Violation	0.00000	0.05547	0.00555	0	22188
	Grade Crossing Collisions	0.57069	1.84014	0.02731	178371	444315
	Total, All Scenarios	0.59476	2.95184	0.06135	243499	722746
Freight	Train-Train Collisions	0.00097	0.00125	0.00013	334	835
	Intrusion Collisions	0.00247	0.00081	0.00008	101	425
	Diamond Collisions	0.00146	0.00063	0.00006	242	493
	Overspeed	0.00082	0.00025	0.00003	447	548
	Broken Rail	0.00686	0.00214	0.00021	3750	4605
	Work Zone Violation	0.00000	0.00635	0.00064	0	2541
	Grade Crossing Collisions	0.04655	0.01654	0.00085	3309	7515
	Total, All Scenarios	0.05912	0.02798	0.00199	8182	16963
Total Passenger + Freight		**0.65388**	**2.97982**	**0.06335**	**251681**	**739709**

Table R1b: Rest of Year, PTC Normal, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00470	0.29589	0.01123	12735	76003
	Intrusion Collisions	0.01118	0.30232	0.01074	12884	75321
	Diamond Collisions	0.00023	0.00242	0.00007	85	543
	Overspeed	0.00125	0.06128	0.00098	4961	14036
	Broken Rail	0.00910	0.44654	0.00716	36154	102287
	Work Zone Violation	0.00000	0.05699	0.00570	0	22798
	Grade Crossing Collisions	0.53365	1.49071	0.02217	144485	360053
	Total, All Scenarios	0.56011	2.65615	0.05804	211304	651041
Freight	Train-Train Collisions	0.00341	0.00398	0.00040	1071	2665
	Intrusion Collisions	0.00448	0.00140	0.00014	175	736
	Diamond Collisions	0.00125	0.00053	0.00005	207	421
	Overspeed	0.00216	0.00063	0.00006	1125	1377
	Broken Rail	0.01177	0.00344	0.00034	6143	7519
	Work Zone Violation	0.00000	0.01282	0.00128	0	5127
	Grade Crossing Collisions	0.07381	0.02316	0.00119	4608	10482
	Total, All Scenarios	0.09688	0.04597	0.00347	13331	28327
Total Passenger + Freight		**0.65698**	**2.70211**	**0.06151**	**224634**	**679369**

Table R1c: Rest of Year, PTC Normal, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00706	0.43578	0.01649	18630	111666
	Intrusion Collisions	0.01719	0.43395	0.01539	18507	108075
	Diamond Collisions	0.00049	0.00531	0.00016	186	1190
	Overspeed	0.00192	0.09100	0.00146	7127	20608
	Broken Rail	0.01399	0.66318	0.01064	51940	150175
	Work Zone Violation	0.00000	0.08457	0.00846	0	33830
	Grade Crossing Collisions	0.48439	1.41064	0.02094	136811	340694
	Total, All Scenarios	0.52505	3.12443	0.07353	233200	766238
		0.00000	0.00000	0.00000	0	0
Freight	Train-Train Collisions	0.00640	0.00804	0.00080	2149	5365
	Intrusion Collisions	0.00998	0.00331	0.00033	416	1741
	Diamond Collisions	0.00279	0.00120	0.00012	463	941
	Overspeed	0.00575	0.00190	0.00019	3197	3956
	Broken Rail	0.02528	0.00833	0.00083	14048	17380
	Work Zone Violation	0.00000	0.03183	0.00318	0	12732
	Grade Crossing Collisions	0.09647	0.03664	0.00187	7313	16602
	Total, All Scenarios	0.14667	0.09124	0.00734	27587	58716
Total Passenger + Freight		**0.67172**	**3.21567**	**0.08087**	**260787**	**824954**

Table R1d: Rest of Year, PTC Normal, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01535	0.98624	0.03744	42444	253400
	Intrusion Collisions	0.03888	1.03669	0.03680	44264	258330
	Diamond Collisions	0.00097	0.01038	0.00031	364	2329
	Overspeed	0.00434	0.21244	0.00341	17046	48519
	Broken Rail	0.03164	1.54813	0.02485	12418	353570
	Work Zone Violation	0.00000	0.19704	0.01970	0	78815
	Grade Crossing Collisions	1.58873	4.74149	0.07042	459666	1145062
	Total, All Scenarios	1.67991	8.73242	0.19293	688003	2140025
Freight	Train-Train Collisions	0.01078	0.01328	0.00133	3554	8864
	Intrusion Collisions	0.01693	0.00552	0.00055	693	2902
	Diamond Collisions	0.00550	0.00236	0.00024	912	1855
	Overspeed	0.00873	0.00278	0.00028	4769	5881
	Broken Rail	0.04390	0.01391	0.00139	23941	29504
	Work Zone Violation	0.00000	0.05100	0.00510	0	20400
	Grade Crossing Collisions	0.21683	0.07635	0.00391	15231	34599
	Total, All Scenarios	0.30267	0.16519	0.01280	49100	104006
Total Passenger + Freight		**1.98258**	**8.89761**	**0.20572**	**737102**	**2244031**

Table R2a: Summer, PTC Normal, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Freight	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Total Passenger + Freight						

There are no seasonal traffic variations on the Joliet Sub-corridor. Therefore only one risk calculation is needed for the full year, and there is no separate summer calculation

Table R2b: Summer, PTC Normal, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00133	0.08837	0.00336	3811	22732
	Intrusion Collisions	0.00371	0.10041	0.00357	4279	25016
	Diamond Collisions	0.00007	0.00072	0.00002	25	162
	Overspeed	0.00041	0.02035	0.00033	1648	4662
	Broken Rail	0.00302	0.14830	0.00238	12007	33971
	Work Zone Violation	0.00000	0.01893	0.00189	0	7572
	Grade Crossing Collisions	0.17723	0.49509	0.00736	47986	119580
	Total, All Scenarios	0.18579	0.87217	0.01891	69756	213693
Freight	Train-Train Collisions	0.00035	0.00042	0.00004	113	282
	Intrusion Collisions	0.00087	0.00027	0.00003	34	144
	Diamond Collisions	0.00037	0.00016	0.00002	62	125
	Overspeed	0.00029	0.00008	0.00001	151	184
	Broken Rail	0.00242	0.00071	0.00007	1265	1548
	Work Zone Violation	0.00000	0.00218	0.00020	0	822
	Grade Crossing Collisions	0.01520	0.00477	0.00024	949	2159
	Total, All Scenarios	0.01951	0.00860	0.00061	2574	5264
Total Passenger + Freight		**0.20530**	**0.88077**	**0.01952**	**72330**	**218957**

Table R2c: Summer, PTC Normal, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00183	0.12177	0.00462	5222	31272
	Intrusion Collisions	0.00571	0.14412	0.00511	6146	35893
	Diamond Collisions	0.00014	0.00149	0.00004	52	334
	Overspeed	0.00064	0.03022	0.00048	2367	6844
	Broken Rail	0.00465	0.22025	0.00353	17250	49876
	Work Zone Violation	0.00000	0.02809	0.00281	0	11235
	Grade Crossing Collisions	0.16087	0.46850	0.00695	45437	113150
	Total, All Scenarios	0.17383	1.01444	0.02356	76474	248604
Freight	Train-Train Collisions	0.00034	0.00043	0.00004	114	285
	Intrusion Collisions	0.00172	0.00057	0.00006	72	301
	Diamond Collisions	0.00078	0.00033	0.00003	130	264
	Overspeed	0.00081	0.00027	0.00003	448	554
	Broken Rail	0.00455	0.00150	0.00015	2531	3131
	Work Zone Violation	0.00000	0.00503	0.00050	0	2014
	Grade Crossing Collisions	0.01738	0.00660	0.00034	1318	2991
	Total, All Scenarios	0.02559	0.01474	0.00115	4612	9539
Total Passenger + Freight		**0.19942**	**1.02917**	**0.02471**	**81087**	**258144**

Table R2d: Summer, PTC Normal, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00316	0.21013	0.00799	9033	54003
	Intrusion Collisions	0.00942	0.24453	0.00868	10425	60909
	Diamond Collisions	0.00021	0.00221	0.00007	77	495
	Overspeed	0.00105	0.05058	0.00081	4015	11506
	Broken Rail	0.00767	0.36856	0.00591	29257	83847
	Work Zone Violation	0.00000	0.04702	0.00470	0	18807
	Grade Crossing Collisions	0.33811	0.96359	0.01432	93423	232730
	Total, All Scenarios	0.35962	1.88660	0.04247	146231	462297
Freight	Train-Train Collisions	0.00069	0.00085	0.00009	227	567
	Intrusion Collisions	0.00260	0.00084	0.00008	106	445
	Diamond Collisions	0.00116	0.00049	0.00005	192	389
	Overspeed	0.00109	0.00035	0.00003	598	738
	Broken Rail	0.00698	0.00221	0.00022	3796	4680
	Work Zone Violation	0.00000	0.00722	0.00070	0	2835
	Grade Crossing Collisions	0.03258	0.01137	0.00058	2267	5150
	Total, All Scenarios	0.04510	0.02334	0.00176	7186	14804
Total Passenger + Freight		**0.40472**	**1.90994**	**0.04423**	**153417**	**477101**

Table R3a: All Year, PTC Normal, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00359	0.25458	0.00973	11079	65731
	Intrusion Collisions	0.01051	0.30042	0.01067	12874	74934
	Diamond Collisions	0.00025	0.00266	0.00008	93	596
	Overspeed	0.00117	0.06016	0.00097	4957	13875
	Broken Rail	0.00855	0.43841	0.00705	36125	101108
	Work Zone Violation	0.00000	0.05547	0.00555	0	22188
	Grade Crossing Collisions	0.57069	1.84014	0.02731	178371	444315
	Total, All Scenarios	0.59476	2.95184	0.06135	243499	722746
Freight	Train-Train Collisions	0.00097	0.00125	0.00013	334	835
	Intrusion Collisions	0.00247	0.00081	0.00008	101	425
	Diamond Collisions	0.00146	0.00063	0.00006	242	493
	Overspeed	0.00082	0.00025	0.00003	447	548
	Broken Rail	0.00686	0.00214	0.00021	3750	4605
	Work Zone Violation	0.00000	0.00635	0.00064	0	2541
	Grade Crossing Collisions	0.04655	0.01654	0.00085	3309	7515
	Total, All Scenarios	0.05912	0.02798	0.00199	8182	16963
Total Passenger + Freight		**0.65388**	**2.97982**	**0.06335**	**251681**	**739709**

Table R3b: All Year, PTC Normal, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00603	0.38426	0.01459	16546	98734
	Intrusion Collisions	0.01490	0.40272	0.01430	17163	100337
	Diamond Collisions	0.00029	0.00314	0.00009	110	705
	Overspeed	0.00166	0.08163	0.00131	6609	18698
	Broken Rail	0.01212	0.59485	0.00954	48162	136259
	Work Zone Violation	0.00000	0.07592	0.00759	0	30369
	Grade Crossing Collisions	0.71088	1.98579	0.02953	192471	479632
	Total, All Scenarios	0.74589	3.52832	0.07695	281060	864734
Freight	Train-Train Collisions	0.00377	0.00441	0.00044	1184	2947
	Intrusion Collisions	0.00535	0.00167	0.00017	210	880
	Diamond Collisions	0.00162	0.00069	0.00007	269	546
	Overspeed	0.00244	0.00071	0.00007	1276	1562
	Broken Rail	0.01419	0.00415	0.00041	7409	9067
	Work Zone Violation	0.00000	0.01500	0.00148	0	5949
	Grade Crossing Collisions	0.08900	0.02793	0.00143	5557	12641
	Total, All Scenarios	0.11639	0.05457	0.00408	15904	33592
Total Passenger + Freight		**0.86228**	**3.58288**	**0.08102**	**296964**	**898326**

Table R3c: All Year, PTC Normal, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00889	0.55754	0.02111	23851	142938
	Intrusion Collisions	0.02290	0.57807	0.02050	24653	143968
	Diamond Collisions	0.00063	0.00679	0.00020	238	1524
	Overspeed	0.00256	0.12123	0.00194	9495	27452
	Broken Rail	0.01864	0.88343	0.01417	69190	200050
	Work Zone Violation	0.00000	0.11266	0.01127	0	45065
	Grade Crossing Collisions	0.64526	1.87914	0.02789	182248	453845
	Total, All Scenarios	0.69888	4.13887	0.09709	309675	1014842
Freight	Train-Train Collisions	0.00674	0.00847	0.00085	2263	5650
	Intrusion Collisions	0.01170	0.00388	0.00039	488	2042
	Diamond Collisions	0.00358	0.00153	0.00015	593	1205
	Overspeed	0.00656	0.00216	0.00022	3645	4509
	Broken Rail	0.02983	0.00983	0.00098	16579	20512
	Work Zone Violation	0.00000	0.03686	0.00369	0	14745
	Grade Crossing Collisions	0.11385	0.04324	0.00221	8631	19593
	Total, All Scenarios	0.17226	0.10598	0.00849	32199	68255
Total Passenger + Freight		**0.87114**	**4.24485**	**0.10558**	**341873**	**1083097**

Table R3d: All Year, PTC Normal, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01851	1.19638	0.04543	51477	307403
	Intrusion Collisions	0.04831	1.28122	0.04548	54690	319239
	Diamond Collisions	0.00117	0.01259	0.00037	441	2825
	Overspeed	0.00539	0.26302	0.00422	21061	60025
	Broken Rail	0.03931	1.91669	0.03076	153476	437417
	Work Zone Violation	0.00000	0.24406	0.02441	0	97622
	Grade Crossing Collisions	1.92684	5.70508	0.08473	553090	1377792
	Total, All Scenarios	2.03953	10.61903	0.23540	834234	2602322
Freight	Train-Train Collisions	0.01147	0.01413	0.00141	3781	9431
	Intrusion Collisions	0.01953	0.00636	0.00064	799	3347
	Diamond Collisions	0.00666	0.00285	0.00029	1104	2244
	Overspeed	0.00982	0.00313	0.00031	5367	6619
	Broken Rail	0.05088	0.01612	0.00161	27737	34184
	Work Zone Violation	0.00000	0.05822	0.00580	0	23235
	Grade Crossing Collisions	0.24941	0.08772	0.00449	17497	39749
	Total, All Scenarios	0.34777	0.18852	0.01456	56285	118810
Total Passenger + Freight		**2.38730**	**10.80755**	**0.24995**	**890519**	**2721132**

Worksheet 3:
PTC Case, Timeout 360 seconds
Latency 10 seconds.

PTC Timeout Operating State

Table R4a: Full Year, PTC Timeout, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00002	0.00114	0.00004	49	293
	Intrusion Collisions	0.00005	0.00149	0.00005	64	372
	Diamond Collisions	0.00000	0.00001	0.00000	0	2
	Overspeed	0.00001	0.00067	0.00001	55	154
	Broken Rail	0.00004	0.00202	0.00003	167	466
	Work Zone Violation	0.00000	0.00037	0.00004	0	147
	Grade Crossing Collisions	0.00263	0.00848	0.00013	822	2048
	Total, All Scenarios	0.00275	0.01418	0.00030	1157	3483
Freight	Train-Train Collisions	0.00000	0.00001	0.00000	2	4
	Intrusion Collisions	0.00001	0.00000	0.00000	1	2
	Diamond Collisions	0.00001	0.00000	0.00000	1	2
	Overspeed	0.00001	0.00000	0.00000	3	4
	Broken Rail	0.00003	0.00001	0.00000	17	21
	Work Zone Violation	0.00000	0.00004	0.00000	0	15
	Grade Crossing Collisions	0.00021	0.00008	0.00000	15	34
	Total, All Scenarios	0.00027	0.00014	0.00001	39	82
Total Passenger + Freight		**0.00303**	**0.01431**	**0.00031**	**1196**	**3565**

Table R4b: Rest of Year, PTC Timeout, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00002	0.00136	0.00005	58	348
	Intrusion Collisions	0.00006	0.00150	0.00005	64	374
	Diamond Collisions	0.00000	0.00001	0.00000	0	1
	Overspeed	0.00001	0.00068	0.00001	55	155
	Broken Rail	0.00004	0.00206	0.00003	167	472
	Work Zone Violation	0.00000	0.00038	0.00004	0	151
	Grade Crossing Collisions	0.00246	0.00687	0.00010	666	1660
	Total, All Scenarios	0.00260	0.01285	0.00029	1010	3161
Freight	Train-Train Collisions	0.00002	0.00002	0.00000	6	15
	Intrusion Collisions	0.00002	0.00001	0.00000	1	4
	Diamond Collisions	0.00001	0.00000	0.00000	1	2
	Overspeed	0.00001	0.00000	0.00000	6	7
	Broken Rail	0.00005	0.00002	0.00000	28	34
	Work Zone Violation	0.00000	0.00007	0.00001	0	26
	Grade Crossing Collisions	0.00033	0.00010	0.00001	21	47
	Total, All Scenarios	0.00044	0.00022	0.00002	62	135
Total Passenger + Freight		**0.00304**	**0.01307**	**0.00031**	**1072**	**3296**

Table R4c: Rest of Year, PTC Timeout, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00003	0.00163	0.00006	69	416
	Intrusion Collisions	0.00009	0.00215	0.00008	92	536
	Diamond Collisions	0.00000	0.00001	0.00000	0	2
	Overspeed	0.00002	0.00101	0.00002	79	228
	Broken Rail	0.00006	0.00306	0.00005	239	692
	Work Zone Violation	0.00000	0.00056	0.00006	0	225
	Grade Crossing Collisions	0.00223	0.00650	0.00010	631	1571
	Total, All Scenarios	0	0	0	1110	3670
Freight	Train-Train Collisions	0.00003	0.00004	0.00000	11	27
	Intrusion Collisions	0.00005	0.00002	0.00000	2	8
	Diamond Collisions	0.00001	0.00000	0.00000	2	4
	Overspeed	0.00003	0.00001	0.00000	16	19
	Broken Rail	0.00011	0.00004	0.00000	63	78
	Work Zone Violation	0.00000	0.00015	0.00002	0	61
	Grade Crossing Collisions	0.00043	0.00016	0.00001	33	74
	Total, All Scenarios	0.00066	0.00042	0.00003	126	271
Total Passenger + Freight		**0.00310**	**0.01534**	**0.00039**	**1236**	**3940**

Table R4d: Rest of Year, PTC Timeout, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00007	0.00412	0.00016	177	1058
	Intrusion Collisions	0.00020	0.00514	0.00018	219	1281
	Diamond Collisions	0.00000	0.00003	0.00000	1	6
	Overspeed	0.00005	0.00235	0.00004	189	537
	Broken Rail	0.00015	0.00714	0.00011	573	1630
	Work Zone Violation	0.00000	0.00131	0.00013	0	523
	Grade Crossing Collisions	0.00732	0.02186	0.00032	2119	5279
	Total, All Scenarios	0.00779	0.04195	0.00095	3278	10314
Freight	Train-Train Collisions	0.00005	0.00007	0.00001	18	45
	Intrusion Collisions	0.00008	0.00003	0.00000	3	14
	Diamond Collisions	0.00002	0.00001	0.00000	4	8
	Overspeed	0.00005	0.00001	0.00000	25	31
	Broken Rail	0.00020	0.00006	0.00001	108	133
	Work Zone Violation	0.00000	0.00025	0.00003	0	102
	Grade Crossing Collisions	0.00098	0.00034	0.00002	69	156
	Total, All Scenarios	0.00138	0.00078	0.00006	226	488
Total Passenger + Freight		**0.00917**	**0.04273**	**0.00101**	**3504**	**10802**

Table R5a: Summer, PTC Timeout, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Freight	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Total Passenger + Freight						

There are no seasonal traffic variations on the Joliet Sub-corridor. Therefore only one risk calculation is needed for the full year, and there is no separate summer calculation

Table R5b: Summer, PTC Timeout, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00040	0.00002	17.1	102.1
	Intrusion Collisions	0.00002	0.00050	0.00002	21.2	124.1
	Diamond Collisions	0.00000	0.00000	0.00000	0.1	0.4
	Overspeed	0.00000	0.00023	0.00000	18.2	51.6
	Broken Rail	0.00001	0.00068	0.00001	55.4	156.6
	Work Zone Violation	0.00000	0.00013	0.00001	0.0	50.3
	Grade Crossing Collisions	0.00082	0.00228	0.00003	221.2	551.3
	Total, All Scenarios	0.00086	0.00421	0.00009	333.2	1036.4
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0.5	1.4
	Intrusion Collisions	0.00000	0.00000	0.00000	0.2	0.8
	Diamond Collisions	0.00000	0.00000	0.00000	0.3	0.6
	Overspeed	0.00000	0.00000	0.00000	1.0	1.3
	Broken Rail	0.00001	0.00000	0.00000	5.8	7.1
	Work Zone Violation	0.00000	0.00001	0.00000	0.0	3.0
	Grade Crossing Collisions	0.00011	0.00003	0.00000	6.9	15.7
	Total, All Scenarios	0.00013	0.00006	0.00000	14.7	29.7
Total Passenger + Freight		**0.00099**	**0.00427**	**0.00010**	**347.9**	**1066.1**

Table R5c: Summer, PTC Timeout, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00054	0.00002	23.3	139.6
	Intrusion Collisions	0.00003	0.00071	0.00003	30.5	178.0
	Diamond Collisions	0.00000	0.00000	0.00000	0.1	0.5
	Overspeed	0.00001	0.00033	0.00001	26.2	75.7
	Broken Rail	0.00002	0.00102	0.00002	79.5	229.9
	Work Zone Violation	0.00000	0.00019	0.00001	0.0	56.8
	Grade Crossing Collisions	0.00074	0.00216	0.00003	209.5	521.7
	Total, All Scenarios	0.00081	0.00496	0.00011	369.1	1202.3
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0.5	1.4
	Intrusion Collisions	0.00001	0.00000	0.00000	0.4	1.5
	Diamond Collisions	0.00000	0.00000	0.00000	0.5	1.0
	Overspeed	0.00000	0.00000	0.00000	2.5	3.1
	Broken Rail	0.00002	0.00001	0.00000	11.4	14.1
	Work Zone Violation	0.00000	0.00003	0.00000	0.0	10.4
	Grade Crossing Collisions	0.00008	0.00003	0.00000	6.0	13.5
	Total, All Scenarios	0.00012	0.00007	0.00001	21.2	45.0
Total Passenger + Freight		**0.00092**	**0.00503**	**0.00012**	**390.3**	**1247.2**

Table R5d: Summer, PTC Timeout, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00094	0.00004	40	242
	Intrusion Collisions	0.00005	0.00121	0.00004	52	302
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00001	0.00056	0.00001	44	127
	Broken Rail	0.00004	0.00170	0.00003	135	387
	Work Zone Violation	0.00000	0.00031	0.00003	0	107
	Grade Crossing Collisions	0.00156	0.00444	0.00007	431	1073
	Total, All Scenarios	0.00167	0.00917	0.00021	702	2239
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	1	3
	Intrusion Collisions	0.00001	0.00000	0.00000	1	2
	Diamond Collisions	0.00000	0.00000	0.00000	1	2
	Overspeed	0.00001	0.00000	0.00000	4	4
	Broken Rail	0.00003	0.00001	0.00000	17	21
	Work Zone Violation	0.00000	0.00004	0.00000	0	13
	Grade Crossing Collisions	0.00019	0.00006	0.00000	13	29
	Total, All Scenarios	0.00025	0.00013	0.00001	36	75
Total Passenger + Freight		**0.00192**	**0.00930**	**0.00022**	**738**	**2313**

Table R6a: All Year, PTC Timeout, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00002	0.00114	0.00004	49	293
	Intrusion Collisions	0.00005	0.00149	0.00005	64	372
	Diamond Collisions	0.00000	0.00001	0.00000	0	2
	Overspeed	0.00001	0.00067	0.00001	55	154
	Broken Rail	0.00004	0.00202	0.00003	167	466
	Work Zone Violation	0.00000	0.00037	0.00004	0	147
	Grade Crossing Collisions	0.00263	0.00848	0.00013	822	2048
	Total, All Scenarios	0.00275	0.01418	0.00030	1157	3483
Freight	Train-Train Collisions	0.00000	0.00001	0.00000	2	4
	Intrusion Collisions	0.00001	0.00000	0.00000	1	2
	Diamond Collisions	0.00001	0.00000	0.00000	1	2
	Overspeed	0.00001	0.00000	0.00000	3	4
	Broken Rail	0.00003	0.00001	0.00000	17	21
	Work Zone Violation	0.00000	0.00004	0.00000	0	15
	Grade Crossing Collisions	0.00021	0.00008	0.00000	15	34
	Total, All Scenarios	0.00027	0.00014	0.00001	39	82
bbb						
Total Passenger + Freight		**0.00303**	**0.01431**	**0.00031**	**1196**	**3565**

Table R6b: All Year, PTC Timeout, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00003	0.00175	0.00007	75	450
	Intrusion Collisions	0.00008	0.00200	0.00007	85	498
	Diamond Collisions	0.00000	0.00001	0.00000	0	2
	Overspeed	0.00002	0.00090	0.00001	73	207
	Broken Rail	0.00006	0.00274	0.00004	222	628
	Work Zone Violation	0.00000	0.00050	0.00005	0	202
	Grade Crossing Collisions	0.00328	0.00916	0.00014	887	2211
	Total, All Scenarios	0.00346	0.01706	0.00038	1343	4197
Freight	Train-Train Collisions	0.00002	0.00002	0.00000	7	16
	Intrusion Collisions	0.00003	0.00001	0.00000	1	4
	Diamond Collisions	0.00001	0.00000	0.00000	1	2
	Overspeed	0.00001	0.00000	0.00000	7	9
	Broken Rail	0.00006	0.00002	0.00000	33	41
	Work Zone Violation	0.00000	0.00008	0.00001	0	29
	Grade Crossing Collisions	0.00044	0.00014	0.00001	28	63
	Total, All Scenarios	0.00057	0.00028	0.00002	77	165
Total Passenger + Freight		**0.00403**	**0.01734**	**0.00040**	**1420**	**4362**

Table R6c: All Year, PTC Timeout, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00004	0.00217	0.00008	93	556
	Intrusion Collisions	0.00012	0.00287	0.00010	122	714
	Diamond Collisions	0.00000	0.00001	0.00000	0	2
	Overspeed	0.00003	0.00134	0.00002	105	304
	Broken Rail	0.00009	0.00407	0.00007	319	922
	Work Zone Violation	0.00000	0.00075	0.00007	0	281
	Grade Crossing Collisions	0.00297	0.00866	0.00013	840	2092
	Total, All Scenarios	0.00325	0.01988	0.00047	1479	4872
Freight	Train-Train Collisions	0.00003	0.00004	0.00000	11	28
	Intrusion Collisions	0.00006	0.00002	0.00000	2	10
	Diamond Collisions	0.00001	0.00001	0.00000	2	5
	Overspeed	0.00003	0.00001	0.00000	18	22
	Broken Rail	0.00013	0.00004	0.00000	74	92
	Work Zone Violation	0.00000	0.00018	0.00002	0	71
	Grade Crossing Collisions	0.00051	0.00019	0.00001	39	88
	Total, All Scenarios	0.00078	0.00049	0.00004	147	316
Total Passenger + Freight		**0.00402**	**0.02037**	**0.00051**	**1626**	**5188**

Table R6d: All Year, PTC timeout, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00008	0.00506	0.00019	218	1299
	Intrusion Collisions	0.00025	0.00635	0.00023	271	1583
	Diamond Collisions	0.00000	0.00003	0.00000	1	7
	Overspeed	0.00006	0.00291	0.00005	233	664
	Broken Rail	0.00018	0.00884	0.00014	708	2017
	Work Zone Violation	0.00000	0.00162	0.00016	0	630
	Grade Crossing Collisions	0.00888	0.02630	0.00039	2550	6352
	Total, All Scenarios	0.00946	0.05112	0.00115	3980	12552
Freight	Train-Train Collisions	0.00006	0.00007	0.00001	19	48
	Intrusion Collisions	0.00009	0.00003	0.00000	4	16
	Diamond Collisions	0.00003	0.00001	0.00000	5	9
	Overspeed	0.00005	0.00002	0.00000	28	35
	Broken Rail	0.00023	0.00007	0.00001	125	154
	Work Zone Violation	0.00000	0.00029	0.00003	0	115
	Grade Crossing Collisions	0.00117	0.00041	0.00002	81	185
	Total, All Scenarios	0.00163	0.00091	0.00007	262	563
Total Passenger + Freight		**0.01108**	**0.05202**	**0.00122**	**4243**	**13115**

Worksheet 3:
PTC Case, Timeout 360 seconds
Latency 10 seconds.

PTC Totals, All Operating States, All Year

Table R7a: Totals: All Year, All Operating States, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00360	0.25571	0.00977	11129	66024
	Intrusion Collisions	0.01056	0.30191	0.01073	12938	75305
	Diamond Collisions	0.00025	0.00267	0.00008	94	599
	Overspeed	0.00119	0.06083	0.00098	5012	14028
	Broken Rail	0.00859	0.44043	0.00708	36291	101574
	Work Zone Violation	0.00000	0.05584	0.00558	0	22335
	Grade Crossing Collisions	0.57332	1.84863	0.02744	179193	446363
	Total, All Scenarios	0.59751	2.96602	0.06166	244656	726229
Freight	Train-Train Collisions	0.00097	0.00126	0.00013	335	839
	Intrusion Collisions	0.00248	0.00081	0.00008	102	428
	Diamond Collisions	0.00146	0.00063	0.00006	243	496
	Overspeed	0.00082	0.00026	0.00003	450	552
	Broken Rail	0.00689	0.00215	0.00021	3767	4626
	Work Zone Violation	0.00000	0.00639	0.00064	0	2556
	Grade Crossing Collisions	0.04676	0.01662	0.00085	3324	7549
	Total, All Scenarios	0.05939	0.02812	0.00200	8221	17045
Total Passenger + Freight		**0.65691**	**2.99413**	**0.06366**	**252877**	**743274**

Table R7b: Totals: All Year, All Operating States, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00606	0.38601	0.01465	16621	99184
	Intrusion Collisions	0.01497	0.40472	0.01437	17248	100835
	Diamond Collisions	0.00029	0.00315	0.00009	110	707
	Overspeed	0.00168	0.08253	0.00132	6682	18905
	Broken Rail	0.01218	0.59759	0.00958	48384	136887
	Work Zone Violation	0.00000	0.07643	0.00764	0	30571
	Grade Crossing Collisions	0.71416	1.99495	0.02966	193358	481843
	Total, All Scenarios	0.74935	3.54538	0.07733	282404	868932
Freight	Train-Train Collisions	0.00379	0.00443	0.00044	1190	2963
	Intrusion Collisions	0.00538	0.00168	0.00017	211	884
	Diamond Collisions	0.00163	0.00070	0.00007	270	549
	Overspeed	0.00246	0.00072	0.00007	1283	1570
	Broken Rail	0.01426	0.00417	0.00042	7442	9108
	Work Zone Violation	0.00000	0.01508	0.00149	0	5978
	Grade Crossing Collisions	0.08945	0.02807	0.00144	5585	12704
	Total, All Scenarios	0.11696	0.05484	0.00410	15981	33757
Total Passenger + Freight		**0.86631**	**3.60022**	**0.08143**	**298385**	**902688**

Table R7c: Totals: All Year, All Operating States, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00892	0.55972	0.02119	23944	143494
	Intrusion Collisions	0.02302	0.58094	0.02060	24775	144682
	Diamond Collisions	0.00063	0.00680	0.00020	238	1526
	Overspeed	0.00259	0.12257	0.00197	9600	27756
	Broken Rail	0.01873	0.88750	0.01424	69509	200973
	Work Zone Violation	0.00000	0.11341	0.01134	0	45346
	Grade Crossing Collisions	0.64824	1.88780	0.02802	183088	455937
	Total, All Scenarios	0.70213	4.15875	0.09756	311154	1019714
Freight	Train-Train Collisions	0.00677	0.00851	0.00085	2274	5678
	Intrusion Collisions	0.01176	0.00390	0.00039	490	2051
	Diamond Collisions	0.00359	0.00154	0.00015	595	1210
	Overspeed	0.00659	0.00217	0.00022	3663	4532
	Broken Rail	0.02997	0.00988	0.00099	16653	20603
	Work Zone Violation	0.00000	0.03704	0.00370	0	14816
	Grade Crossing Collisions	0.11436	0.04344	0.00222	8670	19681
	Total, All Scenarios	0.17304	0.10647	0.00853	32345	68571
Total Passenger + Freight		**0.87517**	**4.26522**	**0.10609**	**343500**	**1088285**

Table R7d: Grand Total: All Year, All Operating States, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01859	1.20144	0.04562	51694	308702
	Intrusion Collisions	0.04856	1.28757	0.04570	54961	320822
	Diamond Collisions	0.00117	0.01262	0.00038	442	2831
	Overspeed	0.00545	0.26593	0.00427	21294	60689
	Broken Rail	0.03950	1.92552	0.03090	154183	439433
	Work Zone Violation	0.00000	0.24568	0.02456	0	98252
	Grade Crossing Collisions	1.93572	5.73138	0.08512	555639	1384144
	Total, All Scenarios	2.04899	10.67014	0.23655	838214	2614874
Freight	Train-Train Collisions	0.01153	0.01420	0.00142	3800	9480
	Intrusion Collisions	0.01962	0.00639	0.00064	803	3363
	Diamond Collisions	0.00669	0.00286	0.00029	1108	2254
	Overspeed	0.00987	0.00315	0.00031	5396	6654
	Broken Rail	0.05111	0.01619	0.00162	27862	34338
	Work Zone Violation	0.00000	0.05851	0.00583	0	23350
	Grade Crossing Collisions	0.25057	0.08813	0.00451	17579	39934
	Total, All Scenarios	0.34940	0.18943	0.01463	56548	119373
Total Passenger + Freight		**2.39839**	**10.85957**	**0.25118**	**894761**	**2734247**

Worksheet 4:
PTC Case, Timeout 60 seconds
Latency 10 seconds

Results Summary: PTC Case, Timeout 60 seconds, Latency 10 seconds.

PTC Normal Operating State

Table R1a: Full Year, PTC Normal, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00360	0.25551	0.00977	11120	65973
	Intrusion Collisions	0.01055	0.30153	0.01071	12921	75210
	Diamond Collisions	0.00025	0.00267	0.00008	93	599
	Overspeed	0.00118	0.06038	0.00097	4976	13926
	Broken Rail	0.00858	0.44003	0.00707	36258	101481
	Work Zone Violation	0.00000	0.05567	0.00557	0	22270
	Grade Crossing Collisions	0.57280	1.84693	0.02741	179028	445954
	Total, All Scenarios	0.59695	2.96273	0.06158	244397	725412
Freight	Train-Train Collisions	0.00097	0.00126	0.00013	335	838
	Intrusion Collisions	0.00248	0.00081	0.00008	102	427
	Diamond Collisions	0.00146	0.00063	0.00006	243	495
	Overspeed	0.00082	0.00026	0.00003	448	550
	Broken Rail	0.00688	0.00215	0.00021	3764	4622
	Work Zone Violation	0.00000	0.00638	0.00064	0	2551
	Grade Crossing Collisions	0.04672	0.01661	0.00085	3321	7543
	Total, All Scenarios	0.05934	0.02808	0.00200	8213	17025
Total Passenger + Freight		**0.65629**	**2.99081**	**0.06358**	**252609**	**742437**

Table R1b: Rest of Year, PTC Normal, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00472	0.29698	0.01127	12782	76283
	Intrusion Collisions	0.01122	0.30343	0.01077	12931	75599
	Diamond Collisions	0.00023	0.00243	0.00007	85	545
	Overspeed	0.00125	0.06150	0.00099	4980	14088
	Broken Rail	0.00913	0.44819	0.00719	36288	102665
	Work Zone Violation	0.00000	0.05720	0.00572	0	22882
	Grade Crossing Collisions	0.53562	1.49620	0.02225	145018	361381
	Total, All Scenarios	0.56217	2.66594	0.05825	212083	653442
Freight	Train-Train Collisions	0.00343	0.00400	0.00040	1075	2675
	Intrusion Collisions	0.00450	0.00140	0.00014	176	739
	Diamond Collisions	0.00126	0.00054	0.00005	208	422
	Overspeed	0.00216	0.00063	0.00006	1129	1382
	Broken Rail	0.01181	0.00345	0.00035	6166	7547
	Work Zone Violation	0.00000	0.01287	0.00129	0	5146
	Grade Crossing Collisions	0.07408	0.02325	0.00119	4625	10521
	Total, All Scenarios	0.09723	0.04614	0.00348	13380	28432
Total Passenger + Freight		**0.65941**	**2.71208**	**0.06173**	**225463**	**681874**

Table R1c: Rest of Year, PTC Normal, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00709	0.43738	0.01655	18698	112078
	Intrusion Collisions	0.01726	0.43555	0.01545	18575	108473
	Diamond Collisions	0.00050	0.00533	0.00016	187	1195
	Overspeed	0.00193	0.09134	0.00147	7154	20684
	Broken Rail	0.01404	0.66562	0.01068	52131	150729
	Work Zone Violation	0.00000	0.08489	0.00849	0	33954
	Grade Crossing Collisions	0.48617	1.41585	0.02102	137315	341951
	Total, All Scenarios	0.52699	3.13596	0.07380	234060	769064
		0.00000	0.00000	0.00000	0	0
Freight	Train-Train Collisions	0.00642	0.00807	0.00081	2157	5385
	Intrusion Collisions	0.01001	0.00332	0.00033	418	1747
	Diamond Collisions	0.00281	0.00120	0.00012	465	945
	Overspeed	0.00577	0.00190	0.00019	3209	3970
	Broken Rail	0.02537	0.00836	0.00084	14099	17444
	Work Zone Violation	0.00000	0.03195	0.00319	0	12779
	Grade Crossing Collisions	0.09683	0.03678	0.00188	7340	16663
	Total, All Scenarios	0.14722	0.09158	0.00736	27688	58933
Total Passenger + Freight		**0.67420**	**3.22753**	**0.08116**	**261749**	**827996**

Table R1d: Rest of Year, PTC Normal, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01540	0.98988	0.03758	42600	254334
	Intrusion Collisions	0.03903	1.04052	0.03693	44428	259282
	Diamond Collisions	0.00097	0.01042	0.00031	365	2338
	Overspeed	0.00436	0.21323	0.00342	17109	48698
	Broken Rail	0.03176	1.55384	0.02494	124677	354874
	Work Zone Violation	0.00000	0.19776	0.01978	0	79106
	Grade Crossing Collisions	1.59459	4.75898	0.07068	461362	1149285
	Total, All Scenarios	1.68611	8.76463	0.19364	690540	2147918
Freight	Train-Train Collisions	0.01082	0.01333	0.00133	3567	8897
	Intrusion Collisions	0.01699	0.00554	0.00055	696	2913
	Diamond Collisions	0.00552	0.00237	0.00024	916	1862
	Overspeed	0.00876	0.00279	0.00028	4787	5903
	Broken Rail	0.04407	0.01396	0.00140	24029	29613
	Work Zone Violation	0.00000	0.05119	0.00512	0	20475
	Grade Crossing Collisions	0.21763	0.07663	0.00393	15287	34727
	Total, All Scenarios	0.30379	0.16580	0.01284	49281	104390
Total Passenger + Freight		**1.98990**	**8.93042**	**0.20648**	**739821**	**2252307**

Table R2a: Summer, PTC Normal, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Freight	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Total Passenger + Freight						

There are no seasonal traffic variations on the Joliet Sub-corridor. Therefore only one risk calculation is needed for the full year, and there is no separate summer calculation

Table R2b: Summer, PTC Normal, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00134	0.08869	0.00337	3825	22815
	Intrusion Collisions	0.00373	0.10078	0.00358	4295	25108
	Diamond Collisions	0.00007	0.00072	0.00002	25	162
	Overspeed	0.00042	0.02043	0.00033	1654	4679
	Broken Rail	0.00303	0.14885	0.00239	12052	34097
	Work Zone Violation	0.00000	0.01900	0.00190	0	7599
	Grade Crossing Collisions	0.17789	0.49691	0.00739	48163	120021
	Total, All Scenarios	0.18647	0.87538	0.01898	70014	214481
Freight	Train-Train Collisions	0.00035	0.00042	0.00004	113	283
	Intrusion Collisions	0.00088	0.00027	0.00003	34	144
	Diamond Collisions	0.00037	0.00016	0.00002	62	126
	Overspeed	0.00029	0.00008	0.00001	151	185
	Broken Rail	0.00243	0.00071	0.00007	1270	1554
	Work Zone Violation	0.00000	0.00219	0.00020	0	825
	Grade Crossing Collisions	0.01526	0.00479	0.00025	952	2167
	Total, All Scenarios	0.01958	0.00863	0.00061	2583	5284
Total Passenger + Freight		**0.20606**	**0.88402**	**0.01959**	**72597**	**219765**

Table R2c: Summer, PTC Normal, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00183	0.12221	0.00464	5241	31387
	Intrusion Collisions	0.00573	0.14465	0.00513	6169	36026
	Diamond Collisions	0.00014	0.00149	0.00004	52	335
	Overspeed	0.00064	0.03034	0.00049	2376	6869
	Broken Rail	0.00466	0.22106	0.00355	17314	50060
	Work Zone Violation	0.00000	0.02819	0.00282	0	11277
	Grade Crossing Collisions	0.16147	0.47023	0.00698	45605	113568
	Total, All Scenarios	0.17447	1.01818	0.02365	76756	249521
Freight	Train-Train Collisions	0.00034	0.00043	0.00004	115	286
	Intrusion Collisions	0.00173	0.00057	0.00006	72	302
	Diamond Collisions	0.00079	0.00034	0.00003	130	265
	Overspeed	0.00081	0.00027	0.00003	449	556
	Broken Rail	0.00457	0.00151	0.00015	2540	3143
	Work Zone Violation	0.00000	0.00505	0.00051	0	2021
	Grade Crossing Collisions	0.01745	0.00663	0.00034	1323	3002
	Total, All Scenarios	0.02568	0.01479	0.00116	4629	9575
Total Passenger + Freight		**0.20016**	**1.03297**	**0.02480**	**81386**	**259096**

Table R2d: Summer, PTC Normal, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00317	0.21091	0.00802	9066	54203
	Intrusion Collisions	0.00946	0.24543	0.00871	10464	61134
	Diamond Collisions	0.00021	0.00222	0.00007	78	497
	Overspeed	0.00106	0.05076	0.00081	4030	11548
	Broken Rail	0.00770	0.36992	0.00593	29365	84156
	Work Zone Violation	0.00000	0.04719	0.00472	0	18876
	Grade Crossing Collisions	0.33935	0.96714	0.01437	93768	233588
	Total, All Scenarios	0.36095	1.89356	0.04263	146770	464002
Freight	Train-Train Collisions	0.00069	0.00085	0.00009	228	569
	Intrusion Collisions	0.00261	0.00085	0.00008	107	446
	Diamond Collisions	0.00116	0.00050	0.00005	192	391
	Overspeed	0.00110	0.00035	0.00004	600	741
	Broken Rail	0.00700	0.00222	0.00022	3810	4697
	Work Zone Violation	0.00000	0.00724	0.00071	0	2846
	Grade Crossing Collisions	0.03270	0.01141	0.00058	2275	5169
	Total, All Scenarios	0.04527	0.02342	0.00177	7212	14858
Total Passenger + Freight		**0.40621**	**1.91699**	**0.04439**	**153983**	**478861**

Table R3a: All Year, PTC Normal, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00360	0.25551	0.00977	11120	65973
	Intrusion Collisions	0.01055	0.30153	0.01071	12921	75210
	Diamond Collisions	0.00025	0.00267	0.00008	93	599
	Overspeed	0.00118	0.06038	0.00097	4976	13926
	Broken Rail	0.00858	0.44003	0.00707	36258	101481
	Work Zone Violation	0.00000	0.05567	0.00557	0	22270
	Grade Crossing Collisions	0.57280	1.84693	0.02741	179028	445954
	Total, All Scenarios	0.59695	2.96273	0.06158	244397	725412
Freight	Train-Train Collisions	0.00097	0.00126	0.00013	335	838
	Intrusion Collisions	0.00248	0.00081	0.00008	102	427
	Diamond Collisions	0.00146	0.00063	0.00006	243	495
	Overspeed	0.00082	0.00026	0.00003	448	550
	Broken Rail	0.00688	0.00215	0.00021	3764	4622
	Work Zone Violation	0.00000	0.00638	0.00064	0	2551
	Grade Crossing Collisions	0.04672	0.01661	0.00085	3321	7543
	Total, All Scenarios	0.05934	0.02808	0.00200	8213	17025
Total Passenger + Freight		**0.65629**	**2.99081**	**0.06358**	**252609**	**742437**

Table R3b: All Year, PTC Normal, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00606	0.38568	0.01464	16607	99098
	Intrusion Collisions	0.01495	0.40421	0.01435	17226	100707
	Diamond Collisions	0.00029	0.00315	0.00009	110	707
	Overspeed	0.00167	0.08193	0.00131	6633	18767
	Broken Rail	0.01217	0.59704	0.00957	48339	136761
	Work Zone Violation	0.00000	0.07620	0.00762	0	30481
	Grade Crossing Collisions	0.71350	1.99312	0.02964	193181	481401
	Total, All Scenarios	0.74864	3.54133	0.07723	282097	867923
Freight	Train-Train Collisions	0.00378	0.00442	0.00044	1188	2958
	Intrusion Collisions	0.00537	0.00168	0.00017	210	883
	Diamond Collisions	0.00163	0.00070	0.00007	270	548
	Overspeed	0.00245	0.00072	0.00007	1281	1567
	Broken Rail	0.01425	0.00416	0.00042	7436	9101
	Work Zone Violation	0.00000	0.01506	0.00149	0	5971
	Grade Crossing Collisions	0.08933	0.02804	0.00144	5578	12688
	Total, All Scenarios	0.11682	0.05477	0.00409	15963	33716
Total Passenger + Freight		**0.86546**	**3.59610**	**0.08132**	**298060**	**901639**

Table R3c: All Year, PTC Normal, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00892	0.55960	0.02119	23939	143465
	Intrusion Collisions	0.02299	0.58020	0.02058	24744	144499
	Diamond Collisions	0.00063	0.00682	0.00020	239	1529
	Overspeed	0.00257	0.12168	0.00195	9530	27553
	Broken Rail	0.01871	0.88669	0.01422	69445	200788
	Work Zone Violation	0.00000	0.11308	0.01131	0	45231
	Grade Crossing Collisions	0.64764	1.88607	0.02800	182920	455519
	Total, All Scenarios	0.70146	4.15413	0.09745	310817	1018585
Freight	Train-Train Collisions	0.00676	0.00850	0.00085	2272	5671
	Intrusion Collisions	0.01175	0.00390	0.00039	490	2049
	Diamond Collisions	0.00359	0.00154	0.00015	595	1209
	Overspeed	0.00658	0.00217	0.00022	3658	4526
	Broken Rail	0.02994	0.00987	0.00099	16640	20587
	Work Zone Violation	0.00000	0.03700	0.00370	0	14800
	Grade Crossing Collisions	0.11427	0.04340	0.00222	8663	19665
	Total, All Scenarios	0.17290	0.10637	0.00852	32317	68507
Total Passenger + Freight		**0.87436**	**4.26050**	**0.10597**	**343134**	**1087092**

Table R3d: All Year, PTC Normal, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01857	1.20079	0.04560	51666	308537
	Intrusion Collisions	0.04849	1.28594	0.04564	54891	320416
	Diamond Collisions	0.00118	0.01264	0.00038	443	2835
	Overspeed	0.00541	0.26399	0.00424	21138	60246
	Broken Rail	0.03946	1.92376	0.03087	154042	439030
	Work Zone Violation	0.00000	0.24496	0.02450	0	97982
	Grade Crossing Collisions	1.93394	5.72612	0.08504	555129	1382874
	Total, All Scenarios	2.04705	10.65819	0.23626	837310	2611920
Freight	Train-Train Collisions	0.01152	0.01418	0.00142	3795	9466
	Intrusion Collisions	0.01960	0.00638	0.00064	802	3359
	Diamond Collisions	0.00668	0.00286	0.00029	1108	2253
	Overspeed	0.00986	0.00314	0.00031	5387	6644
	Broken Rail	0.05107	0.01618	0.00162	27839	34310
	Work Zone Violation	0.00000	0.05843	0.00583	0	23321
	Grade Crossing Collisions	0.25033	0.08804	0.00451	17562	39895
	Total, All Scenarios	0.34905	0.18922	0.01461	56493	119248
Total Passenger + Freight		**2.39611**	**10.84741**	**0.25087**	**893803**	**2731168**

Worksheet 4:
PTC Case, Timeout 60 seconds
Latency 10 seconds

PTC Timeout Operating State

Table R4a: Full Year, PTC Timeout, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00019	0.00001	8	49
	Intrusion Collisions	0.00001	0.00024	0.00001	10	60
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00009	0.00000	7	20
	Broken Rail	0.00001	0.00033	0.00001	27	77
	Work Zone Violation	0.00000	0.00005	0.00001	0	22
	Grade Crossing Collisions	0.00043	0.00140	0.00002	135	337
	Total, All Scenarios	0.00045	0.00230	0.00005	189	565
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0	1
	Intrusion Collisions	0.00000	0.00000	0.00000	0	0
	Diamond Collisions	0.00000	0.00000	0.00000	0	0
	Overspeed	0.00000	0.00000	0.00000	0	1
	Broken Rail	0.00001	0.00000	0.00000	3	3
	Work Zone Violation	0.00000	0.00001	0.00000	0	2
	Grade Crossing Collisions	0.00004	0.00001	0.00000	2	6
	Total, All Scenarios	0.00005	0.00002	0.00000	6	13
Total Passenger + Freight		**0.00050**	**0.00233**	**0.00005**	**195**	**579**

Table R4b: Rest of Year, PTC Timeout, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00023	0.00001	10	58
	Intrusion Collisions	0.00001	0.00024	0.00001	10	60
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00009	0.00000	7	21
	Broken Rail	0.00001	0.00034	0.00001	27	78
	Work Zone Violation	0.00000	0.00006	0.00001	0	23
	Grade Crossing Collisions	0.00040	0.00113	0.00002	110	273
	Total, All Scenarios	0.00043	0.00209	0.00005	164	513
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	1	2
	Intrusion Collisions	0.00000	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	0
	Overspeed	0.00000	0.00000	0.00000	1	1
	Broken Rail	0.00001	0.00000	0.00000	5	6
	Work Zone Violation	0.00000	0.00001	0.00000	0	4
	Grade Crossing Collisions	0.00006	0.00002	0.00000	3	8
	Total, All Scenarios	0.00007	0.00004	0.00000	10	22
Total Passenger + Freight		**0.00050**	**0.00212**	**0.00005**	**175**	**535**

Table R4c: Rest of Year, PTC Timeout, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00027	0.00001	11	69
	Intrusion Collisions	0.00001	0.00035	0.00001	15	86
	Diamond Collisions	0.00000	0.00001	0.00000	0	2
	Overspeed	0.00000	0.00013	0.00000	11	30
	Broken Rail	0.00001	0.00050	0.00001	39	114
	Work Zone Violation	0.00000	0.00008	0.00001	0	33
	Grade Crossing Collisions	0.00037	0.00107	0.00002	104	258
	Total, All Scenarios	0	0	0	180	593
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	2	4
	Intrusion Collisions	0.00001	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00000	0.00000	3	3
	Broken Rail	0.00002	0.00001	0.00000	10	13
	Work Zone Violation	0.00000	0.00002	0.00000	0	10
	Grade Crossing Collisions	0.00007	0.00003	0.00000	5	12
	Total, All Scenarios	0.00011	0.00007	0.00001	21	45
Total Passenger + Freight		**0.00051**	**0.00248**	**0.00006**	**201**	**637**

Table R4d: Rest of Year, PTC Timeout, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00068	0.00003	29	176
	Intrusion Collisions	0.00003	0.00083	0.00003	35	206
	Diamond Collisions	0.00000	0.00001	0.00000	0	3
	Overspeed	0.00001	0.00031	0.00001	25	72
	Broken Rail	0.00002	0.00117	0.00002	94	268
	Work Zone Violation	0.00000	0.00019	0.00002	0	78
	Grade Crossing Collisions	0.00120	0.00360	0.00005	349	868
	Total, All Scenarios	0.00128	0.00680	0.00015	533	1671
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	3	7
	Intrusion Collisions	0.00001	0.00000	0.00000	1	2
	Diamond Collisions	0.00000	0.00000	0.00000	1	2
	Overspeed	0.00001	0.00000	0.00000	4	5
	Broken Rail	0.00003	0.00001	0.00000	18	22
	Work Zone Violation	0.00000	0.00004	0.00000	0	16
	Grade Crossing Collisions	0.00016	0.00006	0.00000	11	26
	Total, All Scenarios	0.00023	0.00013	0.00001	37	80
Total Passenger + Freight		**0.00151**	**0.00693**	**0.00016**	**571**	**1751**

Table R5a: Summer, PTC Timeout, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Freight	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Total Passenger + Freight						

There are no seasonal traffic variations on the Joliet Sub-corridor. Therefore only one risk calculation is needed for the full year, and there is no separate summer calculation

Table R5b: Summer, PTC Timeout, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00007	0.00000	2.9	17.0
	Intrusion Collisions	0.00000	0.00008	0.00000	3.4	20.0
	Diamond Collisions	0.00000	0.00000	0.00000	0.0	0.2
	Overspeed	0.00000	0.00003	0.00000	2.4	6.9
	Broken Rail	0.00000	0.00011	0.00000	9.1	25.8
	Work Zone Violation	0.00000	0.00002	0.00000	0.0	7.5
	Grade Crossing Collisions	0.00013	0.00038	0.00001	36.4	90.7
	Total, All Scenarios	0.00014	0.00068	0.00002	54.2	168.0
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0.1	0.2
	Intrusion Collisions	0.00000	0.00000	0.00000	0.0	0.1
	Diamond Collisions	0.00000	0.00000	0.00000	0.1	0.1
	Overspeed	0.00000	0.00000	0.00000	0.2	0.2
	Broken Rail	0.00000	0.00000	0.00000	1.0	1.2
	Work Zone Violation	0.00000	0.00000	0.00000	0.0	0.5
	Grade Crossing Collisions	0.00002	0.00001	0.00000	1.1	2.6
	Total, All Scenarios	0.00002	0.00001	0.00000	2.4	4.9
Total Passenger + Freight		**0.00016**	**0.00069**	**0.00002**	**56.6**	**172.9**

Table R5c: Summer, PTC Timeout, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00009	0.00000	3.9	23.2
	Intrusion Collisions	0.00000	0.00012	0.00000	4.9	28.6
	Diamond Collisions	0.00000	0.00000	0.00000	0.1	0.4
	Overspeed	0.00000	0.00004	0.00000	3.5	10.1
	Broken Rail	0.00000	0.00017	0.00000	13.1	37.8
	Work Zone Violation	0.00000	0.00003	0.00000	0.0	8.5
	Grade Crossing Collisions	0.00012	0.00036	0.00001	34.5	85.8
	Total, All Scenarios	0.00013	0.00080	0.00002	59.9	194.5
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0.1	0.2
	Intrusion Collisions	0.00000	0.00000	0.00000	0.1	0.2
	Diamond Collisions	0.00000	0.00000	0.00000	0.1	0.2
	Overspeed	0.00000	0.00000	0.00000	0.4	0.5
	Broken Rail	0.00000	0.00000	0.00000	1.9	2.3
	Work Zone Violation	0.00000	0.00000	0.00000	0.0	1.7
	Grade Crossing Collisions	0.00001	0.00000	0.00000	1.0	2.2
	Total, All Scenarios	0.00002	0.00001	0.00000	3.5	7.4
Total Passenger + Freight		**0.00015**	**0.00081**	**0.00002**	**63.4**	**201.9**

Table R5d: Summer, PTC Timeout, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00016	0.00001	7	40
	Intrusion Collisions	0.00001	0.00020	0.00001	8	49
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00007	0.00000	6	17
	Broken Rail	0.00001	0.00028	0.00000	22	64
	Work Zone Violation	0.00000	0.00005	0.00000	0	16
	Grade Crossing Collisions	0.00026	0.00073	0.00001	71	177
	Total, All Scenarios	0.00027	0.00149	0.00003	114	362
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0	0
	Intrusion Collisions	0.00000	0.00000	0.00000	0	0
	Diamond Collisions	0.00000	0.00000	0.00000	0	0
	Overspeed	0.00000	0.00000	0.00000	1	1
	Broken Rail	0.00001	0.00000	0.00000	3	4
	Work Zone Violation	0.00000	0.00001	0.00000	0	2
	Grade Crossing Collisions	0.00003	0.00001	0.00000	2	5
	Total, All Scenarios	0.00004	0.00002	0.00000	6	12
Total Passenger + Freight		**0.00032**	**0.00151**	**0.00003**	**120**	**375**

Table R6a: All Year, PTC Timeout, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00019	0.00001	8	49
	Intrusion Collisions	0.00001	0.00024	0.00001	10	60
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00009	0.00000	7	20
	Broken Rail	0.00001	0.00033	0.00001	27	77
	Work Zone Violation	0.00000	0.00005	0.00001	0	22
	Grade Crossing Collisions	0.00043	0.00140	0.00002	135	337
	Total, All Scenarios	0.00045	0.00230	0.00005	189	565
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0	1
	Intrusion Collisions	0.00000	0.00000	0.00000	0	0
	Diamond Collisions	0.00000	0.00000	0.00000	0	0
	Overspeed	0.00000	0.00000	0.00000	0	1
	Broken Rail	0.00001	0.00000	0.00000	3	3
	Work Zone Violation	0.00000	0.00001	0.00000	0	2
	Grade Crossing Collisions	0.00004	0.00001	0.00000	2	6
	Total, All Scenarios	0.00005	0.00002	0.00000	6	13
bbb						
Total Passenger + Freight		**0.00050**	**0.00233**	**0.00005**	**195**	**579**

Table R6b: All Year, PTC Timeout, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00029	0.00001	13	75
	Intrusion Collisions	0.00001	0.00032	0.00001	14	80
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00012	0.00000	10	28
	Broken Rail	0.00001	0.00045	0.00001	37	103
	Work Zone Violation	0.00000	0.00008	0.00001	0	30
	Grade Crossing Collisions	0.00054	0.00151	0.00002	146	364
	Total, All Scenarios	0.00057	0.00277	0.00006	219	681
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	1	3
	Intrusion Collisions	0.00000	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	0
	Overspeed	0.00000	0.00000	0.00000	1	1
	Broken Rail	0.00001	0.00000	0.00000	6	7
	Work Zone Violation	0.00000	0.00001	0.00000	0	5
	Grade Crossing Collisions	0.00007	0.00002	0.00000	5	10
	Total, All Scenarios	0.00010	0.00004	0.00000	13	27
Total Passenger + Freight		**0.00066**	**0.00281**	**0.00006**	**231**	**707**

Table R6c: All Year, PTC Timeout, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00036	0.00001	15	92
	Intrusion Collisions	0.00002	0.00046	0.00002	20	115
	Diamond Collisions	0.00000	0.00001	0.00000	0	2
	Overspeed	0.00000	0.00018	0.00000	14	40
	Broken Rail	0.00001	0.00067	0.00001	52	152
	Work Zone Violation	0.00000	0.00011	0.00001	0	42
	Grade Crossing Collisions	0.00049	0.00143	0.00002	138	344
	Total, All Scenarios	0.00053	0.00322	0.00008	240	787
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	2	5
	Intrusion Collisions	0.00001	0.00000	0.00000	0	2
	Diamond Collisions	0.00000	0.00000	0.00000	1	1
	Overspeed	0.00001	0.00000	0.00000	3	4
	Broken Rail	0.00002	0.00001	0.00000	12	15
	Work Zone Violation	0.00000	0.00003	0.00000	0	12
	Grade Crossing Collisions	0.00008	0.00003	0.00000	6	15
	Total, All Scenarios	0.00013	0.00008	0.00001	24	52
Total Passenger + Freight		**0.00066**	**0.00330**	**0.00008**	**264**	**839**

Table R6d: All Year, PTC timeout, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00084	0.00003	36	216
	Intrusion Collisions	0.00004	0.00102	0.00004	44	255
	Diamond Collisions	0.00000	0.00002	0.00000	1	4
	Overspeed	0.00001	0.00039	0.00001	31	89
	Broken Rail	0.00003	0.00145	0.00002	116	332
	Work Zone Violation	0.00000	0.00024	0.00002	0	94
	Grade Crossing Collisions	0.00146	0.00433	0.00006	419	1045
	Total, All Scenarios	0.00155	0.00829	0.00019	647	2033
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	3	8
	Intrusion Collisions	0.00002	0.00000	0.00000	1	3
	Diamond Collisions	0.00001	0.00000	0.00000	1	2
	Overspeed	0.00001	0.00000	0.00000	4	6
	Broken Rail	0.00004	0.00001	0.00000	21	26
	Work Zone Violation	0.00000	0.00005	0.00000	0	18
	Grade Crossing Collisions	0.00019	0.00007	0.00000	13	31
	Total, All Scenarios	0.00027	0.00015	0.00001	43	92
Total Passenger + Freight		**0.00182**	**0.00844**	**0.00020**	**691**	**2126**

Worksheet 4:
PTC Case, Timeout 60 seconds
Latency 10 seconds

PTC Totals, All Operating States, All Year

Table R7a: Totals: All Year, All Operating States, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00360	0.25570	0.00977	11129	66022
	Intrusion Collisions	0.01055	0.30177	0.01072	12932	75270
	Diamond Collisions	0.00025	0.00267	0.00008	94	599
	Overspeed	0.00118	0.06047	0.00097	4983	13946
	Broken Rail	0.00859	0.44036	0.00708	36285	101557
	Work Zone Violation	0.00000	0.05573	0.00557	0	22292
	Grade Crossing Collisions	0.57323	1.84832	0.02743	179164	446291
	Total, All Scenarios	0.59740	2.96503	0.06163	244585	725977
Freight	Train-Train Collisions	0.00097	0.00126	0.00013	335	838
	Intrusion Collisions	0.00248	0.00081	0.00008	102	427
	Diamond Collisions	0.00146	0.00063	0.00006	243	495
	Overspeed	0.00082	0.00026	0.00003	449	551
	Broken Rail	0.00689	0.00215	0.00021	3766	4625
	Work Zone Violation	0.00000	0.00638	0.00064	0	2553
	Grade Crossing Collisions	0.04676	0.01662	0.00085	3324	7548
	Total, All Scenarios	0.05938	0.02810	0.00200	8219	17039
Total Passenger + Freight		**0.65679**	**2.99314**	**0.06363**	**252804**	**743016**

Table R7b: Totals: All Year, All Operating States, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00606	0.38597	0.01465	16619	99173
	Intrusion Collisions	0.01497	0.40453	0.01436	17240	100787
	Diamond Collisions	0.00029	0.00316	0.00009	111	708
	Overspeed	0.00167	0.08205	0.00132	6643	18795
	Broken Rail	0.01218	0.59749	0.00958	48376	136864
	Work Zone Violation	0.00000	0.07628	0.00763	0	30511
	Grade Crossing Collisions	0.71404	1.99462	0.02966	193327	481765
	Total, All Scenarios	0.74921	3.54410	0.07729	282315	868604
Freight	Train-Train Collisions	0.00378	0.00443	0.00044	1189	2960
	Intrusion Collisions	0.00538	0.00168	0.00017	211	884
	Diamond Collisions	0.00163	0.00070	0.00007	270	549
	Overspeed	0.00246	0.00072	0.00007	1282	1569
	Broken Rail	0.01426	0.00416	0.00042	7441	9107
	Work Zone Violation	0.00000	0.01507	0.00149	0	5976
	Grade Crossing Collisions	0.08941	0.02806	0.00144	5582	12698
	Total, All Scenarios	0.11691	0.05481	0.00410	15976	33743
Total Passenger + Freight		**0.86612**	**3.59891**	**0.08139**	**298291**	**902347**

Table R7c: Totals: All Year, All Operating States, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00893	0.55996	0.02120	23955	143557
	Intrusion Collisions	0.02301	0.58066	0.02059	24764	144614
	Diamond Collisions	0.00063	0.00683	0.00020	239	1531
	Overspeed	0.00257	0.12186	0.00195	9544	27594
	Broken Rail	0.01872	0.88736	0.01424	69497	200940
	Work Zone Violation	0.00000	0.11319	0.01132	0	45273
	Grade Crossing Collisions	0.64813	1.88750	0.02802	183058	455863
	Total, All Scenarios	0.70199	4.15735	0.09753	311057	1019372
Freight	Train-Train Collisions	0.00677	0.00850	0.00085	2273	5675
	Intrusion Collisions	0.01176	0.00390	0.00039	490	2051
	Diamond Collisions	0.00359	0.00154	0.00015	596	1210
	Overspeed	0.00659	0.00217	0.00022	3661	4530
	Broken Rail	0.02997	0.00988	0.00099	16652	20602
	Work Zone Violation	0.00000	0.03703	0.00370	0	14811
	Grade Crossing Collisions	0.11436	0.04343	0.00222	8669	19680
	Total, All Scenarios	0.17303	0.10645	0.00852	32342	68559
Total Passenger + Freight		**0.87502**	**4.26380**	**0.10605**	**343399**	**1087931**

Table R7d: Grand Total: All Year, All Operating States, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01859	1.20163	0.04563	51703	308753
	Intrusion Collisions	0.04853	1.28697	0.04568	54935	320671
	Diamond Collisions	0.00118	0.01266	0.00038	443	2839
	Overspeed	0.00542	0.26438	0.00424	21170	60335
	Broken Rail	0.03949	1.92521	0.03089	154158	439362
	Work Zone Violation	0.00000	0.24520	0.02452	0	98076
	Grade Crossing Collisions	1.93540	5.73045	0.08511	555549	1383918
	Total, All Scenarios	2.04861	10.66648	0.23645	837958	2613953
Freight	Train-Train Collisions	0.01152	0.01419	0.00142	3798	9474
	Intrusion Collisions	0.01962	0.00639	0.00064	803	3362
	Diamond Collisions	0.00669	0.00286	0.00029	1109	2255
	Overspeed	0.00986	0.00314	0.00031	5391	6649
	Broken Rail	0.05111	0.01619	0.00162	27860	34335
	Work Zone Violation	0.00000	0.05848	0.00583	0	23340
	Grade Crossing Collisions	0.25052	0.08811	0.00451	17575	39926
	Total, All Scenarios	0.34932	0.18937	0.01462	56536	119341
Total Passenger + Freight		**2.39793**	**10.85585**	**0.25107**	**894494**	**2733294**

Worksheet 4:
PTC Case, Timeout 60 seconds
Latency 10 seconds

Results Summary: PTC Case, Timeout 60 seconds, Latency 10 seconds.

PTC Normal Operating State

Table R1a: Full Year, PTC Normal, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00360	0.25551	0.00977	11120	65973
	Intrusion Collisions	0.01055	0.30153	0.01071	12921	75210
	Diamond Collisions	0.00025	0.00267	0.00008	93	599
	Overspeed	0.00118	0.06038	0.00097	4976	13926
	Broken Rail	0.00858	0.44003	0.00707	36258	101481
	Work Zone Violation	0.00000	0.05567	0.00557	0	22270
	Grade Crossing Collisions	0.57280	1.84693	0.02741	179028	445954
	Total, All Scenarios	0.59695	2.96273	0.06158	244397	725412
Freight	Train-Train Collisions	0.00097	0.00126	0.00013	335	838
	Intrusion Collisions	0.00248	0.00081	0.00008	102	427
	Diamond Collisions	0.00146	0.00063	0.00006	243	495
	Overspeed	0.00082	0.00026	0.00003	448	550
	Broken Rail	0.00688	0.00215	0.00021	3764	4622
	Work Zone Violation	0.00000	0.00638	0.00064	0	2551
	Grade Crossing Collisions	0.04672	0.01661	0.00085	3321	7543
	Total, All Scenarios	0.05934	0.02808	0.00200	8213	17025
Total Passenger + Freight		**0.65629**	**2.99081**	**0.06358**	**252609**	**742437**

Table R1b: Rest of Year, PTC Normal, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00472	0.29698	0.01127	12782	76283
	Intrusion Collisions	0.01122	0.30343	0.01077	12931	75599
	Diamond Collisions	0.00023	0.00243	0.00007	85	545
	Overspeed	0.00125	0.06150	0.00099	4980	14088
	Broken Rail	0.00913	0.44819	0.00719	36288	102665
	Work Zone Violation	0.00000	0.05720	0.00572	0	22882
	Grade Crossing Collisions	0.53562	1.49620	0.02225	145018	361381
	Total, All Scenarios	0.56217	2.66594	0.05825	212083	653442
Freight	Train-Train Collisions	0.00343	0.00400	0.00040	1075	2675
	Intrusion Collisions	0.00450	0.00140	0.00014	176	739
	Diamond Collisions	0.00126	0.00054	0.00005	208	422
	Overspeed	0.00216	0.00063	0.00006	1129	1382
	Broken Rail	0.01181	0.00345	0.00035	6166	7547
	Work Zone Violation	0.00000	0.01287	0.00129	0	5146
	Grade Crossing Collisions	0.07408	0.02325	0.00119	4625	10521
	Total, All Scenarios	0.09723	0.04614	0.00348	13380	28432
Total Passenger + Freight		**0.65941**	**2.71208**	**0.06173**	**225463**	**681874**

Table R1c: Rest of Year, PTC Normal, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00709	0.43738	0.01655	18698	112078
	Intrusion Collisions	0.01726	0.43555	0.01545	18575	108473
	Diamond Collisions	0.00050	0.00533	0.00016	187	1195
	Overspeed	0.00193	0.09134	0.00147	7154	20684
	Broken Rail	0.01404	0.66562	0.01068	52131	150729
	Work Zone Violation	0.00000	0.08489	0.00849	0	33954
	Grade Crossing Collisions	0.48617	1.41585	0.02102	137315	341951
	Total, All Scenarios	0.52699	3.13596	0.07380	234060	769064
		0.00000	0.00000	0.00000	0	0
Freight	Train-Train Collisions	0.00642	0.00807	0.00081	2157	5385
	Intrusion Collisions	0.01001	0.00332	0.00033	418	1747
	Diamond Collisions	0.00281	0.00120	0.00012	465	945
	Overspeed	0.00577	0.00190	0.00019	3209	3970
	Broken Rail	0.02537	0.00836	0.00084	14099	17444
	Work Zone Violation	0.00000	0.03195	0.00319	0	12779
	Grade Crossing Collisions	0.09683	0.03678	0.00188	7340	16663
	Total, All Scenarios	0.14722	0.09158	0.00736	27688	58933
Total Passenger + Freight		**0.67420**	**3.22753**	**0.08116**	**261749**	**827996**

Table R1d: Rest of Year, PTC Normal, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01540	0.98988	0.03758	42600	254334
	Intrusion Collisions	0.03903	1.04052	0.03693	44428	259282
	Diamond Collisions	0.00097	0.01042	0.00031	365	2338
	Overspeed	0.00436	0.21323	0.00342	17109	48698
	Broken Rail	0.03176	1.55384	0.02494	124677	354874
	Work Zone Violation	0.00000	0.19776	0.01978	0	79106
	Grade Crossing Collisions	1.59459	4.75898	0.07068	461362	1149285
	Total, All Scenarios	1.68611	8.76463	0.19364	690540	2147918
Freight	Train-Train Collisions	0.01082	0.01333	0.00133	3567	8897
	Intrusion Collisions	0.01699	0.00554	0.00055	696	2913
	Diamond Collisions	0.00552	0.00237	0.00024	916	1862
	Overspeed	0.00876	0.00279	0.00028	4787	5903
	Broken Rail	0.04407	0.01396	0.00140	24029	29613
	Work Zone Violation	0.00000	0.05119	0.00512	0	20475
	Grade Crossing Collisions	0.21763	0.07663	0.00393	15287	34727
	Total, All Scenarios	0.30379	0.16580	0.01284	49281	104390
Total Passenger + Freight		**1.98990**	**8.93042**	**0.20648**	**739821**	**2252307**

Table R2a: Summer, PTC Normal, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Freight	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Total Passenger + Freight						

There are no seasonal traffic variations on the Joliet Sub-corridor. Therefore only one risk calculation is needed for the full year, and there is no separate summer calculation

Table R2b: Summer, PTC Normal, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00134	0.08869	0.00337	3825	22815
	Intrusion Collisions	0.00373	0.10078	0.00358	4295	25108
	Diamond Collisions	0.00007	0.00072	0.00002	25	162
	Overspeed	0.00042	0.02043	0.00033	1654	4679
	Broken Rail	0.00303	0.14885	0.00239	12052	34097
	Work Zone Violation	0.00000	0.01900	0.00190	0	7599
	Grade Crossing Collisions	0.17789	0.49691	0.00739	48163	120021
	Total, All Scenarios	0.18647	0.87538	0.01898	70014	214481
Freight	Train-Train Collisions	0.00035	0.00042	0.00004	113	283
	Intrusion Collisions	0.00088	0.00027	0.00003	34	144
	Diamond Collisions	0.00037	0.00016	0.00002	62	126
	Overspeed	0.00029	0.00008	0.00001	151	185
	Broken Rail	0.00243	0.00071	0.00007	1270	1554
	Work Zone Violation	0.00000	0.00219	0.00020	0	825
	Grade Crossing Collisions	0.01526	0.00479	0.00025	952	2167
	Total, All Scenarios	0.01958	0.00863	0.00061	2583	5284
Total Passenger + Freight		**0.20606**	**0.88402**	**0.01959**	**72597**	**219765**

Table R2c: Summer, PTC Normal, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00183	0.12221	0.00464	5241	31387
	Intrusion Collisions	0.00573	0.14465	0.00513	6169	36026
	Diamond Collisions	0.00014	0.00149	0.00004	52	335
	Overspeed	0.00064	0.03034	0.00049	2376	6869
	Broken Rail	0.00466	0.22106	0.00355	17314	50060
	Work Zone Violation	0.00000	0.02819	0.00282	0	11277
	Grade Crossing Collisions	0.16147	0.47023	0.00698	45605	113568
	Total, All Scenarios	0.17447	1.01818	0.02365	76756	249521
Freight	Train-Train Collisions	0.00034	0.00043	0.00004	115	286
	Intrusion Collisions	0.00173	0.00057	0.00006	72	302
	Diamond Collisions	0.00079	0.00034	0.00003	130	265
	Overspeed	0.00081	0.00027	0.00003	449	556
	Broken Rail	0.00457	0.00151	0.00015	2540	3143
	Work Zone Violation	0.00000	0.00505	0.00051	0	2021
	Grade Crossing Collisions	0.01745	0.00663	0.00034	1323	3002
	Total, All Scenarios	0.02568	0.01479	0.00116	4629	9575
Total Passenger + Freight		**0.20016**	**1.03297**	**0.02480**	**81386**	**259096**

Table R2d: Summer, PTC Normal, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00317	0.21091	0.00802	9066	54203
	Intrusion Collisions	0.00946	0.24543	0.00871	10464	61134
	Diamond Collisions	0.00021	0.00222	0.00007	78	497
	Overspeed	0.00106	0.05076	0.00081	4030	11548
	Broken Rail	0.00770	0.36992	0.00593	29365	84156
	Work Zone Violation	0.00000	0.04719	0.00472	0	18876
	Grade Crossing Collisions	0.33935	0.96714	0.01437	93768	233588
	Total, All Scenarios	0.36095	1.89356	0.04263	146770	464002
Freight	Train-Train Collisions	0.00069	0.00085	0.00009	228	569
	Intrusion Collisions	0.00261	0.00085	0.00008	107	446
	Diamond Collisions	0.00116	0.00050	0.00005	192	391
	Overspeed	0.00110	0.00035	0.00004	600	741
	Broken Rail	0.00700	0.00222	0.00022	3810	4697
	Work Zone Violation	0.00000	0.00724	0.00071	0	2846
	Grade Crossing Collisions	0.03270	0.01141	0.00058	2275	5169
	Total, All Scenarios	0.04527	0.02342	0.00177	7212	14858
Total Passenger + Freight		**0.40621**	**1.91699**	**0.04439**	**153983**	**478861**

Table R3a: All Year, PTC Normal, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00360	0.25551	0.00977	11120	65973
	Intrusion Collisions	0.01055	0.30153	0.01071	12921	75210
	Diamond Collisions	0.00025	0.00267	0.00008	93	599
	Overspeed	0.00118	0.06038	0.00097	4976	13926
	Broken Rail	0.00858	0.44003	0.00707	36258	101481
	Work Zone Violation	0.00000	0.05567	0.00557	0	22270
	Grade Crossing Collisions	0.57280	1.84693	0.02741	179028	445954
	Total, All Scenarios	0.59695	2.96273	0.06158	244397	725412
Freight	Train-Train Collisions	0.00097	0.00126	0.00013	335	838
	Intrusion Collisions	0.00248	0.00081	0.00008	102	427
	Diamond Collisions	0.00146	0.00063	0.00006	243	495
	Overspeed	0.00082	0.00026	0.00003	448	550
	Broken Rail	0.00688	0.00215	0.00021	3764	4622
	Work Zone Violation	0.00000	0.00638	0.00064	0	2551
	Grade Crossing Collisions	0.04672	0.01661	0.00085	3321	7543
	Total, All Scenarios	0.05934	0.02808	0.00200	8213	17025
Total Passenger + Freight		**0.65629**	**2.99081**	**0.06358**	**252609**	**742437**

Table R3b: All Year, PTC Normal, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00606	0.38568	0.01464	16607	99098
	Intrusion Collisions	0.01495	0.40421	0.01435	17226	100707
	Diamond Collisions	0.00029	0.00315	0.00009	110	707
	Overspeed	0.00167	0.08193	0.00131	6633	18767
	Broken Rail	0.01217	0.59704	0.00957	48339	136761
	Work Zone Violation	0.00000	0.07620	0.00762	0	30481
	Grade Crossing Collisions	0.71350	1.99312	0.02964	193181	481401
	Total, All Scenarios	0.74864	3.54133	0.07723	282097	867923
Freight	Train-Train Collisions	0.00378	0.00442	0.00044	1188	2958
	Intrusion Collisions	0.00537	0.00168	0.00017	210	883
	Diamond Collisions	0.00163	0.00070	0.00007	270	548
	Overspeed	0.00245	0.00072	0.00007	1281	1567
	Broken Rail	0.01425	0.00416	0.00042	7436	9101
	Work Zone Violation	0.00000	0.01506	0.00149	0	5971
	Grade Crossing Collisions	0.08933	0.02804	0.00144	5578	12688
	Total, All Scenarios	0.11682	0.05477	0.00409	15963	33716
Total Passenger + Freight		**0.86546**	**3.59610**	**0.08132**	**298060**	**901639**

Table R3c: All Year, PTC Normal, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00892	0.55960	0.02119	23939	143465
	Intrusion Collisions	0.02299	0.58020	0.02058	24744	144499
	Diamond Collisions	0.00063	0.00682	0.00020	239	1529
	Overspeed	0.00257	0.12168	0.00195	9530	27553
	Broken Rail	0.01871	0.88669	0.01422	69445	200788
	Work Zone Violation	0.00000	0.11308	0.01131	0	45231
	Grade Crossing Collisions	0.64764	1.88607	0.02800	182920	455519
	Total, All Scenarios	0.70146	4.15413	0.09745	310817	1018585
Freight	Train-Train Collisions	0.00676	0.00850	0.00085	2272	5671
	Intrusion Collisions	0.01175	0.00390	0.00039	490	2049
	Diamond Collisions	0.00359	0.00154	0.00015	595	1209
	Overspeed	0.00658	0.00217	0.00022	3658	4526
	Broken Rail	0.02994	0.00987	0.00099	16640	20587
	Work Zone Violation	0.00000	0.03700	0.00370	0	14800
	Grade Crossing Collisions	0.11427	0.04340	0.00222	8663	19665
	Total, All Scenarios	0.17290	0.10637	0.00852	32317	68507
Total Passenger + Freight		**0.87436**	**4.26050**	**0.10597**	**343134**	**1087092**

Table R3d: All Year, PTC Normal, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01857	1.20079	0.04560	51666	308537
	Intrusion Collisions	0.04849	1.28594	0.04564	54891	320416
	Diamond Collisions	0.00118	0.01264	0.00038	443	2835
	Overspeed	0.00541	0.26399	0.00424	21138	60246
	Broken Rail	0.03946	1.92376	0.03087	154042	439030
	Work Zone Violation	0.00000	0.24496	0.02450	0	97982
	Grade Crossing Collisions	1.93394	5.72612	0.08504	555129	1382874
	Total, All Scenarios	2.04705	10.65819	0.23626	837310	2611920
Freight	Train-Train Collisions	0.01152	0.01418	0.00142	3795	9466
	Intrusion Collisions	0.01960	0.00638	0.00064	802	3359
	Diamond Collisions	0.00668	0.00286	0.00029	1108	2253
	Overspeed	0.00986	0.00314	0.00031	5387	6644
	Broken Rail	0.05107	0.01618	0.00162	27839	34310
	Work Zone Violation	0.00000	0.05843	0.00583	0	23321
	Grade Crossing Collisions	0.25033	0.08804	0.00451	17562	39895
	Total, All Scenarios	0.34905	0.18922	0.01461	56493	119248
Total Passenger + Freight		**2.39611**	**10.84741**	**0.25087**	**893803**	**2731168**

Worksheet 4:
PTC Case, Timeout 60 seconds
Latency 10 seconds

PTC Timeout Operating State

Table R4a: Full Year, PTC Timeout, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00019	0.00001	8	49
	Intrusion Collisions	0.00001	0.00024	0.00001	10	60
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00009	0.00000	7	20
	Broken Rail	0.00001	0.00033	0.00001	27	77
	Work Zone Violation	0.00000	0.00005	0.00001	0	22
	Grade Crossing Collisions	0.00043	0.00140	0.00002	135	337
	Total, All Scenarios	0.00045	0.00230	0.00005	189	565
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0	1
	Intrusion Collisions	0.00000	0.00000	0.00000	0	0
	Diamond Collisions	0.00000	0.00000	0.00000	0	0
	Overspeed	0.00000	0.00000	0.00000	0	1
	Broken Rail	0.00001	0.00000	0.00000	3	3
	Work Zone Violation	0.00000	0.00001	0.00000	0	2
	Grade Crossing Collisions	0.00004	0.00001	0.00000	2	6
	Total, All Scenarios	0.00005	0.00002	0.00000	6	13
Total Passenger + Freight		**0.00050**	**0.00233**	**0.00005**	**195**	**579**

Table R4b: Rest of Year, PTC Timeout, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00023	0.00001	10	58
	Intrusion Collisions	0.00001	0.00024	0.00001	10	60
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00009	0.00000	7	21
	Broken Rail	0.00001	0.00034	0.00001	27	78
	Work Zone Violation	0.00000	0.00006	0.00001	0	23
	Grade Crossing Collisions	0.00040	0.00113	0.00002	110	273
	Total, All Scenarios	0.00043	0.00209	0.00005	164	513
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	1	2
	Intrusion Collisions	0.00000	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	0
	Overspeed	0.00000	0.00000	0.00000	1	1
	Broken Rail	0.00001	0.00000	0.00000	5	6
	Work Zone Violation	0.00000	0.00001	0.00000	0	4
	Grade Crossing Collisions	0.00006	0.00002	0.00000	3	8
	Total, All Scenarios	0.00007	0.00004	0.00000	10	22
Total Passenger + Freight		**0.00050**	**0.00212**	**0.00005**	**175**	**535**

Table R4c: Rest of Year, PTC Timeout, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00027	0.00001	11	69
	Intrusion Collisions	0.00001	0.00035	0.00001	15	86
	Diamond Collisions	0.00000	0.00001	0.00000	0	2
	Overspeed	0.00000	0.00013	0.00000	11	30
	Broken Rail	0.00001	0.00050	0.00001	39	114
	Work Zone Violation	0.00000	0.00008	0.00001	0	33
	Grade Crossing Collisions	0.00037	0.00107	0.00002	104	258
	Total, All Scenarios	0	0	0	180	593
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	2	4
	Intrusion Collisions	0.00001	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00000	0.00000	3	3
	Broken Rail	0.00002	0.00001	0.00000	10	13
	Work Zone Violation	0.00000	0.00002	0.00000	0	10
	Grade Crossing Collisions	0.00007	0.00003	0.00000	5	12
	Total, All Scenarios	0.00011	0.00007	0.00001	21	45
Total Passenger + Freight		**0.00051**	**0.00248**	**0.00006**	**201**	**637**

Table R4d: Rest of Year, PTC Timeout, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00068	0.00003	29	176
	Intrusion Collisions	0.00003	0.00083	0.00003	35	206
	Diamond Collisions	0.00000	0.00001	0.00000	0	3
	Overspeed	0.00001	0.00031	0.00001	25	72
	Broken Rail	0.00002	0.00117	0.00002	94	268
	Work Zone Violation	0.00000	0.00019	0.00002	0	78
	Grade Crossing Collisions	0.00120	0.00360	0.00005	349	868
	Total, All Scenarios	0.00128	0.00680	0.00015	533	1671
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	3	7
	Intrusion Collisions	0.00001	0.00000	0.00000	1	2
	Diamond Collisions	0.00000	0.00000	0.00000	1	2
	Overspeed	0.00001	0.00000	0.00000	4	5
	Broken Rail	0.00003	0.00001	0.00000	18	22
	Work Zone Violation	0.00000	0.00004	0.00000	0	16
	Grade Crossing Collisions	0.00016	0.00006	0.00000	11	26
	Total, All Scenarios	0.00023	0.00013	0.00001	37	80
Total Passenger + Freight		**0.00151**	**0.00693**	**0.00016**	**571**	**1751**

Table R5a: Summer, PTC Timeout, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Freight	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Total Passenger + Freight						

There are no seasonal traffic variations on the Joliet Sub-corridor. Therefore only one risk calculation is needed for the full year, and there is no separate summer calculation

Table R5b: Summer, PTC Timeout, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00007	0.00000	2.9	17.0
	Intrusion Collisions	0.00000	0.00008	0.00000	3.4	20.0
	Diamond Collisions	0.00000	0.00000	0.00000	0.0	0.2
	Overspeed	0.00000	0.00003	0.00000	2.4	6.9
	Broken Rail	0.00000	0.00011	0.00000	9.1	25.8
	Work Zone Violation	0.00000	0.00002	0.00000	0.0	7.5
	Grade Crossing Collisions	0.00013	0.00038	0.00001	36.4	90.7
	Total, All Scenarios	0.00014	0.00068	0.00002	54.2	168.0
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0.1	0.2
	Intrusion Collisions	0.00000	0.00000	0.00000	0.0	0.1
	Diamond Collisions	0.00000	0.00000	0.00000	0.1	0.1
	Overspeed	0.00000	0.00000	0.00000	0.2	0.2
	Broken Rail	0.00000	0.00000	0.00000	1.0	1.2
	Work Zone Violation	0.00000	0.00000	0.00000	0.0	0.5
	Grade Crossing Collisions	0.00002	0.00001	0.00000	1.1	2.6
	Total, All Scenarios	0.00002	0.00001	0.00000	2.4	4.9
Total Passenger + Freight		**0.00016**	**0.00069**	**0.00002**	**56.6**	**172.9**

Table R5c: Summer, PTC Timeout, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00009	0.00000	3.9	23.2
	Intrusion Collisions	0.00000	0.00012	0.00000	4.9	28.6
	Diamond Collisions	0.00000	0.00000	0.00000	0.1	0.4
	Overspeed	0.00000	0.00004	0.00000	3.5	10.1
	Broken Rail	0.00000	0.00017	0.00000	13.1	37.8
	Work Zone Violation	0.00000	0.00003	0.00000	0.0	8.5
	Grade Crossing Collisions	0.00012	0.00036	0.00001	34.5	85.8
	Total, All Scenarios	0.00013	0.00080	0.00002	59.9	194.5
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0.1	0.2
	Intrusion Collisions	0.00000	0.00000	0.00000	0.1	0.2
	Diamond Collisions	0.00000	0.00000	0.00000	0.1	0.2
	Overspeed	0.00000	0.00000	0.00000	0.4	0.5
	Broken Rail	0.00000	0.00000	0.00000	1.9	2.3
	Work Zone Violation	0.00000	0.00000	0.00000	0.0	1.7
	Grade Crossing Collisions	0.00001	0.00000	0.00000	1.0	2.2
	Total, All Scenarios	0.00002	0.00001	0.00000	3.5	7.4
Total Passenger + Freight		**0.00015**	**0.00081**	**0.00002**	**63.4**	**201.9**

Table R5d: Summer, PTC Timeout, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00016	0.00001	7	40
	Intrusion Collisions	0.00001	0.00020	0.00001	8	49
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00007	0.00000	6	17
	Broken Rail	0.00001	0.00028	0.00000	22	64
	Work Zone Violation	0.00000	0.00005	0.00000	0	16
	Grade Crossing Collisions	0.00026	0.00073	0.00001	71	177
	Total, All Scenarios	0.00027	0.00149	0.00003	114	362
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0	0
	Intrusion Collisions	0.00000	0.00000	0.00000	0	0
	Diamond Collisions	0.00000	0.00000	0.00000	0	0
	Overspeed	0.00000	0.00000	0.00000	1	1
	Broken Rail	0.00001	0.00000	0.00000	3	4
	Work Zone Violation	0.00000	0.00001	0.00000	0	2
	Grade Crossing Collisions	0.00003	0.00001	0.00000	2	5
	Total, All Scenarios	0.00004	0.00002	0.00000	6	12
Total Passenger + Freight		**0.00032**	**0.00151**	**0.00003**	**120**	**375**

Table R6a: All Year, PTC Timeout, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00019	0.00001	8	49
	Intrusion Collisions	0.00001	0.00024	0.00001	10	60
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00009	0.00000	7	20
	Broken Rail	0.00001	0.00033	0.00001	27	77
	Work Zone Violation	0.00000	0.00005	0.00001	0	22
	Grade Crossing Collisions	0.00043	0.00140	0.00002	135	337
	Total, All Scenarios	0.00045	0.00230	0.00005	189	565
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0	1
	Intrusion Collisions	0.00000	0.00000	0.00000	0	0
	Diamond Collisions	0.00000	0.00000	0.00000	0	0
	Overspeed	0.00000	0.00000	0.00000	0	1
	Broken Rail	0.00001	0.00000	0.00000	3	3
	Work Zone Violation	0.00000	0.00001	0.00000	0	2
	Grade Crossing Collisions	0.00004	0.00001	0.00000	2	6
	Total, All Scenarios	0.00005	0.00002	0.00000	6	13
bbb						
Total Passenger + Freight		**0.00050**	**0.00233**	**0.00005**	**195**	**579**

Table R6b: All Year, PTC Timeout, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00029	0.00001	13	75
	Intrusion Collisions	0.00001	0.00032	0.00001	14	80
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00012	0.00000	10	28
	Broken Rail	0.00001	0.00045	0.00001	37	103
	Work Zone Violation	0.00000	0.00008	0.00001	0	30
	Grade Crossing Collisions	0.00054	0.00151	0.00002	146	364
	Total, All Scenarios	0.00057	0.00277	0.00006	219	681
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	1	3
	Intrusion Collisions	0.00000	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	0
	Overspeed	0.00000	0.00000	0.00000	1	1
	Broken Rail	0.00001	0.00000	0.00000	6	7
	Work Zone Violation	0.00000	0.00001	0.00000	0	5
	Grade Crossing Collisions	0.00007	0.00002	0.00000	5	10
	Total, All Scenarios	0.00010	0.00004	0.00000	13	27
Total Passenger + Freight		**0.00066**	**0.00281**	**0.00006**	**231**	**707**

Table R6c: All Year, PTC Timeout, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00036	0.00001	15	92
	Intrusion Collisions	0.00002	0.00046	0.00002	20	115
	Diamond Collisions	0.00000	0.00001	0.00000	0	2
	Overspeed	0.00000	0.00018	0.00000	14	40
	Broken Rail	0.00001	0.00067	0.00001	52	152
	Work Zone Violation	0.00000	0.00011	0.00001	0	42
	Grade Crossing Collisions	0.00049	0.00143	0.00002	138	344
	Total, All Scenarios	0.00053	0.00322	0.00008	240	787
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	2	5
	Intrusion Collisions	0.00001	0.00000	0.00000	0	2
	Diamond Collisions	0.00000	0.00000	0.00000	1	1
	Overspeed	0.00001	0.00000	0.00000	3	4
	Broken Rail	0.00002	0.00001	0.00000	12	15
	Work Zone Violation	0.00000	0.00003	0.00000	0	12
	Grade Crossing Collisions	0.00008	0.00003	0.00000	6	15
	Total, All Scenarios	0.00013	0.00008	0.00001	24	52
Total Passenger + Freight		**0.00066**	**0.00330**	**0.00008**	**264**	**839**

Table R6d: All Year, PTC timeout, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00084	0.00003	36	216
	Intrusion Collisions	0.00004	0.00102	0.00004	44	255
	Diamond Collisions	0.00000	0.00002	0.00000	1	4
	Overspeed	0.00001	0.00039	0.00001	31	89
	Broken Rail	0.00003	0.00145	0.00002	116	332
	Work Zone Violation	0.00000	0.00024	0.00002	0	94
	Grade Crossing Collisions	0.00146	0.00433	0.00006	419	1045
	Total, All Scenarios	0.00155	0.00829	0.00019	647	2033
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	3	8
	Intrusion Collisions	0.00002	0.00000	0.00000	1	3
	Diamond Collisions	0.00001	0.00000	0.00000	1	2
	Overspeed	0.00001	0.00000	0.00000	4	6
	Broken Rail	0.00004	0.00001	0.00000	21	26
	Work Zone Violation	0.00000	0.00005	0.00000	0	18
	Grade Crossing Collisions	0.00019	0.00007	0.00000	13	31
	Total, All Scenarios	0.00027	0.00015	0.00001	43	92
Total Passenger + Freight		**0.00182**	**0.00844**	**0.00020**	**691**	**2126**

Worksheet 4:
PTC Case, Timeout 60 seconds
Latency 10 seconds

PTC Totals, All Operating States, All Year

Table R7a: Totals: All Year, All Operating States, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00360	0.25570	0.00977	11129	66022
	Intrusion Collisions	0.01055	0.30177	0.01072	12932	75270
	Diamond Collisions	0.00025	0.00267	0.00008	94	599
	Overspeed	0.00118	0.06047	0.00097	4983	13946
	Broken Rail	0.00859	0.44036	0.00708	36285	101557
	Work Zone Violation	0.00000	0.05573	0.00557	0	22292
	Grade Crossing Collisions	0.57323	1.84832	0.02743	179164	446291
	Total, All Scenarios	0.59740	2.96503	0.06163	244585	725977
Freight	Train-Train Collisions	0.00097	0.00126	0.00013	335	838
	Intrusion Collisions	0.00248	0.00081	0.00008	102	427
	Diamond Collisions	0.00146	0.00063	0.00006	243	495
	Overspeed	0.00082	0.00026	0.00003	449	551
	Broken Rail	0.00689	0.00215	0.00021	3766	4625
	Work Zone Violation	0.00000	0.00638	0.00064	0	2553
	Grade Crossing Collisions	0.04676	0.01662	0.00085	3324	7548
	Total, All Scenarios	0.05938	0.02810	0.00200	8219	17039
Total Passenger + Freight		**0.65679**	**2.99314**	**0.06363**	**252804**	**743016**

Table R7b: Totals: All Year, All Operating States, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00606	0.38597	0.01465	16619	99173
	Intrusion Collisions	0.01497	0.40453	0.01436	17240	100787
	Diamond Collisions	0.00029	0.00316	0.00009	111	708
	Overspeed	0.00167	0.08205	0.00132	6643	18795
	Broken Rail	0.01218	0.59749	0.00958	48376	136864
	Work Zone Violation	0.00000	0.07628	0.00763	0	30511
	Grade Crossing Collisions	0.71404	1.99462	0.02966	193327	481765
	Total, All Scenarios	0.74921	3.54410	0.07729	282315	868604
Freight	Train-Train Collisions	0.00378	0.00443	0.00044	1189	2960
	Intrusion Collisions	0.00538	0.00168	0.00017	211	884
	Diamond Collisions	0.00163	0.00070	0.00007	270	549
	Overspeed	0.00246	0.00072	0.00007	1282	1569
	Broken Rail	0.01426	0.00416	0.00042	7441	9107
	Work Zone Violation	0.00000	0.01507	0.00149	0	5976
	Grade Crossing Collisions	0.08941	0.02806	0.00144	5582	12698
	Total, All Scenarios	0.11691	0.05481	0.00410	15976	33743
Total Passenger + Freight		**0.86612**	**3.59891**	**0.08139**	**298291**	**902347**

Table R7c: Totals: All Year, All Operating States, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00893	0.55996	0.02120	23955	143557
	Intrusion Collisions	0.02301	0.58066	0.02059	24764	144614
	Diamond Collisions	0.00063	0.00683	0.00020	239	1531
	Overspeed	0.00257	0.12186	0.00195	9544	27594
	Broken Rail	0.01872	0.88736	0.01424	69497	200940
	Work Zone Violation	0.00000	0.11319	0.01132	0	45273
	Grade Crossing Collisions	0.64813	1.88750	0.02802	183058	455863
	Total, All Scenarios	0.70199	4.15735	0.09753	311057	1019372
Freight	Train-Train Collisions	0.00677	0.00850	0.00085	2273	5675
	Intrusion Collisions	0.01176	0.00390	0.00039	490	2051
	Diamond Collisions	0.00359	0.00154	0.00015	596	1210
	Overspeed	0.00659	0.00217	0.00022	3661	4530
	Broken Rail	0.02997	0.00988	0.00099	16652	20602
	Work Zone Violation	0.00000	0.03703	0.00370	0	14811
	Grade Crossing Collisions	0.11436	0.04343	0.00222	8669	19680
	Total, All Scenarios	0.17303	0.10645	0.00852	32342	68559
Total Passenger + Freight		**0.87502**	**4.26380**	**0.10605**	**343399**	**1087931**

Table R7d: Grand Total: All Year, All Operating States, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01859	1.20163	0.04563	51703	308753
	Intrusion Collisions	0.04853	1.28697	0.04568	54935	320671
	Diamond Collisions	0.00118	0.01266	0.00038	443	2839
	Overspeed	0.00542	0.26438	0.00424	21170	60335
	Broken Rail	0.03949	1.92521	0.03089	154158	439362
	Work Zone Violation	0.00000	0.24520	0.02452	0	98076
	Grade Crossing Collisions	1.93540	5.73045	0.08511	555549	1383918
	Total, All Scenarios	2.04861	10.66648	0.23645	837958	2613953
Freight	Train-Train Collisions	0.01152	0.01419	0.00142	3798	9474
	Intrusion Collisions	0.01962	0.00639	0.00064	803	3362
	Diamond Collisions	0.00669	0.00286	0.00029	1109	2255
	Overspeed	0.00986	0.00314	0.00031	5391	6649
	Broken Rail	0.05111	0.01619	0.00162	27860	34335
	Work Zone Violation	0.00000	0.05848	0.00583	0	23340
	Grade Crossing Collisions	0.25052	0.08811	0.00451	17575	39926
	Total, All Scenarios	0.34932	0.18937	0.01462	56536	119341
Total Passenger + Freight		**2.39793**	**10.85585**	**0.25107**	**894494**	**2733294**

Worksheet 5:
PTC Case: Timeout 20 seconds,
Latency 10 seconds.

Results Summary: PTC Case, Timeout 20 seconds, Latency 10 seconds.

PTC Normal Operating State

Table R1a: Full Year, PTC Normal, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00360	0.25564	0.00977	11126	66005
	Intrusion Collisions	0.01055	0.30168	0.01072	12928	75247
	Diamond Collisions	0.00025	0.00267	0.00008	94	599
	Overspeed	0.00118	0.06041	0.00097	4978	13933
	Broken Rail	0.00859	0.44024	0.00708	36276	101530
	Work Zone Violation	0.00000	0.05570	0.00557	0	22281
	Grade Crossing Collisions	0.57308	1.84783	0.02742	179116	446172
	Total, All Scenarios	0.59724	2.96418	0.06161	244517	725767
Freight	Train-Train Collisions	0.00097	0.00126	0.00013	335	838
	Intrusion Collisions	0.00248	0.00081	0.00008	102	427
	Diamond Collisions	0.00146	0.00063	0.00006	243	495
	Overspeed	0.00082	0.00026	0.00003	448	551
	Broken Rail	0.00688	0.00215	0.00021	3765	4624
	Work Zone Violation	0.00000	0.00638	0.00064	0	2552
	Grade Crossing Collisions	0.04674	0.01661	0.00085	3323	7546
	Total, All Scenarios	0.05937	0.02810	0.00200	8217	17034
Total Passenger + Freight		**0.65661**	**2.99228**	**0.06361**	**252733**	**742801**

Table R1b: Rest of Year, PTC Normal, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00472	0.29713	0.01127	12788	76320
	Intrusion Collisions	0.01123	0.30358	0.01078	12938	75636
	Diamond Collisions	0.00023	0.00243	0.00007	85	545
	Overspeed	0.00125	0.06153	0.00099	4982	14095
	Broken Rail	0.00914	0.44841	0.00719	36305	102715
	Work Zone Violation	0.00000	0.05723	0.00572	0	22893
	Grade Crossing Collisions	0.53588	1.49694	0.02226	145089	361558
	Total, All Scenarios	0.56245	2.66725	0.05828	212187	653762
Freight	Train-Train Collisions	0.00343	0.00400	0.00040	1075	2676
	Intrusion Collisions	0.00450	0.00140	0.00014	176	739
	Diamond Collisions	0.00126	0.00054	0.00005	208	423
	Overspeed	0.00216	0.00063	0.00006	1130	1383
	Broken Rail	0.01182	0.00345	0.00035	6169	7550
	Work Zone Violation	0.00000	0.01287	0.00129	0	5149
	Grade Crossing Collisions	0.07411	0.02326	0.00119	4628	10526
	Total, All Scenarios	0.09728	0.04616	0.00348	13386	28446
Total Passenger + Freight		**0.65973**	**2.71341**	**0.06176**	**225573**	**682208**

Table R1c: Rest of Year, PTC Normal, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00709	0.43760	0.01656	18708	112133
	Intrusion Collisions	0.01727	0.43576	0.01546	18584	108526
	Diamond Collisions	0.00050	0.00533	0.00016	187	1195
	Overspeed	0.00193	0.09139	0.00147	7157	20694
	Broken Rail	0.01405	0.66595	0.01068	52157	150802
	Work Zone Violation	0.00000	0.08493	0.00849	0	33971
	Grade Crossing Collisions	0.48641	1.41654	0.02103	137383	342119
	Total, All Scenarios	0.52724	3.13749	0.07384	234175	769441
		0.00000	0.00000	0.00000	0	0
Freight	Train-Train Collisions	0.00642	0.00807	0.00081	2158	5387
	Intrusion Collisions	0.01002	0.00332	0.00033	418	1748
	Diamond Collisions	0.00281	0.00120	0.00012	465	945
	Overspeed	0.00578	0.00190	0.00019	3211	3972
	Broken Rail	0.02538	0.00837	0.00084	14106	17453
	Work Zone Violation	0.00000	0.03196	0.00320	0	12785
	Grade Crossing Collisions	0.09688	0.03679	0.00188	7344	16671
	Total, All Scenarios	0.14729	0.09162	0.00737	27702	58961
Total Passenger + Freight		**0.67453**	**3.22912**	**0.08120**	**261877**	**828402**

Table R1d: Rest of Year, PTC Normal, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01541	0.99037	0.03760	42621	254459
	Intrusion Collisions	0.03905	1.04102	0.03695	44449	259409
	Diamond Collisions	0.00097	0.01043	0.00031	365	2339
	Overspeed	0.00436	0.21333	0.00342	17117	48722
	Broken Rail	0.03178	1.55460	0.02495	124738	355048
	Work Zone Violation	0.00000	0.19786	0.01979	0	79145
	Grade Crossing Collisions	1.59537	4.76131	0.07071	461588	1149848
	Total, All Scenarios	1.68693	8.76892	0.19373	690878	2148970
Freight	Train-Train Collisions	0.01083	0.01333	0.00133	3568	8901
	Intrusion Collisions	0.01700	0.00554	0.00055	696	2914
	Diamond Collisions	0.00553	0.00237	0.00024	916	1863
	Overspeed	0.00876	0.00279	0.00028	4789	5906
	Broken Rail	0.04409	0.01397	0.00140	24041	29627
	Work Zone Violation	0.00000	0.05121	0.00512	0	20485
	Grade Crossing Collisions	0.21773	0.07667	0.00393	15294	34744
	Total, All Scenarios	0.30394	0.16588	0.01285	49305	104441
Total Passenger + Freight		**1.99087**	**8.93480**	**0.20658**	**740183**	**2253411**

Table R2a: Summer, PTC Normal, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Freight	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Total Passenger + Freight						

Table R2b: Summer, PTC Normal, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00134	0.08874	0.00338	3827	22827
	Intrusion Collisions	0.00373	0.10082	0.00358	4297	25120
	Diamond Collisions	0.00007	0.00072	0.00002	25	162
	Overspeed	0.00042	0.02044	0.00033	1655	4681
	Broken Rail	0.00304	0.14892	0.00239	12058	34113
	Work Zone Violation	0.00000	0.01901	0.00190	0	7603
	Grade Crossing Collisions	0.17797	0.49716	0.00739	48186	120079
	Total, All Scenarios	0.18656	0.87581	0.01899	70048	214586
Freight	Train-Train Collisions	0.00036	0.00043	0.00004	113	283
	Intrusion Collisions	0.00088	0.00027	0.00003	34	144
	Diamond Collisions	0.00037	0.00016	0.00002	62	126
	Overspeed	0.00029	0.00008	0.00001	151	185
	Broken Rail	0.00243	0.00071	0.00007	1270	1555
	Work Zone Violation	0.00000	0.00219	0.00020	0	825
	Grade Crossing Collisions	0.01526	0.00479	0.00025	953	2168
	Total, All Scenarios	0.01959	0.00864	0.00061	2584	5286
Total Passenger + Freight		0.20616	0.88445	0.01960	72632	219873

Table R2c: Summer, PTC Normal, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00183	0.12227	0.00464	5243	31403
	Intrusion Collisions	0.00573	0.14472	0.00513	6172	36043
	Diamond Collisions	0.00014	0.00149	0.00004	52	335
	Overspeed	0.00064	0.03035	0.00049	2377	6873
	Broken Rail	0.00467	0.22117	0.00355	17322	50084
	Work Zone Violation	0.00000	0.02821	0.00282	0	11282
	Grade Crossing Collisions	0.16155	0.47046	0.00698	45627	113623
	Total, All Scenarios	0.17456	1.01868	0.02366	76794	249643
Freight	Train-Train Collisions	0.00034	0.00043	0.00004	115	286
	Intrusion Collisions	0.00173	0.00057	0.00006	72	302
	Diamond Collisions	0.00079	0.00034	0.00003	130	265
	Overspeed	0.00081	0.00027	0.00003	449	556
	Broken Rail	0.00457	0.00151	0.00015	2542	3144
	Work Zone Violation	0.00000	0.00505	0.00051	0	2022
	Grade Crossing Collisions	0.01745	0.00663	0.00034	1323	3004
	Total, All Scenarios	0.02569	0.01480	0.00116	4631	9579
Total Passenger + Freight		**0.20025**	**1.03348**	**0.02482**	**81426**	**259223**

Table R2d: Summer, PTC Normal, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00317	0.21101	0.00802	9071	54229
	Intrusion Collisions	0.00946	0.24555	0.00871	10469	61163
	Diamond Collisions	0.00021	0.00222	0.00007	78	497
	Overspeed	0.00106	0.05079	0.00081	4032	11554
	Broken Rail	0.00770	0.37010	0.00594	29380	84197
	Work Zone Violation	0.00000	0.04721	0.00472	0	18886
	Grade Crossing Collisions	0.33952	0.96761	0.01438	93814	233703
	Total, All Scenarios	0.36112	1.89449	0.04265	146842	464230
Freight	Train-Train Collisions	0.00069	0.00085	0.00009	228	570
	Intrusion Collisions	0.00261	0.00085	0.00008	107	446
	Diamond Collisions	0.00116	0.00050	0.00005	192	391
	Overspeed	0.00110	0.00035	0.00004	601	741
	Broken Rail	0.00701	0.00222	0.00022	3812	4699
	Work Zone Violation	0.00000	0.00725	0.00071	0	2847
	Grade Crossing Collisions	0.03272	0.01142	0.00058	2276	5171
	Total, All Scenarios	0.04529	0.02343	0.00177	7216	14866
Total Passenger + Freight		**0.40641**	**1.91792**	**0.04441**	**154058**	**479095**

Table R3a: All Year, PTC Normal, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00360	0.25564	0.00977	11126	66005
	Intrusion Collisions	0.01055	0.30168	0.01072	12928	75247
	Diamond Collisions	0.00025	0.00267	0.00008	94	599
	Overspeed	0.00118	0.06041	0.00097	4978	13933
	Broken Rail	0.00859	0.44024	0.00708	36276	101530
	Work Zone Violation	0.00000	0.05570	0.00557	0	22281
	Grade Crossing Collisions	0.57308	1.84783	0.02742	179116	446172
	Total, All Scenarios	0.59724	2.96418	0.06161	244517	725767
Freight	Train-Train Collisions	0.00097	0.00126	0.00013	335	838
	Intrusion Collisions	0.00248	0.00081	0.00008	102	427
	Diamond Collisions	0.00146	0.00063	0.00006	243	495
	Overspeed	0.00082	0.00026	0.00003	448	551
	Broken Rail	0.00688	0.00215	0.00021	3765	4624
	Work Zone Violation	0.00000	0.00638	0.00064	0	2552
	Grade Crossing Collisions	0.04674	0.01661	0.00085	3323	7546
	Total, All Scenarios	0.05937	0.02810	0.00200	8217	17034
Total Passenger + Freight		0.65661	2.99228	0.06361	252733	742801

Table R3b: All Year, PTC Normal, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00606	0.38586	0.01465	16615	99147
	Intrusion Collisions	0.01496	0.40441	0.01436	17234	100756
	Diamond Collisions	0.00029	0.00315	0.00009	110	708
	Overspeed	0.00167	0.08197	0.00131	6637	18776
	Broken Rail	0.01217	0.59733	0.00958	48363	136828
	Work Zone Violation	0.00000	0.07624	0.00762	0	30496
	Grade Crossing Collisions	0.71385	1.99409	0.02965	193275	481637
	Total, All Scenarios	0.74901	3.54306	0.07727	282235	868349
Freight	Train-Train Collisions	0.00378	0.00443	0.00044	1189	2959
	Intrusion Collisions	0.00538	0.00168	0.00017	211	883
	Diamond Collisions	0.00163	0.00070	0.00007	270	549
	Overspeed	0.00245	0.00072	0.00007	1281	1568
	Broken Rail	0.01425	0.00416	0.00042	7440	9105
	Work Zone Violation	0.00000	0.01506	0.00149	0	5974
	Grade Crossing Collisions	0.08938	0.02805	0.00144	5581	12694
	Total, All Scenarios	0.11687	0.05480	0.00409	15971	33732
Total Passenger + Freight		0.86589	3.59786	0.08136	298206	902081

Table R3c: All Year, PTC Normal, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00892	0.55987	0.02120	23951	143536
	Intrusion Collisions	0.02300	0.58049	0.02059	24756	144570
	Diamond Collisions	0.00063	0.00682	0.00020	239	1530
	Overspeed	0.00257	0.12174	0.00195	9534	27567
	Broken Rail	0.01872	0.88712	0.01423	69479	200886
	Work Zone Violation	0.00000	0.11313	0.01131	0	45253
	Grade Crossing Collisions	0.64796	1.88700	0.02801	183010	455742
	Total, All Scenarios	0.70180	4.15617	0.09750	310969	1019084
Freight	Train-Train Collisions	0.00676	0.00850	0.00085	2273	5673
	Intrusion Collisions	0.01175	0.00390	0.00039	490	2050
	Diamond Collisions	0.00359	0.00154	0.00015	595	1210
	Overspeed	0.00659	0.00217	0.00022	3660	4528
	Broken Rail	0.02996	0.00987	0.00099	16648	20597
	Work Zone Violation	0.00000	0.03702	0.00370	0	14807
	Grade Crossing Collisions	0.11433	0.04342	0.00222	8667	19675
	Total, All Scenarios	0.17298	0.10642	0.00852	32333	68541
Total Passenger + Freight		**0.87478**	**4.26259**	**0.10602**	**343302**	**1087625**

Table R3d: All Year, PTC Normal, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01858	1.20138	0.04562	51692	308688
	Intrusion Collisions	0.04851	1.28657	0.04567	54918	320573
	Diamond Collisions	0.00118	0.01265	0.00038	443	2837
	Overspeed	0.00542	0.26412	0.00424	21149	60276
	Broken Rail	0.03948	1.92470	0.03089	154117	439245
	Work Zone Violation	0.00000	0.24508	0.02451	0	98030
	Grade Crossing Collisions	1.93489	5.72892	0.08509	555401	1383551
	Total, All Scenarios	2.04806	10.66341	0.23638	837721	2613200
Freight	Train-Train Collisions	0.01152	0.01419	0.00142	3797	9471
	Intrusion Collisions	0.01961	0.00639	0.00064	803	3361
	Diamond Collisions	0.00669	0.00286	0.00029	1109	2254
	Overspeed	0.00986	0.00314	0.00031	5390	6647
	Broken Rail	0.05110	0.01618	0.00162	27853	34327
	Work Zone Violation	0.00000	0.05846	0.00583	0	23333
	Grade Crossing Collisions	0.25045	0.08809	0.00451	17570	39915
	Total, All Scenarios	0.34922	0.18931	0.01462	56521	119307
Total Passenger + Freight		**2.39728**	**10.85272**	**0.25100**	**894241**	**2732506**

Worksheet 5:
PTC Case: Timeout 20 seconds,
Latency 10 seconds.

PTC Timeout Operating State

Table R4a: Full Year, PTC Timeout, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00006	0.00000	3	16
	Intrusion Collisions	0.00000	0.00008	0.00000	3	19
	Diamond Collisions	0.00000	0.00000	0.00000	0	0
	Overspeed	0.00000	0.00002	0.00000	1	4
	Broken Rail	0.00000	0.00011	0.00000	9	25
	Work Zone Violation	0.00000	0.00001	0.00000	0	6
	Grade Crossing Collisions	0.00014	0.00046	0.00001	44	110
	Total, All Scenarios	0.00015	0.00074	0.00002	61	180
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0	0
	Intrusion Collisions	0.00000	0.00000	0.00000	0	0
	Diamond Collisions	0.00000	0.00000	0.00000	0	0
	Overspeed	0.00000	0.00000	0.00000	0	0
	Broken Rail	0.00000	0.00000	0.00000	1	1
	Work Zone Violation	0.00000	0.00000	0.00000	0	1
	Grade Crossing Collisions	0.00001	0.00000	0.00000	1	2
	Total, All Scenarios	0.00001	0.00001	0.00000	2	4
Total Passenger + Freight		**0.00016**	**0.00074**	**0.00002**	**63**	**184**

Table R4b: Rest of Year, PTC Timeout, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00008	0.00000	3	19
	Intrusion Collisions	0.00000	0.00008	0.00000	3	19
	Diamond Collisions	0.00000	0.00000	0.00000	0	0
	Overspeed	0.00000	0.00002	0.00000	1	4
	Broken Rail	0.00000	0.00011	0.00000	9	25
	Work Zone Violation	0.00000	0.00001	0.00000	0	6
	Grade Crossing Collisions	0.00013	0.00037	0.00001	36	89
	Total, All Scenarios	0.00014	0.00066	0.00001	53	163
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0	1
	Intrusion Collisions	0.00000	0.00000	0.00000	0	0
	Diamond Collisions	0.00000	0.00000	0.00000	0	0
	Overspeed	0.00000	0.00000	0.00000	0	0
	Broken Rail	0.00000	0.00000	0.00000	2	2
	Work Zone Violation	0.00000	0.00000	0.00000	0	1
	Grade Crossing Collisions	0.00002	0.00001	0.00000	1	3
	Total, All Scenarios	0.00002	0.00001	0.00000	3	7
Total Passenger + Freight		**0**	**0**	**0**	**56**	**170**

Table R4c: Rest of Year, PTC Timeout, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00009	0.00000	4	23
	Intrusion Collisions	0.00000	0.00011	0.00000	5	27
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00003	0.00000	2	6
	Broken Rail	0.00000	0.00016	0.00000	13	37
	Work Zone Violation	0.00000	0.00002	0.00000	0	9
	Grade Crossing Collisions	0.00012	0.00035	0.00001	34	84
	Total, All Scenarios	0	0	0	57	187
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	1	1
	Intrusion Collisions	0.00000	0.00000	0.00000	0	0
	Diamond Collisions	0.00000	0.00000	0.00000	0	0
	Overspeed	0.00000	0.00000	0.00000	1	1
	Broken Rail	0.00001	0.00000	0.00000	3	4
	Work Zone Violation	0.00000	0.00001	0.00000	0	3
	Grade Crossing Collisions	0.00002	0.00001	0.00000	2	4
	Total, All Scenarios	0	0	0	7	15
Total Passenger + Freight		**0**	**0**	**0**	**64**	**202**

Table R4d: Rest of Year, PTC Timeout, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00023	0.00001	10	59
	Intrusion Collisions	0.00001	0.00026	0.00001	11	65
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00006	0.00000	5	14
	Broken Rail	0.00001	0.00038	0.00001	31	87
	Work Zone Violation	0.00000	0.00005	0.00001	0	21
	Grade Crossing Collisions	0.00039	0.00117	0.00002	114	283
	Total, All Scenarios	0.00042	0.00216	0.00005	171	530
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	1	3
	Intrusion Collisions	0.00000	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00000	0.00000	1	1
	Broken Rail	0.00001	0.00000	0.00000	6	7
	Work Zone Violation	0.00000	0.00001	0.00000	0	5
	Grade Crossing Collisions	0.00005	0.00002	0.00000	4	9
	Total, All Scenarios	0.00008	0.00004	0.00000	12	26
Total Passenger + Freight		**0.00049**	**0.00221**	**0.00005**	**183**	**556**

Table R5a: Summer, PTC Timeout, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Freight	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Total Passenger + Freight						

Table R5b: Summer, PTC Timeout, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00002	0.00000	1.0	5.7
	Intrusion Collisions	0.00000	0.00003	0.00000	1.1	6.3
	Diamond Collisions	0.00000	0.00000	0.00000	0.0	0.1
	Overspeed	0.00000	0.00001	0.00000	0.5	1.4
	Broken Rail	0.00000	0.00004	0.00000	3.0	8.4
	Work Zone Violation	0.00000	0.00000	0.00000	0.0	2.0
	Grade Crossing Collisions	0.00004	0.00012	0.00000	11.9	29.6
	Total, All Scenarios	0.00005	0.00022	0.00000	17.4	53.4
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0.0	0.1
	Intrusion Collisions	0.00000	0.00000	0.00000	0.0	0.0
	Diamond Collisions	0.00000	0.00000	0.00000	0.0	0.0
	Overspeed	0.00000	0.00000	0.00000	0.0	0.0
	Broken Rail	0.00000	0.00000	0.00000	0.3	0.4
	Work Zone Violation	0.00000	0.00000	0.00000	0.0	0.1
	Grade Crossing Collisions	0.00001	0.00000	0.00000	0.4	0.9
	Total, All Scenarios	0.00001	0.00000	0.00000	0.8	1.6
Total Passenger + Freight		0.00005	0.00022	0.00000	18.2	54.9

Table R5c: Summer, PTC Timeout, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00003	0.00000	1.3	7.8
	Intrusion Collisions	0.00000	0.00004	0.00000	1.5	9.0
	Diamond Collisions	0.00000	0.00000	0.00000	0.0	0.1
	Overspeed	0.00000	0.00001	0.00000	0.7	2.0
	Broken Rail	0.00000	0.00005	0.00000	4.3	12.3
	Work Zone Violation	0.00000	0.00001	0.00000	0.0	2.3
	Grade Crossing Collisions	0.00004	0.00012	0.00000	11.2	28.0
	Total, All Scenarios	0.00004	0.00025	0.00001	19.1	61.5
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0.0	0.1
	Intrusion Collisions	0.00000	0.00000	0.00000	0.0	0.1
	Diamond Collisions	0.00000	0.00000	0.00000	0.0	0.1
	Overspeed	0.00000	0.00000	0.00000	0.1	0.1
	Broken Rail	0.00000	0.00000	0.00000	0.6	0.8
	Work Zone Violation	0.00000	0.00000	0.00000	0.0	0.5
	Grade Crossing Collisions	0.00000	0.00000	0.00000	0.3	0.7
	Total, All Scenarios	0.00001	0.00000	0.00000	1.1	2.4
Total Passenger + Freight		**0.00005**	**0.00026**	**0.00001**	**20.2**	**63.9**

Table R5d: Summer, PTC Timeout, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00005	0.00000	2	13
	Intrusion Collisions	0.00000	0.00006	0.00000	3	15
	Diamond Collisions	0.00000	0.00000	0.00000	0	0
	Overspeed	0.00000	0.00001	0.00000	1	3
	Broken Rail	0.00000	0.00009	0.00000	7	21
	Work Zone Violation	0.00000	0.00001	0.00000	0	4
	Grade Crossing Collisions	0.00008	0.00024	0.00000	23	58
	Total, All Scenarios	0.00009	0.00047	0.00001	36	115
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0	0
	Intrusion Collisions	0.00000	0.00000	0.00000	0	0
	Diamond Collisions	0.00000	0.00000	0.00000	0	0
	Overspeed	0.00000	0.00000	0.00000	0	0
	Broken Rail	0.00000	0.00000	0.00000	1	1
	Work Zone Violation	0.00000	0.00000	0.00000	0	1
	Grade Crossing Collisions	0.00001	0.00000	0.00000	1	2
	Total, All Scenarios	0.00001	0.00001	0.00000	2	4
Total Passenger + Freight		**0.00010**	**0.00048**	**0.00001**	**38**	**119**

Table R6a: All Year, PTC Timeout, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00006	0.00000	3	16
	Intrusion Collisions	0.00000	0.00008	0.00000	3	19
	Diamond Collisions	0.00000	0.00000	0.00000	0	0
	Overspeed	0.00000	0.00002	0.00000	1	4
	Broken Rail	0.00000	0.00011	0.00000	9	25
	Work Zone Violation	0.00000	0.00001	0.00000	0	6
	Grade Crossing Collisions	0.00014	0.00046	0.00001	44	110
	Total, All Scenarios	0.00015	0.00074	0.00002	61	180
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0	0
	Intrusion Collisions	0.00000	0.00000	0.00000	0	0
	Diamond Collisions	0.00000	0.00000	0.00000	0	0
	Overspeed	0.00000	0.00000	0.00000	0	0
	Broken Rail	0.00000	0.00000	0.00000	1	1
	Work Zone Violation	0.00000	0.00000	0.00000	0	1
	Grade Crossing Collisions	0.00001	0.00000	0.00000	1	2
	Total, All Scenarios	0.00001	0.00001	0.00000	2	4
bbb						
Total Passenger + Freight		**0.00016**	**0.00074**	**0.00002**	**63**	**184**

Table R6b: All Year, PTC Timeout, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00010	0.00000	4	25
	Intrusion Collisions	0.00000	0.00010	0.00000	4	25
	Diamond Collisions	0.00000	0.00000	0.00000	0	0
	Overspeed	0.00000	0.00002	0.00000	2	6
	Broken Rail	0.00000	0.00015	0.00000	12	34
	Work Zone Violation	0.00000	0.00002	0.00000	0	8
	Grade Crossing Collisions	0.00018	0.00049	0.00001	48	119
	Total, All Scenarios	0.00018	0.00088	0.00002	70	216
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0	1
	Intrusion Collisions	0.00000	0.00000	0.00000	0	0
	Diamond Collisions	0.00000	0.00000	0.00000	0	0
	Overspeed	0.00000	0.00000	0.00000	0	0
	Broken Rail	0.00000	0.00000	0.00000	2	2
	Work Zone Violation	0.00000	0.00000	0.00000	0	1
	Grade Crossing Collisions	0.00002	0.00001	0.00000	2	3
	Total, All Scenarios	0.00003	0.00001	0.00000	4	9
Total Passenger + Freight		0.00022	0.00090	0.00002	74	225

Table R6c: All Year, PTC Timeout, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00012	0.00000	5	31
	Intrusion Collisions	0.00001	0.00014	0.00001	6	36
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00004	0.00000	3	8
	Broken Rail	0.00000	0.00022	0.00000	17	49
	Work Zone Violation	0.00000	0.00003	0.00000	0	11
	Grade Crossing Collisions	0.00016	0.00046	0.00001	45	112
	Total, All Scenarios	0.00017	0.00102	0.00002	76	249
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	1	2
	Intrusion Collisions	0.00000	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	0
	Overspeed	0.00000	0.00000	0.00000	1	1
	Broken Rail	0.00001	0.00000	0.00000	4	5
	Work Zone Violation	0.00000	0.00001	0.00000	0	4
	Grade Crossing Collisions	0.00003	0.00001	0.00000	2	5
	Total, All Scenarios	0.00004	0.00003	0.00000	8	17
Total Passenger + Freight		**0.00022**	**0.00104**	**0.00003**	**84**	**266**

Table R6d: All Year, PTC timeout, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00028	0.00001	12	72
	Intrusion Collisions	0.00001	0.00032	0.00001	14	80
	Diamond Collisions	0.00000	0.00001	0.00000	0	1
	Overspeed	0.00000	0.00008	0.00000	6	18
	Broken Rail	0.00001	0.00047	0.00001	38	108
	Work Zone Violation	0.00000	0.00006	0.00001	0	25
	Grade Crossing Collisions	0.00048	0.00141	0.00002	137	341
	Total, All Scenarios	0.00051	0.00263	0.00006	207	645
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	1	3
	Intrusion Collisions	0.00000	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00000	0.00000	1	2
	Broken Rail	0.00001	0.00000	0.00000	7	8
	Work Zone Violation	0.00000	0.00001	0.00000	0	6
	Grade Crossing Collisions	0.00006	0.00002	0.00000	4	10
	Total, All Scenarios	0.00009	0.00005	0.00000	14	30
Total Passenger + Freight		**0.00059**	**0.00268**	**0.00006**	**221**	**675**

Worksheet 5:
PTC Case: Timeout 20 seconds,
Latency 10 seconds.

PTC Totals, All Operating States, All Year

Table R7a: totals: All Year, All Operating States, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00360	0.25570	0.00977	11128	66022
	Intrusion Collisions	0.01055	0.30175	0.01072	12931	75266
	Diamond Collisions	0.00025	0.00267	0.00008	94	599
	Overspeed	0.00118	0.06043	0.00097	4979	13937
	Broken Rail	0.00859	0.44035	0.00708	36285	101556
	Work Zone Violation	0.00000	0.05572	0.00557	0	22286
	Grade Crossing Collisions	0.57322	1.84829	0.02743	179160	446282
	Total, All Scenarios	0.59739	2.96492	0.06163	244577	725947
Freight	Train-Train Collisions	0.00097	0.00126	0.00013	335	838
	Intrusion Collisions	0.00248	0.00081	0.00008	102	427
	Diamond Collisions	0.00146	0.00063	0.00006	243	495
	Overspeed	0.00082	0.00026	0.00003	448	551
	Broken Rail	0.00689	0.00215	0.00021	3766	4625
	Work Zone Violation	0.00000	0.00638	0.00064	0	2552
	Grade Crossing Collisions	0.04675	0.01662	0.00085	3324	7548
	Total, All Scenarios	0.05938	0.02810	0.00200	8219	17038
Total Passenger + Freight		**0.65677**	**2.99302**	**0.06363**	**252796**	**742985**

Table R7b: Totals: All Year, All Operating States, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00606	0.38596	0.01465	16619	99172
	Intrusion Collisions	0.01496	0.40451	0.01436	17239	100781
	Diamond Collisions	0.00029	0.00316	0.00009	111	708
	Overspeed	0.00167	0.08199	0.00131	6639	18782
	Broken Rail	0.01218	0.59748	0.00958	48375	136862
	Work Zone Violation	0.00000	0.07626	0.00763	0	30504
	Grade Crossing Collisions	0.71403	1.99459	0.02966	193323	481756
	Total, All Scenarios	0.74920	3.54395	0.07729	282305	868565
Freight	Train-Train Collisions	0.00378	0.00443	0.00044	1189	2960
	Intrusion Collisions	0.00538	0.00168	0.00017	211	884
	Diamond Collisions	0.00163	0.00070	0.00007	270	549
	Overspeed	0.00246	0.00072	0.00007	1282	1569
	Broken Rail	0.01426	0.00416	0.00042	7441	9107
	Work Zone Violation	0.00000	0.01507	0.00149	0	5975
	Grade Crossing Collisions	0.08940	0.02806	0.00144	5582	12697
	Total, All Scenarios	0.11691	0.05481	0.00410	15975	33741
Total Passenger + Freight		**0.86610**	**3.59876**	**0.08138**	**298280**	**902306**

Table R7c: Totals: All Year, All Operating States, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00893	0.55999	0.02120	23956	143567
	Intrusion Collisions	0.02301	0.58063	0.02059	24762	144606
	Diamond Collisions	0.00063	0.00682	0.00020	239	1531
	Overspeed	0.00257	0.12177	0.00195	9537	27575
	Broken Rail	0.01872	0.88734	0.01424	69496	200936
	Work Zone Violation	0.00000	0.11316	0.01132	0	45264
	Grade Crossing Collisions	0.64812	1.88746	0.02802	183055	455854
	Total, All Scenarios	0.70198	4.15719	0.09752	311045	1019333
Freight	Train-Train Collisions	0.00677	0.00850	0.00085	2273	5675
	Intrusion Collisions	0.01175	0.00390	0.00039	490	2051
	Diamond Collisions	0.00359	0.00154	0.00015	596	1210
	Overspeed	0.00659	0.00217	0.00022	3661	4529
	Broken Rail	0.02997	0.00988	0.00099	16652	20602
	Work Zone Violation	0.00000	0.03703	0.00370	0	14810
	Grade Crossing Collisions	0.11436	0.04343	0.00222	8669	19680
	Total, All Scenarios	0.17302	0.10645	0.00852	32341	68558
Total Passenger + Freight		**0.87500**	**4.26363**	**0.10605**	**343387**	**1087890**

Table R7d: Grand Total: All Year, All Operating States, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01859	1.20166	0.04563	51704	308760
	Intrusion Collisions	0.04852	1.28689	0.04568	54932	320653
	Diamond Collisions	0.00118	0.01265	0.00038	443	2838
	Overspeed	0.00542	0.26420	0.00424	21155	60293
	Broken Rail	0.03949	1.92517	0.03089	154155	439353
	Work Zone Violation	0.00000	0.24514	0.02451	0	98055
	Grade Crossing Collisions	1.93537	5.73034	0.08511	555538	1383892
	Total, All Scenarios	2.04856	10.66605	0.23644	837928	2613845
Freight	Train-Train Collisions	0.01152	0.01419	0.00142	3798	9473
	Intrusion Collisions	0.01962	0.00639	0.00064	803	3362
	Diamond Collisions	0.00669	0.00286	0.00029	1109	2255
	Overspeed	0.00986	0.00314	0.00031	5391	6649
	Broken Rail	0.05111	0.01619	0.00162	27860	34335
	Work Zone Violation	0.00000	0.05848	0.00583	0	23338
	Grade Crossing Collisions	0.25051	0.08811	0.00451	17575	39925
	Total, All Scenarios	0.34931	0.18936	0.01462	56535	119337
Total Passenger + Freight		**2.39788**	**10.85541**	**0.25106**	**894462**	**2733181**

Worksheet 6:
PTC Case, Timeout 120 seconds,
Latency 20 seconds

Results Summary: PTC Case, Timeout 120 Seconds, Latency 20 seconds.

PTC Normal Operating State

Table R1a: Full Year, PTC Normal, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00361	0.25603	0.00978	11142	66099
	Intrusion Collisions	0.01078	0.30625	0.01088	13123	76384
	Diamond Collisions	0.00028	0.00304	0.00009	107	682
	Overspeed	0.00141	0.07241	0.00116	5966	16699
	Broken Rail	0.00863	0.44245	0.00711	36458	102040
	Work Zone Violation	0.00000	0.05953	0.00595	0	23811
	Grade Crossing Collisions	0.57595	1.85711	0.02756	180015	448411
	Total, All Scenarios	0.60067	2.99681	0.06255	246810	734126
Freight	Train-Train Collisions	0.00099	0.00128	0.00013	340	852
	Intrusion Collisions	0.00254	0.00083	0.00008	104	437
	Diamond Collisions	0.00152	0.00065	0.00006	251	509
	Overspeed	0.00088	0.00027	0.00003	481	591
	Broken Rail	0.00691	0.00215	0.00022	3778	4640
	Work Zone Violation	0.00000	0.00664	0.00066	0	2655
	Grade Crossing Collisions	0.04690	0.01667	0.00086	3334	7572
	Total, All Scenarios	0.05974	0.02849	0.00204	8289	17257
Total Passenger + Freight		**0.66040**	**3.02530**	**0.06458**	**255100**	**751383**

Table R1b: Rest of Year, PTC Normal, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00479	0.30004	0.01138	12911	77042
	Intrusion Collisions	0.01147	0.30818	0.01094	13133	76780
	Diamond Collisions	0.00026	0.00277	0.00008	97	622
	Overspeed	0.00150	0.07375	0.00118	5971	16893
	Broken Rail	0.00919	0.45066	0.00723	36488	103230
	Work Zone Violation	0.00000	0.06116	0.00612	0	24466
	Grade Crossing Collisions	0.53857	1.50445	0.02237	145817	363372
	Total, All Scenarios	0.56577	2.70101	0.05930	214417	662405
Freight	Train-Train Collisions	0.00358	0.00422	0.00042	1130	2818
	Intrusion Collisions	0.00456	0.00142	0.00014	178	749
	Diamond Collisions	0.00131	0.00055	0.00006	216	436
	Overspeed	0.00223	0.00065	0.00007	1163	1423
	Broken Rail	0.01184	0.00346	0.00035	6179	7563
	Work Zone Violation	0.00000	0.01313	0.00131	0	5253
	Grade Crossing Collisions	0.07424	0.02330	0.00119	4635	10544
	Total, All Scenarios	0.09775	0.04673	0.00354	13501	28784
Total Passenger + Freight		**0.66352**	**2.74775**	**0.06283**	**227918**	**691189**

Table R1c: Rest of Year, PTC Normal, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00717	0.44111	0.01668	18854	112996
	Intrusion Collisions	0.01763	0.44236	0.01569	18865	110167
	Diamond Collisions	0.00057	0.00612	0.00018	214	1373
	Overspeed	0.00231	0.10953	0.00176	8578	24802
	Broken Rail	0.01412	0.66929	0.01074	52418	151559
	Work Zone Violation	0.00000	0.09076	0.00908	0	36304
	Grade Crossing Collisions	0.48885	1.42365	0.02113	138072	343835
	Total, All Scenarios	0.53066	3.18281	0.07525	237002	781037
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0	0
	Intrusion Collisions	0.00657	0.00830	0.00083	2214	5534
	Diamond Collisions	0.01009	0.00335	0.00033	421	1760
	Overspeed	0.00293	0.00123	0.00012	483	975
	Broken Rail	0.00585	0.00193	0.00019	3251	4022
	Work Zone Violation	0.02540	0.00837	0.00084	14112	17460
	Grade Crossing Collisions	0.00000	0.03227	0.00323	0	12910
		0.09692	0.03681	0.00188	7347	16678
	Total, All Scenarios	0.14775	0.09226	0.00743	27828	59341
Total Passenger + Freight		**0.67841**	**3.27508**	**0.08268**	**264830**	**840378**

Table R1d: Rest of Year, PTC Normal, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01557	0.99718	0.03784	42908	256137
	Intrusion Collisions	0.03988	1.05678	0.03751	45121	263330
	Diamond Collisions	0.00111	0.01194	0.00036	418	2678
	Overspeed	0.00523	0.25568	0.00410	20515	58394
	Broken Rail	0.03194	1.56240	0.02508	125364	356829
	Work Zone Violation	0.00000	0.21145	0.02115	0	84581
	Grade Crossing Collisions	1.60338	4.78520	0.07106	463904	1155618
	Total, All Scenarios	1.69710	8.88064	0.19709	698230	2177568
Freight	Train-Train Collisions	0.01114	0.01380	0.00138	3684	9204
	Intrusion Collisions	0.01719	0.00560	0.00056	703	2946
	Diamond Collisions	0.00575	0.00243	0.00024	949	1920
	Overspeed	0.00896	0.00285	0.00029	4895	6036
	Broken Rail	0.04414	0.01398	0.00140	24070	29663
	Work Zone Violation	0.00000	0.05205	0.00520	0	20818
	Grade Crossing Collisions	0.21805	0.07678	0.00393	15316	34794
	Total, All Scenarios	0.30524	0.16748	0.01300	49618	105381
Total Passenger + Freight		**2.00234**	**9.04812**	**0.21010**	**747847**	**2282949**

Table R2a: Summer, PTC Normal, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Freight	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Total Passenger + Freight						

There are no seasonal traffic variations on the Joliet Sub-corridor. Therefore only one risk calculation is needed for the full year, and there is no separate summer calculation

Table R2b: Summer, PTC Normal, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00135	0.08906	0.00339	3841	22905
	Intrusion Collisions	0.00381	0.10235	0.00363	4362	25500
	Diamond Collisions	0.00008	0.00083	0.00002	29	185
	Overspeed	0.00050	0.02449	0.00039	1983	5611
	Broken Rail	0.00305	0.14967	0.00240	12118	34285
	Work Zone Violation	0.00000	0.02031	0.00203	0	8125
	Grade Crossing Collisions	0.17887	0.49965	0.00743	48428	120682
	Total, All Scenarios	0.18765	0.88637	0.01930	70761	217293
Freight	Train-Train Collisions	0.00036	0.00044	0.00004	117	292
	Intrusion Collisions	0.00090	0.00028	0.00003	35	148
	Diamond Collisions	0.00039	0.00016	0.00002	64	130
	Overspeed	0.00031	0.00009	0.00001	162	199
	Broken Rail	0.00244	0.00071	0.00007	1275	1560
	Work Zone Violation	0.00000	0.00228	0.00021	0	861
	Grade Crossing Collisions	0.01531	0.00481	0.00025	956	2175
	Total, All Scenarios	0.01972	0.00877	0.00063	2609	5364
Total Passenger + Freight		**0.20737**	**0.89514**	**0.01992**	**73370**	**222657**

Table R2c: Summer, PTC Normal, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00184	0.12244	0.00465	5250	31442
	Intrusion Collisions	0.00586	0.14691	0.00521	6265	36588
	Diamond Collisions	0.00016	0.00172	0.00005	60	385
	Overspeed	0.00077	0.03638	0.00058	2849	8237
	Broken Rail	0.00469	0.22228	0.00357	17409	50335
	Work Zone Violation	0.00000	0.03014	0.00301	0	12057
	Grade Crossing Collisions	0.16236	0.47282	0.00702	45856	114193
	Total, All Scenarios	0.17567	1.03269	0.02409	77690	253238
Freight	Train-Train Collisions	0.00035	0.00044	0.00004	117	293
	Intrusion Collisions	0.00176	0.00058	0.00006	73	306
	Diamond Collisions	0.00082	0.00035	0.00003	135	273
	Overspeed	0.00083	0.00028	0.00003	464	574
	Broken Rail	0.00458	0.00151	0.00015	2546	3150
	Work Zone Violation	0.00000	0.00517	0.00052	0	2066
	Grade Crossing Collisions	0.01749	0.00664	0.00034	1326	3009
	Total, All Scenarios	0.02583	0.01496	0.00117	4661	9672
Total Passenger + Freight		**0.20149**	**1.04765**	**0.02526**	**82351**	**262910**

Table R2d: Summer, PTC Normal, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00319	0.21150	0.00804	9091	54347
	Intrusion Collisions	0.00967	0.24926	0.00884	10627	62088
	Diamond Collisions	0.00024	0.00254	0.00008	89	570
	Overspeed	0.00127	0.06087	0.00098	4832	13848
	Broken Rail	0.00774	0.37195	0.00597	29527	84620
	Work Zone Violation	0.00000	0.05046	0.00505	0	20183
	Grade Crossing Collisions	0.34122	0.97247	0.01445	94284	234875
	Total, All Scenarios	0.36332	1.91905	0.04339	148450	470531
Freight	Train-Train Collisions	0.00071	0.00088	0.00009	234	585
	Intrusion Collisions	0.00265	0.00086	0.00009	108	454
	Diamond Collisions	0.00121	0.00051	0.00005	199	403
	Overspeed	0.00115	0.00037	0.00004	626	772
	Broken Rail	0.00702	0.00222	0.00022	3821	4710
	Work Zone Violation	0.00000	0.00745	0.00073	0	2927
	Grade Crossing Collisions	0.03280	0.01145	0.00059	2282	5184
	Total, All Scenarios	0.04554	0.02373	0.00180	7270	15036
Total Passenger + Freight		**0.40886**	**1.94279**	**0.04519**	**155721**	**485567**

Table R3a: All Year, PTC Normal, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00361	0.25603	0.00978	11142	66099
	Intrusion Collisions	0.01078	0.30625	0.01088	13123	76384
	Diamond Collisions	0.00028	0.00304	0.00009	107	682
	Overspeed	0.00141	0.07241	0.00116	5966	16699
	Broken Rail	0.00863	0.44245	0.00711	36458	102040
	Work Zone Violation	0.00000	0.05953	0.00595	0	23811
	Grade Crossing Collisions	0.57595	1.85711	0.02756	180015	448411
	Total, All Scenarios	0.60067	2.99681	0.06255	246810	734126
Freight	Train-Train Collisions	0.00099	0.00128	0.00013	340	852
	Intrusion Collisions	0.00254	0.00083	0.00008	104	437
	Diamond Collisions	0.00152	0.00065	0.00006	251	509
	Overspeed	0.00088	0.00027	0.00003	481	591
	Broken Rail	0.00691	0.00215	0.00022	3778	4640
	Work Zone Violation	0.00000	0.00664	0.00066	0	2655
	Grade Crossing Collisions	0.04690	0.01667	0.00086	3334	7572
	Total, All Scenarios	0.05974	0.02849	0.00204	8289	17257
Total Passenger + Freight		**0.66040**	**3.02530**	**0.06458**	**255100**	**751383**

Table R3b: All Year, PTC Normal, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00613	0.38910	0.01476	16752	99947
	Intrusion Collisions	0.01528	0.41053	0.01458	17495	102279
	Diamond Collisions	0.00033	0.00360	0.00011	126	808
	Overspeed	0.00200	0.09824	0.00158	7954	22504
	Broken Rail	0.01224	0.60033	0.00963	48606	137515
	Work Zone Violation	0.00000	0.08148	0.00815	0	32591
	Grade Crossing Collisions	0.71743	2.00410	0.02980	194245	484054
	Total, All Scenarios	0.75342	3.58738	0.07859	285178	879697
Freight	Train-Train Collisions	0.00394	0.00466	0.00047	1246	3109
	Intrusion Collisions	0.00546	0.00170	0.00017	214	896
	Diamond Collisions	0.00170	0.00071	0.00007	280	565
	Overspeed	0.00254	0.00074	0.00007	1325	1621
	Broken Rail	0.01428	0.00417	0.00042	7454	9123
	Work Zone Violation	0.00000	0.01541	0.00152	0	6114
	Grade Crossing Collisions	0.08955	0.02810	0.00144	5591	12719
	Total, All Scenarios	0.11747	0.05551	0.00416	16110	34148
Total Passenger + Freight		**0.87089**	**3.64289**	**0.08276**	**301288**	**913845**

Table R3c: All Year, PTC Normal, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00901	0.56355	0.02133	24104	144438
	Intrusion Collisions	0.02349	0.58927	0.02090	25130	146755
	Diamond Collisions	0.00073	0.00784	0.00023	275	1758
	Overspeed	0.00308	0.14590	0.00234	11427	33040
	Broken Rail	0.01881	0.89157	0.01430	69827	201895
	Work Zone Violation	0.00000	0.12090	0.01209	0	48362
	Grade Crossing Collisions	0.65121	1.89647	0.02815	183928	458029
	Total, All Scenarios	0.70633	4.21550	0.09934	314692	1034276
Freight	Train-Train Collisions	0.00692	0.00874	0.00087	2331	5827
	Intrusion Collisions	0.01184	0.00393	0.00039	494	2066
	Diamond Collisions	0.00375	0.00158	0.00016	618	1249
	Overspeed	0.00669	0.00220	0.00022	3715	4596
	Broken Rail	0.02998	0.00988	0.00099	16659	20610
	Work Zone Violation	0.00000	0.03744	0.00374	0	14976
	Grade Crossing Collisions	0.11440	0.04345	0.00222	8673	19687
	Total, All Scenarios	0.17358	0.10722	0.00860	32489	69012
Total Passenger + Freight		**0.87991**	**4.32272**	**0.10795**	**347181**	**1103288**

Table R3d: All Year, PTC Normal, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01876	1.20867	0.04587	51999	310484
	Intrusion Collisions	0.04955	1.30604	0.04636	55748	325418
	Diamond Collisions	0.00135	0.01448	0.00043	507	3248
	Overspeed	0.00649	0.31655	0.00508	25348	72242
	Broken Rail	0.03968	1.93436	0.03104	154891	441449
	Work Zone Violation	0.00000	0.26191	0.02619	0	104764
	Grade Crossing Collisions	1.94460	5.75767	0.08551	558188	1390494
	Total, All Scenarios	2.06042	10.79969	0.24048	846680	2648099
Freight	Train-Train Collisions	0.01185	0.01468	0.00147	3918	9788
	Intrusion Collisions	0.01984	0.00646	0.00065	812	3400
	Diamond Collisions	0.00697	0.00294	0.00029	1149	2323
	Overspeed	0.01010	0.00322	0.00032	5521	6809
	Broken Rail	0.05117	0.01621	0.00162	27891	34373
	Work Zone Violation	0.00000	0.05949	0.00593	0	23745
	Grade Crossing Collisions	0.25085	0.08822	0.00452	17598	39978
	Total, All Scenarios	0.35078	0.19122	0.01480	56888	120417
Total Passenger + Freight		**2.41120**	**10.99091**	**0.25529**	**903568**	**2768516**

Worksheet 6:
PTC Case, Timeout 120 seconds,
Latency 20 seconds

PTC Timeout Operating State

Table R4a: Full Year, PTC Timeout, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00038	0.00001	16	98
	Intrusion Collisions	0.00002	0.00050	0.00002	21	124
	Diamond Collisions	0.00000	0.00001	0.00000	0	2
	Overspeed	0.00000	0.00022	0.00000	18	51
	Broken Rail	0.00001	0.00067	0.00001	56	155
	Work Zone Violation	0.00000	0.00012	0.00001	0	49
	Grade Crossing Collisions	0.00088	0.00283	0.00004	274	683
	Total, All Scenarios	0.00092	0.00473	0.00010	386	1162
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	1	1
	Intrusion Collisions	0.00000	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00000	0.00000	1	1
	Broken Rail	0.00001	0.00000	0.00000	6	7
	Work Zone Violation	0.00000	0.00001	0.00000	0	5
	Grade Crossing Collisions	0.00007	0.00003	0.00000	5	11
	Total, All Scenarios	0.00009	0.00005	0.00000	13	28
Total Passenger + Freight		**0.00101**	**0.00478**	**0.00010**	**399**	**1190**

Table R4b: Rest of Year, PTC Timeout, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00045	0.00002	19	116
	Intrusion Collisions	0.00002	0.00050	0.00002	21	125
	Diamond Collisions	0.00000	0.00001	0.00000	0	2
	Overspeed	0.00000	0.00023	0.00000	18	52
	Broken Rail	0.00001	0.00069	0.00001	56	157
	Work Zone Violation	0.00000	0.00013	0.00001	0	50
	Grade Crossing Collisions	0.00082	0.00229	0.00003	222	553
	Total, All Scenarios	0.00087	0.00429	0.00010	337	1055
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	2	5
	Intrusion Collisions	0.00001	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00000	0.00000	2	2
	Broken Rail	0.00002	0.00001	0.00000	9	11
	Work Zone Violation	0.00000	0.00002	0.00000	0	9
	Grade Crossing Collisions	0.00011	0.00003	0.00000	7	16
	Total, All Scenarios	0.00015	0.00007	0.00001	21	45
Total Passenger + Freight		**0.00101**	**0.00436**	**0.00010**	**358**	**1100**

Table R4c: Rest of Year, PTC Timeout, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00054	0.00002	23	139
	Intrusion Collisions	0.00003	0.00072	0.00003	31	179
	Diamond Collisions	0.00000	0.00001	0.00000	0	3
	Overspeed	0.00001	0.00034	0.00001	26	76
	Broken Rail	0.00002	0.00102	0.00002	80	231
	Work Zone Violation	0.00000	0.00019	0.00002	0	75
	Grade Crossing Collisions	0.00074	0.00217	0.00003	210	524
	Total, All Scenarios	0	0	0	370	1226
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	4	9
	Intrusion Collisions	0.00002	0.00001	0.00000	1	3
	Diamond Collisions	0.00001	0.00000	0.00000	1	2
	Overspeed	0.00001	0.00000	0.00000	5	6
	Broken Rail	0.00004	0.00001	0.00000	21	26
	Work Zone Violation	0.00000	0.00005	0.00001	0	20
	Grade Crossing Collisions	0.00014	0.00005	0.00000	11	25
	Total, All Scenarios	bbbb	0.00014	0.00001	42	91
Total Passenger + Freight		**0.00104**	**0.00512**	**0.00013**	**413**	**1316**

Table R4d: Rest of Year, PTC Timeout, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00002	0.00137	0.00005	59	352
	Intrusion Collisions	0.00007	0.00171	0.00006	73	427
	Diamond Collisions	0.00000	0.00003	0.00000	1	7
	Overspeed	0.00002	0.00078	0.00001	63	179
	Broken Rail	0.00005	0.00238	0.00004	191	543
	Work Zone Violation	0.00000	0.00044	0.00004	0	174
	Grade Crossing Collisions	0.00244	0.00729	0.00011	706	1760
	Total, All Scenarios	0.00260	0.01400	0.00032	1093	3442
Freight	Train-Train Collisions	0.00002	0.00002	0.00000	6	15
	Intrusion Collisions	0.00003	0.00001	0.00000	1	5
	Diamond Collisions	0.00001	0.00000	0.00000	2	3
	Overspeed	0.00002	0.00000	0.00000	8	10
	Broken Rail	0.00007	0.00002	0.00000	36	44
	Work Zone Violation	0.00000	0.00008	0.00001	0	34
	Grade Crossing Collisions	0.00033	0.00011	0.00001	23	52
	Total, All Scenarios	0.00046	0.00026	0.00002	76	163
Total Passenger + Freight		**0.00306**	**0.01426**	**0.00034**	**1169**	**3606**

Table R5a: Summer, PTC Timeout, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Freight	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Total Passenger + Freight						

There are no seasonal traffic variations on the Joliet Sub-corridor. Therefore only one risk calculation is needed for the full year, and there is no separate summer calculation

Table R5b: Summer, PTC Timeout, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00013	0.00001	5.7	34.0
	Intrusion Collisions	0.00001	0.00017	0.00001	7.1	41.4
	Diamond Collisions	0.00000	0.00000	0.00000	0.1	0.4
	Overspeed	0.00000	0.00008	0.00000	6.1	17.2
	Broken Rail	0.00000	0.00023	0.00000	18.5	52.2
	Work Zone Violation	0.00000	0.00004	0.00000	0.0	16.8
	Grade Crossing Collisions	0.00027	0.00076	0.00001	73.7	183.8
	Total, All Scenarios	0.00029	0.00141	0.00003	111.1	345.8
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0.2	0.5
	Intrusion Collisions	0.00000	0.00000	0.00000	0.1	0.3
	Diamond Collisions	0.00000	0.00000	0.00000	0.1	0.2
	Overspeed	0.00000	0.00000	0.00000	0.3	0.4
	Broken Rail	0.00000	0.00000	0.00000	1.9	2.4
	Work Zone Violation	0.00000	0.00000	0.00000	0.0	1.0
	Grade Crossing Collisions	0.00004	0.00001	0.00000	2.3	5.2
	Total, All Scenarios	0.00004	0.00002	0.00000	4.9	10.0
Total Passenger + Freight		**0.00033**	**0.00142**	**0.00003**	**116.1**	**355.7**

Table R5c: Summer, PTC Timeout, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00018	0.00001	7.8	46.5
	Intrusion Collisions	0.00001	0.00024	0.00001	10.2	59.3
	Diamond Collisions	0.00000	0.00000	0.00000	0.1	0.9
	Overspeed	0.00000	0.00011	0.00000	8.7	25.2
	Broken Rail	0.00001	0.00034	0.00001	26.5	76.6
	Work Zone Violation	0.00000	0.00006	0.00000	0.0	18.9
	Grade Crossing Collisions	0.00025	0.00072	0.00001	69.8	173.9
	Total, All Scenarios	0.00027	0.00166	0.00004	123.1	401.4
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0.2	0.5
	Intrusion Collisions	0.00000	0.00000	0.00000	0.1	0.5
	Diamond Collisions	0.00000	0.00000	0.00000	0.2	0.5
	Overspeed	0.00000	0.00000	0.00000	0.8	1.0
	Broken Rail	0.00001	0.00000	0.00000	3.8	4.7
	Work Zone Violation	0.00000	0.00001	0.00000	0.0	3.5
	Grade Crossing Collisions	0.00003	0.00001	0.00000	2.0	4.5
	Total, All Scenarios	0.00004	0.00002	0.00000	7.1	15.1
Total Passenger + Freight		**0.00031**	**0.00168**	**0.00004**	**130.3**	**416.6**

Table R5d: Summer, PTC Timeout, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00031	0.00001	13	81
	Intrusion Collisions	0.00002	0.00040	0.00001	17	101
	Diamond Collisions	0.00000	0.00001	0.00000	0	1
	Overspeed	0.00000	0.00019	0.00000	15	42
	Broken Rail	0.00001	0.00057	0.00001	45	129
	Work Zone Violation	0.00000	0.00010	0.00001	0	36
	Grade Crossing Collisions	0.00052	0.00148	0.00002	144	358
	Total, All Scenarios	0.00056	0.00306	0.00007	234	747
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0	1
	Intrusion Collisions	0.00000	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00000	0.00000	1	1
	Broken Rail	0.00001	0.00000	0.00000	6	7
	Work Zone Violation	0.00000	0.00001	0.00000	0	4
	Grade Crossing Collisions	0.00006	0.00002	0.00000	4	10
	Total, All Scenarios	0.00008	0.00004	0.00000	12	25
Total Passenger + Freight		**0.00064**	**0.00310**	**0.00007**	**246**	**772**

Table R6a: All Year, PTC Timeout, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00038	0.00001	16	98
	Intrusion Collisions	0.00002	0.00050	0.00002	21	124
	Diamond Collisions	0.00000	0.00001	0.00000	0	2
	Overspeed	0.00000	0.00022	0.00000	18	51
	Broken Rail	0.00001	0.00067	0.00001	56	155
	Work Zone Violation	0.00000	0.00012	0.00001	0	49
	Grade Crossing Collisions	0.00088	0.00283	0.00004	274	683
	Total, All Scenarios	0.00092	0.00473	0.00010	386	1162
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	1	1
	Intrusion Collisions	0.00000	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00000	0.00000	1	1
	Broken Rail	0.00001	0.00000	0.00000	6	7
	Work Zone Violation	0.00000	0.00001	0.00000	0	5
	Grade Crossing Collisions	0.00007	0.00003	0.00000	5	11
	Total, All Scenarios	0.00009	0.00005	0.00000	13	28
bbb						
Total Passenger + Freight		**0.00101**	**0.00478**	**0.00010**	**399**	**1190**

Table R6b: All Year, PTC Timeout, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00058	0.00002	25	150
	Intrusion Collisions	0.00003	0.00067	0.00002	28	166
	Diamond Collisions	0.00000	0.00001	0.00000	0	2
	Overspeed	0.00001	0.00030	0.00000	24	69
	Broken Rail	0.00002	0.00091	0.00001	74	209
	Work Zone Violation	0.00000	0.00017	0.00002	0	67
	Grade Crossing Collisions	0.00109	0.00305	0.00005	296	737
	Total, All Scenarios	0.00115	0.00569	0.00013	448	1400
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	2	5
	Intrusion Collisions	0.00001	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	1	1
	Overspeed	0.00000	0.00000	0.00000	2	3
	Broken Rail	0.00002	0.00001	0.00000	11	14
	Work Zone Violation	0.00000	0.00003	0.00000	0	10
	Grade Crossing Collisions	0.00015	0.00005	0.00000	9	21
	Total, All Scenarios	0.00019	0.00009	0.00001	26	55
Total Passenger + Freight		**0.00135**	**0.00579**	**0.00013**	**474**	**1456**

Table R6c: All Year, PTC Timeout, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00072	0.00003	31	185
	Intrusion Collisions	0.00004	0.00096	0.00003	41	238
	Diamond Collisions	0.00000	0.00002	0.00000	1	4
	Overspeed	0.00001	0.00045	0.00001	35	101
	Broken Rail	0.00003	0.00136	0.00002	106	307
	Work Zone Violation	0.00000	0.00025	0.00002	0	94
	Grade Crossing Collisions	0.00099	0.00289	0.00004	280	697
	Total, All Scenarios	0.00108	0.00664	0.00016	494	1627
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	4	9
	Intrusion Collisions	0.00002	0.00001	0.00000	1	3
	Diamond Collisions	0.00001	0.00000	0.00000	1	2
	Overspeed	0.00001	0.00000	0.00000	6	7
	Broken Rail	0.00004	0.00001	0.00000	25	31
	Work Zone Violation	0.00000	0.00006	0.00001	0	24
	Grade Crossing Collisions	0.00017	0.00006	0.00000	13	29
	Total, All Scenarios	0.00026	0.00016	0.00001	49	106
Total Passenger + Freight		**0.00134**	**0.00680**	**0.00017**	**543**	**1733**

Table R6d: All Year, PTC timeout, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00003	0.00169	0.00006	72	433
	Intrusion Collisions	0.00008	0.00212	0.00008	90	528
	Diamond Collisions	0.00000	0.00004	0.00000	1	8
	Overspeed	0.00002	0.00097	0.00002	78	221
	Broken Rail	0.00006	0.00295	0.00005	236	672
	Work Zone Violation	0.00000	0.00054	0.00005	0	210
	Grade Crossing Collisions	0.00296	0.00877	0.00013	850	2117
	Total, All Scenarios	0.00315	0.01706	0.00039	1328	4189
Freight	Train-Train Collisions	0.00002	0.00002	0.00000	6	16
	Intrusion Collisions	0.00003	0.00001	0.00000	1	5
	Diamond Collisions	0.00001	0.00001	0.00000	2	4
	Overspeed	0.00002	0.00001	0.00000	9	12
	Broken Rail	0.00008	0.00002	0.00000	42	51
	Work Zone Violation	0.00000	0.00010	0.00001	0	38
	Grade Crossing Collisions	0.00039	0.00014	0.00001	27	62
	Total, All Scenarios	0.00055	0.00030	0.00002	88	188
Total Passenger + Freight		**0.00370**	**0.01737**	**0.00041**	**1416**	**4378**

Worksheet 6:
PTC Case, Timeout 120 seconds,
Latency 20 seconds

PTC Totals, All Operating States, All Year

Table R7a: Totals: All Year, All Operating States, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00362	0.25641	0.00980	11159	66197
	Intrusion Collisions	0.01079	0.30674	0.01090	13144	76508
	Diamond Collisions	0.00028	0.00305	0.00009	107	684
	Overspeed	0.00142	0.07263	0.00117	5984	16750
	Broken Rail	0.00864	0.44313	0.00712	36513	102195
	Work Zone Violation	0.00000	0.05965	0.00597	0	23860
	Grade Crossing Collisions	0.57683	1.85993	0.02760	180289	449094
	Total, All Scenarios	0.60159	3.00154	0.06265	247196	735288
Freight	Train-Train Collisions	0.00099	0.00128	0.00013	341	853
	Intrusion Collisions	0.00254	0.00083	0.00008	104	438
	Diamond Collisions	0.00152	0.00065	0.00006	252	510
	Overspeed	0.00088	0.00027	0.00003	482	592
	Broken Rail	0.00692	0.00216	0.00022	3784	4647
	Work Zone Violation	0.00000	0.00665	0.00067	0	2660
	Grade Crossing Collisions	0.04697	0.01670	0.00086	3339	7583
	Total, All Scenarios	0.05983	0.02854	0.00204	8302	17284
Total Passenger + Freight		**0.66142**	**3.03007**	**0.06469**	**255498**	**752572**

Table R7b: Totals: All Year, All Operating States, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00614	0.38968	0.01478	16777	100097
	Intrusion Collisions	0.01530	0.41119	0.01460	17523	102445
	Diamond Collisions	0.00034	0.00361	0.00011	126	810
	Overspeed	0.00201	0.09854	0.00158	7979	22573
	Broken Rail	0.01225	0.60124	0.00964	48680	137724
	Work Zone Violation	0.00000	0.08165	0.00816	0	32658
	Grade Crossing Collisions	0.71853	2.00715	0.02984	194541	484791
	Total, All Scenarios	0.75457	3.59307	0.07872	285626	881098
Freight	Train-Train Collisions	0.00395	0.00467	0.00047	1248	3115
	Intrusion Collisions	0.00547	0.00170	0.00017	214	898
	Diamond Collisions	0.00170	0.00072	0.00007	280	566
	Overspeed	0.00254	0.00074	0.00007	1327	1624
	Broken Rail	0.01430	0.00418	0.00042	7465	9136
	Work Zone Violation	0.00000	0.01544	0.00153	0	6123
	Grade Crossing Collisions	0.08970	0.02815	0.00144	5601	12740
	Total, All Scenarios	0.11766	0.05560	0.00417	16136	34203
Total Passenger + Freight		**0.87223**	**3.64867**	**0.08289**	**301762**	**915301**

Table R7c: Totals: All Year, All Operating States, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00902	0.56427	0.02135	24135	144623
	Intrusion Collisions	0.02353	0.59023	0.02093	25171	146993
	Diamond Collisions	0.00073	0.00786	0.00023	275	1762
	Overspeed	0.00309	0.14635	0.00235	11462	33141
	Broken Rail	0.01884	0.89293	0.01433	69934	202202
	Work Zone Violation	0.00000	0.12115	0.01211	0	48456
	Grade Crossing Collisions	0.65220	1.89935	0.02819	184208	458726
	Total, All Scenarios	0.70741	4.22214	0.09950	315185	1035903
Freight	Train-Train Collisions	0.00693	0.00875	0.00088	2335	5836
	Intrusion Collisions	0.01186	0.00394	0.00039	495	2070
	Diamond Collisions	0.00375	0.00158	0.00016	619	1251
	Overspeed	0.00670	0.00221	0.00022	3721	4604
	Broken Rail	0.03002	0.00989	0.00099	16683	20641
	Work Zone Violation	0.00000	0.03750	0.00375	0	15000
	Grade Crossing Collisions	0.11457	0.04351	0.00223	8686	19717
	Total, All Scenarios	0.17384	0.10738	0.00861	32538	69118
Total Passenger + Freight		**0.88125**	**4.32953**	**0.10811**	**347724**	**1105021**

Table R7d: Grand Total: All Year, All Operating States, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01878	1.21036	0.04594	52071	310917
	Intrusion Collisions	0.04963	1.30816	0.04643	55838	325946
	Diamond Collisions	0.00135	0.01452	0.00043	508	3256
	Overspeed	0.00651	0.31752	0.00510	25425	72464
	Broken Rail	0.03974	1.93730	0.03109	155127	442121
	Work Zone Violation	0.00000	0.26245	0.02624	0	104974
	Grade Crossing Collisions	1.94756	5.76644	0.08564	559038	1392611
	Total, All Scenarios	2.06357	10.81675	0.24087	848008	2652289
Freight	Train-Train Collisions	0.01187	0.01470	0.00147	3924	9804
	Intrusion Collisions	0.01987	0.00647	0.00065	813	3405
	Diamond Collisions	0.00698	0.00294	0.00029	1151	2328
	Overspeed	0.01012	0.00322	0.00032	5530	6820
	Broken Rail	0.05124	0.01623	0.00162	27932	34424
	Work Zone Violation	0.00000	0.05959	0.00594	0	23783
	Grade Crossing Collisions	0.25124	0.08836	0.00453	17625	40040
	Total, All Scenarios	0.35133	0.19152	0.01483	56976	120605
Total Passenger + Freight		**2.41490**	**11.00827**	**0.25569**	**904984**	**2772894**

Worksheet 7:
PTC Case, Timeout 120 seconds,
Latency 5 seconds.

Results Summary: PTC Case, Timeout 120 seconds, Latency 5 seconds.

PTC Normal Operating State

Table R1a: Full Year, PTC Normal, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00359	0.25491	0.00975	11094	65821
	Intrusion Collisions	0.01042	0.29871	0.01061	12801	74508
	Diamond Collisions	0.00023	0.00248	0.00007	87	556
	Overspeed	0.00106	0.05430	0.00087	4475	12524
	Broken Rail	0.00855	0.43833	0.00705	36118	101089
	Work Zone Violation	0.00000	0.05563	0.00556	0	22253
	Grade Crossing Collisions	0.57059	1.83980	0.02731	178338	444233
	Total, All Scenarios	0.59443	2.94418	0.06122	242912	720985
Freight	Train-Train Collisions	0.00096	0.00124	0.00012	331	828
	Intrusion Collisions	0.00245	0.00080	0.00008	100	421
	Diamond Collisions	0.00143	0.00062	0.00006	239	487
	Overspeed	0.00079	0.00025	0.00002	431	529
	Broken Rail	0.00686	0.00214	0.00021	3752	4608
	Work Zone Violation	0.00000	0.00637	0.00064	0	2549
	Grade Crossing Collisions	0.04658	0.01656	0.00085	3311	7520
	Total, All Scenarios	0.05907	0.02798	0.00199	8165	16943
Total Passenger + Freight		**0.65350**	**2.97215**	**0.06321**	**251077**	**737927**

Table R1b: Rest of Year, PTC Normal, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00467	0.29477	0.01119	12688	75732
	Intrusion Collisions	0.01109	0.30060	0.01067	12811	74893
	Diamond Collisions	0.00021	0.00225	0.00007	79	506
	Overspeed	0.00113	0.05531	0.00089	4478	12670
	Broken Rail	0.00910	0.44646	0.00716	36148	102268
	Work Zone Violation	0.00000	0.05716	0.00572	0	22865
	Grade Crossing Collisions	0.53355	1.49043	0.02216	144458	359987
	Total, All Scenarios	0.55974	2.64699	0.05785	210662	648921
Freight	Train-Train Collisions	0.00334	0.00387	0.00039	1044	2593
	Intrusion Collisions	0.00446	0.00139	0.00014	175	733
	Diamond Collisions	0.00123	0.00053	0.00005	204	415
	Overspeed	0.00213	0.00062	0.00006	1112	1361
	Broken Rail	0.01179	0.00344	0.00034	6153	7530
	Work Zone Violation	0.00000	0.01286	0.00129	0	5142
	Grade Crossing Collisions	0.07392	0.02320	0.00119	4615	10498
	Total, All Scenarios	0.09686	0.04591	0.00346	13302	28272
Total Passenger + Freight		**0.65660**	**2.69290**	**0.06131**	**223963**	**677193**

Table R1c: Rest of Year, PTC Normal, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00702	0.43430	0.01644	18569	111311
	Intrusion Collisions	0.01704	0.43148	0.01530	18402	107460
	Diamond Collisions	0.00046	0.00492	0.00015	172	1104
	Overspeed	0.00173	0.08215	0.00132	6434	18602
	Broken Rail	0.01399	0.66306	0.01064	51930	150147
	Work Zone Violation	0.00000	0.08482	0.00848	0	33929
	Grade Crossing Collisions	0.48430	1.41038	0.02094	136786	340632
	Total, All Scenarios	0.52454	3.11111	0.07326	232292	763186
		0.00000	0.00000	0.00000	0	0
Freight	Train-Train Collisions	0.00632	0.00792	0.00079	2119	5285
	Intrusion Collisions	0.00997	0.00331	0.00033	416	1739
	Diamond Collisions	0.00274	0.00118	0.00012	455	928
	Overspeed	0.00573	0.00189	0.00019	3184	3940
	Broken Rail	0.02533	0.00835	0.00083	14077	17417
	Work Zone Violation	0.00000	0.03192	0.00319	0	12769
	Grade Crossing Collisions	0.09668	0.03672	0.00188	7329	16637
	Total, All Scenarios	0.14677	0.09128	0.00734	27580	58715
Total Passenger + Freight		**0.67131**	**3.20239**	**0.08060**	**259873**	**821900**

Table R1d: Rest of Year, PTC Normal, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01528	0.98398	0.03737	42351	252865
	Intrusion Collisions	0.03854	1.03079	0.03659	44013	256861
	Diamond Collisions	0.00090	0.00965	0.00029	338	2166
	Overspeed	0.00392	0.19176	0.00308	15387	43796
	Broken Rail	0.03164	1.54785	0.02484	124196	353505
	Work Zone Violation	0.00000	0.19762	0.01976	0	79048
	Grade Crossing Collisions	1.58844	4.74062	0.07040	459582	1144852
	Total, All Scenarios	1.67871	8.70227	0.19233	685866	2133091
Freight	Train-Train Collisions	0.01062	0.01303	0.00130	3493	8706
	Intrusion Collisions	0.01688	0.00550	0.00055	691	2893
	Diamond Collisions	0.00540	0.00233	0.00023	898	1831
	Overspeed	0.00865	0.00276	0.00028	4727	5830
	Broken Rail	0.04398	0.01393	0.00139	23982	29555
	Work Zone Violation	0.00000	0.05115	0.00512	0	20460
	Grade Crossing Collisions	0.21717	0.07647	0.00392	15255	34655
	Total, All Scenarios	0.30270	0.16517	0.01279	49047	103930
Total Passenger + Freight		**1.98141**	**8.86744**	**0.20512**	**734913**	**2237021**

Table R2a: Summer, PTC Normal, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Freight	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Total Passenger + Freight						

There are no seasonal traffic variations on the Joliet Sub-corridor. Therefore only one risk calculation is needed for the full year, and there is no separate summer calculation

Table R2b: Summer, PTC Normal, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00133	0.08837	0.00336	3811	22734
	Intrusion Collisions	0.00368	0.09983	0.00355	4255	24873
	Diamond Collisions	0.00006	0.00067	0.00002	24	151
	Overspeed	0.00037	0.01837	0.00029	1487	4208
	Broken Rail	0.00302	0.14828	0.00238	12005	33965
	Work Zone Violation	0.00000	0.01898	0.00190	0	7594
	Grade Crossing Collisions	0.17720	0.49500	0.00736	47977	119558
	Total, All Scenarios	0.18567	0.86950	0.01886	69559	213083
Freight	Train-Train Collisions	0.00035	0.00042	0.00004	111	278
	Intrusion Collisions	0.00087	0.00027	0.00003	34	142
	Diamond Collisions	0.00037	0.00016	0.00002	61	124
	Overspeed	0.00028	0.00008	0.00001	145	178
	Broken Rail	0.00243	0.00071	0.00007	1266	1549
	Work Zone Violation	0.00000	0.00219	0.00020	0	824
	Grade Crossing Collisions	0.01521	0.00477	0.00024	950	2160
	Total, All Scenarios	0.01949	0.00860	0.00061	2567	5255
Total Passenger + Freight		**0.20517**	**0.87810**	**0.01947**	**72126**	**218338**

Table R2c: Summer, PTC Normal, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00183	0.12191	0.00463	5228	31311
	Intrusion Collisions	0.00566	0.14330	0.00508	6112	35689
	Diamond Collisions	0.00013	0.00138	0.00004	48	309
	Overspeed	0.00058	0.02728	0.00044	2137	6178
	Broken Rail	0.00465	0.22021	0.00353	17247	49866
	Work Zone Violation	0.00000	0.02817	0.00282	0	11269
	Grade Crossing Collisions	0.16084	0.46841	0.00695	45429	113130
	Total, All Scenarios	0.17368	1.01067	0.02350	76200	247752
Freight	Train-Train Collisions	0.00033	0.00042	0.00004	113	281
	Intrusion Collisions	0.00172	0.00057	0.00006	72	299
	Diamond Collisions	0.00077	0.00033	0.00003	128	260
	Overspeed	0.00079	0.00026	0.00003	441	546
	Broken Rail	0.00456	0.00150	0.00015	2535	3136
	Work Zone Violation	0.00000	0.00505	0.00050	0	2019
	Grade Crossing Collisions	0.01741	0.00661	0.00034	1320	2995
	Total, All Scenarios	0.02558	0.01475	0.00115	4608	9538
Total Passenger + Freight		**0.19926**	**1.02541**	**0.02465**	**80808**	**257290**

Table R2d: Summer, PTC Normal, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00316	0.21028	0.00799	9039	54045
	Intrusion Collisions	0.00934	0.24313	0.00863	10366	60563
	Diamond Collisions	0.00019	0.00205	0.00006	72	460
	Overspeed	0.00095	0.04565	0.00073	3624	10386
	Broken Rail	0.00767	0.36849	0.00591	29252	83831
	Work Zone Violation	0.00000	0.04716	0.00472	0	18862
	Grade Crossing Collisions	0.33804	0.96341	0.01431	93406	232687
	Total, All Scenarios	0.35935	1.88017	0.04235	145759	460835
Freight	Train-Train Collisions	0.00068	0.00084	0.00008	224	559
	Intrusion Collisions	0.00258	0.00084	0.00008	105	442
	Diamond Collisions	0.00113	0.00049	0.00005	188	384
	Overspeed	0.00107	0.00034	0.00003	587	724
	Broken Rail	0.00699	0.00221	0.00022	3800	4685
	Work Zone Violation	0.00000	0.00724	0.00071	0	2844
	Grade Crossing Collisions	0.03261	0.01138	0.00058	2269	5155
	Total, All Scenarios	0.04507	0.02334	0.00176	7174	14793
Total Passenger + Freight		**0.40443**	**1.90351**	**0.04411**	**152934**	**475627**

Table R3a: All Year, PTC Normal, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00359	0.25491	0.00975	11094	65821
	Intrusion Collisions	0.01042	0.29871	0.01061	12801	74508
	Diamond Collisions	0.00023	0.00248	0.00007	87	556
	Overspeed	0.00106	0.05430	0.00087	4475	12524
	Broken Rail	0.00855	0.43833	0.00705	36118	101089
	Work Zone Violation	0.00000	0.05563	0.00556	0	22253
	Grade Crossing Collisions	0.57059	1.83980	0.02731	178338	444233
	Total, All Scenarios	0.59443	2.94418	0.06122	242912	720985
Freight	Train-Train Collisions	0.00096	0.00124	0.00012	331	828
	Intrusion Collisions	0.00245	0.00080	0.00008	100	421
	Diamond Collisions	0.00143	0.00062	0.00006	239	487
	Overspeed	0.00079	0.00025	0.00002	431	529
	Broken Rail	0.00686	0.00214	0.00021	3752	4608
	Work Zone Violation	0.00000	0.00637	0.00064	0	2549
	Grade Crossing Collisions	0.04658	0.01656	0.00085	3311	7520
	Total, All Scenarios	0.05907	0.02798	0.00199	8165	16943
Total Passenger + Freight		**0.65350**	**2.97215**	**0.06321**	**251077**	**737927**

Table R3b: All Year, PTC Normal, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00600	0.38314	0.01455	16499	98466
	Intrusion Collisions	0.01477	0.40043	0.01422	17065	99766
	Diamond Collisions	0.00027	0.00293	0.00009	102	656
	Overspeed	0.00150	0.07368	0.00118	5966	16878
	Broken Rail	0.01212	0.59474	0.00954	48153	136234
	Work Zone Violation	0.00000	0.07615	0.00761	0	30459
	Grade Crossing Collisions	0.71075	1.98543	0.02952	192436	479544
	Total, All Scenarios	0.74542	3.51649	0.07671	280221	862003
Freight	Train-Train Collisions	0.00369	0.00429	0.00043	1155	2870
	Intrusion Collisions	0.00533	0.00166	0.00017	209	875
	Diamond Collisions	0.00159	0.00069	0.00007	265	539
	Overspeed	0.00241	0.00070	0.00007	1257	1539
	Broken Rail	0.01421	0.00415	0.00042	7419	9080
	Work Zone Violation	0.00000	0.01505	0.00149	0	5967
	Grade Crossing Collisions	0.08913	0.02797	0.00143	5565	12658
	Total, All Scenarios	0.11635	0.05451	0.00407	15869	33528
Total Passenger + Freight		**0.86177**	**3.57100**	**0.08078**	**296090**	**895531**

Table R3c: All Year, PTC Normal, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00885	0.55621	0.02107	23797	142622
	Intrusion Collisions	0.02270	0.57478	0.02039	24513	143149
	Diamond Collisions	0.00059	0.00630	0.00019	221	1413
	Overspeed	0.00231	0.10943	0.00176	8570	24780
	Broken Rail	0.01864	0.88327	0.01417	69177	200014
	Work Zone Violation	0.00000	0.11299	0.01130	0	45198
	Grade Crossing Collisions	0.64514	1.87880	0.02789	182215	453761
	Total, All Scenarios	0.69822	4.12177	0.09676	308492	1010938
Freight	Train-Train Collisions	0.00665	0.00834	0.00083	2231	5566
	Intrusion Collisions	0.01168	0.00388	0.00039	487	2038
	Diamond Collisions	0.00351	0.00151	0.00015	583	1188
	Overspeed	0.00652	0.00215	0.00022	3626	4486
	Broken Rail	0.02989	0.00985	0.00099	16612	20553
	Work Zone Violation	0.00000	0.03697	0.00370	0	14789
	Grade Crossing Collisions	0.11408	0.04333	0.00222	8648	19632
	Total, All Scenarios	0.17235	0.10603	0.00849	32188	68252
Total Passenger + Freight		**0.87057**	**4.22780**	**0.10524**	**340680**	**1079190**

Table R3d: All Year, PTC Normal, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01843	1.19426	0.04536	51390	306910
	Intrusion Collisions	0.04789	1.27392	0.04522	54379	317424
	Diamond Collisions	0.00109	0.01171	0.00035	410	2626
	Overspeed	0.00487	0.23742	0.00381	19011	54182
	Broken Rail	0.03931	1.91633	0.03075	153448	437336
	Work Zone Violation	0.00000	0.24478	0.02448	0	97910
	Grade Crossing Collisions	1.92648	5.70403	0.08472	552988	1377539
	Total, All Scenarios	2.03807	10.58244	0.23469	831626	2593926
Freight	Train-Train Collisions	0.01130	0.01387	0.00139	3717	9264
	Intrusion Collisions	0.01946	0.00634	0.00063	796	3335
	Diamond Collisions	0.00654	0.00282	0.00028	1086	2215
	Overspeed	0.00972	0.00310	0.00031	5314	6554
	Broken Rail	0.05097	0.01614	0.00161	27783	34240
	Work Zone Violation	0.00000	0.05839	0.00582	0	23304
	Grade Crossing Collisions	0.24979	0.08786	0.00450	17524	39810
	Total, All Scenarios	0.34777	0.18851	0.01455	56221	118722
Total Passenger + Freight		**2.38584**	**10.77095**	**0.24924**	**887847**	**2712648**

Worksheet 7:
PTC Case, Timeout 120 seconds,
Latency 5 seconds.

PTC Timeout Operating State

Table R4a: Full Year, PTC Timeout, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00038	0.00001	16	98
	Intrusion Collisions	0.00002	0.00050	0.00002	21	124
	Diamond Collisions	0.00000	0.00001	0.00000	0	2
	Overspeed	0.00000	0.00022	0.00000	18	51
	Broken Rail	0.00001	0.00067	0.00001	56	155
	Work Zone Violation	0.00000	0.00012	0.00001	0	49
	Grade Crossing Collisions	0.00088	0.00283	0.00004	274	683
	Total, All Scenarios	0.00092	0.00473	0.00010	386	1162
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	1	1
	Intrusion Collisions	0.00000	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00000	0.00000	1	1
	Broken Rail	0.00001	0.00000	0.00000	6	7
	Work Zone Violation	0.00000	0.00001	0.00000	0	5
	Grade Crossing Collisions	0.00007	0.00003	0.00000	5	11
	Total, All Scenarios	0.00009	0.00005	0.00000	13	28
Total Passenger + Freight		**0.00101**	**0.00478**	**0.00010**	**399**	**1190**

Table R4b: Rest of Year, PTC Timeout, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00045	0.00002	19	116
	Intrusion Collisions	0.00002	0.00050	0.00002	21	125
	Diamond Collisions	0.00000	0.00001	0.00000	0	2
	Overspeed	0.00000	0.00023	0.00000	18	52
	Broken Rail	0.00001	0.00069	0.00001	56	157
	Work Zone Violation	0.00000	0.00013	0.00001	0	50
	Grade Crossing Collisions	0.00082	0.00229	0.00003	222	553
	Total, All Scenarios	0.00087	0.00429	0.00010	337	1055
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	2	5
	Intrusion Collisions	0.00001	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00000	0.00000	2	2
	Broken Rail	0.00002	0.00001	0.00000	9	11
	Work Zone Violation	0.00000	0.00002	0.00000	0	9
	Grade Crossing Collisions	0.00011	0.00003	0.00000	7	16
	Total, All Scenarios	0.00015	0.00007	0.00001	21	45
Total Passenger + Freight		**0.00101**	**0.00436**	**0.00010**	**358**	**1100**

Table R4c: Rest of Year, PTC Timeout, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00054	0.00002	23	139
	Intrusion Collisions	0.00003	0.00072	0.00003	31	179
	Diamond Collisions	0.00000	0.00001	0.00000	0	3
	Overspeed	0.00001	0.00034	0.00001	26	76
	Broken Rail	0.00002	0.00102	0.00002	80	231
	Work Zone Violation	0.00000	0.00019	0.00002	0	75
	Grade Crossing Collisions	0.00074	0.00217	0.00003	210	524
	Total, All Scenarios	0	0	0	370	1226
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	4	9
	Intrusion Collisions	0.00002	0.00001	0.00000	1	3
	Diamond Collisions	0.00001	0.00000	0.00000	1	2
	Overspeed	0.00001	0.00000	0.00000	5	6
	Broken Rail	0.00004	0.00001	0.00000	21	26
	Work Zone Violation	0.00000	0.00005	0.00001	0	20
	Grade Crossing Collisions	0.00014	0.00005	0.00000	11	25
	Total, All Scenarios	0.00022	0.00014	0.00001	42	91
Total Passenger + Freight		**0.00104**	**0.00512**	**0.00013**	**413**	**1316**

Table R4d: Rest of Year, PTC Timeout, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00002	0.00137	0.00005	59	352
	Intrusion Collisions	0.00007	0.00171	0.00006	73	427
	Diamond Collisions	0.00000	0.00003	0.00000	1	7
	Overspeed	0.00002	0.00078	0.00001	63	179
	Broken Rail	0.00005	0.00238	0.00004	191	543
	Work Zone Violation	0.00000	0.00044	0.00004	0	174
	Grade Crossing Collisions	0.00244	0.00729	0.00011	706	1760
	Total, All Scenarios	0.00260	0.01400	0.00032	1093	3442
Freight	Train-Train Collisions	0.00002	0.00002	0.00000	6	15
	Intrusion Collisions	0.00003	0.00001	0.00000	1	5
	Diamond Collisions	0.00001	0.00000	0.00000	2	3
	Overspeed	0.00002	0.00000	0.00000	8	10
	Broken Rail	0.00007	0.00002	0.00000	36	44
	Work Zone Violation	0.00000	0.00008	0.00001	0	34
	Grade Crossing Collisions	0.00033	0.00011	0.00001	23	52
	Total, All Scenarios	0.00046	0.00026	0.00002	76	163
Total Passenger + Freight		**0.00306**	**0.01426**	**0.00034**	**1169**	**3606**

Table R5a: Summer, PTC Timeout, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Freight	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Total Passenger + Freight						

There are no seasonal traffic variations on the Joliet Sub-corridor. Therefore only one risk calculation is needed for the full year, and there is no separate summer calculation

Table R5b: Summer, PTC Timeout, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00013	0.00001	5.7	34.0
	Intrusion Collisions	0.00001	0.00017	0.00001	7.1	41.4
	Diamond Collisions	0.00000	0.00000	0.00000	0.1	0.4
	Overspeed	0.00000	0.00008	0.00000	6.1	17.2
	Broken Rail	0.00000	0.00023	0.00000	18.5	52.2
	Work Zone Violation	0.00000	0.00004	0.00000	0.0	16.8
	Grade Crossing Collisions	0.00027	0.00076	0.00001	73.7	183.8
	Total, All Scenarios	0.00029	0.00141	0.00003	111.1	345.8
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0.2	0.5
	Intrusion Collisions	0.00000	0.00000	0.00000	0.1	0.3
	Diamond Collisions	0.00000	0.00000	0.00000	0.1	0.2
	Overspeed	0.00000	0.00000	0.00000	0.3	0.4
	Broken Rail	0.00000	0.00000	0.00000	1.9	2.4
	Work Zone Violation	0.00000	0.00000	0.00000	0.0	1.0
	Grade Crossing Collisions	0.00004	0.00001	0.00000	2.3	5.2
	Total, All Scenarios	0.00004	0.00002	0.00000	4.9	10.0
Total Passenger + Freight		**0.00033**	**0.00142**	**0.00003**	**116.1**	**355.7**

Table R5c: Summer, PTC Timeout, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00018	0.00001	7.8	46.5
	Intrusion Collisions	0.00001	0.00024	0.00001	10.2	59.3
	Diamond Collisions	0.00000	0.00000	0.00000	0.1	0.9
	Overspeed	0.00000	0.00011	0.00000	8.7	25.2
	Broken Rail	0.00001	0.00034	0.00001	26.5	76.6
	Work Zone Violation	0.00000	0.00006	0.00000	0.0	18.9
	Grade Crossing Collisions	0.00025	0.00072	0.00001	69.8	173.9
	Total, All Scenarios	0.00027	0.00166	0.00004	123.1	401.4
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0.2	0.5
	Intrusion Collisions	0.00000	0.00000	0.00000	0.1	0.5
	Diamond Collisions	0.00000	0.00000	0.00000	0.2	0.5
	Overspeed	0.00000	0.00000	0.00000	0.8	1.0
	Broken Rail	0.00001	0.00000	0.00000	3.8	4.7
	Work Zone Violation	0.00000	0.00001	0.00000	0.0	3.5
	Grade Crossing Collisions	0.00003	0.00001	0.00000	2.0	4.5
	Total, All Scenarios	0.00004	0.00002	0.00000	7.1	15.1
Total Passenger + Freight		**0.00031**	**0.00168**	**0.00004**	**130.3**	**416.6**

Table R5d: Summer, PTC Timeout, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00031	0.00001	13	81
	Intrusion Collisions	0.00002	0.00040	0.00001	17	101
	Diamond Collisions	0.00000	0.00001	0.00000	0	1
	Overspeed	0.00000	0.00019	0.00000	15	42
	Broken Rail	0.00001	0.00057	0.00001	45	129
	Work Zone Violation	0.00000	0.00010	0.00001	0	36
	Grade Crossing Collisions	0.00052	0.00148	0.00002	144	358
	Total, All Scenarios	0.00056	0.00306	0.00007	234	747
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0	1
	Intrusion Collisions	0.00000	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00000	0.00000	1	1
	Broken Rail	0.00001	0.00000	0.00000	6	7
	Work Zone Violation	0.00000	0.00001	0.00000	0	4
	Grade Crossing Collisions	0.00006	0.00002	0.00000	4	10
	Total, All Scenarios	0.00008	0.00004	0.00000	12	25
Total Passenger + Freight		**0.00064**	**0.00310**	**0.00007**	**246**	**772**

Table R6a: All Year, PTC Timeout, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00038	0.00001	16	98
	Intrusion Collisions	0.00002	0.00050	0.00002	21	124
	Diamond Collisions	0.00000	0.00001	0.00000	0	2
	Overspeed	0.00000	0.00022	0.00000	18	51
	Broken Rail	0.00001	0.00067	0.00001	56	155
	Work Zone Violation	0.00000	0.00012	0.00001	0	49
	Grade Crossing Collisions	0.00088	0.00283	0.00004	274	683
	Total, All Scenarios	0.00092	0.00473	0.00010	386	1162
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	1	1
	Intrusion Collisions	0.00000	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00000	0.00000	1	1
	Broken Rail	0.00001	0.00000	0.00000	6	7
	Work Zone Violation	0.00000	0.00001	0.00000	0	5
	Grade Crossing Collisions	0.00007	0.00003	0.00000	5	11
	Total, All Scenarios	0.00009	0.00005	0.00000	13	28
bbb						
Total Passenger + Freight		**0.00101**	**0.00478**	**0.00010**	**399**	**1190**

Table R6b: All Year, PTC Timeout, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00058	0.00002	25	150
	Intrusion Collisions	0.00003	0.00067	0.00002	28	166
	Diamond Collisions	0.00000	0.00001	0.00000	0	2
	Overspeed	0.00001	0.00030	0.00000	24	69
	Broken Rail	0.00002	0.00091	0.00001	74	209
	Work Zone Violation	0.00000	0.00017	0.00002	0	67
	Grade Crossing Collisions	0.00109	0.00305	0.00005	296	737
	Total, All Scenarios	0.00115	0.00569	0.00013	448	1400
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	2	5
	Intrusion Collisions	0.00001	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	1	1
	Overspeed	0.00000	0.00000	0.00000	2	3
	Broken Rail	0.00002	0.00001	0.00000	11	14
	Work Zone Violation	0.00000	0.00003	0.00000	0	10
	Grade Crossing Collisions	0.00015	0.00005	0.00000	9	21
	Total, All Scenarios	0.00019	0.00009	0.00001	26	55
Total Passenger + Freight		**0.00135**	**0.00579**	**0.00013**	**474**	**1456**

Table R6c: All Year, PTC Timeout, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00072	0.00003	31	185
	Intrusion Collisions	0.00004	0.00096	0.00003	41	238
	Diamond Collisions	0.00000	0.00002	0.00000	1	4
	Overspeed	0.00001	0.00045	0.00001	35	101
	Broken Rail	0.00003	0.00136	0.00002	106	307
	Work Zone Violation	0.00000	0.00025	0.00002	0	94
	Grade Crossing Collisions	0.00099	0.00289	0.00004	280	697
	Total, All Scenarios	0.00108	0.00664	0.00016	494	1627
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	4	9
	Intrusion Collisions	0.00002	0.00001	0.00000	1	3
	Diamond Collisions	0.00001	0.00000	0.00000	1	2
	Overspeed	0.00001	0.00000	0.00000	6	7
	Broken Rail	0.00004	0.00001	0.00000	25	31
	Work Zone Violation	0.00000	0.00006	0.00001	0	24
	Grade Crossing Collisions	0.00017	0.00006	0.00000	13	29
	Total, All Scenarios	0.00026	0.00016	0.00001	49	106
Total Passenger + Freight		**0.00134**	**0.00680**	**0.00017**	**543**	**1733**

Table R6d: All Year, PTC timeout, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00003	0.00169	0.00006	72	433
	Intrusion Collisions	0.00008	0.00212	0.00008	90	528
	Diamond Collisions	0.00000	0.00004	0.00000	1	8
	Overspeed	0.00002	0.00097	0.00002	78	221
	Broken Rail	0.00006	0.00295	0.00005	236	672
	Work Zone Violation	0.00000	0.00054	0.00005	0	210
	Grade Crossing Collisions	0.00296	0.00877	0.00013	850	2117
	Total, All Scenarios	0.00315	0.01706	0.00039	1328	4189
Freight	Train-Train Collisions	0.00002	0.00002	0.00000	6	16
	Intrusion Collisions	0.00003	0.00001	0.00000	1	5
	Diamond Collisions	0.00001	0.00001	0.00000	2	4
	Overspeed	0.00002	0.00001	0.00000	9	12
	Broken Rail	0.00008	0.00002	0.00000	42	51
	Work Zone Violation	0.00000	0.00010	0.00001	0	38
	Grade Crossing Collisions	0.00039	0.00014	0.00001	27	62
	Total, All Scenarios	0.00055	0.00030	0.00002	88	188
Total Passenger + Freight		**0.00370**	**0.01737**	**0.00041**	**1416**	**4378**

Worksheet 7:
PTC Case, Timeout 120 seconds,
Latency 5 seconds.

PTC Totals, All Operating States, All Year

Table R7a: totals: All Year, All Operating States, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00359	0.25529	0.00976	11111	65919
	Intrusion Collisions	0.01043	0.29921	0.01063	12822	74631
	Diamond Collisions	0.00023	0.00249	0.00007	87	558
	Overspeed	0.00106	0.05453	0.00088	4493	12575
	Broken Rail	0.00856	0.43900	0.00706	36173	101245
	Work Zone Violation	0.00000	0.05576	0.00558	0	22302
	Grade Crossing Collisions	0.57147	1.84263	0.02735	178612	444916
	Total, All Scenarios	0.59535	2.94891	0.06132	243298	722147
Freight	Train-Train Collisions	0.00097	0.00124	0.00012	332	829
	Intrusion Collisions	0.00245	0.00080	0.00008	101	422
	Diamond Collisions	0.00144	0.00062	0.00006	239	488
	Overspeed	0.00079	0.00025	0.00002	432	531
	Broken Rail	0.00687	0.00214	0.00021	3758	4615
	Work Zone Violation	0.00000	0.00638	0.00064	0	2554
	Grade Crossing Collisions	0.04665	0.01658	0.00085	3316	7531
	Total, All Scenarios	0.05916	0.02802	0.00200	8178	16970
Total Passenger + Freight		**0.65451**	**2.97693**	**0.06332**	**251476**	**739117**

Table R7b: Totals: All Year, All Operating States, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00601	0.38372	0.01457	16524	98616
	Intrusion Collisions	0.01479	0.40110	0.01424	17094	99932
	Diamond Collisions	0.00027	0.00293	0.00009	103	658
	Overspeed	0.00151	0.07398	0.00119	5990	16947
	Broken Rail	0.01214	0.59565	0.00955	48227	136443
	Work Zone Violation	0.00000	0.07632	0.00763	0	30526
	Grade Crossing Collisions	0.71184	1.98848	0.02957	192731	480281
	Total, All Scenarios	0.74657	3.52218	0.07684	280669	863404
Freight	Train-Train Collisions	0.00369	0.00430	0.00043	1157	2876
	Intrusion Collisions	0.00534	0.00166	0.00017	209	877
	Diamond Collisions	0.00160	0.00069	0.00007	265	540
	Overspeed	0.00241	0.00070	0.00007	1259	1541
	Broken Rail	0.01423	0.00416	0.00042	7430	9093
	Work Zone Violation	0.00000	0.01507	0.00149	0	5976
	Grade Crossing Collisions	0.08927	0.02802	0.00143	5574	12679
	Total, All Scenarios	0.11655	0.05460	0.00408	15894	33583
Total Passenger + Freight		**0.86312**	**3.57679**	**0.08091**	**296563**	**896987**

Table R7c: Totals: All Year, All Operating States, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00886	0.55693	0.02110	23827	142807
	Intrusion Collisions	0.02274	0.57574	0.02042	24554	143387
	Diamond Collisions	0.00059	0.00632	0.00019	221	1417
	Overspeed	0.00232	0.10988	0.00176	8605	24881
	Broken Rail	0.01866	0.88463	0.01419	69283	200321
	Work Zone Violation	0.00000	0.11324	0.01132	0	45292
	Grade Crossing Collisions	0.64613	1.88168	0.02793	182495	454459
	Total, All Scenarios	0.69931	4.12841	0.09691	308986	1012565
Freight	Train-Train Collisions	0.00666	0.00835	0.00083	2235	5575
	Intrusion Collisions	0.01170	0.00388	0.00039	488	2042
	Diamond Collisions	0.00352	0.00152	0.00015	584	1190
	Overspeed	0.00654	0.00215	0.00022	3632	4493
	Broken Rail	0.02994	0.00987	0.00099	16637	20584
	Work Zone Violation	0.00000	0.03703	0.00370	0	14812
	Grade Crossing Collisions	0.11425	0.04339	0.00222	8661	19662
	Total, All Scenarios	0.17261	0.10619	0.00850	32237	68358
Total Passenger + Freight		**0.87191**	**4.23461**	**0.10541**	**341223**	**1080922**

Table R7d: Grand Total: All Year, All Operating States, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01846	1.19594	0.04543	51463	307342
	Intrusion Collisions	0.04797	1.27604	0.04529	54470	317951
	Diamond Collisions	0.00109	0.01174	0.00035	411	2633
	Overspeed	0.00489	0.23839	0.00383	19088	54403
	Broken Rail	0.03937	1.91928	0.03080	153683	438009
	Work Zone Violation	0.00000	0.24532	0.02453	0	98120
	Grade Crossing Collisions	1.92944	5.71280	0.08485	553838	1379656
	Total, All Scenarios	2.04122	10.59950	0.23507	832953	2598115
Freight	Train-Train Collisions	0.01132	0.01389	0.00139	3724	9280
	Intrusion Collisions	0.01949	0.00635	0.00064	798	3340
	Diamond Collisions	0.00655	0.00283	0.00028	1088	2219
	Overspeed	0.00974	0.00311	0.00031	5323	6566
	Broken Rail	0.05104	0.01617	0.00162	27825	34292
	Work Zone Violation	0.00000	0.05849	0.00583	0	23342
	Grade Crossing Collisions	0.25017	0.08799	0.00451	17552	39872
	Total, All Scenarios	0.34832	0.18882	0.01457	56309	118911
Total Passenger + Freight		**2.38954**	**10.78832**	**0.24964**	**889262**	**2717026**

Results Summary: PTC Case, Low preventability - 88%, Timeout 120 seconds, Latency 10 seconds

PTC Normal Operating State

Table R1a: Full Year, PTC Normal, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00422	0.30114	0.01151	13109	77766
	Intrusion Collisions	0.01059	0.30235	0.01074	12956	75413
	Diamond Collisions	0.00026	0.00283	0.00008	99	635
	Overspeed	0.00129	0.06637	0.00107	5469	15307
	Broken Rail	0.00859	0.44016	0.00708	36269	101512
	Work Zone Violation	0.00000	0.05675	0.00567	0	22698
	Grade Crossing Collisions	0.57297	1.84749	0.02742	179083	446090
	Total, All Scenarios	0.59793	3.01709	0.06358	246985	739422
Freight	Train-Train Collisions	0.00107	0.00136	0.00014	365	908
	Intrusion Collisions	0.00249	0.00082	0.00008	102	429
	Diamond Collisions	0.00149	0.00065	0.00006	248	506
	Overspeed	0.00085	0.00026	0.00003	465	570
	Broken Rail	0.00688	0.00215	0.00021	3764	4622
	Work Zone Violation	0.00000	0.00645	0.00064	0	2579
	Grade Crossing Collisions	0.04672	0.01661	0.00085	3321	7543
	Total, All Scenarios	0.05950	0.02828	0.00202	8264	17158
Total Passenger + Freight		**0.65743**	**3.04538**	**0.06560**	**255249**	**756580**

Table R1b: Rest of Year, PTC Normal, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00539	0.34204	0.01298	14729	87882
	Intrusion Collisions	0.01127	0.30426	0.01080	12966	75804
	Diamond Collisions	0.00024	0.00257	0.00008	90	576
	Overspeed	0.00138	0.06760	0.00108	5474	15486
	Broken Rail	0.00914	0.44833	0.00719	36299	102696
	Work Zone Violation	0.00000	0.05831	0.00583	0	23322
	Grade Crossing Collisions	0.53578	1.49666	0.02225	145062	361491
	Total, All Scenarios	0.56320	2.71976	0.06022	214619	667256
Freight	Train-Train Collisions	0.00358	0.00415	0.00042	1119	2780
	Intrusion Collisions	0.00451	0.00141	0.00014	177	741
	Diamond Collisions	0.00128	0.00055	0.00005	212	432
	Overspeed	0.00219	0.00064	0.00006	146	1402
	Broken Rail	0.01181	0.00345	0.00035	6165	7545
	Work Zone Violation	0.00000	0.01293	0.00129	0	5174
	Grade Crossing Collisions	0.07406	0.02324	0.00119	4624	10518
	Total, All Scenarios	0.09743	0.04638	0.00350	13442	28592
Total Passenger + Freight		**0.66062**	**2.76613**	**0.06372**	**228061**	**695848**

Table R1c: Rest of Year, PTC Normal, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00806	0.50173	0.01899	21463	128615
	Intrusion Collisions	0.01733	0.43673	0.01549	18625	108767
	Diamond Collisions	0.00052	0.00563	0.00017	197	1263
	Overspeed	0.00212	0.10040	0.00161	7863	22735
	Broken Rail	0.01405	0.66583	0.01068	52147	150775
	Work Zone Violation	0.00000	0.08652	0.00865	0	34608
	Grade Crossing Collisions	0.48632	1.41628	0.02102	137358	342056
	Total, All Scenarios	0.52840	3.21312	0.07662	237654	788818
Freight		0.00000	0.00000	0.00000	0	0
	Train-Train Collisions	0.00660	0.00825	0.00083	2211	5512
	Intrusion Collisions	0.01003	0.00333	0.00033	418	1749
	Diamond Collisions	0.00285	0.00123	0.00012	474	965
	Overspeed	0.00581	0.00191	0.00019	3229	3995
	Broken Rail	0.02536	0.00836	0.00084	14093	17436
	Work Zone Violation	0.00000	0.03202	0.00320	0	12809
	Grade Crossing Collisions	0.09678	0.03676	0.00188	7337	16655
	Total, All Scenarios	0.14743	0.09186	0.00739	27762	59122
Total Passenger + Freight		0.67583	3.30498	0.08401	265415	847941

Table R1d: Rest of Year, PTC Normal, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01766	1.14491	0.04349	49301	294263
	Intrusion Collisions	0.03920	1.04333	0.03703	44548	259984
	Diamond Collisions	0.00103	0.01103	0.00033	386	2474
	Overspeed	0.00479	0.23438	0.00376	18806	53528
	Broken Rail	0.03177	1.55432	0.02495	124715	354982
	Work Zone Violation	0.00000	0.20157	0.02016	0	80629
	Grade Crossing Collisions	1.59508	4.76043	0.07070	461503	1149637
	Total, All Scenarios	1.68952	8.94997	0.20041	699258	2195497
Freight	Train-Train Collisions	0.01125	0.01376	0.00138	3695	9201
	Intrusion Collisions	0.01703	0.00555	0.00056	697	2919
	Diamond Collisions	0.00561	0.00242	0.00024	933	1903
	Overspeed	0.00885	0.00282	0.00028	4839	5967
	Broken Rail	0.04405	0.01395	0.00140	24021	29603
	Work Zone Violation	0.00000	0.05141	0.00514	0	20562
	Grade Crossing Collisions	0.21756	0.07661	0.00392	15282	34717
	Total, All Scenarios	0.30436	0.16653	0.01292	49468	104872
Total Passenger + Freight		**1.99388**	**9.11649**	**0.21333**	**748726**	**2300369**

Table R2a: Summer, PTC Normal, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Freight	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Total Passenger + Freight						

Table R2b: Summer, PTC Normal, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00157	0.10452	0.00398	4509	26890
	Intrusion Collisions	0.00374	0.10105	0.00359	4306	25176
	Diamond Collisions	0.00007	0.00076	0.00002	27	172
	Overspeed	0.00046	0.02245	0.00036	1818	5143
	Broken Rail	0.00303	0.14890	0.00239	12055	34107
	Work Zone Violation	0.00000	0.01936	0.00194	0	7746
	Grade Crossing Collisions	0.17794	0.49707	0.00739	48178	120057
	Total, All Scenarios	0.18682	0.89411	0.01966	70893	219291
Freight	Train-Train Collisions	0.00039	0.00046	0.00005	124	308
	Intrusion Collisions	0.00088	0.00027	0.00003	35	145
	Diamond Collisions	0.00038	0.00016	0.00002	63	129
	Overspeed	0.00030	0.00009	0.00001	157	192
	Broken Rail	0.00243	0.00071	0.00007	1270	1554
	Work Zone Violation	0.00000	0.00222	0.00020	0	835
	Grade Crossing Collisions	0.01526	0.00479	0.00025	953	2167
	Total, All Scenarios	0.01964	0.00870	0.00062	2601	5329
Total Passenger + Freight		0.20646	0.90281	0.02028	73494	224619

Table R2c: Summer, PTC Normal, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00216	0.14478	0.00550	6210	37187
	Intrusion Collisions	0.00576	0.14505	0.00514	6186	36123
	Diamond Collisions	0.00015	0.00158	0.00005	55	354
	Overspeed	0.00070	0.03334	0.00053	2612	7551
	Broken Rail	0.00467	0.22113	0.00355	17319	50075
	Work Zone Violation	0.00000	0.02873	0.00287	0	11494
	Grade Crossing Collisions	0.16152	0.47037	0.00698	45619	113602
	Total, All Scenarios	0.17495	1.04498	0.02463	78000	256386
Freight	Train-Train Collisions	0.00037	0.00046	0.00005	125	310
	Intrusion Collisions	0.00174	0.00058	0.00006	72	303
	Diamond Collisions	0.00080	0.00034	0.00003	133	270
	Overspeed	0.00082	0.00027	0.00003	456	565
	Broken Rail	0.00457	0.00151	0.00015	2540	3142
	Work Zone Violation	0.00000	0.00508	0.00051	0	2033
	Grade Crossing Collisions	0.01744	0.00662	0.00034	1322	3001
	Total, All Scenarios	0.02574	0.01487	0.00116	4648	9624
Total Passenger + Freight		0.20069	1.05985	0.02579	82648	266010

Table R2d: Summer, PTC Normal, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00373	0.24930	0.00948	10719	64077
	Intrusion Collisions	0.00950	0.24609	0.00873	10492	61299
	Diamond Collisions	0.00022	0.00234	0.00007	82	525
	Overspeed	0.00116	0.05580	0.00089	4429	12694
	Broken Rail	0.00770	0.37003	0.00593	29374	84182
	Work Zone Violation	0.00000	0.04810	0.00481	0	19240
	Grade Crossing Collisions	0.33946	0.96744	0.01437	93796	233660
	Total, All Scenarios	0.36177	1.93910	0.04429	148893	475677
Freight	Train-Train Collisions	0.00076	0.00092	0.00009	248	618
	Intrusion Collisions	0.00262	0.00085	0.00009	107	448
	Diamond Collisions	0.00118	0.00051	0.00005	196	399
	Overspeed	0.00112	0.00036	0.00004	613	756
	Broken Rail	0.00700	0.00222	0.00022	3810	4696
	Work Zone Violation	0.00000	0.00730	0.00071	0	2868
	Grade Crossing Collisions	0.03270	0.01141	0.00058	2275	5168
	Total, All Scenarios	0.04538	0.02357	0.00178	7249	14953
Total Passenger + Freight		**0.40715**	**1.96266**	**0.04607**	**156142**	**490630**

Table R3a: All Year, PTC Normal, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00422	0.30114	0.01151	13109	77766
	Intrusion Collisions	0.01059	0.30235	0.01074	12956	75413
	Diamond Collisions	0.00026	0.00283	0.00008	99	635
	Overspeed	0.00129	0.06637	0.00107	5469	15307
	Broken Rail	0.00859	0.44016	0.00708	36269	101512
	Work Zone Violation	0.00000	0.05675	0.00567	0	22698
	Grade Crossing Collisions	0.57297	1.84749	0.02742	179083	446090
	Total, All Scenarios	0.59793	3.01709	0.06358	246985	739422
Freight	Train-Train Collisions	0.00107	0.00136	0.00014	365	908
	Intrusion Collisions	0.00249	0.00082	0.00008	102	429
	Diamond Collisions	0.00149	0.00065	0.00006	248	506
	Overspeed	0.00085	0.00026	0.00003	465	570
	Broken Rail	0.00688	0.00215	0.00021	3764	4622
	Work Zone Violation	0.00000	0.00645	0.00064	0	2579
	Grade Crossing Collisions	0.04672	0.01661	0.00085	3321	7543
	Total, All Scenarios	0.05950	0.02828	0.00202	8264	17158
Total Passenger + Freight		0.65743	3.04538	0.06560	255249	756580

Table R3b: All Year, PTC Normal, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00696	0.44656	0.01696	19238	114772
	Intrusion Collisions	0.01502	0.40530	0.01439	17273	100980
	Diamond Collisions	0.00031	0.00333	0.00010	117	747
	Overspeed	0.00184	0.09006	0.00144	7291	20629
	Broken Rail	0.01217	0.59722	0.00958	48354	136803
	Work Zone Violation	0.00000	0.07767	0.00777	0	31068
	Grade Crossing Collisions	0.71372	1.99373	0.02965	193240	481548
	Total, All Scenarios	0.75002	3.61387	0.07988	285512	886547
Freight	Train-Train Collisions	0.00397	0.00461	0.00046	1243	3088
	Intrusion Collisions	0.00539	0.00168	0.00017	211	886
	Diamond Collisions	0.00166	0.00071	0.00007	275	560
	Overspeed	0.00249	0.00073	0.00007	1302	1594
	Broken Rail	0.01424	0.00416	0.00042	7434	9099
	Work Zone Violation	0.00000	0.01515	0.00150	0	6009
	Grade Crossing Collisions	0.08931	0.02803	0.00144	5577	12685
	Total, All Scenarios	0.11707	0.05508	0.00412	16043	33921
Total Passenger + Freight		0.86709	3.66895	0.08401	301555	920468

Table R3c: All Year, PTC Normal, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01022	0.64651	0.02449	27673	165802
	Intrusion Collisions	0.02309	0.58177	0.02063	24811	144890
	Diamond Collisions	0.00067	0.00721	0.00021	252	1617
	Overspeed	0.00282	0.13375	0.00215	10475	30286
	Broken Rail	0.01871	0.88696	0.01423	69466	200850
	Work Zone Violation	0.00000	0.11525	0.01153	0	46102
	Grade Crossing Collisions	0.64784	1.88665	0.02801	182976	455658
	Total, All Scenarios	0.70335	4.25810	0.10125	315654	1045204
Freight	Train-Train Collisions	0.00697	0.00871	0.00087	2336	5822
	Intrusion Collisions	0.01176	0.00390	0.00039	491	2052
	Diamond Collisions	0.00365	0.00157	0.00016	606	1235
	Overspeed	0.00663	0.00219	0.00022	3685	4559
	Broken Rail	0.02993	0.00986	0.00099	16633	20578
	Work Zone Violation	0.00000	0.03711	0.00371	0	14842
	Grade Crossing Collisions	0.11422	0.04338	0.00222	8659	19657
	Total, All Scenarios	0.17317	0.10673	0.00855	32410	68746
Total Passenger + Freight		0.87652	4.36483	0.10980	348064	1113951

Table R3d: All Year, PTC Normal, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.02139	1.39421	0.05297	60020	358341
	Intrusion Collisions	0.04870	1.28943	0.04577	55040	321283
	Diamond Collisions	0.00124	0.01337	0.00040	468	2999
	Overspeed	0.00595	0.29017	0.00466	23235	66222
	Broken Rail	0.03947	1.92434	0.03088	154089	439164
	Work Zone Violation	0.00000	0.24967	0.02497	0	99868
	Grade Crossing Collisions	1.93453	5.72787	0.08507	555299	1383297
	Total, All Scenarios	2.05129	10.88906	0.24471	848151	2671174
Freight	Train-Train Collisions	0.01201	0.01469	0.00147	3944	9818
	Intrusion Collisions	0.01965	0.00640	0.00064	804	3367
	Diamond Collisions	0.00679	0.00293	0.00029	1129	2302
	Overspeed	0.00998	0.00318	0.00032	5452	6724
	Broken Rail	0.05105	0.01617	0.00162	27831	34299
	Work Zone Violation	0.00000	0.05870	0.00585	0	23430
	Grade Crossing Collisions	0.25026	0.08802	0.00451	17557	39885
	Total, All Scenarios	0.34974	0.19009	0.01470	56717	119825
Total Passenger + Freight		**2.40104**	**11.07916**	**0.25941**	**904868**	**2790999**

PTC Timeout Operating State

Table R4a: Full Year, PTC Timeout, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00045	0.00002	19	115
	Intrusion Collisions	0.00002	0.00050	0.00002	21	124
	Diamond Collisions	0.00000	0.00001	0.00000	0	2
	Overspeed	0.00000	0.00023	0.00000	19	52
	Broken Rail	0.00001	0.00067	0.00001	56	155
	Work Zone Violation	0.00000	0.00012	0.00001	0	49
	Grade Crossing Collisions	0.00088	0.00283	0.00004	274	683
	Total, All Scenarios	0.00092	0.00480	0.00010	389	1181
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	1	1
	Intrusion Collisions	0.00000	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00000	0.00000	1	1
	Broken Rail	0.00001	0.00000	0.00000	6	7
	Work Zone Violation	0.00000	0.00001	0.00000	0	5
	Grade Crossing Collisions	0.00007	0.00003	0.00000	5	11
	Total, All Scenarios	0.00009	0.00005	0.00000	13	28
Total Passenger + Freight		**0.00101**	**0.00485**	**0.00011**	**402**	**1209**

Table R4b: Rest of Year, PTC Timeout, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00052	0.00002	22	133
	Intrusion Collisions	0.00002	0.00050	0.00002	21	125
	Diamond Collisions	0.00000	0.00001	0.00000	0	2
	Overspeed	0.00000	0.00023	0.00000	19	53
	Broken Rail	0.00001	0.00069	0.00001	56	157
	Work Zone Violation	0.00000	0.00013	0.00001	0	51
	Grade Crossing Collisions	0.00082	0.00229	0.00003	222	553
	Total, All Scenarios	0.00087	0.00436	0.00010	340	1073
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	2	5
	Intrusion Collisions	0.00001	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00000	0.00000	2	3
	Broken Rail	0.00002	0.00001	0.00000	9	11
	Work Zone Violation	0.00000	0.00002	0.00000	0	9
	Grade Crossing Collisions	0.00011	0.00003	0.00000	7	16
	Total, All Scenarios	0.00015	0.00007	0.00001	21	45
Total Passenger + Freight		**0**	**0**	**0**	**361**	**1119**

Table R4c: Rest of Year, PTC Timeout, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00061	0.00002	26	157
	Intrusion Collisions	0.00003	0.00072	0.00003	31	179
	Diamond Collisions	0.00000	0.00001	0.00000	1	3
	Overspeed	0.00001	0.00034	0.00001	27	78
	Broken Rail	0.00002	0.00102	0.00002	80	231
	Work Zone Violation	0.00000	0.00019	0.00002	0	75
	Grade Crossing Collisions	0.00074	0.00217	0.00003	210	524
	Total, All Scenarios	0	0	0	374	1246
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	4	9
	Intrusion Collisions	0.00002	0.00001	0.00000	1	3
	Diamond Collisions	0.00001	0.00000	0.00000	1	2
	Overspeed	0.00001	0.00000	0.00000	5	6
	Broken Rail	0.00004	0.00001	0.00000	21	26
	Work Zone Violation	0.00000	0.00005	0.00001	0	20
	Grade Crossing Collisions	0.00014	0.00005	0.00000	11	25
	Total, All Scenarios	0	0	0	42	91
Total Passenger + Freight		**0**	**0**	**0**	**416**	**1337**

Table R4d: Rest of Year, PTC Timeout, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00003	0.00158	0.00006	68	405
	Intrusion Collisions	0.00007	0.00171	0.00006	73	427
	Diamond Collisions	0.00000	0.00003	0.00000	1	7
	Overspeed	0.00002	0.00080	0.00001	64	183
	Broken Rail	0.00005	0.00238	0.00004	191	543
	Work Zone Violation	0.00000	0.00044	0.00004	0	176
	Grade Crossing Collisions	0.00244	0.00729	0.00011	706	1760
	Total, All Scenarios	0.00260	0.01423	0.00032	1103	3500
Freight	Train-Train Collisions	0.00002	0.00002	0.00000	6	16
	Intrusion Collisions	0.00003	0.00001	0.00000	1	5
	Diamond Collisions	0.00001	0.00000	0.00000	2	3
	Overspeed	0.00002	0.00000	0.00000	8	10
	Broken Rail	0.00007	0.00002	0.00000	36	44
	Work Zone Violation	0.00000	0.00008	0.00001	0	34
	Grade Crossing Collisions	0.00033	0.00011	0.00001	23	52
	Total, All Scenarios	0.00046	0.00026	0.00002	76	164
Total Passenger + Freight		**0.00306**	**0.01449**	**0.00035**	**1180**	**3664**

Table R5a: Summer, PTC Timeout, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Freight	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Total Passenger + Freight						

Table R5b: Summer, PTC Timeout, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00016	0.00001	6.7	40.0
	Intrusion Collisions	0.00001	0.00017	0.00001	7.1	41.4
	Diamond Collisions	0.00000	0.00000	0.00000	0.1	0.5
	Overspeed	0.00000	0.00008	0.00000	6.2	17.5
	Broken Rail	0.00000	0.00023	0.00000	18.5	52.2
	Work Zone Violation	0.00000	0.00004	0.00000	0.0	16.9
	Grade Crossing Collisions	0.00027	0.00076	0.00001	73.7	183.8
	Total, All Scenarios	0.00029	0.00143	0.00003	112.3	352.2
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0.2	0.5
	Intrusion Collisions	0.00000	0.00000	0.00000	0.1	0.3
	Diamond Collisions	0.00000	0.00000	0.00000	0.1	0.2
	Overspeed	0.00000	0.00000	0.00000	0.4	0.4
	Broken Rail	0.00000	0.00000	0.00000	1.9	2.4
	Work Zone Violation	0.00000	0.00000	0.00000	0.0	1.0
	Grade Crossing Collisions	0.00004	0.00001	0.00000	2.3	5.2
	Total, All Scenarios	0.00004	0.00002	0.00000	5.0	10.0
Total Passenger + Freight		0.00033	0.00145	0.00003	117.2	362.2

Table R5c: Summer, PTC Timeout, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00021	0.00001	9.2	55.1
	Intrusion Collisions	0.00001	0.00024	0.00001	10.2	59.3
	Diamond Collisions	0.00000	0.00000	0.00000	0.1	0.9
	Overspeed	0.00000	0.00011	0.00000	8.9	25.7
	Broken Rail	0.00001	0.00034	0.00001	26.5	76.6
	Work Zone Violation	0.00000	0.00006	0.00000	0.0	19.1
	Grade Crossing Collisions	0.00025	0.00072	0.00001	69.8	173.9
	Total, All Scenarios	0.00027	0.00169	0.00004	124.7	410.7
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0.2	0.5
	Intrusion Collisions	0.00000	0.00000	0.00000	0.1	0.5
	Diamond Collisions	0.00000	0.00000	0.00000	0.2	0.5
	Overspeed	0.00000	0.00000	0.00000	0.8	1.0
	Broken Rail	0.00001	0.00000	0.00000	3.8	4.7
	Work Zone Violation	0.00000	0.00001	0.00000	0.0	3.5
	Grade Crossing Collisions	0.00003	0.00001	0.00000	2.0	4.5
	Total, All Scenarios	0.00004	0.00002	0.00000	7.2	15.2
Total Passenger + Freight		**0.00031**	**0.00172**	**0.00004**	**131.9**	**425.8**

Table R2d: Summer, PTC Timeout, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00037	0.00001	16	95
	Intrusion Collisions	0.00002	0.00040	0.00001	17	101
	Diamond Collisions	0.00000	0.00001	0.00000	0	1
	Overspeed	0.00000	0.00019	0.00000	15	43
	Broken Rail	0.00001	0.00057	0.00001	45	129
	Work Zone Violation	0.00000	0.00010	0.00001	0	36
	Grade Crossing Collisions	0.00052	0.00148	0.00002	144	358
	Total, All Scenarios	0.00056	0.00312	0.00007	237	763
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0	1
	Intrusion Collisions	0.00000	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00000	0.00000	1	1
	Broken Rail	0.00001	0.00000	0.00000	6	7
	Work Zone Violation	0.00000	0.00001	0.00000	0	4
	Grade Crossing Collisions	0.00006	0.00002	0.00000	4	10
	Total, All Scenarios	0.00008	0.00004	0.00000	12	25
Total Passenger + Freight		**0.00064**	**0.00316**	**0.00007**	**249**	**788**

Table R6a: All Year, PTC Timeout, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00045	0.00002	19	115
	Intrusion Collisions	0.00002	0.00050	0.00002	21	124
	Diamond Collisions	0.00000	0.00001	0.00000	0	2
	Overspeed	0.00000	0.00023	0.00000	19	52
	Broken Rail	0.00001	0.00067	0.00001	56	155
	Work Zone Violation	0.00000	0.00012	0.00001	0	49
	Grade Crossing Collisions	0.00088	0.00283	0.00004	274	683
	Total, All Scenarios	0.00092	0.00480	0.00010	389	1181
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	1	1
	Intrusion Collisions	0.00000	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00000	0.00000	1	1
	Broken Rail	0.00001	0.00000	0.00000	6	7
	Work Zone Violation	0.00000	0.00001	0.00000	0	5
	Grade Crossing Collisions	0.00007	0.00003	0.00000	5	11
	Total, All Scenarios	0.00009	0.00005	0.00000	13	28
bbb **Total Passenger + Freight**		0.00101	0.00485	0.00011	402	1209

Table R6b: All Year, PTC Timeout, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00067	0.00003	29	173
	Intrusion Collisions	0.00003	0.00067	0.00002	28	166
	Diamond Collisions	0.00000	0.00001	0.00000	0	2
	Overspeed	0.00001	0.00031	0.00000	25	70
	Broken Rail	0.00002	0.00091	0.00001	74	209
	Work Zone Violation	0.00000	0.00017	0.00002	0	68
	Grade Crossing Collisions	0.00109	0.00305	0.00005	296	737
	Total, All Scenarios	0.00115	0.00579	0.00013	452	1425
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	2	6
	Intrusion Collisions	0.00001	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	1	1
	Overspeed	0.00000	0.00000	0.00000	2	3
	Broken Rail	0.00002	0.00001	0.00000	11	14
	Work Zone Violation	0.00000	0.00003	0.00000	0	10
	Grade Crossing Collisions	0.00015	0.00005	0.00000	9	21
	Total, All Scenarios	0.00019	0.00009	0.00001	26	55
Total Passenger + Freight		0.00135	0.00588	0.00014	478	1481

Table R6c: All Year, PTC Timeout, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00083	0.00003	35	212
	Intrusion Collisions	0.00004	0.00096	0.00003	41	238
	Diamond Collisions	0.00000	0.00002	0.00000	1	4
	Overspeed	0.00001	0.00046	0.00001	36	103
	Broken Rail	0.00003	0.00136	0.00002	106	307
	Work Zone Violation	0.00000	0.00025	0.00002	0	94
	Grade Crossing Collisions	0.00099	0.00289	0.00004	280	697
	Total, All Scenarios	0.00108	0.00675	0.00016	499	1657
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	4	10
	Intrusion Collisions	0.00002	0.00001	0.00000	1	3
	Diamond Collisions	0.00001	0.00000	0.00000	1	2
	Overspeed	0.00001	0.00000	0.00000	6	7
	Broken Rail	0.00004	0.00001	0.00000	25	31
	Work Zone Violation	0.00000	0.00006	0.00001	0	24
	Grade Crossing Collisions	0.00017	0.00006	0.00000	13	29
	Total, All Scenarios	0.00026	0.00017	0.00001	49	106
Total Passenger + Freight		0.00135	0.00692	0.00017	548	1763

Table R6d: All Year, PTC timeout, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00003	0.00195	0.00007	84	500
	Intrusion Collisions	0.00008	0.00212	0.00008	90	528
	Diamond Collisions	0.00000	0.00004	0.00000	1	8
	Overspeed	0.00002	0.00099	0.00002	79	226
	Broken Rail	0.00006	0.00295	0.00005	236	672
	Work Zone Violation	0.00000	0.00054	0.00005	0	212
	Grade Crossing Collisions	0.00296	0.00877	0.00013	850	2117
	Total, All Scenarios	0.00316	0.01735	0.00040	1340	4263
Freight	Train-Train Collisions	0.00002	0.00002	0.00000	7	17
	Intrusion Collisions	0.00003	0.00001	0.00000	1	5
	Diamond Collisions	0.00001	0.00001	0.00000	2	4
	Overspeed	0.00002	0.00001	0.00000	9	12
	Broken Rail	0.00008	0.00002	0.00000	42	51
	Work Zone Violation	0.00000	0.00010	0.00001	0	38
	Grade Crossing Collisions	0.00039	0.00014	0.00001	27	62
	Total, All Scenarios	0.00055	0.00030	0.00002	88	189
Total Passenger + Freight		**0.00371**	**0.01765**	**0.00042**	**1429**	**4452**

PTC Totals, All Operating States, All Year

Table R7a: totals: All Year, All Operating States, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00422	0.30159	0.01153	13128	77881
	Intrusion Collisions	0.01061	0.30285	0.01076	12977	75537
	Diamond Collisions	0.00026	0.00284	0.00008	100	637
	Overspeed	0.00130	0.06660	0.00107	5488	15359
	Broken Rail	0.00860	0.44084	0.00709	36324	101667
	Work Zone Violation	0.00000	0.05687	0.00569	0	22748
	Grade Crossing Collisions	0.57385	1.85032	0.02746	179357	446773
	Total, All Scenarios	0.59885	3.02190	0.06368	247375	740603
Freight	Train-Train Collisions	0.00107	0.00136	0.00014	365	909
	Intrusion Collisions	0.00250	0.00082	0.00008	103	430
	Diamond Collisions	0.00149	0.00065	0.00006	248	507
	Overspeed	0.00085	0.00027	0.00003	466	572
	Broken Rail	0.00689	0.00215	0.00021	3769	4629
	Work Zone Violation	0.00000	0.00646	0.00065	0	2584
	Grade Crossing Collisions	0.04679	0.01663	0.00085	3326	7554
	Total, All Scenarios	0.05960	0.02833	0.00203	8277	17186
Total Passenger + Freight		0.65844	3.05023	0.06570	255652	757789

Table R7b: Totals: All Year, All Operating States, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00697	0.44723	0.01699	19267	114945
	Intrusion Collisions	0.01504	0.40597	0.01442	17301	101145
	Diamond Collisions	0.00031	0.00334	0.00010	117	749
	Overspeed	0.00184	0.09036	0.00145	7316	20699
	Broken Rail	0.01219	0.59814	0.00959	48428	137012
	Work Zone Violation	0.00000	0.07784	0.00778	0	31136
	Grade Crossing Collisions	0.71481	1.99678	0.02969	193536	482286
	Total, All Scenarios	0.75117	3.61966	0.08001	285965	887973
Freight	Train-Train Collisions	0.00398	0.00462	0.00046	1245	3094
	Intrusion Collisions	0.00540	0.00168	0.00017	211	887
	Diamond Collisions	0.00166	0.00071	0.00007	276	561
	Overspeed	0.00250	0.00073	0.00007	1305	1597
	Broken Rail	0.01426	0.00417	0.00042	7446	9112
	Work Zone Violation	0.00000	0.01518	0.00150	0	6018
	Grade Crossing Collisions	0.08946	0.02808	0.00144	5586	12706
	Total, All Scenarios	0.11726	0.05517	0.00413	16069	33976
Total Passenger + Freight		0.86843	3.67483	0.08414	302033	921949

Table R7c: Totals: All Year, All Operating States, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01023	0.64734	0.02452	27709	166014
	Intrusion Collisions	0.02313	0.58273	0.02067	24852	145128
	Diamond Collisions	0.00067	0.00722	0.00022	253	1621
	Overspeed	0.00283	0.13420	0.00215	10511	30390
	Broken Rail	0.01874	0.88832	0.01425	69572	201157
	Work Zone Violation	0.00000	0.11551	0.01155	0	46196
	Grade Crossing Collisions	0.64883	1.88954	0.02805	183256	456356
	Total, All Scenarios	0.70444	4.26486	0.10141	316153	1046861
Freight	Train-Train Collisions	0.00698	0.00873	0.00087	2340	5831
	Intrusion Collisions	0.01178	0.00391	0.00039	491	2055
	Diamond Collisions	0.00366	0.00158	0.00016	607	1238
	Overspeed	0.00664	0.00219	0.00022	3691	4567
	Broken Rail	0.02998	0.00988	0.00099	16657	20609
	Work Zone Violation	0.00000	0.03717	0.00372	0	14866
	Grade Crossing Collisions	0.11439	0.04345	0.00222	8672	19686
	Total, All Scenarios	0.17343	0.10689	0.00857	32459	68852
Total Passenger + Freight		0.87787	4.37175	0.10998	348612	1115713

Table R7d: Grand Total: All Year, All Operating States, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.02142	1.39615	0.05304	60104	358841
	Intrusion Collisions	0.04878	1.29155	0.04584	55130	321811
	Diamond Collisions	0.00125	0.01341	0.00040	470	3007
	Overspeed	0.00597	0.29116	0.00467	23314	66448
	Broken Rail	0.03953	1.92729	0.03093	154325	439837
	Work Zone Violation	0.00000	0.25021	0.02502	0	100080
	Grade Crossing Collisions	1.93750	5.73664	0.08520	556149	1385414
	Total, All Scenarios	2.05445	10.90641	0.24510	849492	2675437
Freight	Train-Train Collisions	0.01203	0.01471	0.00147	3950	9835
	Intrusion Collisions	0.01968	0.00641	0.00064	805	3372
	Diamond Collisions	0.00681	0.00294	0.00029	1131	2306
	Overspeed	0.00999	0.00318	0.00032	5462	6735
	Broken Rail	0.05113	0.01620	0.00162	27872	34351
	Work Zone Violation	0.00000	0.05880	0.00586	0	23468
	Grade Crossing Collisions	0.25065	0.08816	0.00452	17584	39946
	Total, All Scenarios	0.35029	0.19040	0.01472	56805	120014
Total Passenger + Freight		**2.40474**	**11.09681**	**0.25982**	**906297**	**2795451**

Results Summary: PTC Case, High Preventability - 94%, Timeout 120 seconds, Latency 10 seconds

PTC Normal Operating State

Table R1a: Full Year, PTC Normal, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00235	0.16370	0.00625	7119	42241
	Intrusion Collisions	0.01043	0.29923	0.01063	12823	74637
	Diamond Collisions	0.00022	0.00233	0.00007	82	524
	Overspeed	0.00100	0.05129	0.00082	4226	11828
	Broken Rail	0.00856	0.43879	0.00705	36156	101195
	Work Zone Violation	0.00000	0.05341	0.00534	0	21363
	Grade Crossing Collisions	0.57118	1.84173	0.02733	178524	444698
	Total, All Scenarios	0.59375	2.85048	0.05750	238930	696486
Freight	Train-Train Collisions	0.00078	0.00105	0.00011	275	695
	Intrusion Collisions	0.00245	0.00080	0.00008	101	422
	Diamond Collisions	0.00141	0.00060	0.00006	233	472
	Overspeed	0.00077	0.00024	0.00002	423	519
	Broken Rail	0.00687	0.00214	0.00021	3755	4611
	Work Zone Violation	0.00000	0.00622	0.00062	0	2488
	Grade Crossing Collisions	0.04661	0.01657	0.00085	3314	7526
	Total, All Scenarios	0.05889	0.02762	0.00196	8100	16733
Total Passenger + Freight		**0.65264**	**2.87810**	**0.05946**	**247029**	**713219**

Table R1b: Rest of Year, PTC Normal, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00336	0.20622	0.00781	8859	52917
	Intrusion Collisions	0.01110	0.30112	0.01069	12833	75023
	Diamond Collisions	0.00020	0.00215	0.00006	75	482
	Overspeed	0.00106	0.05224	0.00084	4230	11966
	Broken Rail	0.00911	0.44693	0.00717	36185	102375
	Work Zone Violation	0.00000	0.05488	0.00549	0	21951
	Grade Crossing Collisions	0.53411	1.49199	0.02218	144609	360363
	Total, All Scenarios	0.55895	2.55552	0.05424	206792	625077
Freight	Train-Train Collisions	0.00312	0.00368	0.00037	984	2457
	Intrusion Collisions	0.00446	0.00139	0.00014	175	733
	Diamond Collisions	0.00121	0.00051	0.00005	200	403
	Overspeed	0.00211	0.00062	0.00006	1103	1350
	Broken Rail	0.01179	0.00345	0.00034	6156	7534
	Work Zone Violation	0.00000	0.01270	0.00127	0	5079
	Grade Crossing Collisions	0.07395	0.02321	0.00119	4617	10503
	Total, All Scenarios	0.09665	0.04555	0.00342	13234	28060
Total Passenger + Freight		**0.65559**	**2.60107**	**0.05767**	**220026**	**653137**

Table R1c: Rest of Year, PTC Normal, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00514	0.30773	0.01162	13127	78757
	Intrusion Collisions	0.01707	0.43223	0.01533	18434	107647
	Diamond Collisions	0.00044	0.00471	0.00014	165	1056
	Overspeed	0.00164	0.07758	0.00124	6076	17568
	Broken Rail	0.01400	0.66375	0.01065	51984	150304
	Work Zone Violation	0.00000	0.08143	0.00814	0	32572
	Grade Crossing Collisions	0.48481	1.41186	0.02096	136929	340988
	Total, All Scenarios	0.52309	2.97928	0.06808	226715	728892
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0	0
	Intrusion Collisions	0.00605	0.00769	0.00077	2044	5118
	Diamond Collisions	0.00997	0.00331	0.00033	416	1739
	Overspeed	0.00271	0.00114	0.00011	446	902
	Broken Rail	0.00571	0.00188	0.00019	3173	3926
	Work Zone Violation	0.02534	0.00835	0.00084	14081	17422
	Grade Crossing Collisions	0.00000	0.03172	0.00317	0	12689
	Total, All Scenarios	0.09670	0.03673	0.00188	7331	16642
	Total, All Scenarios	0.14648	0.09081	0.00729	27491	58437
Total Passenger + Freight		0.66957	3.07010	0.07537	254206	787329

Table R1d: Rest of Year, PTC Normal, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01085	0.67764	0.02568	29105	173915
	Intrusion Collisions	0.03860	1.03258	0.03665	44090	257308
	Diamond Collisions	0.00085	0.00919	0.00027	322	2062
	Overspeed	0.00370	0.18111	0.00291	14532	41363
	Broken Rail	0.03167	1.54946	0.02487	124325	353874
	Work Zone Violation	0.00000	0.18971	0.01897	0	75886
	Grade Crossing Collisions	1.59010	4.74557	0.07048	460062	1146048
	Total, All Scenarios	1.67578	8.38528	0.17983	672436	2050456
Freight	Train-Train Collisions	0.00995	0.01242	0.00124	3302	8270
	Intrusion Collisions	0.01688	0.00550	0.00055	691	2894
	Diamond Collisions	0.00533	0.00224	0.00022	879	1777
	Overspeed	0.00860	0.00274	0.00027	4699	5795
	Broken Rail	0.04400	0.01394	0.00139	23992	29567
	Work Zone Violation	0.00000	0.05064	0.00506	0	20256
	Grade Crossing Collisions	0.21727	0.07651	0.00392	15262	34670
	Total, All Scenarios	0.30203	0.16399	0.01267	48825	103229
Total Passenger + Freight		**1.97781**	**8.54927**	**0.19250**	**721261**	**2153685**

Table R2a: Summer, PTC Normal, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Freight	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Total Passenger + Freight						

There are no seasonal traffic variations on the Joliet Sub-corridor. Therefore only one risk calculation is needed for the full year, and there is no separate summer calculation

Table R2b: Summer, PTC Normal, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00087	0.05685	0.00216	2449	14615
	Intrusion Collisions	0.00369	0.10001	0.00355	4262	24917
	Diamond Collisions	0.00006	0.00064	0.00002	22	144
	Overspeed	0.00035	0.01735	0.00028	1405	3974
	Broken Rail	0.00303	0.14843	0.00238	12018	34001
	Work Zone Violation	0.00000	0.01823	0.00182	0	7290
	Grade Crossing Collisions	0.17739	0.49551	0.00737	48027	119682
	Total, All Scenarios	0.18538	0.83702	0.01758	68184	204623
Freight	Train-Train Collisions	0.00028	0.00035	0.00004	92	233
	Intrusion Collisions	0.00087	0.00027	0.00003	34	142
	Diamond Collisions	0.00036	0.00015	0.00002	59	120
	Overspeed	0.00027	0.00008	0.00001	143	175
	Broken Rail	0.00243	0.00071	0.00007	1267	1551
	Work Zone Violation	0.00000	0.00214	0.00020	0	803
	Grade Crossing Collisions	0.01522	0.00478	0.00024	950	2162
	Total, All Scenarios	0.01943	0.00848	0.00060	2546	5186
Total Passenger + Freight		0.20482	0.84550	0.01818	70729	209809

Table R2c: Summer, PTC Normal, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00117	0.07682	0.00292	3291	19718
	Intrusion Collisions	0.00567	0.14355	0.00509	6122	35751
	Diamond Collisions	0.00012	0.00132	0.00004	46	296
	Overspeed	0.00054	0.02577	0.00041	2018	5835
	Broken Rail	0.00465	0.22044	0.00354	17265	49918
	Work Zone Violation	0.00000	0.02704	0.00270	0	10818
	Grade Crossing Collisions	0.16101	0.46890	0.00696	45476	113248
	Total, All Scenarios	0.17317	0.96384	0.02166	74219	235585
Freight	Train-Train Collisions	0.00027	0.00036	0.00004	94	238
	Intrusion Collisions	0.00172	0.00057	0.00006	72	300
	Diamond Collisions	0.00076	0.00032	0.00003	125	253
	Overspeed	0.00079	0.00026	0.00003	438	542
	Broken Rail	0.00456	0.00150	0.00015	2536	3137
	Work Zone Violation	0.00000	0.00498	0.00050	0	1993
	Grade Crossing Collisions	0.01741	0.00661	0.00034	1320	2997
	Total, All Scenarios	0.02551	0.01461	0.00114	4585	9459
Total Passenger + Freight		0.19868	0.97845	0.02280	78804	245044

Table R2d: Summer, PTC Normal, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00204	0.13366	0.00508	5741	34334
	Intrusion Collisions	0.00936	0.24356	0.00864	10384	60668
	Diamond Collisions	0.00018	0.00196	0.00006	69	440
	Overspeed	0.00090	0.04312	0.00069	3423	9809
	Broken Rail	0.00768	0.36887	0.00592	29283	83919
	Work Zone Violation	0.00000	0.04527	0.00453	0	18108
	Grade Crossing Collisions	0.33840	0.96442	0.01433	93504	232930
	Total, All Scenarios	0.35855	1.80086	0.03924	142402	440208
Freight	Train-Train Collisions	0.00055	0.00071	0.00007	187	471
	Intrusion Collisions	0.00258	0.00084	0.00008	106	442
	Diamond Collisions	0.00112	0.00047	0.00005	185	373
	Overspeed	0.00106	0.00034	0.00003	580	716
	Broken Rail	0.00699	0.00221	0.00022	3803	4688
	Work Zone Violation	0.00000	0.00712	0.00069	0	2796
	Grade Crossing Collisions	0.03264	0.01139	0.00058	2271	5159
	Total, All Scenarios	0.04495	0.02309	0.00174	7130	14645
Total Passenger + Freight		**0.40350**	**1.82394**	**0.04098**	**149533**	**454853**

Table R3a: All Year, PTC Normal, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00235	0.16370	0.00625	7119	42241
	Intrusion Collisions	0.01043	0.29923	0.01063	12823	74637
	Diamond Collisions	0.00022	0.00233	0.00007	82	524
	Overspeed	0.00100	0.05129	0.00082	4226	11828
	Broken Rail	0.00856	0.43879	0.00705	36156	101195
	Work Zone Violation	0.00000	0.05341	0.00534	0	21363
	Grade Crossing Collisions	0.57118	1.84173	0.02733	178524	444698
	Total, All Scenarios	0.59375	2.85048	0.05750	238930	696486
Freight	Train-Train Collisions	0.00078	0.00105	0.00011	275	695
	Intrusion Collisions	0.00245	0.00080	0.00008	101	422
	Diamond Collisions	0.00141	0.00060	0.00006	233	472
	Overspeed	0.00077	0.00024	0.00002	423	519
	Broken Rail	0.00687	0.00214	0.00021	3755	4611
	Work Zone Violation	0.00000	0.00622	0.00062	0	2488
	Grade Crossing Collisions	0.04661	0.01657	0.00085	3314	7526
	Total, All Scenarios	0.05889	0.02762	0.00196	8100	16733
Total Passenger + Freight		0.65264	2.87810	0.05946	247029	713219

Table R3b: All Year, PTC Normal, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00424	0.26306	0.00997	11308	67532
	Intrusion Collisions	0.01479	0.40113	0.01424	17095	99940
	Diamond Collisions	0.00026	0.00279	0.00008	98	626
	Overspeed	0.00142	0.06959	0.00112	5634	15940
	Broken Rail	0.01213	0.59536	0.00955	48203	136376
	Work Zone Violation	0.00000	0.07310	0.00731	0	29241
	Grade Crossing Collisions	0.71149	1.98750	0.02955	192637	480045
	Total, All Scenarios	0.74433	3.39253	0.07182	274975	829700
Freight	Train-Train Collisions	0.00340	0.00404	0.00040	1076	2690
	Intrusion Collisions	0.00533	0.00166	0.00017	209	876
	Diamond Collisions	0.00157	0.00066	0.00007	259	523
	Overspeed	0.00239	0.00070	0.00007	1246	1525
	Broken Rail	0.01422	0.00415	0.00042	7423	9084
	Work Zone Violation	0.00000	0.01484	0.00147	0	5883
	Grade Crossing Collisions	0.08917	0.02799	0.00143	5568	12665
	Total, All Scenarios	0.11608	0.05403	0.00402	15780	33246
Total Passenger + Freight		0.86041	3.44657	0.07584	290755	862946

Table R3c: All Year, PTC Normal, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00630	0.38454	0.01453	16419	98475
	Intrusion Collisions	0.02274	0.57578	0.02042	24556	143399
	Diamond Collisions	0.00056	0.00603	0.00018	211	1352
	Overspeed	0.00218	0.10335	0.00166	8094	23403
	Broken Rail	0.01866	0.88419	0.01418	69249	200223
	Work Zone Violation	0.00000	0.10847	0.01085	0	43390
	Grade Crossing Collisions	0.64582	1.88076	0.02792	182405	454236
	Total, All Scenarios	0.69625	3.94312	0.08974	300934	964477
Freight	Train-Train Collisions	0.00632	0.00804	0.00080	2138	5356
	Intrusion Collisions	0.01169	0.00388	0.00039	487	2039
	Diamond Collisions	0.00347	0.00146	0.00015	571	1154
	Overspeed	0.00650	0.00214	0.00021	3611	4468
	Broken Rail	0.02990	0.00986	0.00099	16617	20559
	Work Zone Violation	0.00000	0.03670	0.00367	0	14681
	Grade Crossing Collisions	0.11412	0.04334	0.00222	8651	19638
	Total, All Scenarios	0.17200	0.10542	0.00843	32076	67896
Total Passenger + Freight		0.86825	4.04854	0.09817	333010	1032373

Table R3d: All Year, PTC Normal, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01289	0.81131	0.03076	34846	208249
	Intrusion Collisions	0.04796	1.27614	0.04530	54474	317976
	Diamond Collisions	0.00104	0.01115	0.00033	391	2501
	Overspeed	0.00460	0.22423	0.00360	17954	51172
	Broken Rail	0.03935	1.91834	0.03078	153608	437793
	Work Zone Violation	0.00000	0.23498	0.02350	0	93994
	Grade Crossing Collisions	1.92850	5.70999	0.08480	553566	1378978
	Total, All Scenarios	2.03433	10.18614	0.21907	814838	2490663
Freight	Train-Train Collisions	0.01050	0.01313	0.00131	3489	8742
	Intrusion Collisions	0.01947	0.00634	0.00064	797	3336
	Diamond Collisions	0.00645	0.00272	0.00027	1063	2149
	Overspeed	0.00966	0.00308	0.00031	5280	6511
	Broken Rail	0.05099	0.01615	0.00162	27795	34255
	Work Zone Violation	0.00000	0.05776	0.00576	0	23052
	Grade Crossing Collisions	0.24990	0.08790	0.00450	17533	39829
	Total, All Scenarios	0.34697	0.18707	0.01440	55955	117874
Total Passenger + Freight		**2.38130**	**10.37321**	**0.23347**	**870794**	**2608538**

PTC Timeout Operating State

Table R4a: Full Year, PTC Timeout, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00024	0.00001	11	63
	Intrusion Collisions	0.00002	0.00050	0.00002	21	124
	Diamond Collisions	0.00000	0.00001	0.00000	0	2
	Overspeed	0.00000	0.00021	0.00000	18	49
	Broken Rail	0.00001	0.00067	0.00001	56	155
	Work Zone Violation	0.00000	0.00012	0.00001	0	48
	Grade Crossing Collisions	0.00088	0.00283	0.00004	274	683
	Total, All Scenarios	0.00092	0.00458	0.00010	379	1124
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0	1
	Intrusion Collisions	0.00000	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00000	0.00000	1	1
	Broken Rail	0.00001	0.00000	0.00000	6	7
	Work Zone Violation	0.00000	0.00001	0.00000	0	5
	Grade Crossing Collisions	0.00007	0.00003	0.00000	5	11
	Total, All Scenarios	0.00009	0.00005	0.00000	13	27
Total Passenger + Freight		**0.00101**	**0.00463**	**0.00010**	**392**	**1152**

Table R4b: Rest of Year, PTC Timeout, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00032	0.00001	14	82
	Intrusion Collisions	0.00002	0.00050	0.00002	21	125
	Diamond Collisions	0.00000	0.00001	0.00000	0	1
	Overspeed	0.00000	0.00022	0.00000	18	50
	Broken Rail	0.00001	0.00069	0.00001	56	157
	Work Zone Violation	0.00000	0.00012	0.00001	0	50
	Grade Crossing Collisions	0.00082	0.00229	0.00003	222	553
	Total, All Scenarios	0.00086	0.00414	0.00009	330	1018
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	2	5
	Intrusion Collisions	0.00001	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00000	0.00000	2	2
	Broken Rail	0.00002	0.00001	0.00000	9	11
	Work Zone Violation	0.00000	0.00002	0.00000	0	9
	Grade Crossing Collisions	0.00011	0.00003	0.00000	7	16
	Total, All Scenarios	0.00015	0.00007	0.00001	21	45
Total Passenger + Freight		**0**	**0**	**0**	**351**	**1062**

Table R4c: Rest of Year, PTC Timeout, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00040	0.00002	17	102
	Intrusion Collisions	0.00003	0.00072	0.00003	31	179
	Diamond Collisions	0.00000	0.00001	0.00000	0	3
	Overspeed	0.00001	0.00032	0.00001	25	73
	Broken Rail	0.00002	0.00102	0.00002	80	231
	Work Zone Violation	0.00000	0.00018	0.00002	0	74
	Grade Crossing Collisions	0.00074	0.00217	0.00003	210	524
	Total, All Scenarios	0	0	0	363	1185
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	3	8
	Intrusion Collisions	0.00002	0.00001	0.00000	1	3
	Diamond Collisions	0.00000	0.00000	0.00000	1	2
	Overspeed	0.00001	0.00000	0.00000	5	6
	Broken Rail	0.00004	0.00001	0.00000	21	26
	Work Zone Violation	0.00000	0.00005	0.00001	0	20
	Grade Crossing Collisions	0.00014	0.00005	0.00000	11	25
	Total, All Scenarios	0	0	0	42	90
Total Passenger + Freight		**0**	**0**	**0**	**405**	**1275**

Table R4d: Rest of Year, PTC Timeout, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00002	0.00096	0.00004	41	247
	Intrusion Collisions	0.00007	0.00171	0.00006	73	427
	Diamond Collisions	0.00000	0.00003	0.00000	1	6
	Overspeed	0.00002	0.00075	0.00001	60	172
	Broken Rail	0.00005	0.00238	0.00004	191	543
	Work Zone Violation	0.00000	0.00043	0.00004	0	172
	Grade Crossing Collisions	0.00244	0.00729	0.00011	706	1760
	Total, All Scenarios	0.00259	0.01355	0.00030	1073	3327
Freight	Train-Train Collisions	0.00002	0.00002	0.00000	6	14
	Intrusion Collisions	0.00003	0.00001	0.00000	1	5
	Diamond Collisions	0.00001	0.00000	0.00000	2	3
	Overspeed	0.00001	0.00000	0.00000	8	10
	Broken Rail	0.00007	0.00002	0.00000	36	44
	Work Zone Violation	0.00000	0.00008	0.00001	0	34
	Grade Crossing Collisions	0.00033	0.00011	0.00001	23	52
	Total, All Scenarios	0.00046	0.00026	0.00002	75	162
Total Passenger + Freight		**0.00305**	**0.01381**	**0.00032**	**1148**	**3489**

Table R5a: Summer, PTC Timeout, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Freight	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Total Passenger + Freight						

There are no seasonal traffic variations on the Joliet Sub-corridor. Therefore only one risk calculation is needed for the full year, and there is no separate summer calculation

Table R5b: Summer, PTC Timeout, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00009	0.00000	3.7	22.0
	Intrusion Collisions	0.00001	0.00017	0.00001	7.1	41.4
	Diamond Collisions	0.00000	0.00000	0.00000	0.1	0.4
	Overspeed	0.00000	0.00007	0.00000	5.8	16.5
	Broken Rail	0.00000	0.00023	0.00000	18.5	52.2
	Work Zone Violation	0.00000	0.00004	0.00000	0.0	16.5
	Grade Crossing Collisions	0.00027	0.00076	0.00001	73.7	183.8
	Total, All Scenarios	0.00029	0.00136	0.00003	108.9	332.8
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0.2	0.4
	Intrusion Collisions	0.00000	0.00000	0.00000	0.1	0.3
	Diamond Collisions	0.00000	0.00000	0.00000	0.1	0.2
	Overspeed	0.00000	0.00000	0.00000	0.3	0.4
	Broken Rail	0.00000	0.00000	0.00000	1.9	2.4
	Work Zone Violation	0.00000	0.00000	0.00000	0.0	1.0
	Grade Crossing Collisions	0.00004	0.00001	0.00000	2.3	5.2
	Total, All Scenarios	0.00004	0.00002	0.00000	4.9	9.9
Total Passenger + Freight		0.00033	0.00137	0.00003	113.7	342.6

Table R5c: Summer, PTC Timeout, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00011	0.00000	4.9	29.4
	Intrusion Collisions	0.00001	0.00024	0.00001	10.2	59.3
	Diamond Collisions	0.00000	0.00000	0.00000	0.1	0.8
	Overspeed	0.00000	0.00011	0.00000	8.4	24.2
	Broken Rail	0.00001	0.00034	0.00001	26.5	76.6
	Work Zone Violation	0.00000	0.00006	0.00000	0.0	18.7
	Grade Crossing Collisions	0.00025	0.00072	0.00001	69.8	173.9
	Total, All Scenarios	0.00027	0.00158	0.00003	119.9	383.0
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0.2	0.4
	Intrusion Collisions	0.00000	0.00000	0.00000	0.1	0.5
	Diamond Collisions	0.00000	0.00000	0.00000	0.2	0.4
	Overspeed	0.00000	0.00000	0.00000	0.8	1.0
	Broken Rail	0.00001	0.00000	0.00000	3.8	4.7
	Work Zone Violation	0.00000	0.00001	0.00000	0.0	3.4
	Grade Crossing Collisions	0.00003	0.00001	0.00000	2.0	4.5
	Total, All Scenarios	0.00004	0.00002	0.00000	7.1	15.0
Total Passenger + Freight		**0.00031**	**0.00161**	**0.00004**	**127.0**	**398.0**

Table R2d: Summer, PTC Timeout, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00020	0.00001	9	51
	Intrusion Collisions	0.00002	0.00040	0.00001	17	101
	Diamond Collisions	0.00000	0.00001	0.00000	0	1
	Overspeed	0.00000	0.00018	0.00000	14	41
	Broken Rail	0.00001	0.00057	0.00001	45	129
	Work Zone Violation	0.00000	0.00010	0.00001	0	35
	Grade Crossing Collisions	0.00052	0.00148	0.00002	144	358
	Total, All Scenarios	0.00055	0.00294	0.00006	229	716
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0	1
	Intrusion Collisions	0.00000	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00000	0.00000	1	1
	Broken Rail	0.00001	0.00000	0.00000	6	7
	Work Zone Violation	0.00000	0.00001	0.00000	0	4
	Grade Crossing Collisions	0.00006	0.00002	0.00000	4	10
	Total, All Scenarios	0.00008	0.00004	0.00000	12	25
Total Passenger + Freight		**0.00064**	**0.00298**	**0.00007**	**241**	**741**

Table R6a: All Year, PTC Timeout, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00024	0.00001	11	63
	Intrusion Collisions	0.00002	0.00050	0.00002	21	124
	Diamond Collisions	0.00000	0.00001	0.00000	0	2
	Overspeed	0.00000	0.00021	0.00000	18	49
	Broken Rail	0.00001	0.00067	0.00001	56	155
	Work Zone Violation	0.00000	0.00012	0.00001	0	48
	Grade Crossing Collisions	0.00088	0.00283	0.00004	274	683
	Total, All Scenarios	0.00092	0.00458	0.00010	379	1124
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0	1
	Intrusion Collisions	0.00000	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00000	0.00000	1	1
	Broken Rail	0.00001	0.00000	0.00000	6	7
	Work Zone Violation	0.00000	0.00001	0.00000	0	5
	Grade Crossing Collisions	0.00007	0.00003	0.00000	5	11
	Total, All Scenarios	0.00009	0.00005	0.00000	13	27
bbb						
Total Passenger + Freight		0.00101	0.00463	0.00010	392	1152

Table R6b: All Year, PTC Timeout, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00040	0.00002	17	104
	Intrusion Collisions	0.00003	0.00067	0.00002	28	166
	Diamond Collisions	0.00000	0.00001	0.00000	0	2
	Overspeed	0.00001	0.00029	0.00000	23	66
	Broken Rail	0.00002	0.00091	0.00001	74	209
	Work Zone Violation	0.00000	0.00017	0.00002	0	66
	Grade Crossing Collisions	0.00109	0.00305	0.00005	296	737
	Total, All Scenarios	0.00115	0.00550	0.00012	439	1350
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	2	5
	Intrusion Collisions	0.00001	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00000	0.00000	2	3
	Broken Rail	0.00002	0.00001	0.00000	11	14
	Work Zone Violation	0.00000	0.00003	0.00000	0	10
	Grade Crossing Collisions	0.00015	0.00005	0.00000	9	21
	Total, All Scenarios	0.00019	0.00009	0.00001	26	55
Total Passenger + Freight		0.00134	0.00559	0.00013	465	1405

Table R6c: All Year, PTC Timeout, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00051	0.00002	22	131
	Intrusion Collisions	0.00004	0.00096	0.00003	41	238
	Diamond Collisions	0.00000	0.00002	0.00000	1	4
	Overspeed	0.00001	0.00043	0.00001	34	97
	Broken Rail	0.00003	0.00136	0.00002	106	307
	Work Zone Violation	0.00000	0.00025	0.00002	0	93
	Grade Crossing Collisions	0.00099	0.00289	0.00004	280	697
	Total, All Scenarios	0.00108	0.00641	0.00015	483	1568
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	4	9
	Intrusion Collisions	0.00002	0.00001	0.00000	1	3
	Diamond Collisions	0.00001	0.00000	0.00000	1	2
	Overspeed	0.00001	0.00000	0.00000	6	7
	Broken Rail	0.00004	0.00001	0.00000	25	31
	Work Zone Violation	0.00000	0.00006	0.00001	0	24
	Grade Crossing Collisions	0.00017	0.00006	0.00000	13	29
	Total, All Scenarios	0.00026	0.00016	0.00001	49	105
Total Passenger + Freight		0.00134	0.00657	0.00016	532	1673

Table R6d: All Year, PTC timeout, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00002	0.00116	0.00004	50	298
	Intrusion Collisions	0.00008	0.00212	0.00008	90	528
	Diamond Collisions	0.00000	0.00003	0.00000	1	7
	Overspeed	0.00002	0.00093	0.00001	75	213
	Broken Rail	0.00006	0.00295	0.00005	236	672
	Work Zone Violation	0.00000	0.00053	0.00005	0	207
	Grade Crossing Collisions	0.00296	0.00877	0.00013	850	2117
	Total, All Scenarios	0.00315	0.01649	0.00036	1302	4043
Freight	Train-Train Collisions	0.00002	0.00002	0.00000	6	15
	Intrusion Collisions	0.00003	0.00001	0.00000	1	5
	Diamond Collisions	0.00001	0.00000	0.00000	2	4
	Overspeed	0.00002	0.00001	0.00000	9	12
	Broken Rail	0.00008	0.00002	0.00000	42	51
	Work Zone Violation	0.00000	0.00010	0.00001	0	38
	Grade Crossing Collisions	0.00039	0.00014	0.00001	27	62
	Total, All Scenarios	0.00054	0.00030	0.00002	87	187
Total Passenger + Freight		**0.00369**	**0.01679**	**0.00039**	**1389**	**4229**

PTC Totals, All Operating States, All Year

Table R7a: totals: All Year, All Operating States, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00236	0.16395	0.00626	7129	42304
	Intrusion Collisions	0.01045	0.29973	0.01065	12844	74761
	Diamond Collisions	0.00022	0.00234	0.00007	82	525
	Overspeed	0.00100	0.05150	0.00083	4244	11877
	Broken Rail	0.00857	0.43946	0.00706	36211	101350
	Work Zone Violation	0.00000	0.05353	0.00535	0	21412
	Grade Crossing Collisions	0.57206	1.84455	0.02738	178798	445380
	Total, All Scenarios	0.59466	2.85506	0.05760	239309	697611
Freight	Train-Train Collisions	0.00078	0.00105	0.00011	275	696
	Intrusion Collisions	0.00245	0.00080	0.00008	101	422
	Diamond Collisions	0.00141	0.00060	0.00006	233	473
	Overspeed	0.00077	0.00024	0.00002	424	520
	Broken Rail	0.00688	0.00214	0.00021	3761	4618
	Work Zone Violation	0.00000	0.00623	0.00062	0	2493
	Grade Crossing Collisions	0.04668	0.01659	0.00085	3319	7537
	Total, All Scenarios	0.05899	0.02766	0.00196	8112	16760
Total Passenger + Freight		0.65365	2.88273	0.05956	247421	714371

Table R7b: Totals: All Year, All Operating States, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00424	0.26347	0.00999	11326	67636
	Intrusion Collisions	0.01482	0.40179	0.01427	17123	100106
	Diamond Collisions	0.00026	0.00280	0.00008	98	628
	Overspeed	0.00142	0.06988	0.00112	5658	16007
	Broken Rail	0.01215	0.59627	0.00956	48277	136585
	Work Zone Violation	0.00000	0.07327	0.00733	0	29307
	Grade Crossing Collisions	0.71259	1.99056	0.02960	192932	480782
	Total, All Scenarios	0.74548	3.39803	0.07194	275414	831051
Freight	Train-Train Collisions	0.00340	0.00404	0.00040	1078	2695
	Intrusion Collisions	0.00534	0.00167	0.00017	209	877
	Diamond Collisions	0.00158	0.00066	0.00007	260	524
	Overspeed	0.00239	0.00070	0.00007	1248	1528
	Broken Rail	0.01424	0.00416	0.00042	7434	9098
	Work Zone Violation	0.00000	0.01486	0.00147	0	5892
	Grade Crossing Collisions	0.08932	0.02803	0.00144	5577	12686
	Total, All Scenarios	0.11627	0.05412	0.00403	15805	33300
Total Passenger + Freight		0.86175	3.45216	0.07597	291220	864351

Table R7c: Totals: All Year, All Operating States, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00631	0.38506	0.01455	16440	98607
	Intrusion Collisions	0.02278	0.57674	0.02046	24597	143637
	Diamond Collisions	0.00056	0.00604	0.00018	212	1356
	Overspeed	0.00219	0.10378	0.00166	8128	23500
	Broken Rail	0.01868	0.88555	0.01421	69355	200530
	Work Zone Violation	0.00000	0.10872	0.01087	0	43483
	Grade Crossing Collisions	0.64681	1.88365	0.02796	182685	454933
	Total, All Scenarios	0.69733	3.94953	0.08989	301417	966045
Freight	Train-Train Collisions	0.00633	0.00806	0.00081	2142	5365
	Intrusion Collisions	0.01170	0.00388	0.00039	488	2042
	Diamond Collisions	0.00347	0.00146	0.00015	572	1156
	Overspeed	0.00651	0.00215	0.00021	3617	4475
	Broken Rail	0.02995	0.00987	0.00099	16642	20590
	Work Zone Violation	0.00000	0.03676	0.00368	0	14705
	Grade Crossing Collisions	0.11429	0.04341	0.00222	8664	19668
	Total, All Scenarios	0.17226	0.10559	0.00844	32125	68001
Total Passenger + Freight		0.86959	4.05512	0.09833	333542	1034046

Table R7d: Grand Total: All Year, All Operating States, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01291	0.81247	0.03080	34896	208547
	Intrusion Collisions	0.04804	1.27826	0.04537	54564	318504
	Diamond Collisions	0.00104	0.01118	0.00033	392	2509
	Overspeed	0.00462	0.22516	0.00361	18029	51384
	Broken Rail	0.03941	1.92128	0.03083	153844	438466
	Work Zone Violation	0.00000	0.23552	0.02355	0	94201
	Grade Crossing Collisions	1.93146	5.71876	0.08493	554416	1381096
	Total, All Scenarios	2.03748	10.20263	0.21943	816140	2494706
Freight	Train-Train Collisions	0.01052	0.01315	0.00132	3495	8756
	Intrusion Collisions	0.01950	0.00635	0.00064	798	3341
	Diamond Collisions	0.00646	0.00272	0.00027	1065	2153
	Overspeed	0.00967	0.00309	0.00031	5289	6523
	Broken Rail	0.05106	0.01617	0.00162	27836	34306
	Work Zone Violation	0.00000	0.05786	0.00577	0	23090
	Grade Crossing Collisions	0.25029	0.08803	0.00451	17560	39891
	Total, All Scenarios	0.34751	0.18737	0.01443	56043	118061
Total Passenger + Freight		**2.38499**	**10.39000**	**0.23386**	**872183**	**2612767**

Results Summary: Basic PTC Case, Timeout 120 seconds, Latency 10 seconds with Reduced Severity of Consequences

PTC Normal Operating State

Table R1a: Full Year, PTC Normal, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00360	0.20937	0.00800	9112	54058
	Intrusion Collisions	0.01054	0.29310	0.01041	12560	73109
	Diamond Collisions	0.00025	0.00219	0.00007	77	491
	Overspeed	0.00118	0.06034	0.00097	4972	13916
	Broken Rail	0.00858	0.43531	0.00700	35869	100392
	Work Zone Violation	0.00000	0.05563	0.00556	0	22253
	Grade Crossing Collisions	0.57238	1.84557	0.02739	178897	445626
	Total, All Scenarios	0.59651	2.90151	0.05940	241487	709844
Freight	Train-Train Collisions	0.00097	0.00103	0.00010	274	686
	Intrusion Collisions	0.00248	0.00077	0.00008	97	406
	Diamond Collisions	0.00146	0.00052	0.00005	199	406
	Overspeed	0.00082	0.00026	0.00003	448	550
	Broken Rail	0.00688	0.00212	0.00021	3723	4572
	Work Zone Violation	0.00000	0.00637	0.00064	0	2549
	Grade Crossing Collisions	0.04669	0.01659	0.00085	3319	7537
	Total, All Scenarios	0.05930	0.02766	0.00196	8060	16706
Total Passenger + Freight		**0.65581**	**2.92917**	**0.06136**	**249547**	**726550**

Table R1b: Rest of Year, PTC Normal, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00471	0.24335	0.00923	10473	62506
	Intrusion Collisions	0.01122	0.29495	0.01047	12570	73487
	Diamond Collisions	0.00023	0.00199	0.00006	70	446
	Overspeed	0.00125	0.06146	0.00099	4976	14078
	Broken Rail	0.00913	0.44338	0.00711	35898	101563
	Work Zone Violation	0.00000	0.05716	0.00572	0	22865
	Grade Crossing Collisions	0.53522	1.49510	0.02223	144911	361115
	Total, All Scenarios	0.56176	2.59739	0.05581	208899	636061
Freight	Train-Train Collisions	0.00342	0.00328	0.00033	881	2192
	Intrusion Collisions	0.00449	0.00135	0.00014	170	711
	Diamond Collisions	0.00125	0.00044	0.00004	170	346
	Overspeed	0.00216	0.00063	0.00006	1129	1381
	Broken Rail	0.01180	0.00341	0.00034	6100	7466
	Work Zone Violation	0.00000	0.01286	0.00129	0	5142
	Grade Crossing Collisions	0.07402	0.02323	0.00119	4622	10513
	Total, All Scenarios	0.09716	0.04520	0.00339	13071	27752
Total Passenger + Freight		**0.65892**	**2.64259**	**0.05919**	**221970**	**663812**

Table R1c: Rest of Year, PTC Normal, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00708	0.35839	0.01356	15321	91837
	Intrusion Collisions	0.01724	0.42338	0.01502	18056	105443
	Diamond Collisions	0.00049	0.00436	0.00013	153	979
	Overspeed	0.00193	0.09127	0.00146	7148	20669
	Broken Rail	0.01403	0.65848	0.01056	51572	149112
	Work Zone Violation	0.00000	0.08482	0.00848	0	33929
	Grade Crossing Collisions	0.48582	1.41481	0.02100	137215	341700
	Total, All Scenarios	0.52660	3.03552	0.07022	229465	743667
Freight		0.00000	0.00000	0.00000	0	0
	Train-Train Collisions	0.00642	0.00661	0.00066	1767	4412
	Intrusion Collisions	0.01001	0.00322	0.00032	405	1695
	Diamond Collisions	0.00280	0.00098	0.00010	381	774
	Overspeed	0.00577	0.00190	0.00019	3207	3967
	Broken Rail	0.02535	0.00827	0.00083	13948	17257
	Work Zone Violation	0.00000	0.03192	0.00319	0	12769
	Grade Crossing Collisions	0.09676	0.03675	0.00188	7335	16651
	Total, All Scenarios	0.14711	0.08966	0.00717	27043	57526
Total Passenger + Freight		0.67371	3.12518	0.07739	256509	801193

Table R1d: Rest of Year, PTC Normal, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01539	0.81111	0.03079	34907	208401
	Intrusion Collisions	0.03900	1.01143	0.03590	43187	252038
	Diamond Collisions	0.00097	0.00854	0.00025	299	1916
	Overspeed	0.00436	0.21307	0.00342	17096	48662
	Broken Rail	0.03174	1.53717	0.02467	123339	351067
	Work Zone Violation	0.00000	0.19762	0.01976	0	79048
	Grade Crossing Collisions	1.59342	4.75548	0.07062	461023	1148441
	Total, All Scenarios	1.68487	8.53442	0.18543	679851	2089572
Freight	Train-Train Collisions	0.01081	0.01092	0.00109	2923	7290
	Intrusion Collisions	0.01698	0.00535	0.00054	672	2813
	Diamond Collisions	0.00552	0.00194	0.00019	750	1526
	Overspeed	0.00875	0.00279	0.00028	4783	5899
	Broken Rail	0.04403	0.01381	0.00138	23771	29295
	Work Zone Violation	0.00000	0.05115	0.00512	0	20460
	Grade Crossing Collisions	0.21747	0.07657	0.00392	15276	34701
	Total, All Scenarios	0.30356	0.16253	0.01252	48175	101984
Total Passenger + Freight		**1.98843**	**8.69694**	**0.19795**	**728025**	**2191556**

Table R2a: Summer, PTC Normal, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Freight	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Total Passenger + Freight						

Table R2b: Summer, PTC Normal, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00134	0.07268	0.00276	3134	18695
	Intrusion Collisions	0.00373	0.09796	0.00348	4175	24406
	Diamond Collisions	0.00007	0.00059	0.00002	21	133
	Overspeed	0.00042	0.02041	0.00033	1653	4675
	Broken Rail	0.00303	0.14725	0.00236	11922	33731
	Work Zone Violation	0.00000	0.01898	0.00190	0	7594
	Grade Crossing Collisions	0.17776	0.49655	0.00738	48127	119932
	Total, All Scenarios	0.18633	0.85443	0.01823	69032	209167
Freight	Train-Train Collisions	0.00035	0.00035	0.00003	93	232
	Intrusion Collisions	0.00088	0.00026	0.00003	33	137
	Diamond Collisions	0.00037	0.00013	0.00001	51	103
	Overspeed	0.00029	0.00008	0.00001	151	185
	Broken Rail	0.00243	0.00070	0.00007	1256	1537
	Work Zone Violation	0.00000	0.00219	0.00020	0	824
	Grade Crossing Collisions	0.01524	0.00478	0.00024	952	2165
	Total, All Scenarios	0.01957	0.00850	0.00060	2535	5184
Total Passenger + Freight		0.20590	0.86293	0.01883	71568	214351

Table R2c: Summer, PTC Normal, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00183	0.10014	0.00380	4294	25719
	Intrusion Collisions	0.00573	0.14061	0.00499	5997	35019
	Diamond Collisions	0.00014	0.00122	0.00004	43	274
	Overspeed	0.00064	0.03031	0.00049	2374	6864
	Broken Rail	0.00466	0.21869	0.00351	17128	49522
	Work Zone Violation	0.00000	0.02817	0.00282	0	11269
	Grade Crossing Collisions	0.16135	0.46988	0.00697	45571	113484
	Total, All Scenarios	0.17435	0.98903	0.02261	75407	242152
Freight	Train-Train Collisions	0.00034	0.00035	0.00004	94	234
	Intrusion Collisions	0.00173	0.00055	0.00006	69	290
	Diamond Collisions	0.00079	0.00028	0.00003	107	217
	Overspeed	0.00081	0.00027	0.00003	449	555
	Broken Rail	0.00457	0.00149	0.00015	2513	3109
	Work Zone Violation	0.00000	0.00505	0.00050	0	2019
	Grade Crossing Collisions	0.01743	0.00662	0.00034	1322	3000
	Total, All Scenarios	0.02566	0.01461	0.00114	4554	9426
Total Passenger + Freight		0.20001	1.00364	0.02375	79961	251577

Table R2d: Summer, PTC Normal, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00317	0.17282	0.00657	7429	44414
	Intrusion Collisions	0.00945	0.23857	0.00847	10172	59425
	Diamond Collisions	0.00021	0.00182	0.00005	64	407
	Overspeed	0.00106	0.05072	0.00081	4027	11540
	Broken Rail	0.00769	0.36595	0.00587	29050	83253
	Work Zone Violation	0.00000	0.04716	0.00472	0	18862
	Grade Crossing Collisions	0.33910	0.96643	0.01436	93699	233417
	Total, All Scenarios	0.36068	1.84346	0.04084	144440	451319
Freight	Train-Train Collisions	0.00069	0.00070	0.00007	187	466
	Intrusion Collisions	0.00261	0.00081	0.00008	102	428
	Diamond Collisions	0.00116	0.00041	0.00004	158	320
	Overspeed	0.00110	0.00035	0.00004	600	740
	Broken Rail	0.00700	0.00219	0.00022	3769	4647
	Work Zone Violation	0.00000	0.00724	0.00071	0	2844
	Grade Crossing Collisions	0.03268	0.01141	0.00058	2273	5165
	Total, All Scenarios	0.04523	0.02311	0.00174	7089	14610
Total Passenger + Freight		**0.40591**	**1.86657**	**0.04258**	**151529**	**465928**

Table R3a: All Year, PTC Normal, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00360	0.20937	0.00800	9112	54058
	Intrusion Collisions	0.01054	0.29310	0.01041	12560	73109
	Diamond Collisions	0.00025	0.00219	0.00007	77	491
	Overspeed	0.00118	0.06034	0.00097	4972	13916
	Broken Rail	0.00858	0.43531	0.00700	35869	100392
	Work Zone Violation	0.00000	0.05563	0.00556	0	22253
	Grade Crossing Collisions	0.57238	1.84557	0.02739	178897	445626
	Total, All Scenarios	0.59651	2.90151	0.05940	241487	709844
Freight	Train-Train Collisions	0.00097	0.00103	0.00010	274	686
	Intrusion Collisions	0.00248	0.00077	0.00008	97	406
	Diamond Collisions	0.00146	0.00052	0.00005	199	406
	Overspeed	0.00082	0.00026	0.00003	448	550
	Broken Rail	0.00688	0.00212	0.00021	3723	4572
	Work Zone Violation	0.00000	0.00637	0.00064	0	2549
	Grade Crossing Collisions	0.04669	0.01659	0.00085	3319	7537
	Total, All Scenarios	0.05930	0.02766	0.00196	8060	16706
Total Passenger + Freight		0.65581	2.92917	0.06136	249547	726550

Table R3b: All Year, PTC Normal, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00605	0.31602	0.01200	13608	81201
	Intrusion Collisions	0.01494	0.39291	0.01395	16745	97893
	Diamond Collisions	0.00029	0.00258	0.00008	90	579
	Overspeed	0.00167	0.08187	0.00131	6629	18753
	Broken Rail	0.01216	0.59064	0.00947	47821	135294
	Work Zone Violation	0.00000	0.07615	0.00761	0	30459
	Grade Crossing Collisions	0.71298	1.99165	0.02961	193039	481047
	Total, All Scenarios	0.74809	3.45182	0.07404	277931	845227
Freight	Train-Train Collisions	0.00378	0.00362	0.00036	974	2424
	Intrusion Collisions	0.00537	0.00161	0.00016	202	848
	Diamond Collisions	0.00163	0.00057	0.00006	221	449
	Overspeed	0.00245	0.00072	0.00007	1280	1566
	Broken Rail	0.01423	0.00412	0.00041	7356	9003
	Work Zone Violation	0.00000	0.01505	0.00149	0	5967
	Grade Crossing Collisions	0.08927	0.02802	0.00143	5574	12678
	Total, All Scenarios	0.11673	0.05370	0.00399	15607	32936
Total Passenger + Freight		0.86483	3.50552	0.07802	293538	878163

Table R3c: All Year, PTC Normal, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00891	0.45853	0.01736	19616	117555
	Intrusion Collisions	0.02297	0.56399	0.02000	24053	140462
	Diamond Collisions	0.00063	0.00559	0.00017	196	1253
	Overspeed	0.00257	0.12159	0.00195	9523	27533
	Broken Rail	0.01869	0.87718	0.01407	68700	198634
	Work Zone Violation	0.00000	0.11299	0.01130	0	45198
	Grade Crossing Collisions	0.64717	1.88469	0.02798	182786	455184
	Total, All Scenarios	0.70094	4.02455	0.09283	304873	985819
Freight	Train-Train Collisions	0.00675	0.00696	0.00070	1861	4647
	Intrusion Collisions	0.01174	0.00378	0.00038	475	1986
	Diamond Collisions	0.00359	0.00126	0.00013	488	991
	Overspeed	0.00658	0.00217	0.00022	3656	4523
	Broken Rail	0.02992	0.00976	0.00098	16461	20366
	Work Zone Violation	0.00000	0.03697	0.00370	0	14789
	Grade Crossing Collisions	0.11419	0.04337	0.00222	8657	19651
	Total, All Scenarios	0.17277	0.10427	0.00831	31597	66951
Total Passenger + Freight		0.87371	4.12882	0.10114	336470	1052770

Table R3d: All Year, PTC Normal, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01856	0.98392	0.03736	42335	252814
	Intrusion Collisions	0.04845	1.25000	0.04437	53358	311464
	Diamond Collisions	0.00117	0.01036	0.00031	363	2323
	Overspeed	0.00541	0.26379	0.00423	21123	60202
	Broken Rail	0.03943	1.90312	0.03054	152389	434320
	Work Zone Violation	0.00000	0.24478	0.02448	0	97910
	Grade Crossing Collisions	1.93252	5.72191	0.08498	554721	1381857
	Total, All Scenarios	2.04555	10.37788	0.22627	824290	2540891
Freight	Train-Train Collisions	0.01151	0.01162	0.00116	3109	7757
	Intrusion Collisions	0.01959	0.00616	0.00062	774	3240
	Diamond Collisions	0.00668	0.00234	0.00023	908	1846
	Overspeed	0.00985	0.00314	0.00031	5383	6639
	Broken Rail	0.05103	0.01600	0.00160	27541	33942
	Work Zone Violation	0.00000	0.05839	0.00582	0	23304
	Grade Crossing Collisions	0.25014	0.08798	0.00451	17549	39866
	Total, All Scenarios	0.34880	0.18563	0.01426	55264	116593
Total Passenger + Freight		**2.39435**	**10.56351**	**0.24053**	**879554**	**2657484**

PTC Timeout Operating State

Table R4a: Full Year, PTC Timeout, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00038	0.00001	16	98
	Intrusion Collisions	0.00002	0.00050	0.00002	21	124
	Diamond Collisions	0.00000	0.00001	0.00000	0	2
	Overspeed	0.00000	0.00022	0.00000	18	51
	Broken Rail	0.00001	0.00067	0.00001	56	155
	Work Zone Violation	0.00000	0.00012	0.00001	0	49
	Grade Crossing Collisions	0.00088	0.00283	0.00004	274	683
	Total, All Scenarios	0.00092	0.00473	0.00010	386	1162
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	1	1
	Intrusion Collisions	0.00000	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00000	0.00000	1	1
	Broken Rail	0.00001	0.00000	0.00000	6	7
	Work Zone Violation	0.00000	0.00001	0.00000	0	5
	Grade Crossing Collisions	0.00007	0.00003	0.00000	5	11
	Total, All Scenarios	0.00009	0.00005	0.00000	13	28
Total Passenger + Freight		**0.00101**	**0.00478**	**0.00010**	**399**	**1190**

Table R4b: Rest of Year, PTC Timeout, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00045	0.00002	19	116
	Intrusion Collisions	0.00002	0.00050	0.00002	21	125
	Diamond Collisions	0.00000	0.00001	0.00000	0	2
	Overspeed	0.00000	0.00023	0.00000	18	52
	Broken Rail	0.00001	0.00069	0.00001	56	157
	Work Zone Violation	0.00000	0.00013	0.00001	0	50
	Grade Crossing Collisions	0.00082	0.00229	0.00003	222	553
	Total, All Scenarios	0.00087	0.00429	0.00010	337	1055
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	2	5
	Intrusion Collisions	0.00001	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00000	0.00000	2	2
	Broken Rail	0.00002	0.00001	0.00000	9	11
	Work Zone Violation	0.00000	0.00002	0.00000	0	9
	Grade Crossing Collisions	0.00011	0.00003	0.00000	7	16
	Total, All Scenarios	0.00015	0.00007	0.00001	21	45
Total Passenger + Freight		**0**	**0**	**0**	**358**	**1100**

Table R4c: Rest of Year, PTC Timeout, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00054	0.00002	23	139
	Intrusion Collisions	0.00003	0.00072	0.00003	31	179
	Diamond Collisions	0.00000	0.00001	0.00000	0	3
	Overspeed	0.00001	0.00034	0.00001	26	76
	Broken Rail	0.00002	0.00102	0.00002	80	231
	Work Zone Violation	0.00000	0.00019	0.00002	0	75
	Grade Crossing Collisions	0.00074	0.00217	0.00003	210	524
	Total, All Scenarios	0	0	0	370	1226
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	4	9
	Intrusion Collisions	0.00002	0.00001	0.00000	1	3
	Diamond Collisions	0.00001	0.00000	0.00000	1	2
	Overspeed	0.00001	0.00000	0.00000	5	6
	Broken Rail	0.00004	0.00001	0.00000	21	26
	Work Zone Violation	0.00000	0.00005	0.00001	0	20
	Grade Crossing Collisions	0.00014	0.00005	0.00000	11	25
	Total, All Scenarios	0	0	0	42	91
Total Passenger + Freight		**0**	**0**	**0**	**413**	**1316**

Table R4d: Rest of Year, PTC Timeout, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00002	0.00137	0.00005	59	352
	Intrusion Collisions	0.00007	0.00171	0.00006	73	427
	Diamond Collisions	0.00000	0.00003	0.00000	1	7
	Overspeed	0.00002	0.00078	0.00001	63	179
	Broken Rail	0.00005	0.00238	0.00004	191	543
	Work Zone Violation	0.00000	0.00044	0.00004	0	174
	Grade Crossing Collisions	0.00244	0.00729	0.00011	706	1760
	Total, All Scenarios	0.00260	0.01400	0.00032	1093	3442
Freight	Train-Train Collisions	0.00002	0.00002	0.00000	6	15
	Intrusion Collisions	0.00003	0.00001	0.00000	1	5
	Diamond Collisions	0.00001	0.00000	0.00000	2	3
	Overspeed	0.00002	0.00000	0.00000	8	10
	Broken Rail	0.00007	0.00002	0.00000	36	44
	Work Zone Violation	0.00000	0.00008	0.00001	0	34
	Grade Crossing Collisions	0.00033	0.00011	0.00001	23	52
	Total, All Scenarios	0.00046	0.00026	0.00002	76	163
Total Passenger + Freight		**0.00306**	**0.01426**	**0.00034**	**1169**	**3606**

Table R5a: Summer, PTC Timeout, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Freight	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Total Passenger + Freight						

Table R5b: Summer, PTC Timeout, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00013	0.00001	5.7	34.0
	Intrusion Collisions	0.00001	0.00017	0.00001	7.1	41.4
	Diamond Collisions	0.00000	0.00000	0.00000	0.1	0.4
	Overspeed	0.00000	0.00008	0.00000	6.1	17.2
	Broken Rail	0.00000	0.00023	0.00000	18.5	52.2
	Work Zone Violation	0.00000	0.00004	0.00000	0.0	16.8
	Grade Crossing Collisions	0.00027	0.00076	0.00001	73.7	183.8
	Total, All Scenarios	0.00029	0.00141	0.00003	111.1	345.8
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0.2	0.5
	Intrusion Collisions	0.00000	0.00000	0.00000	0.1	0.3
	Diamond Collisions	0.00000	0.00000	0.00000	0.1	0.2
	Overspeed	0.00000	0.00000	0.00000	0.3	0.4
	Broken Rail	0.00000	0.00000	0.00000	1.9	2.4
	Work Zone Violation	0.00000	0.00000	0.00000	0.0	1.0
	Grade Crossing Collisions	0.00004	0.00001	0.00000	2.3	5.2
	Total, All Scenarios	0.00004	0.00002	0.00000	4.9	10.0
Total Passenger + Freight		0.00033	0.00142	0.00003	116.1	355.7

Table R5c: Summer, PTC Timeout, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00018	0.00001	7.8	46.5
	Intrusion Collisions	0.00001	0.00024	0.00001	10.2	59.3
	Diamond Collisions	0.00000	0.00000	0.00000	0.1	0.9
	Overspeed	0.00000	0.00011	0.00000	8.7	25.2
	Broken Rail	0.00001	0.00034	0.00001	26.5	76.6
	Work Zone Violation	0.00000	0.00006	0.00000	0.0	18.9
	Grade Crossing Collisions	0.00025	0.00072	0.00001	69.8	173.9
	Total, All Scenarios	0.00027	0.00166	0.00004	123.1	401.4
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0.2	0.5
	Intrusion Collisions	0.00000	0.00000	0.00000	0.1	0.5
	Diamond Collisions	0.00000	0.00000	0.00000	0.2	0.5
	Overspeed	0.00000	0.00000	0.00000	0.8	1.0
	Broken Rail	0.00001	0.00000	0.00000	3.8	4.7
	Work Zone Violation	0.00000	0.00001	0.00000	0.0	3.5
	Grade Crossing Collisions	0.00003	0.00001	0.00000	2.0	4.5
	Total, All Scenarios	0.00004	0.00002	0.00000	7.1	15.1
Total Passenger + Freight		**0.00031**	**0.00168**	**0.00004**	**130.3**	**416.6**

Table R2d: Summer, PTC Timeout, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00031	0.00001	13	81
	Intrusion Collisions	0.00002	0.00040	0.00001	17	101
	Diamond Collisions	0.00000	0.00001	0.00000	0	1
	Overspeed	0.00000	0.00019	0.00000	15	42
	Broken Rail	0.00001	0.00057	0.00001	45	129
	Work Zone Violation	0.00000	0.00010	0.00001	0	36
	Grade Crossing Collisions	0.00052	0.00148	0.00002	144	358
	Total, All Scenarios	0.00056	0.00306	0.00007	234	747
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0	1
	Intrusion Collisions	0.00000	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00000	0.00000	1	1
	Broken Rail	0.00001	0.00000	0.00000	6	7
	Work Zone Violation	0.00000	0.00001	0.00000	0	4
	Grade Crossing Collisions	0.00006	0.00002	0.00000	4	10
	Total, All Scenarios	0.00008	0.00004	0.00000	12	25
Total Passenger + Freight		**0.00064**	**0.00310**	**0.00007**	**246**	**772**

Table R6a: All Year, PTC Timeout, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00038	0.00001	16	98
	Intrusion Collisions	0.00002	0.00050	0.00002	21	124
	Diamond Collisions	0.00000	0.00001	0.00000	0	2
	Overspeed	0.00000	0.00022	0.00000	18	51
	Broken Rail	0.00001	0.00067	0.00001	56	155
	Work Zone Violation	0.00000	0.00012	0.00001	0	49
	Grade Crossing Collisions	0.00088	0.00283	0.00004	274	683
	Total, All Scenarios	0.00092	0.00473	0.00010	386	1162
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	1	1
	Intrusion Collisions	0.00000	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00000	0.00000	1	1
	Broken Rail	0.00001	0.00000	0.00000	6	7
	Work Zone Violation	0.00000	0.00001	0.00000	0	5
	Grade Crossing Collisions	0.00007	0.00003	0.00000	5	11
	Total, All Scenarios	0.00009	0.00005	0.00000	13	28
bbb						
Total Passenger + Freight		0.00101	0.00478	0.00010	399	1190

Table R6b: All Year, PTC Timeout, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00058	0.00002	25	150
	Intrusion Collisions	0.00003	0.00067	0.00002	28	166
	Diamond Collisions	0.00000	0.00001	0.00000	0	2
	Overspeed	0.00001	0.00030	0.00000	24	69
	Broken Rail	0.00002	0.00091	0.00001	74	209
	Work Zone Violation	0.00000	0.00017	0.00002	0	67
	Grade Crossing Collisions	0.00109	0.00305	0.00005	296	737
	Total, All Scenarios	0.00115	0.00569	0.00013	448	1400
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	2	5
	Intrusion Collisions	0.00001	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	1	1
	Overspeed	0.00000	0.00000	0.00000	2	3
	Broken Rail	0.00002	0.00001	0.00000	11	14
	Work Zone Violation	0.00000	0.00003	0.00000	0	10
	Grade Crossing Collisions	0.00015	0.00005	0.00000	9	21
	Total, All Scenarios	0.00019	0.00009	0.00001	26	55
Total Passenger + Freight		0.00135	0.00579	0.00013	474	1456

Table R6c: All Year, PTC Timeout, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00072	0.00003	31	185
	Intrusion Collisions	0.00004	0.00096	0.00003	41	238
	Diamond Collisions	0.00000	0.00002	0.00000	1	4
	Overspeed	0.00001	0.00045	0.00001	35	101
	Broken Rail	0.00003	0.00136	0.00002	106	307
	Work Zone Violation	0.00000	0.00025	0.00002	0	94
	Grade Crossing Collisions	0.00099	0.00289	0.00004	280	697
	Total, All Scenarios	0.00108	0.00664	0.00016	494	1627
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	4	9
	Intrusion Collisions	0.00002	0.00001	0.00000	1	3
	Diamond Collisions	0.00001	0.00000	0.00000	1	2
	Overspeed	0.00001	0.00000	0.00000	6	7
	Broken Rail	0.00004	0.00001	0.00000	25	31
	Work Zone Violation	0.00000	0.00006	0.00001	0	24
	Grade Crossing Collisions	0.00017	0.00006	0.00000	13	29
	Total, All Scenarios	0.00026	0.00016	0.00001	49	106
Total Passenger + Freight		0.00134	0.00680	0.00017	543	1733

Table R6d: All Year, PTC timeout, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00003	0.00169	0.00006	72	433
	Intrusion Collisions	0.00008	0.00212	0.00008	90	528
	Diamond Collisions	0.00000	0.00004	0.00000	1	8
	Overspeed	0.00002	0.00097	0.00002	78	221
	Broken Rail	0.00006	0.00295	0.00005	236	672
	Work Zone Violation	0.00000	0.00054	0.00005	0	210
	Grade Crossing Collisions	0.00296	0.00877	0.00013	850	2117
	Total, All Scenarios	0.00315	0.01706	0.00039	1328	4189
Freight	Train-Train Collisions	0.00002	0.00002	0.00000	6	16
	Intrusion Collisions	0.00003	0.00001	0.00000	1	5
	Diamond Collisions	0.00001	0.00001	0.00000	2	4
	Overspeed	0.00002	0.00001	0.00000	9	12
	Broken Rail	0.00008	0.00002	0.00000	42	51
	Work Zone Violation	0.00000	0.00010	0.00001	0	38
	Grade Crossing Collisions	0.00039	0.00014	0.00001	27	62
	Total, All Scenarios	0.00055	0.00030	0.00002	88	188
Total Passenger + Freight		**0.00370**	**0.01737**	**0.00041**	**1416**	**4378**

PTC Totals, All Operating States, All Year

Table R7a: totals: All Year, All Operating States, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00360	0.20975	0.00802	9128	54156
	Intrusion Collisions	0.01056	0.29360	0.01043	12582	73233
	Diamond Collisions	0.00025	0.00220	0.00007	77	492
	Overspeed	0.00118	0.06056	0.00097	4990	13967
	Broken Rail	0.00859	0.43598	0.00701	35924	100548
	Work Zone Violation	0.00000	0.05576	0.00558	0	22302
	Grade Crossing Collisions	0.57325	1.84840	0.02743	179171	446309
	Total, All Scenarios	0.59743	2.90624	0.05950	241873	711006
Freight	Train-Train Collisions	0.00097	0.00103	0.00010	275	688
	Intrusion Collisions	0.00248	0.00077	0.00008	97	407
	Diamond Collisions	0.00146	0.00052	0.00005	200	407
	Overspeed	0.00082	0.00026	0.00003	449	551
	Broken Rail	0.00689	0.00213	0.00021	3729	4579
	Work Zone Violation	0.00000	0.00638	0.00064	0	2554
	Grade Crossing Collisions	0.04676	0.01662	0.00085	3324	7549
	Total, All Scenarios	0.05939	0.02771	0.00196	8073	16734
Total Passenger + Freight		0.65682	2.93394	0.06147	249946	727740

Table R7b: Totals: All Year, All Operating States, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00606	0.31661	0.01202	13633	81351
	Intrusion Collisions	0.01497	0.39358	0.01398	16773	98059
	Diamond Collisions	0.00029	0.00259	0.00008	91	581
	Overspeed	0.00167	0.08217	0.00132	6653	18822
	Broken Rail	0.01218	0.59155	0.00948	47895	135503
	Work Zone Violation	0.00000	0.07632	0.00763	0	30526
	Grade Crossing Collisions	0.71407	1.99470	0.02966	193335	481784
	Total, All Scenarios	0.74925	3.45751	0.07417	278379	846628
Freight	Train-Train Collisions	0.00379	0.00363	0.00036	976	2429
	Intrusion Collisions	0.00538	0.00161	0.00016	203	850
	Diamond Collisions	0.00163	0.00057	0.00006	222	450
	Overspeed	0.00246	0.00072	0.00007	1282	1569
	Broken Rail	0.01426	0.00412	0.00041	7367	9017
	Work Zone Violation	0.00000	0.01507	0.00149	0	5976
	Grade Crossing Collisions	0.08942	0.02806	0.00144	5583	12699
	Total, All Scenarios	0.11692	0.05379	0.00399	15632	32991
Total Passenger + Freight		0.86617	3.51131	0.07816	294011	879619

Table R7c: Totals: All Year, All Operating States, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00893	0.45926	0.01739	19647	117740
	Intrusion Collisions	0.02301	0.56494	0.02004	24094	140700
	Diamond Collisions	0.00064	0.00560	0.00017	196	1257
	Overspeed	0.00257	0.12203	0.00196	9558	27634
	Broken Rail	0.01872	0.87853	0.01409	68806	198942
	Work Zone Violation	0.00000	0.11324	0.01132	0	45292
	Grade Crossing Collisions	0.64816	1.88757	0.02802	183066	455881
	Total, All Scenarios	0.70203	4.03119	0.09299	305366	987446
Freight	Train-Train Collisions	0.00677	0.00698	0.00070	1865	4656
	Intrusion Collisions	0.01176	0.00378	0.00038	475	1989
	Diamond Collisions	0.00360	0.00126	0.00013	489	993
	Overspeed	0.00659	0.00217	0.00022	3662	4530
	Broken Rail	0.02997	0.00978	0.00098	16486	20397
	Work Zone Violation	0.00000	0.03703	0.00370	0	14812
	Grade Crossing Collisions	0.11436	0.04343	0.00222	8669	19680
	Total, All Scenarios	0.17303	0.10443	0.00832	31646	67057
Total Passenger + Freight		0.87506	4.13562	0.10131	337012	1054503

Table R7d: Grand Total: All Year, All Operating States, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01859	0.98561	0.03743	42408	253247
	Intrusion Collisions	0.04854	1.25212	0.04444	53449	311991
	Diamond Collisions	0.00118	0.01039	0.00031	364	2331
	Overspeed	0.00543	0.26476	0.00425	21201	60423
	Broken Rail	0.03949	1.90606	0.03059	152625	434992
	Work Zone Violation	0.00000	0.24532	0.02453	0	98120
	Grade Crossing Collisions	1.93548	5.73068	0.08511	555571	1383975
	Total, All Scenarios	2.04870	10.39494	0.22666	825618	2545080
Freight	Train-Train Collisions	0.01153	0.01164	0.00116	3116	7773
	Intrusion Collisions	0.01962	0.00617	0.00062	775	3245
	Diamond Collisions	0.00669	0.00235	0.00023	910	1850
	Overspeed	0.00987	0.00315	0.00031	5392	6650
	Broken Rail	0.05111	0.01603	0.00160	27582	33993
	Work Zone Violation	0.00000	0.05849	0.00583	0	23342
	Grade Crossing Collisions	0.25053	0.08811	0.00451	17576	39928
	Total, All Scenarios	0.34934	0.18593	0.01428	55351	116782
Total Passenger + Freight		**2.39805**	**10.58087**	**0.24094**	**880969**	**2661862**

Worksheet 8:
Basic Case, Cab Signal and ATS,
70% Preventability

Results Summary: Basic Case, Cab Signal and ATS, 70% Preventability.

Table R1a: Full Year, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00949	0.70571	0.02705	30764	182477
	Intrusion Collisions	0.00994	0.28484	0.01012	12206	71048
	Diamond Collisions	0.00038	0.00407	0.00012	143	913
	Overspeed	0.00589	0.30214	0.00486	24896	69680
	Broken Rail	0.00841	0.43118	0.00693	35529	99440
	Work Zone Violation	0.00000	0.11143	0.01114	0	44572
	Grade Crossing Collisions	0.59710	1.92530	0.02857	186625	464876
	Total, All Scenarios	0.63121	3.76467	0.08879	290162	933006
Freight	Train-Train Collisions	0.00161	0.00174	0.00017	504	1199
	Intrusion Collisions	0.00218	0.00071	0.00007	90	376
	Diamond Collisions	0.00168	0.00078	0.00008	286	599
	Overspeed	0.00204	0.00064	0.00006	1117	1372
	Broken Rail	0.00667	0.00208	0.00021	3650	4482
	Work Zone Violation	0.00000	0.01020	0.00102	0	4078
	Grade Crossing Collisions	0.04820	0.01713	0.00088	3426	7781
	Total, All Scenarios	0.06239	0.03328	0.00250	9073	19887
Total Passenger + Freight		**0.69360**	**3.79795**	**0.09129**	**299236**	**952893**

Table R1b: Rest of Year, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01061	0.72542	0.02767	31371	186923
	Intrusion Collisions	0.01058	0.28664	0.01018	12216	71416
	Diamond Collisions	0.00033	0.00358	0.00011	125	803
	Overspeed	0.00627	0.30774	0.00493	24916	70493
	Broken Rail	0.00895	0.43917	0.00704	35558	100600
	Work Zone Violation	0.00000	0.11449	0.01145	0	45798
	Grade Crossing Collisions	0.55834	1.55969	0.02319	151171	376715
	Total, All Scenarios	0.59509	3.43673	0.08457	255358	852746
Freight	Train-Train Collisions	0.00335	0.00353	0.00035	1000	2411
	Intrusion Collisions	0.00371	0.00116	0.00012	145	609
	Diamond Collisions	0.00144	0.00066	0.00007	244	509
	Overspeed	0.00347	0.00101	0.00010	1810	2215
	Broken Rail	0.01132	0.00331	0.00033	5911	7235
	Work Zone Violation	0.00000	0.01682	0.00168	0	6729
	Grade Crossing Collisions	0.07555	0.02371	0.00121	4717	10730
	Total, All Scenarios	0.09883	0.05020	0.00386	13827	30438
Total Passenger + Freight		**0.69393**	**3.48694**	**0.08843**	**269185**	**883184**

Table R1c: Rest of Year, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01539	1.04349	0.03975	44878	268485
	Intrusion Collisions	0.01626	0.41145	0.01459	17547	102471
	Diamond Collisions	0.00073	0.00784	0.00023	275	1760
	Overspeed	0.00964	0.45704	0.00733	35795	103495
	Broken Rail	0.01376	0.65224	0.01046	51083	147697
	Work Zone Violation	0.00000	0.16990	0.01699	0	67959
	Grade Crossing Collisions	0.50680	1.47592	0.02191	143142	356461
	Total, All Scenarios	0.56259	4.21788	0.11127	292720	1048327
		0.00000	0.00000	0.00000	0	0
Freight	Train-Train Collisions	0.00460	0.00503	0.00050	1439	3451
	Intrusion Collisions	0.00790	0.00262	0.00026	329	1377
	Diamond Collisions	0.00320	0.00148	0.00015	544	1135
	Overspeed	0.00739	0.00243	0.00024	4105	5079
	Broken Rail	0.02413	0.00795	0.00080	13409	16590
	Work Zone Violation	0.00000	0.03701	0.00370	0	14802
	Grade Crossing Collisions	0.09797	0.03721	0.00190	7427	16859
	Total, All Scenarios	0.14517	0.09373	0.00756	27253	59293
Total Passenger + Freight		**0.70776**	**4.31160**	**0.11883**	**319973**	**1107620**

Table R1d: Rest of Year, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.03549	2.47462	0.09447	107014	637884
	Intrusion Collisions	0.03678	0.98293	0.03489	41970	244936
	Diamond Collisions	0.00144	0.01549	0.00046	543	3475
	Overspeed	0.02181	1.06692	0.01712	85607	243668
	Broken Rail	0.03112	1.52259	0.02444	122169	347736
	Work Zone Violation	0.00000	0.39582	0.03958	0	158328
	Grade Crossing Collisions	1.66225	4.96091	0.07367	480938	1198052
	Total, All Scenarios	1.78889	11.41928	0.28464	838240	2834079
Freight	Train-Train Collisions	0.00956	0.01030	0.00103	2943	7061
	Intrusion Collisions	0.01378	0.00449	0.00045	564	2362
	Diamond Collisions	0.00631	0.00292	0.00029	1074	2243
	Overspeed	0.01290	0.00408	0.00041	7032	8666
	Broken Rail	0.04213	0.01334	0.00133	22970	28307
	Work Zone Violation	0.00000	0.06402	0.00640	0	25609
	Grade Crossing Collisions	0.22171	0.07805	0.00400	15570	35370
	Total, All Scenarios	0.30639	0.17720	0.01391	50153	109618
Total Passenger + Freight		**2.09529**	**11.59649**	**0.29855**	**888393**	**2943697**

Table R2a: Summer, Joliet (included in Full Year Table)

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Freight	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Total Passenger + Freight						

There are no seasonal traffic variations on the Joliet Sub-corridor. Therefore only one risk calculation is needed for the full year, and there is no separate summer calculation

Table R2b: Summer, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00356	0.24461	0.00933	10571	63007
	Intrusion Collisions	0.00351	0.09520	0.00338	4057	23718
	Diamond Collisions	0.00010	0.00107	0.00003	37	239
	Overspeed	0.00208	0.10221	0.00164	8275	23412
	Broken Rail	0.00297	0.14586	0.00234	11809	33411
	Work Zone Violation	0.00000	0.03748	0.00380	0	15156
	Grade Crossing Collisions	0.18544	0.51800	0.00770	50207	125113
	Total, All Scenarios	0.19766	1.14442	0.02822	84957	284057
Freight	Train-Train Collisions	0.00060	0.00061	0.00006	177	421
	Intrusion Collisions	0.00077	0.00024	0.00002	30	127
	Diamond Collisions	0.00043	0.00020	0.00002	73	152
	Overspeed	0.00072	0.00021	0.00002	377	461
	Broken Rail	0.00236	0.00069	0.00007	1231	1507
	Work Zone Violation	0.00000	0.00350	0.00035	0	1402
	Grade Crossing Collisions	0.01574	0.00494	0.00025	983	2235
	Total, All Scenarios	0.02062	0.01039	0.00080	2871	6304
Total Passenger + Freight		**0.21828**	**1.15481**	**0.02902**	**87827**	**290361**

Table R2c: Summer, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00504	0.34592	0.01316	14858	88937
	Intrusion Collisions	0.00540	0.13665	0.00485	5828	34032
	Diamond Collisions	0.00020	0.00220	0.00007	77	493
	Overspeed	0.00320	0.15179	0.00244	11888	34372
	Broken Rail	0.00457	0.21662	0.00348	16965	49053
	Work Zone Violation	0.00000	0.05643	0.00564	0	22570
	Grade Crossing Collisions	0.16832	0.49018	0.00728	47540	118387
	Total, All Scenarios	0.18674	1.39978	0.03690	97156	347844
Freight	Train-Train Collisions	0.00056	0.00058	0.00006	172	405
	Intrusion Collisions	0.00144	0.00048	0.00005	60	250
	Diamond Collisions	0.00090	0.00041	0.00004	152	318
	Overspeed	0.00134	0.00044	0.00004	746	923
	Broken Rail	0.00439	0.00145	0.00014	2438	3017
	Work Zone Violation	0.00000	0.00673	0.00067	0	2691
	Grade Crossing Collisions	0.01781	0.00677	0.00035	1350	3065
	Total, All Scenarios	0.02643	0.01686	0.00136	4919	10670
Total Passenger + Freight		**0.21317**	**1.41664**	**0.03826**	**102074**	**358514**

Table R2d: Summer, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00860	0.59053	0.02249	25429	151944
	Intrusion Collisions	0.00891	0.23185	0.00823	9885	57751
	Diamond Collisions	0.00030	0.00326	0.00010	114	732
	Overspeed	0.00529	0.25400	0.00407	20163	57784
	Broken Rail	0.00754	0.36248	0.00581	28775	82463
	Work Zone Violation	0.00000	0.09391	0.00945	0	37726
	Grade Crossing Collisions	0.35375	1.00818	0.01498	97746	243500
	Total, All Scenarios	0.38440	2.54419	0.06512	182112	631901
Freight	Train-Train Collisions	0.00116	0.00119	0.00012	348	826
	Intrusion Collisions	0.00221	0.00072	0.00007	90	377
	Diamond Collisions	0.00132	0.00061	0.00006	225	470
	Overspeed	0.00207	0.00065	0.00007	1123	1385
	Broken Rail	0.00675	0.00214	0.00021	3669	4524
	Work Zone Violation	0.00000	0.01023	0.00102	0	4093
	Grade Crossing Collisions	0.03355	0.01170	0.00060	2333	5300
	Total, All Scenarios	0.04706	0.02725	0.00215	7789	16974
Total Passenger + Freight		**0.43146**	**2.57144**	**0.06728**	**189902**	**648875**

Table R3a: All Year, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00949	0.70571	0.02705	30764	182477
	Intrusion Collisions	0.00994	0.28484	0.01012	12206	71048
	Diamond Collisions	0.00038	0.00407	0.00012	143	913
	Overspeed	0.00589	0.30214	0.00486	24896	69680
	Broken Rail	0.00841	0.43118	0.00693	35529	99440
	Work Zone Violation	0.00000	0.11143	0.01114	0	44572
	Grade Crossing Collisions	0.59710	1.92530	0.02857	186625	464876
	Total, All Scenarios	0.63121	3.76467	0.08879	290162	933006
Freight	Train-Train Collisions	0.00161	0.00174	0.00017	504	1199
	Intrusion Collisions	0.00218	0.00071	0.00007	90	376
	Diamond Collisions	0.00168	0.00078	0.00008	286	599
	Overspeed	0.00204	0.00064	0.00006	1117	1372
	Broken Rail	0.00667	0.00208	0.00021	3650	4482
	Work Zone Violation	0.00000	0.01020	0.00102	0	4078
	Grade Crossing Collisions	0.04820	0.01713	0.00088	3426	7781
	Total, All Scenarios	0.06239	0.03328	0.00250	9073	19887
Total Passenger + Freight		**0.69360**	**3.79795**	**0.09129**	**299236**	**952893**

Table R3b: All Year, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01417	0.97002	0.03700	41943	249930
	Intrusion Collisions	0.01409	0.38184	0.01356	16273	95135
	Diamond Collisions	0.00043	0.00464	0.00014	163	1042
	Overspeed	0.00836	0.40995	0.00657	33191	93905
	Broken Rail	0.01192	0.58503	0.00938	47367	134010
	Work Zone Violation	0.00000	0.15197	0.01525	0	60953
	Grade Crossing Collisions	0.74378	2.07769	0.03089	201378	501828
	Total, All Scenarios	0.79275	4.58115	0.11279	340315	1136803
Freight	Train-Train Collisions	0.00396	0.00414	0.00041	1177	2832
	Intrusion Collisions	0.00448	0.00140	0.00014	175	736
	Diamond Collisions	0.00186	0.00086	0.00009	317	660
	Overspeed	0.00419	0.00122	0.00012	2187	2676
	Broken Rail	0.01368	0.00400	0.00040	7143	8742
	Work Zone Violation	0.00000	0.02033	0.00203	0	8130
	Grade Crossing Collisions	0.09129	0.02865	0.00147	5700	12965
	Total, All Scenarios	0.11946	0.06059	0.00466	16698	36742
Total Passenger + Freight		**0.91221**	**4.64174**	**0.11745**	**357012**	**1173545**

Table R3c: All Year, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.02043	1.38941	0.05291	59736	357421
	Intrusion Collisions	0.02166	0.54810	0.01944	23375	136503
	Diamond Collisions	0.00093	0.01004	0.00030	352	2253
	Overspeed	0.01285	0.60883	0.00977	47683	137868
	Broken Rail	0.01833	0.86885	0.01394	68048	196750
	Work Zone Violation	0.00000	0.22632	0.02263	0	90529
	Grade Crossing Collisions	0.67512	1.96610	0.02919	190682	474847
	Total, All Scenarios	0.74933	5.61766	0.14818	389876	1396171
Freight	Train-Train Collisions	0.00516	0.00561	0.00056	1610	3856
	Intrusion Collisions	0.00933	0.00310	0.00031	389	1628
	Diamond Collisions	0.00409	0.00189	0.00019	696	1452
	Overspeed	0.00873	0.00288	0.00029	4851	6002
	Broken Rail	0.02852	0.00940	0.00094	15847	19607
	Work Zone Violation	0.00000	0.04373	0.00437	0	17494
	Grade Crossing Collisions	0.11578	0.04397	0.00225	8777	19924
	Total, All Scenarios	0.17161	0.11058	0.00891	32171	69963
Total Passenger + Freight		**0.92094**	**5.72824**	**0.15709**	**422047**	**1466134**

Table R3d: All Year, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.04409	3.06515	0.11696	132442	789828
	Intrusion Collisions	0.04569	1.21478	0.04312	51854	302686
	Diamond Collisions	0.00174	0.01876	0.00056	657	4208
	Overspeed	0.02709	1.32091	0.02120	105770	301452
	Broken Rail	0.03867	1.88506	0.03025	150943	430200
	Work Zone Violation	0.00000	0.48973	0.04903	0	196054
	Grade Crossing Collisions	2.01600	5.96909	0.08865	578685	1441552
	Total, All Scenarios	2.17329	13.96348	0.34976	1020352	3465980
Freight	Train-Train Collisions	0.01072	0.01149	0.00115	3292	7887
	Intrusion Collisions	0.01599	0.00521	0.00052	654	2739
	Diamond Collisions	0.00764	0.00353	0.00035	1299	2712
	Overspeed	0.01496	0.00474	0.00047	8155	10051
	Broken Rail	0.04887	0.01548	0.00155	26640	32831
	Work Zone Violation	0.00000	0.07426	0.00743	0	29702
	Grade Crossing Collisions	0.25526	0.08975	0.00460	17903	40670
	Total, All Scenarios	0.35345	0.20445	0.01607	57943	126592
Total Passenger + Freight		**2.52674**	**14.16793**	**0.36583**	**1078295**	**3592572**

Worksheet 9:
Cab Singnal and ATS Case,
80% Preventability

Results Summary: Cab Signal and ATS Case, 80% Preventability

Table R1a: Full Year, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00633	0.47048	0.01803	20509	121651
	Intrusion Collisions	0.00963	0.27834	0.00989	11928	69428
	Diamond Collisions	0.00030	0.00324	0.00010	113	726
	Overspeed	0.00589	0.30214	0.00486	24896	69680
	Broken Rail	0.00832	0.42659	0.00686	35151	98382
	Work Zone Violation	0.00000	0.11143	0.01114	0	44572
	Grade Crossing Collisions	0.59710	1.92530	0.02857	186625	464876
	Total, All Scenarios	0.62757	3.51751	0.07945	279222	869316
Freight	Train-Train Collisions	0.00107	0.00116	0.00012	336	799
	Intrusion Collisions	0.00208	0.00068	0.00007	85	358
	Diamond Collisions	0.00155	0.00070	0.00007	262	542
	Overspeed	0.00204	0.00064	0.00006	1117	1372
	Broken Rail	0.00660	0.00206	0.00021	3611	4434
	Work Zone Violation	0.00000	0.01020	0.00102	0	4078
	Grade Crossing Collisions	0.04820	0.01713	0.00088	3426	7781
	Total, All Scenarios	0.06155	0.03256	0.00242	8838	19365
Total Passenger + Freight		**0.68912**	**3.55007**	**0.08187**	**288060**	**888681**

Table R1b: Rest of Year, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00708	0.48361	0.01845	20914	124615
	Intrusion Collisions	0.01025	0.28010	0.00995	11938	69787
	Diamond Collisions	0.00027	0.00288	0.00009	101	647
	Overspeed	0.00627	0.30774	0.00493	24916	70493
	Broken Rail	0.00886	0.43450	0.00697	35179	99529
	Work Zone Violation	0.00000	0.11449	0.01145	0	45798
	Grade Crossing Collisions	0.55834	1.55969	0.02319	151171	376715
	Total, All Scenarios	0.59107	3.18302	0.07502	244220	787584
Freight	Train-Train Collisions	0.00223	0.00235	0.00024	667	1608
	Intrusion Collisions	0.00353	0.00110	0.00011	138	580
	Diamond Collisions	0.00133	0.00059	0.00006	223	461
	Overspeed	0.00347	0.00101	0.00010	1810	2215
	Broken Rail	0.01120	0.00327	0.00033	5848	7158
	Work Zone Violation	0.00000	0.01682	0.00168	0	6729
	Grade Crossing Collisions	0.07555	0.02371	0.00121	4717	10730
	Total, All Scenarios	0.09731	0.04887	0.00373	13404	29480
Total Passenger + Freight		**0.68838**	**3.23189**	**0.07875**	**257623**	**817064**

Table R1c: Rest of Year, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01026	0.69566	0.02650	29919	178990
	Intrusion Collisions	0.01576	0.40206	0.01426	17148	100134
	Diamond Collisions	0.00059	0.00631	0.00019	221	1415
	Overspeed	0.00964	0.45704	0.00733	35795	103495
	Broken Rail	0.01362	0.64530	0.01035	50539	146126
	Work Zone Violation	0.00000	0.16990	0.01699	0	67959
	Grade Crossing Collisions	0.50680	1.47592	0.02191	143142	356461
	Total, All Scenarios	0.55667	3.85218	0.09753	276763	954579
		0.00000	0.00000	0.00000	0	0
Freight	Train-Train Collisions	0.00308	0.00336	0.00034	963	2309
	Intrusion Collisions	0.00752	0.00250	0.00025	314	1312
	Diamond Collisions	0.00296	0.00133	0.00013	498	1029
	Overspeed	0.00739	0.00243	0.00024	4105	5079
	Broken Rail	0.02387	0.00787	0.00079	13267	16414
	Work Zone Violation	0.00000	0.03701	0.00370	0	14802
	Grade Crossing Collisions	0.09797	0.03721	0.00190	7427	16859
	Total, All Scenarios	0.14279	0.09170	0.00735	26573	57804
Total Passenger + Freight		**0.69946**	**3.94388**	**0.10489**	**303337**	**1012383**

Table R1d: Rest of Year, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.02366	1.64975	0.06298	71342	425256
	Intrusion Collisions	0.03564	0.96050	0.03410	41013	239350
	Diamond Collisions	0.00116	0.01243	0.00037	435	2788
	Overspeed	0.02181	1.06692	0.01712	85607	243668
	Broken Rail	0.03079	1.50639	0.02418	120869	344037
	Work Zone Violation	0.00000	0.39582	0.03958	0	158328
	Grade Crossing Collisions	1.66225	4.96091	0.07367	480938	1198052
	Total, All Scenarios	1.77531	10.55271	0.25200	800206	2611479
Freight	Train-Train Collisions	0.00639	0.00687	0.00069	1966	4716
	Intrusion Collisions	0.01313	0.00428	0.00043	537	2250
	Diamond Collisions	0.00584	0.00262	0.00026	983	2032
	Overspeed	0.01290	0.00408	0.00041	7032	8666
	Broken Rail	0.04168	0.01320	0.00132	22726	28006
	Work Zone Violation	0.00000	0.06402	0.00640	0	25609
	Grade Crossing Collisions	0.22171	0.07805	0.00400	15570	35370
	Total, All Scenarios	0.30165	0.17313	0.01351	48815	106650
Total Passenger + Freight		**2.07696**	**10.72584**	**0.26551**	**849020**	**2718128**

Table R2a: Summer, Joliet (Included in Full Year Table)

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Freight	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Total Passenger + Freight						

There are no seasonal traffic variations on the Joliet Sub-corridor. Therefore only one risk calculation is needed for the full year, and there is no separate summer calculation

Table R2b: Summer, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00237	0.16307	0.00622	7048	42005
	Intrusion Collisions	0.00340	0.09303	0.00330	3965	23178
	Diamond Collisions	0.00008	0.00086	0.00003	30	193
	Overspeed	0.00208	0.10221	0.00164	8275	23412
	Broken Rail	0.00294	0.14431	0.00231	11684	33055
	Work Zone Violation	0.00000	0.03748	0.00380	0	15156
	Grade Crossing Collisions	0.18544	0.51800	0.00770	50207	125113
	Total, All Scenarios	0.19632	1.05895	0.02500	81208	262111
Freight	Train-Train Collisions	0.00040	0.00041	0.00004	118	280
	Intrusion Collisions	0.00074	0.00023	0.00002	29	121
	Diamond Collisions	0.00040	0.00018	0.00002	67	137
	Overspeed	0.00072	0.00021	0.00002	377	461
	Broken Rail	0.00233	0.00068	0.00007	1218	1491
	Work Zone Violation	0.00000	0.00350	0.00035	0	1402
	Grade Crossing Collisions	0.01574	0.00494	0.00025	983	2235
	Total, All Scenarios	0.02033	0.01015	0.00077	2791	6128
Total Passenger + Freight		**0.21664**	**1.06910**	**0.02578**	**83999**	**268239**

Table R2c: Summer, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00336	0.23061	0.00877	9905	59291
	Intrusion Collisions	0.00523	0.13353	0.00474	5695	33256
	Diamond Collisions	0.00016	0.00177	0.00005	62	397
	Overspeed	0.00320	0.15179	0.00244	11888	34372
	Broken Rail	0.00452	0.21431	0.00344	16785	48531
	Work Zone Violation	0.00000	0.05643	0.00564	0	22570
	Grade Crossing Collisions	0.16832	0.49018	0.00728	47540	118387
	Total, All Scenarios	0.18480	1.27862	0.03236	91875	316804
Freight	Train-Train Collisions	0.00037	0.00039	0.00004	114	270
	Intrusion Collisions	0.00137	0.00045	0.00005	57	239
	Diamond Collisions	0.00083	0.00037	0.00004	140	288
	Overspeed	0.00134	0.00044	0.00004	746	923
	Broken Rail	0.00434	0.00143	0.00014	2412	2984
	Work Zone Violation	0.00000	0.00673	0.00067	0	2691
	Grade Crossing Collisions	0.01781	0.00677	0.00035	1350	3065
	Total, All Scenarios	0.02607	0.01658	0.00133	4820	10462
Total Passenger + Freight		**0.21087**	**1.29520**	**0.03368**	**96695**	**327266**

Table R2d: Summer, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00573	0.39368	0.01499	16953	101296
	Intrusion Collisions	0.00864	0.22655	0.00804	9660	56434
	Diamond Collisions	0.00024	0.00263	0.00008	92	589
	Overspeed	0.00529	0.25400	0.00407	20163	57784
	Broken Rail	0.00746	0.35862	0.00575	28469	81586
	Work Zone Violation	0.00000	0.09391	0.00945	0	37726
	Grade Crossing Collisions	0.35375	1.00818	0.01498	97746	243500
	Total, All Scenarios	0.38112	2.33757	0.05736	173082	578915
Freight	Train-Train Collisions	0.00078	0.00080	0.00008	232	550
	Intrusion Collisions	0.00210	0.00068	0.00007	86	359
	Diamond Collisions	0.00122	0.00055	0.00005	206	426
	Overspeed	0.00207	0.00065	0.00007	1123	1385
	Broken Rail	0.00667	0.00211	0.00021	3630	4475
	Work Zone Violation	0.00000	0.01023	0.00102	0	4093
	Grade Crossing Collisions	0.03355	0.01170	0.00060	2333	5300
	Total, All Scenarios	0.04639	0.02673	0.00210	7611	16589
Total Passenger + Freight		**0.42751**	**2.36430**	**0.05946**	**180693**	**595505**

Table R3a: All Year, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00633	0.47048	0.01803	20509	121651
	Intrusion Collisions	0.00963	0.27834	0.00989	11928	69428
	Diamond Collisions	0.00030	0.00324	0.00010	113	726
	Overspeed	0.00589	0.30214	0.00486	24896	69680
	Broken Rail	0.00832	0.42659	0.00686	35151	98382
	Work Zone Violation	0.00000	0.11143	0.01114	0	44572
	Grade Crossing Collisions	0.59710	1.92530	0.02857	186625	464876
	Total, All Scenarios	0.62757	3.51751	0.07945	279222	869316
Freight	Train-Train Collisions	0.00107	0.00116	0.00012	336	799
	Intrusion Collisions	0.00208	0.00068	0.00007	85	358
	Diamond Collisions	0.00155	0.00070	0.00007	262	542
	Overspeed	0.00204	0.00064	0.00006	1117	1372
	Broken Rail	0.00660	0.00206	0.00021	3611	4434
	Work Zone Violation	0.00000	0.01020	0.00102	0	4078
	Grade Crossing Collisions	0.04820	0.01713	0.00088	3426	7781
	Total, All Scenarios	0.06155	0.03256	0.00242	8838	19365
Total Passenger + Freight		**0.68912**	**3.55007**	**0.08187**	**288060**	**888681**

Table R3b: All Year, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00945	0.64668	0.02466	27962	166620
	Intrusion Collisions	0.01365	0.37312	0.01325	15902	92965
	Diamond Collisions	0.00035	0.00374	0.00011	131	839
	Overspeed	0.00836	0.40995	0.00657	33191	93905
	Broken Rail	0.01180	0.57881	0.00928	46863	132585
	Work Zone Violation	0.00000	0.15197	0.01525	0	60953
	Grade Crossing Collisions	0.74378	2.07769	0.03089	201378	501828
	Total, All Scenarios	0.78738	4.24197	0.10002	325427	1049695
Freight	Train-Train Collisions	0.00264	0.00276	0.00028	785	1888
	Intrusion Collisions	0.00427	0.00133	0.00013	167	701
	Diamond Collisions	0.00172	0.00077	0.00008	290	598
	Overspeed	0.00419	0.00122	0.00012	2187	2676
	Broken Rail	0.01354	0.00396	0.00040	7067	8649
	Work Zone Violation	0.00000	0.02033	0.00203	0	8130
	Grade Crossing Collisions	0.09129	0.02865	0.00147	5700	12965
	Total, All Scenarios	0.11764	0.05902	0.00450	16195	35608
Total Passenger + Freight		**0.90502**	**4.30098**	**0.10453**	**341622**	**1085303**

Table R3c: All Year, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01362	0.92627	0.03528	39824	238281
	Intrusion Collisions	0.02099	0.53559	0.01900	22842	133391
	Diamond Collisions	0.00075	0.00807	0.00024	283	1811
	Overspeed	0.01285	0.60883	0.00977	47683	137868
	Broken Rail	0.01814	0.85961	0.01379	67324	194656
	Work Zone Violation	0.00000	0.22632	0.02263	0	90529
	Grade Crossing Collisions	0.67512	1.96610	0.02919	190682	474847
	Total, All Scenarios	0.74147	5.13080	0.12989	368638	1271383
Freight	Train-Train Collisions	0.00345	0.00375	0.00038	1078	2579
	Intrusion Collisions	0.00889	0.00295	0.00030	371	1551
	Diamond Collisions	0.00379	0.00170	0.00017	638	1317
	Overspeed	0.00873	0.00288	0.00029	4851	6002
	Broken Rail	0.02821	0.00930	0.00093	15679	19398
	Work Zone Violation	0.00000	0.04373	0.00437	0	17494
	Grade Crossing Collisions	0.11578	0.04397	0.00225	8777	19924
	Total, All Scenarios	0.16885	0.10828	0.00868	31393	68266
Total Passenger + Freight		**0.91032**	**5.23908**	**0.13857**	**400031**	**1339648**

Table R3d: All Year, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.02940	2.04343	0.07797	88295	526552
	Intrusion Collisions	0.04428	1.18705	0.04214	50673	295784
	Diamond Collisions	0.00140	0.01505	0.00045	527	3377
	Overspeed	0.02709	1.32091	0.02120	105770	301452
	Broken Rail	0.03825	1.86501	0.02993	149338	425623
	Work Zone Violation	0.00000	0.48973	0.04903	0	196054
	Grade Crossing Collisions	2.01600	5.96909	0.08865	578685	1441552
	Total, All Scenarios	2.15643	12.89027	0.30936	973288	3190394
Freight	Train-Train Collisions	0.00716	0.00767	0.00077	2198	5266
	Intrusion Collisions	0.01524	0.00496	0.00050	623	2610
	Diamond Collisions	0.00706	0.00317	0.00032	1189	2458
	Overspeed	0.01496	0.00474	0.00047	8155	10051
	Broken Rail	0.04835	0.01531	0.00153	26356	32481
	Work Zone Violation	0.00000	0.07426	0.00743	0	29702
	Grade Crossing Collisions	0.25526	0.08975	0.00460	17903	40670
	Total, All Scenarios	0.34804	0.19986	0.01561	56426	123239
Total Passenger + Freight		**2.50447**	**13.09014**	**0.32497**	**1029714**	**3313633**

Worksheet 10:
Cab Signal and ATS Case,
Preventability 60%

Results Summary: Cab Signal and ATS Case, 60% Preventability

Table R1a: Full Year, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01265	0.94095	0.03606	41018	243303
	Intrusion Collisions	0.01025	0.29135	0.01035	12484	72669
	Diamond Collisions	0.00046	0.00490	0.00015	172	1099
	Overspeed	0.00589	0.30214	0.00486	24896	69680
	Broken Rail	0.00850	0.43576	0.00700	35907	100497
	Work Zone Violation	0.00000	0.11143	0.01114	0	44572
	Grade Crossing Collisions	0.59710	1.92530	0.02857	186625	464876
	Total, All Scenarios	0.63485	4.01183	0.09814	301102	996696
Freight	Train-Train Collisions	0.00215	0.00232	0.00023	672	1598
	Intrusion Collisions	0.00229	0.00075	0.00007	94	393
	Diamond Collisions	0.00181	0.00086	0.00009	311	656
	Overspeed	0.00204	0.00064	0.00006	1117	1372
	Broken Rail	0.00674	0.00210	0.00021	3688	4530
	Work Zone Violation	0.00000	0.01020	0.00102	0	4078
	Grade Crossing Collisions	0.04820	0.01713	0.00088	3426	7781
	Total, All Scenarios	0.06323	0.03399	0.00257	9309	20409
Total Passenger + Freight		**0.69807**	**4.04582**	**0.10070**	**310411**	**1017106**

Table R1b: Rest of Year, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01415	0.96722	0.03689	41829	249230
	Intrusion Collisions	0.01090	0.29319	0.01041	12494	73045
	Diamond Collisions	0.00040	0.00427	0.00013	150	959
	Overspeed	0.00627	0.30774	0.00493	24916	70493
	Broken Rail	0.00905	0.44385	0.00712	35936	101670
	Work Zone Violation	0.00000	0.11449	0.01145	0	45798
	Grade Crossing Collisions	0.55834	1.55969	0.02319	151171	376715
	Total, All Scenarios	0.59912	3.69045	0.09412	266496	917909
Freight	Train-Train Collisions	0.00447	0.00470	0.00047	1333	3215
	Intrusion Collisions	0.00388	0.00121	0.00012	152	637
	Diamond Collisions	0.00154	0.00073	0.00007	264	557
	Overspeed	0.00347	0.00101	0.00010	1810	2215
	Broken Rail	0.01145	0.00334	0.00033	5974	7312
	Work Zone Violation	0.00000	0.01682	0.00168	0	6729
	Grade Crossing Collisions	0.07555	0.02371	0.00121	4717	10730
	Total, All Scenarios	0.10035	0.05153	0.00400	14251	31395
Total Passenger + Freight		**0.69947**	**3.74199**	**0.09812**	**280747**	**949303**

Table R1c: Rest of Year, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.02052	1.39132	0.05300	59838	357980
	Intrusion Collisions	0.01676	0.42084	0.01493	17947	104808
	Diamond Collisions	0.00087	0.00938	0.00028	329	2105
	Overspeed	0.00964	0.45704	0.00733	35795	103495
	Broken Rail	0.01391	0.65917	0.01057	51626	149268
	Work Zone Violation	0.00000	0.16990	0.01699	0	67959
	Grade Crossing Collisions	0.50680	1.47592	0.02191	143142	356461
	Total, All Scenarios	0.56851	4.58358	0.12501	308676	1142075
Freight		0.00000	0.00000	0.00000	0	0
	Train-Train Collisions	0.00611	0.00670	0.00067	1914	4593
	Intrusion Collisions	0.00827	0.00274	0.00027	345	1442
	Diamond Collisions	0.00344	0.00163	0.00016	589	1240
	Overspeed	0.00739	0.00243	0.00024	4105	5079
	Broken Rail	0.02439	0.00804	0.00080	13552	16767
	Work Zone Violation	0.00000	0.03701	0.00370	0	14802
	Grade Crossing Collisions	0.09797	0.03721	0.00190	7427	16859
	Total, All Scenarios	0.14756	0.09575	0.00776	27932	60782
Total Passenger + Freight		**0.71607**	**4.67933**	**0.13277**	**336608**	**1202857**

Table R1d: Rest of Year, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.04733	3.29950	0.12596	142685	850513
	Intrusion Collisions	0.03791	1.00537	0.03569	42926	250521
	Diamond Collisions	0.00173	0.01856	0.00055	650	4163
	Overspeed	0.02181	1.06692	0.01712	85607	243668
	Broken Rail	0.03145	1.53878	0.02470	123468	351435
	Work Zone Violation	0.00000	0.39582	0.03958	0	158328
	Grade Crossing Collisions	1.66225	4.96091	0.07367	480938	1198052
	Total, All Scenarios	1.80248	12.28586	0.31727	876274	3056679
Freight	Train-Train Collisions	0.01273	0.01372	0.00137	3920	9407
	Intrusion Collisions	0.01443	0.00470	0.00047	591	2473
	Diamond Collisions	0.00679	0.00322	0.00032	1165	2453
	Overspeed	0.01290	0.00408	0.00041	7032	8666
	Broken Rail	0.04258	0.01348	0.00135	23215	28608
	Work Zone Violation	0.00000	0.06402	0.00640	0	25609
	Grade Crossing Collisions	0.22171	0.07805	0.00400	15570	35370
	Total, All Scenarios	0.31114	0.18128	0.01432	51492	112587
Total Passenger + Freight		**2.11362**	**12.46713**	**0.33160**	**927767**	**3169266**

Table R2a: Summer, Joliet (Included in Full Year Table)

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Freight	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Total Passenger + Freight						

There are no seasonal traffic variations on the Joliet Sub-corridor. Therefore only one risk calculation is needed for the full year, and there is no separate summer calculation

Table R2b: Summer, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00475	0.32614	0.01243	14095	84010
	Intrusion Collisions	0.00362	0.09737	0.00346	4150	24259
	Diamond Collisions	0.00012	0.00127	0.00004	45	286
	Overspeed	0.00208	0.10221	0.00164	8275	23412
	Broken Rail	0.00300	0.14741	0.00236	11935	33766
	Work Zone Violation	0.00000	0.03748	0.00380	0	15156
	Grade Crossing Collisions	0.18544	0.51800	0.00770	50207	125113
	Total, All Scenarios	0.19901	1.22988	0.03144	88706	306002
Freight	Train-Train Collisions	0.00080	0.00081	0.00008	236	561
	Intrusion Collisions	0.00081	0.00025	0.00003	32	133
	Diamond Collisions	0.00046	0.00022	0.00002	79	166
	Overspeed	0.00072	0.00021	0.00002	377	461
	Broken Rail	0.00238	0.00070	0.00007	1244	1523
	Work Zone Violation	0.00000	0.00350	0.00035	0	1402
	Grade Crossing Collisions	0.01574	0.00494	0.00025	983	2235
	Total, All Scenarios	0.02092	0.01063	0.00082	2950	6481
Total Passenger + Freight		**0.21992**	**1.24052**	**0.03226**	**91656**	**312483**

Table R2c: Summer, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00672	0.46123	0.01755	19810	118582
	Intrusion Collisions	0.00557	0.13977	0.00496	5961	34808
	Diamond Collisions	0.00024	0.00263	0.00008	92	590
	Overspeed	0.00320	0.15179	0.00244	11888	34372
	Broken Rail	0.00462	0.21892	0.00351	17146	49574
	Work Zone Violation	0.00000	0.05643	0.00564	0	22570
	Grade Crossing Collisions	0.16832	0.49018	0.00728	47540	118387
	Total, All Scenarios	0.18867	1.52094	0.04145	102437	378884
Freight	Train-Train Collisions	0.00075	0.00078	0.00008	229	540
	Intrusion Collisions	0.00150	0.00050	0.00005	63	262
	Diamond Collisions	0.00096	0.00046	0.00005	165	348
	Overspeed	0.00134	0.00044	0.00004	746	923
	Broken Rail	0.00443	0.00146	0.00015	2464	3049
	Work Zone Violation	0.00000	0.00673	0.00067	0	2691
	Grade Crossing Collisions	0.01781	0.00677	0.00035	1350	3065
	Total, All Scenarios	0.02680	0.01713	0.00138	5017	10879
Total Passenger + Freight		**0.21548**	**1.53807**	**0.04283**	**107454**	**389763**

Table R2d: Summer, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01147	0.78737	0.02998	33905	202592
	Intrusion Collisions	0.00919	0.23714	0.00841	10110	59068
	Diamond Collisions	0.00036	0.00390	0.00012	137	876
	Overspeed	0.00529	0.25400	0.00407	20163	57784
	Broken Rail	0.00762	0.36633	0.00588	29081	83341
	Work Zone Violation	0.00000	0.09391	0.00945	0	37726
	Grade Crossing Collisions	0.35375	1.00818	0.01498	97746	243500
	Total, All Scenarios	0.38768	2.75082	0.07289	191142	684886
Freight	Train-Train Collisions	0.00155	0.00159	0.00016	464	1101
	Intrusion Collisions	0.00231	0.00075	0.00008	94	395
	Diamond Collisions	0.00142	0.00067	0.00007	244	513
	Overspeed	0.00207	0.00065	0.00007	1123	1385
	Broken Rail	0.00682	0.00216	0.00022	3708	4572
	Work Zone Violation	0.00000	0.01023	0.00102	0	4093
	Grade Crossing Collisions	0.03355	0.01170	0.00060	2333	5300
	Total, All Scenarios	0.04772	0.02776	0.00221	7968	17359
Total Passenger + Freight		**0.43540**	**2.77859**	**0.07509**	**199110**	**702245**

Table R3a: All Year, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01265	0.94095	0.03606	41018	243303
	Intrusion Collisions	0.01025	0.29135	0.01035	12484	72669
	Diamond Collisions	0.00046	0.00490	0.00015	172	1099
	Overspeed	0.00589	0.30214	0.00486	24896	69680
	Broken Rail	0.00850	0.43576	0.00700	35907	100497
	Work Zone Violation	0.00000	0.11143	0.01114	0	44572
	Grade Crossing Collisions	0.59710	1.92530	0.02857	186625	464876
	Total, All Scenarios	0.63485	4.01183	0.09814	301102	996696
Freight	Train-Train Collisions	0.00215	0.00232	0.00023	672	1598
	Intrusion Collisions	0.00229	0.00075	0.00007	94	393
	Diamond Collisions	0.00181	0.00086	0.00009	311	656
	Overspeed	0.00204	0.00064	0.00006	1117	1372
	Broken Rail	0.00674	0.00210	0.00021	3688	4530
	Work Zone Violation	0.00000	0.01020	0.00102	0	4078
	Grade Crossing Collisions	0.04820	0.01713	0.00088	3426	7781
	Total, All Scenarios	0.06323	0.03399	0.00257	9309	20409
Total Passenger + Freight		**0.69807**	**4.04582**	**0.10070**	**310411**	**1017106**

Table R3b: All Year, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01890	1.29336	0.04933	55924	333240
	Intrusion Collisions	0.01453	0.39056	0.01387	16644	97304
	Diamond Collisions	0.00052	0.00555	0.00017	194	1244
	Overspeed	0.00836	0.40995	0.00657	33191	93905
	Broken Rail	0.01205	0.59126	0.00948	47871	135436
	Work Zone Violation	0.00000	0.15197	0.01525	0	60953
	Grade Crossing Collisions	0.74378	2.07769	0.03089	201378	501828
	Total, All Scenarios	0.79813	4.92033	0.12556	355202	1223911
Freight	Train-Train Collisions	0.00527	0.00552	0.00055	1569	3776
	Intrusion Collisions	0.00469	0.00146	0.00015	184	770
	Diamond Collisions	0.00200	0.00095	0.00009	343	722
	Overspeed	0.00419	0.00122	0.00012	2187	2676
	Broken Rail	0.01383	0.00404	0.00040	7219	8835
	Work Zone Violation	0.00000	0.02033	0.00203	0	8130
	Grade Crossing Collisions	0.09129	0.02865	0.00147	5700	12965
	Total, All Scenarios	0.12127	0.06217	0.00482	17201	37875
Total Passenger + Freight		**0.91940**	**4.98250**	**0.13038**	**372403**	**1261786**

Table R3c: All Year, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.02724	1.85255	0.07055	79648	476562
	Intrusion Collisions	0.02233	0.56060	0.01988	23908	139616
	Diamond Collisions	0.00112	0.01201	0.00036	421	2695
	Overspeed	0.01285	0.60883	0.00977	47683	137868
	Broken Rail	0.01853	0.87810	0.01409	68772	198843
	Work Zone Violation	0.00000	0.22632	0.02263	0	90529
	Grade Crossing Collisions	0.67512	1.96610	0.02919	190682	474847
	Total, All Scenarios	0.75719	6.10451	0.16646	411113	1520959
Freight	Train-Train Collisions	0.00686	0.00748	0.00075	2143	5133
	Intrusion Collisions	0.00977	0.00324	0.00032	407	1705
	Diamond Collisions	0.00440	0.00208	0.00021	754	1588
	Overspeed	0.00873	0.00288	0.00029	4851	6002
	Broken Rail	0.02882	0.00950	0.00095	16016	19815
	Work Zone Violation	0.00000	0.04373	0.00437	0	17494
	Grade Crossing Collisions	0.11578	0.04397	0.00225	8777	19924
	Total, All Scenarios	0.17436	0.11288	0.00914	32949	71661
Total Passenger + Freight		**0.93155**	**6.21740**	**0.17561**	**444062**	**1592620**

Table R3d: All Year, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.05879	4.08686	0.15594	176590	1053105
	Intrusion Collisions	0.04710	1.24251	0.04410	53036	309589
	Diamond Collisions	0.00209	0.02246	0.00067	787	5038
	Overspeed	0.02709	1.32091	0.02120	105770	301452
	Broken Rail	0.03908	1.90512	0.03057	152549	434776
	Work Zone Violation	0.00000	0.48973	0.04903	0	196054
	Grade Crossing Collisions	2.01600	5.96909	0.08865	578685	1441552
	Total, All Scenarios	2.19016	15.03668	0.39016	1067417	3741566
Freight	Train-Train Collisions	0.01428	0.01531	0.00153	4385	10508
	Intrusion Collisions	0.01674	0.00545	0.00055	685	2868
	Diamond Collisions	0.00821	0.00389	0.00039	1409	2967
	Overspeed	0.01496	0.00474	0.00047	8155	10051
	Broken Rail	0.04939	0.01564	0.00156	26923	33180
	Work Zone Violation	0.00000	0.07426	0.00743	0	29702
	Grade Crossing Collisions	0.25526	0.08975	0.00460	17903	40670
	Total, All Scenarios	0.35886	0.20904	0.01653	59460	129946
Total Passenger + Freight		**2.54902**	**15.24572**	**0.40669**	**1126876**	**3871511**

Results Summary: Basic Case, Cab Signal and ATS 70% Preventability with Reduced Severity of Consequences

Table R1a: Full Year, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00949	0.60691	0.02326	26457	156930
	Intrusion Collisions	0.00994	0.26920	0.00956	11537	67150
	Diamond Collisions	0.00038	0.00350	0.00010	123	785
	Overspeed	0.00589	0.30214	0.00486	24896	69680
	Broken Rail	0.00841	0.42255	0.00679	34818	97451
	Work Zone Violation	0.00000	0.11143	0.01114	0	44572
	Grade Crossing Collisions	0.59710	1.92530	0.02857	186625	464876
	Total, All Scenarios	0.63121	3.64103	0.08430	284455	901444
Freight	Train-Train Collisions	0.00161	0.00149	0.00015	434	1031
	Intrusion Collisions	0.00218	0.00059	0.00006	74	312
	Diamond Collisions	0.00168	0.00067	0.00007	246	515
	Overspeed	0.00204	0.00064	0.00006	1117	1372
	Broken Rail	0.00667	0.00204	0.00020	3577	4392
	Work Zone Violation	0.00000	0.01020	0.00102	0	4078
	Grade Crossing Collisions	0.04820	0.01713	0.00088	3426	7781
	Total, All Scenarios	0.06239	0.03276	0.00244	8875	19482
Total Passenger + Freight		**0.69360**	**3.67379**	**0.08674**	**293330**	**920926**

Table R1b: Rest of Year, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01061	0.62386	0.02380	26979	160754
	Intrusion Collisions	0.01058	0.27090	0.00962	11546	67497
	Diamond Collisions	0.00033	0.00308	0.00009	108	690
	Overspeed	0.00627	0.30774	0.00493	24916	70493
	Broken Rail	0.00895	0.43039	0.00690	34847	98588
	Work Zone Violation	0.00000	0.11449	0.01145	0	45798
	Grade Crossing Collisions	0.55834	1.55969	0.02319	151171	376715
	Total, All Scenarios	0.59509	3.31015	0.07998	249567	820533
Freight	Train-Train Collisions	0.00335	0.00303	0.00030	860	2074
	Intrusion Collisions	0.00371	0.00096	0.00010	120	505
	Diamond Collisions	0.00144	0.00057	0.00006	210	438
	Overspeed	0.00347	0.00101	0.00010	1810	2215
	Broken Rail	0.01132	0.00324	0.00032	5793	7090
	Work Zone Violation	0.00000	0.01682	0.00168	0	6729
	Grade Crossing Collisions	0.07555	0.02371	0.00121	4717	10730
	Total, All Scenarios	0.09883	0.04935	0.00378	13510	29781
Total Passenger + Freight		**0.69393**	**3.35950**	**0.08376**	**263078**	**850314**

Table R1c: Rest of Year, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01539	0.89740	0.03419	38595	230897
	Intrusion Collisions	0.01626	0.38885	0.01379	16585	96848
	Diamond Collisions	0.00073	0.00675	0.00020	236	1513
	Overspeed	0.00964	0.45704	0.00733	35795	103495
	Broken Rail	0.01376	0.63919	0.01025	50061	144743
	Work Zone Violation	0.00000	0.16990	0.01699	0	67959
	Grade Crossing Collisions	0.50680	1.47592	0.02191	143142	356461
	Total, All Scenarios	0.56259	4.03505	0.10467	284415	1001916
		0.00000	0.00000	0.00000	0	0
Freight	Train-Train Collisions	0.00460	0.00433	0.00043	1237	2968
	Intrusion Collisions	0.00790	0.00217	0.00022	273	1143
	Diamond Collisions	0.00320	0.00127	0.00013	467	976
	Overspeed	0.00739	0.00243	0.00024	4105	5079
	Broken Rail	0.02413	0.00779	0.00078	13141	16258
	Work Zone Violation	0.00000	0.03701	0.00370	0	14802
	Grade Crossing Collisions	0.09797	0.03721	0.00190	7427	16859
	Total, All Scenarios	0.14517	0.09221	0.00740	26651	58085
Total Passenger + Freight		0.70776	4.12726	0.11207	311066	1060001

Table R1d: Rest of Year, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.03549	2.12817	0.08124	92032	548581
	Intrusion Collisions	0.03678	0.92895	0.03298	39668	231495
	Diamond Collisions	0.00144	0.01332	0.00040	467	2989
	Overspeed	0.02181	1.06692	0.01712	85607	243668
	Broken Rail	0.03112	1.49213	0.02395	119725	340781
	Work Zone Violation	0.00000	0.39582	0.03958	0	158328
	Grade Crossing Collisions	1.66225	4.96091	0.07367	480938	1198052
	Total, All Scenarios	1.78889	10.98623	0.26894	818437	2723894
Freight	Train-Train Collisions	0.00956	0.00885	0.00089	2531	6073
	Intrusion Collisions	0.01378	0.00373	0.00037	468	1960
	Diamond Collisions	0.00631	0.00251	0.00025	924	1929
	Overspeed	0.01290	0.00408	0.00041	7032	8666
	Broken Rail	0.04213	0.01308	0.00131	22511	27741
	Work Zone Violation	0.00000	0.06402	0.00640	0	25609
	Grade Crossing Collisions	0.22171	0.07805	0.00400	15570	35370
	Total, All Scenarios	0.30639	0.17432	0.01363	49036	107348
Total Passenger + Freight		**2.09529**	**11.16055**	**0.28257**	**867473**	**2831241**

Table R2a: Summer, Joliet (Included in Full Year Table)

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Freight	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Total Passenger + Freight						

Table R2b: Summer, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00356	0.21036	0.00802	9091	54186
	Intrusion Collisions	0.00351	0.08997	0.00320	3835	22417
	Diamond Collisions	0.00010	0.00092	0.00003	32	206
	Overspeed	0.00208	0.10221	0.00164	8275	23412
	Broken Rail	0.00297	0.14294	0.00229	11573	32743
	Work Zone Violation	0.00000	0.03748	0.00380	0	15156
	Grade Crossing Collisions	0.18544	0.51800	0.00770	50207	125113
	Total, All Scenarios	0.19766	1.10187	0.02668	83013	273232
Freight	Train-Train Collisions	0.00060	0.00052	0.00005	152	362
	Intrusion Collisions	0.00077	0.00020	0.00002	25	105
	Diamond Collisions	0.00043	0.00017	0.00002	63	130
	Overspeed	0.00072	0.00021	0.00002	377	461
	Broken Rail	0.00236	0.00068	0.00007	1207	1477
	Work Zone Violation	0.00000	0.00350	0.00035	0	1402
	Grade Crossing Collisions	0.01574	0.00494	0.00025	983	2235
	Total, All Scenarios	0.02062	0.01022	0.00078	2806	6172
Total Passenger + Freight		**0.21828**	**1.11210**	**0.02746**	**85819**	**279405**

Table R2c: Summer, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00504	0.29749	0.01132	12778	76485
	Intrusion Collisions	0.00540	0.12914	0.00458	5508	32165
	Diamond Collisions	0.00020	0.00189	0.00006	66	424
	Overspeed	0.00320	0.15179	0.00244	11888	34372
	Broken Rail	0.00457	0.21229	0.00341	16626	48072
	Work Zone Violation	0.00000	0.05643	0.00564	0	22570
	Grade Crossing Collisions	0.16832	0.49018	0.00728	47540	118387
	Total, All Scenarios	0.18674	1.33921	0.03472	94406	332475
Freight	Train-Train Collisions	0.00056	0.00050	0.00005	148	348
	Intrusion Collisions	0.00144	0.00040	0.00004	50	208
	Diamond Collisions	0.00090	0.00036	0.00004	131	273
	Overspeed	0.00134	0.00044	0.00004	746	923
	Broken Rail	0.00439	0.00142	0.00014	2389	2956
	Work Zone Violation	0.00000	0.00673	0.00067	0	2691
	Grade Crossing Collisions	0.01781	0.00677	0.00035	1350	3065
	Total, All Scenarios	0.02643	0.01661	0.00133	4814	10466
Total Passenger + Freight		**0.21317**	**1.35581**	**0.03605**	**99220**	**342941**

Table R2d: Summer, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00860	0.50785	0.01934	21869	130672
	Intrusion Collisions	0.00891	0.21911	0.00778	9343	54582
	Diamond Collisions	0.00030	0.00281	0.00008	98	630
	Overspeed	0.00529	0.25400	0.00407	20163	57784
	Broken Rail	0.00754	0.35523	0.00570	28199	80814
	Work Zone Violation	0.00000	0.09391	0.00945	0	37726
	Grade Crossing Collisions	0.35375	1.00818	0.01498	97746	243500
	Total, All Scenarios	0.38440	2.44108	0.06139	177419	605708
Freight	Train-Train Collisions	0.00116	0.00103	0.00010	300	710
	Intrusion Collisions	0.00221	0.00060	0.00006	75	313
	Diamond Collisions	0.00132	0.00053	0.00005	194	404
	Overspeed	0.00207	0.00065	0.00007	1123	1385
	Broken Rail	0.00675	0.00209	0.00021	3596	4433
	Work Zone Violation	0.00000	0.01023	0.00102	0	4093
	Grade Crossing Collisions	0.03355	0.01170	0.00060	2333	5300
	Total, All Scenarios	0.04706	0.02683	0.00211	7620	16638
Total Passenger + Freight		**0.43146**	**2.46791**	**0.06351**	**185039**	**622346**

Table R3a: All Year, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00949	0.60691	0.02326	26457	156930
	Intrusion Collisions	0.00994	0.26920	0.00956	11537	67150
	Diamond Collisions	0.00038	0.00350	0.00010	123	785
	Overspeed	0.00589	0.30214	0.00486	24896	69680
	Broken Rail	0.00841	0.42255	0.00679	34818	97451
	Work Zone Violation	0.00000	0.11143	0.01114	0	44572
	Grade Crossing Collisions	0.59710	1.92530	0.02857	186625	464876
	Total, All Scenarios	0.63121	3.64103	0.08430	284455	901444
Freight	Train-Train Collisions	0.00161	0.00149	0.00015	434	1031
	Intrusion Collisions	0.00218	0.00059	0.00006	74	312
	Diamond Collisions	0.00168	0.00067	0.00007	246	515
	Overspeed	0.00204	0.00064	0.00006	1117	1372
	Broken Rail	0.00667	0.00204	0.00020	3577	4392
	Work Zone Violation	0.00000	0.01020	0.00102	0	4078
	Grade Crossing Collisions	0.04820	0.01713	0.00088	3426	7781
	Total, All Scenarios	0.06239	0.03276	0.00244	8875	19482
Total Passenger + Freight		0.69360	3.67379	0.08674	293330	920926

Table R3b: All Year, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01417	0.83422	0.03182	36071	214940
	Intrusion Collisions	0.01409	0.36087	0.01282	15381	89914
	Diamond Collisions	0.00043	0.00399	0.00012	140	896
	Overspeed	0.00836	0.40995	0.00657	33191	93905
	Broken Rail	0.01192	0.57333	0.00919	46420	131330
	Work Zone Violation	0.00000	0.15197	0.01525	0	60953
	Grade Crossing Collisions	0.74378	2.07769	0.03089	201378	501828
	Total, All Scenarios	0.79275	4.41202	0.10666	332580	1093766
Freight	Train-Train Collisions	0.00396	0.00356	0.00036	1012	2435
	Intrusion Collisions	0.00448	0.00116	0.00012	145	611
	Diamond Collisions	0.00186	0.00074	0.00007	272	568
	Overspeed	0.00419	0.00122	0.00012	2187	2676
	Broken Rail	0.01368	0.00392	0.00039	7000	8567
	Work Zone Violation	0.00000	0.02033	0.00203	0	8130
	Grade Crossing Collisions	0.09129	0.02865	0.00147	5700	12965
	Total, All Scenarios	0.11946	0.05957	0.00456	16316	35953
Total Passenger + Freight		0.91221	4.47160	0.11122	348896	1129719

Table R3c: All Year, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.02043	1.19489	0.04551	51373	307382
	Intrusion Collisions	0.02166	0.51800	0.01837	22093	129013
	Diamond Collisions	0.00093	0.00864	0.00026	303	1938
	Overspeed	0.01285	0.60883	0.00977	47683	137868
	Broken Rail	0.01833	0.85148	0.01366	66687	192815
	Work Zone Violation	0.00000	0.22632	0.02263	0	90529
	Grade Crossing Collisions	0.67512	1.96610	0.02919	190682	474847
	Total, All Scenarios	0.74933	5.37426	0.13938	378821	1334391
Freight	Train-Train Collisions	0.00516	0.00483	0.00048	1385	3316
	Intrusion Collisions	0.00933	0.00257	0.00026	323	1351
	Diamond Collisions	0.00409	0.00163	0.00016	598	1249
	Overspeed	0.00873	0.00288	0.00029	4851	6002
	Broken Rail	0.02852	0.00921	0.00092	15530	19215
	Work Zone Violation	0.00000	0.04373	0.00437	0	17494
	Grade Crossing Collisions	0.11578	0.04397	0.00225	8777	19924
	Total, All Scenarios	0.17161	0.10882	0.00873	31465	68551
Total Passenger + Freight		0.92094	5.48308	0.14812	410286	1402942

Table R3d: All Year, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.04409	2.63603	0.10058	113901	679252
	Intrusion Collisions	0.04569	1.14806	0.04075	49011	286077
	Diamond Collisions	0.00174	0.01613	0.00048	565	3618
	Overspeed	0.02709	1.32091	0.02120	105770	301452
	Broken Rail	0.03867	1.84736	0.02964	147925	421596
	Work Zone Violation	0.00000	0.48973	0.04903	0	196054
	Grade Crossing Collisions	2.01600	5.96909	0.08865	578685	1441552
	Total, All Scenarios	2.17329	13.42731	0.33034	995856	3329601
Freight	Train-Train Collisions	0.01072	0.00988	0.00099	2831	6783
	Intrusion Collisions	0.01599	0.00432	0.00043	543	2273
	Diamond Collisions	0.00764	0.00304	0.00030	1117	2333
	Overspeed	0.01496	0.00474	0.00047	8155	10051
	Broken Rail	0.04887	0.01517	0.00152	26107	32174
	Work Zone Violation	0.00000	0.07426	0.00743	0	29702
	Grade Crossing Collisions	0.25526	0.08975	0.00460	17903	40670
	Total, All Scenarios	0.35345	0.20115	0.01574	56656	123986
Total Passenger + Freight		**2.52674**	**13.62846**	**0.34608**	**1052512**	**3453588**

Results Summary: Northeast Corridor ATC Basic Case, 85% Preventability.

Table R1a: Full Year, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00474	0.35286	0.01352	15382	91238
	Intrusion Collisions	0.00941	0.27340	0.00971	11717	68197
	Diamond Collisions	0.00026	0.00282	0.00008	99	633
	Overspeed	0.00589	0.30214	0.00486	24896	69680
	Broken Rail	0.00823	0.42200	0.00678	34773	97324
	Work Zone Violation	0.00000	0.11143	0.01114	0	44572
	Grade Crossing Collisions	0.59710	1.92530	0.02857	186625	464876
	Total, All Scenarios	0.62565	3.38995	0.07468	273491	836520
Freight	Train-Train Collisions	0.00080	0.00087	0.00009	252	599
	Intrusion Collisions	0.00201	0.00066	0.00007	83	347
	Diamond Collisions	0.00149	0.00066	0.00007	250	514
	Overspeed	0.00204	0.00064	0.00006	1117	1372
	Broken Rail	0.00653	0.00204	0.00020	3572	4387
	Work Zone Violation	0.00000	0.01020	0.00102	0	4078
	Grade Crossing Collisions	0.04820	0.01713	0.00088	3426	7781
	Total, All Scenarios	0.06108	0.03219	0.00239	8700	19078
Total Passenger + Freight		**0.68673**	**3.42213**	**0.07706**	**282191**	**855598**

Table R1b: Rest of Year, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00531	0.36271	0.01383	15686	93461
	Intrusion Collisions	0.01002	0.27512	0.00977	11726	68549
	Diamond Collisions	0.00024	0.00253	0.00008	89	569
	Overspeed	0.00627	0.30774	0.00493	24916	70493
	Broken Rail	0.00876	0.42983	0.00689	34801	98459
	Work Zone Violation	0.00000	0.11449	0.01145	0	45798
	Grade Crossing Collisions	0.55834	1.55969	0.02319	151171	376715
	Total, All Scenarios	0.58894	3.05212	0.07015	238389	754043
Freight	Train-Train Collisions	0.00168	0.00176	0.00018	500	1206
	Intrusion Collisions	0.00342	0.00107	0.00011	134	562
	Diamond Collisions	0.00127	0.00056	0.00006	213	437
	Overspeed	0.00347	0.00101	0.00010	1810	2215
	Broken Rail	0.01108	0.00324	0.00032	5786	7081
	Work Zone Violation	0.00000	0.01682	0.00168	0	6729
	Grade Crossing Collisions	0.07555	0.02371	0.00121	4717	10730
	Total, All Scenarios	0.09647	0.04818	0.00366	13159	28959
Total Passenger + Freight		**0.68541**	**3.10030**	**0.07381**	**251548**	**783003**

Table R1c: Rest of Year, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00770	0.52175	0.01988	22439	134242
	Intrusion Collisions	0.01541	0.39492	0.01401	16843	98358
	Diamond Collisions	0.00052	0.00554	0.00016	194	1242
	Overspeed	0.00964	0.45704	0.00733	35795	103495
	Broken Rail	0.01347	0.63836	0.01024	49996	144554
	Work Zone Violation	0.00000	0.16990	0.01699	0	67959
	Grade Crossing Collisions	0.50680	1.47592	0.02191	143142	356461
	Total, All Scenarios	0.55353	3.66342	0.09052	268409	906311
		0.00000	0.00000	0.00000	0	0
Freight	Train-Train Collisions	0.00232	0.00253	0.00025	725	1738
	Intrusion Collisions	0.00728	0.00242	0.00024	304	1271
	Diamond Collisions	0.00284	0.00125	0.00013	475	976
	Overspeed	0.00739	0.00243	0.00024	4105	5079
	Broken Rail	0.02362	0.00778	0.00078	13124	16237
	Work Zone Violation	0.00000	0.03701	0.00370	0	14802
	Grade Crossing Collisions	0.09797	0.03721	0.00190	7427	16859
	Total, All Scenarios	0.14141	0.09063	0.00725	26160	56962
Total Passenger + Freight		0.69495	3.75405	0.09777	294569	963273

Table R1d: Rest of Year, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01775	1.23731	0.04723	53507	318942
	Intrusion Collisions	0.03484	0.94344	0.03349	40286	235104
	Diamond Collisions	0.00101	0.01090	0.00032	382	2444
	Overspeed	0.02181	1.06692	0.01712	85607	243668
	Broken Rail	0.03046	1.49019	0.02392	119569	340337
	Work Zone Violation	0.00000	0.39582	0.03958	0	158328
	Grade Crossing Collisions	1.66225	4.96091	0.07367	480938	1198052
	Total, All Scenarios	1.76812	10.10549	0.23535	780289	2496875
Freight	Train-Train Collisions	0.00480	0.00516	0.00052	1478	3543
	Intrusion Collisions	0.01272	0.00414	0.00041	520	2179
	Diamond Collisions	0.00560	0.00247	0.00025	938	1927
	Overspeed	0.01290	0.00408	0.00041	7032	8666
	Broken Rail	0.04123	0.01306	0.00131	22482	27705
	Work Zone Violation	0.00000	0.06402	0.00640	0	25609
	Grade Crossing Collisions	0.22171	0.07805	0.00400	15570	35370
	Total, All Scenarios	0.29896	0.17099	0.01329	48019	104999
Total Passenger + Freight		**2.06708**	**10.27648**	**0.24864**	**828309**	**2601874**

Table R2a: Summer, Joliet (Included in Full Year Table)

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Freight	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Total Passenger + Freight						

Table R2b: Summer, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00178	0.12230	0.00466	5286	31504
	Intrusion Collisions	0.00333	0.09137	0.00324	3894	22766
	Diamond Collisions	0.00007	0.00076	0.00002	26	169
	Overspeed	0.00208	0.10221	0.00164	8275	23412
	Broken Rail	0.00291	0.14275	0.00229	11558	32700
	Work Zone Violation	0.00000	0.03748	0.00380	0	15156
	Grade Crossing Collisions	0.18544	0.51800	0.00770	50207	125113
	Total, All Scenarios	0.19561	1.01487	0.02336	79246	250820
Freight	Train-Train Collisions	0.00030	0.00030	0.00003	88	210
	Intrusion Collisions	0.00071	0.00022	0.00002	28	117
	Diamond Collisions	0.00038	0.00017	0.00002	63	130
	Overspeed	0.00072	0.00021	0.00002	377	461
	Broken Rail	0.00231	0.00067	0.00007	1205	1475
	Work Zone Violation	0.00000	0.00350	0.00035	0	1402
	Grade Crossing Collisions	0.01574	0.00494	0.00025	983	2235
	Total, All Scenarios	0.02016	0.01002	0.00076	2744	6031
Total Passenger + Freight		**0.21577**	**1.02490**	**0.02412**	**81991**	**256851**

Table R2c: Summer, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00252	0.17296	0.00658	7429	44468
	Intrusion Collisions	0.00512	0.13116	0.00465	5594	32666
	Diamond Collisions	0.00014	0.00155	0.00005	54	348
	Overspeed	0.00320	0.15179	0.00244	11888	34372
	Broken Rail	0.00447	0.21201	0.00340	16604	48009
	Work Zone Violation	0.00000	0.05643	0.00564	0	22570
	Grade Crossing Collisions	0.16832	0.49018	0.00728	47540	118387
	Total, All Scenarios	0.18378	1.21607	0.03003	89110	300821
Freight	Train-Train Collisions	0.00028	0.00029	0.00003	86	203
	Intrusion Collisions	0.00132	0.00044	0.00004	55	231
	Diamond Collisions	0.00080	0.00035	0.00004	133	274
	Overspeed	0.00134	0.00044	0.00004	746	923
	Broken Rail	0.00429	0.00142	0.00014	2386	2952
	Work Zone Violation	0.00000	0.00673	0.00067	0	2691
	Grade Crossing Collisions	0.01781	0.00677	0.00035	1350	3065
	Total, All Scenarios	0.02585	0.01643	0.00131	4757	10340
Total Passenger + Freight		**0.20963**	**1.23251**	**0.03135**	**93867**	**311161**

Table R2d: Summer, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00430	0.29526	0.01124	12714	75972
	Intrusion Collisions	0.00844	0.22253	0.00790	9488	55433
	Diamond Collisions	0.00021	0.00231	0.00007	81	518
	Overspeed	0.00529	0.25400	0.00407	20163	57784
	Broken Rail	0.00738	0.35476	0.00569	28162	80709
	Work Zone Violation	0.00000	0.09391	0.00945	0	37726
	Grade Crossing Collisions	0.35375	1.00818	0.01498	97746	243500
	Total, All Scenarios	0.37938	2.23095	0.05340	168356	551641
Freight	Train-Train Collisions	0.00058	0.00060	0.00006	174	413
	Intrusion Collisions	0.00204	0.00066	0.00007	83	348
	Diamond Collisions	0.00118	0.00052	0.00005	197	404
	Overspeed	0.00207	0.00065	0.00007	1123	1385
	Broken Rail	0.00660	0.00209	0.00021	3591	4427
	Work Zone Violation	0.00000	0.01023	0.00102	0	4093
	Grade Crossing Collisions	0.03355	0.01170	0.00060	2333	5300
	Total, All Scenarios	0.04601	0.02646	0.00207	7502	16370
Total Passenger + Freight		**0.42539**	**2.25740**	**0.05547**	**175857**	**568011**

Table R3a: All Year, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00474	0.35286	0.01352	15382	91238
	Intrusion Collisions	0.00941	0.27340	0.00971	11717	68197
	Diamond Collisions	0.00026	0.00282	0.00008	99	633
	Overspeed	0.00589	0.30214	0.00486	24896	69680
	Broken Rail	0.00823	0.42200	0.00678	34773	97324
	Work Zone Violation	0.00000	0.11143	0.01114	0	44572
	Grade Crossing Collisions	0.59710	1.92530	0.02857	186625	464876
	Total, All Scenarios	0.62565	3.38995	0.07468	273491	836520
Freight	Train-Train Collisions	0.00080	0.00087	0.00009	252	599
	Intrusion Collisions	0.00201	0.00066	0.00007	83	347
	Diamond Collisions	0.00149	0.00066	0.00007	250	514
	Overspeed	0.00204	0.00064	0.00006	1117	1372
	Broken Rail	0.00653	0.00204	0.00020	3572	4387
	Work Zone Violation	0.00000	0.01020	0.00102	0	4078
	Grade Crossing Collisions	0.04820	0.01713	0.00088	3426	7781
	Total, All Scenarios	0.06108	0.03219	0.00239	8700	19078
Total Passenger + Freight		0.68673	3.42213	0.07706	282191	855598

Table R3b: All Year, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00709	0.48501	0.01850	20971	124965
	Intrusion Collisions	0.01335	0.36650	0.01302	15620	91316
	Diamond Collisions	0.00031	0.00329	0.00010	115	738
	Overspeed	0.00836	0.40995	0.00657	33191	93905
	Broken Rail	0.01167	0.57258	0.00918	46359	131159
	Work Zone Violation	0.00000	0.15197	0.01525	0	60953
	Grade Crossing Collisions	0.74378	2.07769	0.03089	201378	501828
	Total, All Scenarios	0.78455	4.06700	0.09351	317635	1004864
Freight	Train-Train Collisions	0.00198	0.00207	0.00021	588	1416
	Intrusion Collisions	0.00413	0.00129	0.00013	162	679
	Diamond Collisions	0.00165	0.00073	0.00007	276	567
	Overspeed	0.00419	0.00122	0.00012	2187	2676
	Broken Rail	0.01339	0.00391	0.00039	6991	8556
	Work Zone Violation	0.00000	0.02033	0.00203	0	8130
	Grade Crossing Collisions	0.09129	0.02865	0.00147	5700	12965
	Total, All Scenarios	0.11663	0.05820	0.00442	15904	34990
Total Passenger + Freight		0.90118	4.12519	0.09793	333539	1039854

Table R3c: All Year, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01022	0.69471	0.02646	29868	178711
	Intrusion Collisions	0.02052	0.52608	0.01866	22437	131024
	Diamond Collisions	0.00066	0.00709	0.00021	248	1590
	Overspeed	0.01285	0.60883	0.00977	47683	137868
	Broken Rail	0.01794	0.85037	0.01364	66600	192563
	Work Zone Violation	0.00000	0.22632	0.02263	0	90529
	Grade Crossing Collisions	0.67512	1.96610	0.02919	190682	474847
	Total, All Scenarios	0.73731	4.87949	0.12055	357519	1207132
Freight	Train-Train Collisions	0.00260	0.00282	0.00028	811	1941
	Intrusion Collisions	0.00861	0.00286	0.00029	359	1502
	Diamond Collisions	0.00364	0.00160	0.00016	608	1250
	Overspeed	0.00873	0.00288	0.00029	4851	6002
	Broken Rail	0.02791	0.00920	0.00092	15510	19190
	Work Zone Violation	0.00000	0.04373	0.00437	0	17494
	Grade Crossing Collisions	0.11578	0.04397	0.00225	8777	19924
	Total, All Scenarios	0.16726	0.10706	0.00856	30917	67302
Total Passenger + Freight		0.90457	4.98656	0.12911	388436	1274434

Table R3d: All Year, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.02205	1.53257	0.05848	66221	394914
	Intrusion Collisions	0.04329	1.16598	0.04139	49775	290536
	Diamond Collisions	0.00123	0.01320	0.00039	463	2962
	Overspeed	0.02709	1.32091	0.02120	105770	301452
	Broken Rail	0.03784	1.84495	0.02961	147732	421046
	Work Zone Violation	0.00000	0.48973	0.04903	0	196054
	Grade Crossing Collisions	2.01600	5.96909	0.08865	578685	1441552
	Total, All Scenarios	2.14750	12.33644	0.28874	948645	3048516
Freight	Train-Train Collisions	0.00538	0.00576	0.00058	1652	3956
	Intrusion Collisions	0.01475	0.00480	0.00048	603	2527
	Diamond Collisions	0.00678	0.00299	0.00030	1134	2331
	Overspeed	0.01496	0.00474	0.00047	8155	10051
	Broken Rail	0.04783	0.01515	0.00151	26073	32132
	Work Zone Violation	0.00000	0.07426	0.00743	0	29702
	Grade Crossing Collisions	0.25526	0.08975	0.00460	17903	40670
	Total, All Scenarios	0.34497	0.19745	0.01537	55521	121369
Total Passenger + Freight		**2.49248**	**12.53388**	**0.30411**	**1004166**	**3169886**

Results Summary: Northeast Corridor ATC Case, 80% Preventability

Table R1a: Full Year, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00633	0.47048	0.01803	20509	121651
	Intrusion Collisions	0.00963	0.27834	0.00989	11928	69428
	Diamond Collisions	0.00030	0.00324	0.00010	113	726
	Overspeed	0.00589	0.30214	0.00486	24896	69680
	Broken Rail	0.00832	0.42659	0.00686	35151	98382
	Work Zone Violation	0.00000	0.11143	0.01114	0	44572
	Grade Crossing Collisions	0.59710	1.92530	0.02857	186625	464876
	Total, All Scenarios	0.62757	3.51751	0.07945	279222	869316
Freight	Train-Train Collisions	0.00107	0.00116	0.00012	336	799
	Intrusion Collisions	0.00208	0.00068	0.00007	85	358
	Diamond Collisions	0.00155	0.00070	0.00007	262	542
	Overspeed	0.00204	0.00064	0.00006	1117	1372
	Broken Rail	0.00660	0.00206	0.00021	3611	4434
	Work Zone Violation	0.00000	0.01020	0.00102	0	4078
	Grade Crossing Collisions	0.04820	0.01713	0.00088	3426	7781
	Total, All Scenarios	0.06155	0.03256	0.00242	8838	19365
Total Passenger + Freight		**0.68912**	**3.55007**	**0.08187**	**288060**	**888681**

Table R1b: Rest of Year, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00708	0.48361	0.01845	20914	124615
	Intrusion Collisions	0.01025	0.28010	0.00995	11938	69787
	Diamond Collisions	0.00027	0.00288	0.00009	101	647
	Overspeed	0.00627	0.30774	0.00493	24916	70493
	Broken Rail	0.00886	0.43450	0.00697	35179	99529
	Work Zone Violation	0.00000	0.11449	0.01145	0	45798
	Grade Crossing Collisions	0.55834	1.55969	0.02319	151171	376715
	Total, All Scenarios	0.59107	3.18302	0.07502	244220	787584
Freight	Train-Train Collisions	0.00223	0.00235	0.00024	667	1608
	Intrusion Collisions	0.00353	0.00110	0.00011	138	580
	Diamond Collisions	0.00133	0.00059	0.00006	223	461
	Overspeed	0.00347	0.00101	0.00010	1810	2215
	Broken Rail	0.01120	0.00327	0.00033	5848	7158
	Work Zone Violation	0.00000	0.01682	0.00168	0	6729
	Grade Crossing Collisions	0.07555	0.02371	0.00121	4717	10730
	Total, All Scenarios	0.09731	0.04887	0.00373	13404	29480
Total Passenger + Freight		**0.68838**	**3.23189**	**0.07875**	**257623**	**817064**

Table R1c: Rest of Year, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01026	0.69566	0.02650	29919	178990
	Intrusion Collisions	0.01576	0.40206	0.01426	17148	100134
	Diamond Collisions	0.00059	0.00631	0.00019	221	1415
	Overspeed	0.00964	0.45704	0.00733	35795	103495
	Broken Rail	0.01362	0.64530	0.01035	50539	146126
	Work Zone Violation	0.00000	0.16990	0.01699	0	67959
	Grade Crossing Collisions	0.50680	1.47592	0.02191	143142	356461
	Total, All Scenarios	0.55667	3.85218	0.09753	276763	954579
		0.00000	0.00000	0.00000	0	0
Freight	Train-Train Collisions	0.00308	0.00336	0.00034	963	2309
	Intrusion Collisions	0.00752	0.00250	0.00025	314	1312
	Diamond Collisions	0.00296	0.00133	0.00013	498	1029
	Overspeed	0.00739	0.00243	0.00024	4105	5079
	Broken Rail	0.02387	0.00787	0.00079	13267	16414
	Work Zone Violation	0.00000	0.03701	0.00370	0	14802
	Grade Crossing Collisions	0.09797	0.03721	0.00190	7427	16859
	Total, All Scenarios	0.14279	0.09170	0.00735	26573	57804
Total Passenger + Freight		**0.69946**	**3.94388**	**0.10489**	**303337**	**1012383**

Table R1d: Rest of Year, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.02366	1.64975	0.06298	71342	425256
	Intrusion Collisions	0.03564	0.96050	0.03410	41013	239350
	Diamond Collisions	0.00116	0.01243	0.00037	435	2788
	Overspeed	0.02181	1.06692	0.01712	85607	243668
	Broken Rail	0.03079	1.50639	0.02418	120869	344037
	Work Zone Violation	0.00000	0.39582	0.03958	0	158328
	Grade Crossing Collisions	1.66225	4.96091	0.07367	480938	1198052
	Total, All Scenarios	1.77531	10.55271	0.25200	800206	2611479
Freight	Train-Train Collisions	0.00639	0.00687	0.00069	1966	4716
	Intrusion Collisions	0.01313	0.00428	0.00043	537	2250
	Diamond Collisions	0.00584	0.00262	0.00026	983	2032
	Overspeed	0.01290	0.00408	0.00041	7032	8666
	Broken Rail	0.04168	0.01320	0.00132	22726	28006
	Work Zone Violation	0.00000	0.06402	0.00640	0	25609
	Grade Crossing Collisions	0.22171	0.07805	0.00400	15570	35370
	Total, All Scenarios	0.30165	0.17313	0.01351	48815	106650
Total Passenger + Freight		**2.07696**	**10.72584**	**0.26551**	**849020**	**2718128**

Table R2a: Summer, Joliet (Included in Full Year Table)

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Freight	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Total Passenger + Freight						

Table R2b: Summer, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00237	0.16307	0.00622	7048	42005
	Intrusion Collisions	0.00340	0.09303	0.00330	3965	23178
	Diamond Collisions	0.00008	0.00086	0.00003	30	193
	Overspeed	0.00208	0.10221	0.00164	8275	23412
	Broken Rail	0.00294	0.14431	0.00231	11684	33055
	Work Zone Violation	0.00000	0.03748	0.00380	0	15156
	Grade Crossing Collisions	0.18544	0.51800	0.00770	50207	125113
	Total, All Scenarios	0.19632	1.05895	0.02500	81208	262111
Freight	Train-Train Collisions	0.00040	0.00041	0.00004	118	280
	Intrusion Collisions	0.00074	0.00023	0.00002	29	121
	Diamond Collisions	0.00040	0.00018	0.00002	67	137
	Overspeed	0.00072	0.00021	0.00002	377	461
	Broken Rail	0.00233	0.00068	0.00007	1218	1491
	Work Zone Violation	0.00000	0.00350	0.00035	0	1402
	Grade Crossing Collisions	0.01574	0.00494	0.00025	983	2235
	Total, All Scenarios	0.02033	0.01015	0.00077	2791	6128
Total Passenger + Freight		**0.21664**	**1.06910**	**0.02578**	**83999**	**268239**

Table R2c: Summer, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00336	0.23061	0.00877	9905	59291
	Intrusion Collisions	0.00523	0.13353	0.00474	5695	33256
	Diamond Collisions	0.00016	0.00177	0.00005	62	397
	Overspeed	0.00320	0.15179	0.00244	11888	34372
	Broken Rail	0.00452	0.21431	0.00344	16785	48531
	Work Zone Violation	0.00000	0.05643	0.00564	0	22570
	Grade Crossing Collisions	0.16832	0.49018	0.00728	47540	118387
	Total, All Scenarios	0.18480	1.27862	0.03236	91875	316804
Freight	Train-Train Collisions	0.00037	0.00039	0.00004	114	270
	Intrusion Collisions	0.00137	0.00045	0.00005	57	239
	Diamond Collisions	0.00083	0.00037	0.00004	140	288
	Overspeed	0.00134	0.00044	0.00004	746	923
	Broken Rail	0.00434	0.00143	0.00014	2412	2984
	Work Zone Violation	0.00000	0.00673	0.00067	0	2691
	Grade Crossing Collisions	0.01781	0.00677	0.00035	1350	3065
	Total, All Scenarios	0.02607	0.01658	0.00133	4820	10462
Total Passenger + Freight		**0.21087**	**1.29520**	**0.03368**	**96695**	**327266**

Table R2d: Summer, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00573	0.39368	0.01499	16953	101296
	Intrusion Collisions	0.00864	0.22655	0.00804	9660	56434
	Diamond Collisions	0.00024	0.00263	0.00008	92	589
	Overspeed	0.00529	0.25400	0.00407	20163	57784
	Broken Rail	0.00746	0.35862	0.00575	28469	81586
	Work Zone Violation	0.00000	0.09391	0.00945	0	37726
	Grade Crossing Collisions	0.35375	1.00818	0.01498	97746	243500
	Total, All Scenarios	0.38112	2.33757	0.05736	173082	578915
Freight	Train-Train Collisions	0.00078	0.00080	0.00008	232	550
	Intrusion Collisions	0.00210	0.00068	0.00007	86	359
	Diamond Collisions	0.00122	0.00055	0.00005	206	426
	Overspeed	0.00207	0.00065	0.00007	1123	1385
	Broken Rail	0.00667	0.00211	0.00021	3630	4475
	Work Zone Violation	0.00000	0.01023	0.00102	0	4093
	Grade Crossing Collisions	0.03355	0.01170	0.00060	2333	5300
	Total, All Scenarios	0.04639	0.02673	0.00210	7611	16589
Total Passenger + Freight		**0.42751**	**2.36430**	**0.05946**	**180693**	**595505**

Table R3a: All Year, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00633	0.47048	0.01803	20509	121651
	Intrusion Collisions	0.00963	0.27834	0.00989	11928	69428
	Diamond Collisions	0.00030	0.00324	0.00010	113	726
	Overspeed	0.00589	0.30214	0.00486	24896	69680
	Broken Rail	0.00832	0.42659	0.00686	35151	98382
	Work Zone Violation	0.00000	0.11143	0.01114	0	44572
	Grade Crossing Collisions	0.59710	1.92530	0.02857	186625	464876
	Total, All Scenarios	0.62757	3.51751	0.07945	279222	869316
Freight	Train-Train Collisions	0.00107	0.00116	0.00012	336	799
	Intrusion Collisions	0.00208	0.00068	0.00007	85	358
	Diamond Collisions	0.00155	0.00070	0.00007	262	542
	Overspeed	0.00204	0.00064	0.00006	1117	1372
	Broken Rail	0.00660	0.00206	0.00021	3611	4434
	Work Zone Violation	0.00000	0.01020	0.00102	0	4078
	Grade Crossing Collisions	0.04820	0.01713	0.00088	3426	7781
	Total, All Scenarios	0.06155	0.03256	0.00242	8838	19365
Total Passenger + Freight		**0.68912**	**3.55007**	**0.08187**	**288060**	**888681**

Table R3b: All Year, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00945	0.64668	0.02466	27962	166620
	Intrusion Collisions	0.01365	0.37312	0.01325	15902	92965
	Diamond Collisions	0.00035	0.00374	0.00011	131	839
	Overspeed	0.00836	0.40995	0.00657	33191	93905
	Broken Rail	0.01180	0.57881	0.00928	46863	132585
	Work Zone Violation	0.00000	0.15197	0.01525	0	60953
	Grade Crossing Collisions	0.74378	2.07769	0.03089	201378	501828
	Total, All Scenarios	0.78738	4.24197	0.10002	325427	1049695
Freight	Train-Train Collisions	0.00264	0.00276	0.00028	785	1888
	Intrusion Collisions	0.00427	0.00133	0.00013	167	701
	Diamond Collisions	0.00172	0.00077	0.00008	290	598
	Overspeed	0.00419	0.00122	0.00012	2187	2676
	Broken Rail	0.01354	0.00396	0.00040	7067	8649
	Work Zone Violation	0.00000	0.02033	0.00203	0	8130
	Grade Crossing Collisions	0.09129	0.02865	0.00147	5700	12965
	Total, All Scenarios	0.11764	0.05902	0.00450	16195	35608
Total Passenger + Freight		**0.90502**	**4.30098**	**0.10453**	**341622**	**1085303**

Table R3c: All Year, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01362	0.92627	0.03528	39824	238281
	Intrusion Collisions	0.02099	0.53559	0.01900	22842	133391
	Diamond Collisions	0.00075	0.00807	0.00024	283	1811
	Overspeed	0.01285	0.60883	0.00977	47683	137868
	Broken Rail	0.01814	0.85961	0.01379	67324	194656
	Work Zone Violation	0.00000	0.22632	0.02263	0	90529
	Grade Crossing Collisions	0.67512	1.96610	0.02919	190682	474847
	Total, All Scenarios	0.74147	5.13080	0.12989	368638	1271383
Freight	Train-Train Collisions	0.00345	0.00375	0.00038	1078	2579
	Intrusion Collisions	0.00889	0.00295	0.00030	371	1551
	Diamond Collisions	0.00379	0.00170	0.00017	638	1317
	Overspeed	0.00873	0.00288	0.00029	4851	6002
	Broken Rail	0.02821	0.00930	0.00093	15679	19398
	Work Zone Violation	0.00000	0.04373	0.00437	0	17494
	Grade Crossing Collisions	0.11578	0.04397	0.00225	8777	19924
	Total, All Scenarios	0.16885	0.10828	0.00868	31393	68266
Total Passenger + Freight		**0.91032**	**5.23908**	**0.13857**	**400031**	**1339648**

Table R3d: All Year, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.02940	2.04343	0.07797	88295	526552
	Intrusion Collisions	0.04428	1.18705	0.04214	50673	295784
	Diamond Collisions	0.00140	0.01505	0.00045	527	3377
	Overspeed	0.02709	1.32091	0.02120	105770	301452
	Broken Rail	0.03825	1.86501	0.02993	149338	425623
	Work Zone Violation	0.00000	0.48973	0.04903	0	196054
	Grade Crossing Collisions	2.01600	5.96909	0.08865	578685	1441552
	Total, All Scenarios	2.15643	12.89027	0.30936	973288	3190394
Freight	Train-Train Collisions	0.00716	0.00767	0.00077	2198	5266
	Intrusion Collisions	0.01524	0.00496	0.00050	623	2610
	Diamond Collisions	0.00706	0.00317	0.00032	1189	2458
	Overspeed	0.01496	0.00474	0.00047	8155	10051
	Broken Rail	0.04835	0.01531	0.00153	26356	32481
	Work Zone Violation	0.00000	0.07426	0.00743	0	29702
	Grade Crossing Collisions	0.25526	0.08975	0.00460	17903	40670
	Total, All Scenarios	0.34804	0.19986	0.01561	56426	123239
Total Passenger + Freight		**2.50447**	**13.09014**	**0.32497**	**1029714**	**3313633**

Results Summary: Northeast Corridor ATC Case, 90% Preventability

Table R1a: Full Year, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00316	0.23524	0.00902	10255	60826
	Intrusion Collisions	0.00932	0.27184	0.00966	11650	67808
	Diamond Collisions	0.00022	0.00241	0.00007	84	540
	Overspeed	0.00589	0.30214	0.00486	24896	69680
	Broken Rail	0.00823	0.42200	0.00678	34773	97324
	Work Zone Violation	0.00000	0.11143	0.01114	0	44572
	Grade Crossing Collisions	0.59710	1.92530	0.02857	186625	464876
	Total, All Scenarios	0.62394	3.27035	0.07010	268283	805626
Freight	Train-Train Collisions	0.00054	0.00058	0.00006	168	400
	Intrusion Collisions	0.00198	0.00065	0.00006	81	340
	Diamond Collisions	0.00142	0.00062	0.00006	237	485
	Overspeed	0.00204	0.00064	0.00006	1117	1372
	Broken Rail	0.00653	0.00204	0.00020	3572	4387
	Work Zone Violation	0.00000	0.01020	0.00102	0	4078
	Grade Crossing Collisions	0.04820	0.01713	0.00088	3426	7781
	Total, All Scenarios	0.06071	0.03184	0.00235	8602	18843
Total Passenger + Freight		**0.68465**	**3.30220**	**0.07246**	**276884**	**824469**

Table R1b: Rest of Year, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00354	0.24181	0.00922	10457	62308
	Intrusion Collisions	0.00992	0.27355	0.00971	11659	68159
	Diamond Collisions	0.00020	0.00219	0.00007	77	491
	Overspeed	0.00627	0.30774	0.00493	24916	70493
	Broken Rail	0.00876	0.42983	0.00689	34801	98459
	Work Zone Violation	0.00000	0.11449	0.01145	0	45798
	Grade Crossing Collisions	0.55834	1.55969	0.02319	151171	376715
	Total, All Scenarios	0.58704	2.92930	0.06547	233082	722421
Freight	Train-Train Collisions	0.00112	0.00118	0.00012	333	804
	Intrusion Collisions	0.00336	0.00105	0.00011	131	551
	Diamond Collisions	0.00122	0.00053	0.00005	203	413
	Overspeed	0.00347	0.00101	0.00010	1810	2215
	Broken Rail	0.01108	0.00324	0.00032	5786	7081
	Work Zone Violation	0.00000	0.01682	0.00168	0	6729
	Grade Crossing Collisions	0.07555	0.02371	0.00121	4717	10730
	Total, All Scenarios	0.09579	0.04753	0.00360	12980	28523
Total Passenger + Freight		**0.68283**	**2.97684**	**0.06907**	**246062**	**750945**

Table R1c: Rest of Year, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00513	0.34783	0.01325	14959	89495
	Intrusion Collisions	0.01526	0.39267	0.01393	16748	97798
	Diamond Collisions	0.00044	0.00477	0.00014	167	1070
	Overspeed	0.00964	0.45704	0.00733	35795	103495
	Broken Rail	0.01347	0.63836	0.01024	49996	144554
	Work Zone Violation	0.00000	0.16990	0.01699	0	67959
	Grade Crossing Collisions	0.50680	1.47592	0.02191	143142	356461
	Total, All Scenarios	0.55074	3.48648	0.08379	260807	860831
		0.00000	0.00000	0.00000	0	0
Freight	Train-Train Collisions	0.00156	0.00170	0.00017	488	1167
	Intrusion Collisions	0.00715	0.00237	0.00024	298	1248
	Diamond Collisions	0.00272	0.00118	0.00012	452	923
	Overspeed	0.00739	0.00243	0.00024	4105	5079
	Broken Rail	0.02362	0.00778	0.00078	13124	16237
	Work Zone Violation	0.00000	0.03701	0.00370	0	14802
	Grade Crossing Collisions	0.09797	0.03721	0.00190	7427	16859
	Total, All Scenarios	0.14040	0.08968	0.00715	25894	56315
Total Passenger + Freight		**0.69115**	**3.57616**	**0.09094**	**286701**	**917146**

Table R1d: Rest of Year, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01183	0.82487	0.03149	35671	212628
	Intrusion Collisions	0.03450	0.93806	0.03330	40057	233765
	Diamond Collisions	0.00087	0.00936	0.00028	328	2100
	Overspeed	0.02181	1.06692	0.01712	85607	243668
	Broken Rail	0.03046	1.49019	0.02392	119569	340337
	Work Zone Violation	0.00000	0.39582	0.03958	0	158328
	Grade Crossing Collisions	1.66225	4.96091	0.07367	480938	1198052
	Total, All Scenarios	1.76172	9.68614	0.21936	762171	2388878
Freight	Train-Train Collisions	0.00322	0.00345	0.00035	989	2370
	Intrusion Collisions	0.01248	0.00407	0.00041	511	2139
	Diamond Collisions	0.00536	0.00232	0.00023	892	1822
	Overspeed	0.01290	0.00408	0.00041	7032	8666
	Broken Rail	0.04123	0.01306	0.00131	22482	27705
	Work Zone Violation	0.00000	0.06402	0.00640	0	25609
	Grade Crossing Collisions	0.22171	0.07805	0.00400	15570	35370
	Total, All Scenarios	0.29691	0.16906	0.01310	47476	103681
Total Passenger + Freight		**2.05863**	**9.85519**	**0.23246**	**809647**	**2492560**

Table R2a: Summer, Joliet (Included in Full Year Table)

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Freight	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Total Passenger + Freight						

Table R2b: Summer, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00119	0.08154	0.00311	3524	21002
	Intrusion Collisions	0.00330	0.09085	0.00323	3872	22637
	Diamond Collisions	0.00006	0.00065	0.00002	23	146
	Overspeed	0.00208	0.10221	0.00164	8275	23412
	Broken Rail	0.00291	0.14275	0.00229	11558	32700
	Work Zone Violation	0.00000	0.03748	0.00380	0	15156
	Grade Crossing Collisions	0.18544	0.51800	0.00770	50207	125113
	Total, All Scenarios	0.19497	0.97348	0.02179	77459	240166
Freight	Train-Train Collisions	0.00020	0.00020	0.00002	59	140
	Intrusion Collisions	0.00070	0.00022	0.00002	27	115
	Diamond Collisions	0.00036	0.00016	0.00002	60	123
	Overspeed	0.00072	0.00021	0.00002	377	461
	Broken Rail	0.00231	0.00067	0.00007	1205	1475
	Work Zone Violation	0.00000	0.00350	0.00035	0	1402
	Grade Crossing Collisions	0.01574	0.00494	0.00025	983	2235
	Total, All Scenarios	0.02003	0.00991	0.00075	2711	5951
Total Passenger + Freight		**0.21500**	**0.98339**	**0.02254**	**80170**	**246117**

Table R2c: Summer, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00168	0.11531	0.00439	4953	29646
	Intrusion Collisions	0.00507	0.13041	0.00463	5562	32480
	Diamond Collisions	0.00012	0.00134	0.00004	47	300
	Overspeed	0.00320	0.15179	0.00244	11888	34372
	Broken Rail	0.00447	0.21201	0.00340	16604	48009
	Work Zone Violation	0.00000	0.05643	0.00564	0	22570
	Grade Crossing Collisions	0.16832	0.49018	0.00728	47540	118387
	Total, All Scenarios	0.18287	1.15746	0.02781	86594	285764
Freight	Train-Train Collisions	0.00019	0.00019	0.00002	57	135
	Intrusion Collisions	0.00130	0.00043	0.00004	54	227
	Diamond Collisions	0.00076	0.00033	0.00003	127	259
	Overspeed	0.00134	0.00044	0.00004	746	923
	Broken Rail	0.00429	0.00142	0.00014	2386	2952
	Work Zone Violation	0.00000	0.00673	0.00067	0	2691
	Grade Crossing Collisions	0.01781	0.00677	0.00035	1350	3065
	Total, All Scenarios	0.02570	0.01631	0.00130	4721	10253
Total Passenger + Freight		**0.20856**	**1.17377**	**0.02911**	**91315**	**296017**

Table R2d: Summer, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00287	0.19684	0.00750	8476	50648
	Intrusion Collisions	0.00836	0.22126	0.00785	9434	55117
	Diamond Collisions	0.00018	0.00199	0.00006	70	446
	Overspeed	0.00529	0.25400	0.00407	20163	57784
	Broken Rail	0.00738	0.35476	0.00569	28162	80709
	Work Zone Violation	0.00000	0.09391	0.00945	0	37726
	Grade Crossing Collisions	0.35375	1.00818	0.01498	97746	243500
	Total, All Scenarios	0.37784	2.13094	0.04959	164052	525930
Freight	Train-Train Collisions	0.00039	0.00040	0.00004	116	275
	Intrusion Collisions	0.00200	0.00065	0.00007	82	342
	Diamond Collisions	0.00113	0.00049	0.00005	187	382
	Overspeed	0.00207	0.00065	0.00007	1123	1385
	Broken Rail	0.00660	0.00209	0.00021	3591	4427
	Work Zone Violation	0.00000	0.01023	0.00102	0	4093
	Grade Crossing Collisions	0.03355	0.01170	0.00060	2333	5300
	Total, All Scenarios	0.04573	0.02621	0.00205	7433	16204
Total Passenger + Freight		**0.42357**	**2.15715**	**0.05164**	**171485**	**542134**

Table R3a: All Year, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00316	0.23524	0.00902	10255	60826
	Intrusion Collisions	0.00932	0.27184	0.00966	11650	67808
	Diamond Collisions	0.00022	0.00241	0.00007	84	540
	Overspeed	0.00589	0.30214	0.00486	24896	69680
	Broken Rail	0.00823	0.42200	0.00678	34773	97324
	Work Zone Violation	0.00000	0.11143	0.01114	0	44572
	Grade Crossing Collisions	0.59710	1.92530	0.02857	186625	464876
	Total, All Scenarios	0.62394	3.27035	0.07010	268283	805626
Freight	Train-Train Collisions	0.00054	0.00058	0.00006	168	400
	Intrusion Collisions	0.00198	0.00065	0.00006	81	340
	Diamond Collisions	0.00142	0.00062	0.00006	237	485
	Overspeed	0.00204	0.00064	0.00006	1117	1372
	Broken Rail	0.00653	0.00204	0.00020	3572	4387
	Work Zone Violation	0.00000	0.01020	0.00102	0	4078
	Grade Crossing Collisions	0.04820	0.01713	0.00088	3426	7781
	Total, All Scenarios	0.06071	0.03184	0.00235	8602	18843
Total Passenger + Freight		**0.68465**	**3.30220**	**0.07246**	**276884**	**824469**

Table R3b: All Year, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00472	0.32334	0.01233	13981	83310
	Intrusion Collisions	0.01322	0.36441	0.01294	15531	90795
	Diamond Collisions	0.00026	0.00284	0.00008	99	637
	Overspeed	0.00836	0.40995	0.00657	33191	93905
	Broken Rail	0.01167	0.57258	0.00918	46359	131159
	Work Zone Violation	0.00000	0.15197	0.01525	0	60953
	Grade Crossing Collisions	0.74378	2.07769	0.03089	201378	501828
	Total, All Scenarios	0.78201	3.90278	0.08726	310540	962587
Freight	Train-Train Collisions	0.00132	0.00138	0.00014	392	944
	Intrusion Collisions	0.00406	0.00126	0.00013	159	666
	Diamond Collisions	0.00158	0.00068	0.00007	263	536
	Overspeed	0.00419	0.00122	0.00012	2187	2676
	Broken Rail	0.01339	0.00391	0.00039	6991	8556
	Work Zone Violation	0.00000	0.02033	0.00203	0	8130
	Grade Crossing Collisions	0.09129	0.02865	0.00147	5700	12965
	Total, All Scenarios	0.11583	0.05744	0.00435	15691	34475
Total Passenger + Freight		**0.89784**	**3.96022**	**0.09160**	**326232**	**997062**

Table R3c: All Year, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00681	0.46314	0.01764	19912	119140
	Intrusion Collisions	0.02032	0.52308	0.01855	22310	130278
	Diamond Collisions	0.00057	0.00611	0.00018	214	1369
	Overspeed	0.01285	0.60883	0.00977	47683	137868
	Broken Rail	0.01794	0.85037	0.01364	66600	192563
	Work Zone Violation	0.00000	0.22632	0.02263	0	90529
	Grade Crossing Collisions	0.67512	1.96610	0.02919	190682	474847
	Total, All Scenarios	0.73361	4.64394	0.11160	347401	1146595
Freight	Train-Train Collisions	0.00175	0.00189	0.00019	545	1302
	Intrusion Collisions	0.00845	0.00280	0.00028	352	1474
	Diamond Collisions	0.00348	0.00151	0.00015	579	1182
	Overspeed	0.00873	0.00288	0.00029	4851	6002
	Broken Rail	0.02791	0.00920	0.00092	15510	19190
	Work Zone Violation	0.00000	0.04373	0.00437	0	17494
	Grade Crossing Collisions	0.11578	0.04397	0.00225	8777	19924
	Total, All Scenarios	0.16610	0.10599	0.00845	30615	66568
Total Passenger + Freight		**0.89971**	**4.74993**	**0.12005**	**378016**	**1213163**

Table R3d: All Year, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01470	1.02172	0.03899	44147	263276
	Intrusion Collisions	0.04286	1.15932	0.04115	49492	288882
	Diamond Collisions	0.00106	0.01135	0.00034	398	2546
	Overspeed	0.02709	1.32091	0.02120	105770	301452
	Broken Rail	0.03784	1.84495	0.02961	147732	421046
	Work Zone Violation	0.00000	0.48973	0.04903	0	196054
	Grade Crossing Collisions	2.01600	5.96909	0.08865	578685	1441552
	Total, All Scenarios	2.13956	11.81707	0.26896	926224	2914808
Freight	Train-Train Collisions	0.00360	0.00385	0.00039	1105	2646
	Intrusion Collisions	0.01448	0.00472	0.00047	592	2481
	Diamond Collisions	0.00649	0.00281	0.00028	1080	2204
	Overspeed	0.01496	0.00474	0.00047	8155	10051
	Broken Rail	0.04783	0.01515	0.00151	26073	32132
	Work Zone Violation	0.00000	0.07426	0.00743	0	29702
	Grade Crossing Collisions	0.25526	0.08975	0.00460	17903	40670
	Total, All Scenarios	0.34264	0.19527	0.01515	54908	119886
Total Passenger + Freight		**2.48220**	**12.01234**	**0.28411**	**981132**	**3034694**

Results Summary: Northeast Corridor Basic Case: ATC 85% Preventability with Reduced Severity of Consequences

Table R1a: Full Year, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00474	0.28229	0.01082	12306	72991
	Intrusion Collisions	0.00941	0.25179	0.00895	10793	62812
	Diamond Collisions	0.00026	0.00226	0.00007	79	507
	Overspeed	0.00589	0.30214	0.00486	24896	69680
	Broken Rail	0.00823	0.40934	0.00658	33729	94404
	Work Zone Violation	0.00000	0.11143	0.01114	0	44572
	Grade Crossing Collisions	0.59710	1.92530	0.02857	186625	464876
	Total, All Scenarios	0.62565	3.28454	0.07099	268427	809842
Freight	Train-Train Collisions	0.00080	0.00069	0.00007	202	480
	Intrusion Collisions	0.00201	0.00047	0.00005	60	250
	Diamond Collisions	0.00149	0.00053	0.00005	200	411
	Overspeed	0.00204	0.00064	0.00006	1117	1372
	Broken Rail	0.00653	0.00198	0.00020	3465	4255
	Work Zone Violation	0.00000	0.01020	0.00102	0	4078
	Grade Crossing Collisions	0.04820	0.01713	0.00088	3426	7781
	Total, All Scenarios	0.06108	0.03164	0.00233	8469	18627
Total Passenger + Freight		**0.68673**	**3.31617**	**0.07332**	**276897**	**828468**

Table R1b: Rest of Year, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00531	0.29017	0.01107	12549	74769
	Intrusion Collisions	0.01002	0.25338	0.00900	10801	63137
	Diamond Collisions	0.00024	0.00203	0.00006	71	455
	Overspeed	0.00627	0.30774	0.00493	24916	70493
	Broken Rail	0.00876	0.41694	0.00668	33757	95505
	Work Zone Violation	0.00000	0.11449	0.01145	0	45798
	Grade Crossing Collisions	0.55834	1.55969	0.02319	151171	376715
	Total, All Scenarios	0.58894	2.94443	0.06639	233265	726871
Freight	Train-Train Collisions	0.00168	0.00141	0.00014	400	965
	Intrusion Collisions	0.00342	0.00077	0.00008	96	404
	Diamond Collisions	0.00127	0.00045	0.00004	170	350
	Overspeed	0.00347	0.00101	0.00010	1810	2215
	Broken Rail	0.01108	0.00314	0.00031	5612	6868
	Work Zone Violation	0.00000	0.01682	0.00168	0	6729
	Grade Crossing Collisions	0.07555	0.02371	0.00121	4717	10730
	Total, All Scenarios	0.09647	0.04731	0.00357	12806	28261
Total Passenger + Freight		**0.68541**	**2.99175**	**0.06996**	**246071**	**755132**

Table R1c: Rest of Year, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00770	0.41740	0.01590	17951	107394
	Intrusion Collisions	0.01541	0.36371	0.01290	15515	90592
	Diamond Collisions	0.00052	0.00443	0.00013	155	994
	Overspeed	0.00964	0.45704	0.00733	35795	103495
	Broken Rail	0.01347	0.61921	0.00993	48496	140218
	Work Zone Violation	0.00000	0.16990	0.01699	0	67959
	Grade Crossing Collisions	0.50680	1.47592	0.02191	143142	356461
	Total, All Scenarios	0.55353	3.50760	0.08510	261054	867112
Freight		0.00000	0.00000	0.00000	0	0
	Train-Train Collisions	0.00232	0.00203	0.00020	580	1390
	Intrusion Collisions	0.00728	0.00174	0.00017	219	915
	Diamond Collisions	0.00284	0.00100	0.00010	380	781
	Overspeed	0.00739	0.00243	0.00024	4105	5079
	Broken Rail	0.02362	0.00755	0.00075	12730	15750
	Work Zone Violation	0.00000	0.03701	0.00370	0	14802
	Grade Crossing Collisions	0.09797	0.03721	0.00190	7427	16859
	Total, All Scenarios	0.14141	0.08896	0.00708	25441	55576
Total Passenger + Freight		0.69495	3.59657	0.09218	286495	922688

Table R1d: Rest of Year, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01775	0.98985	0.03779	42805	255154
	Intrusion Collisions	0.03484	0.86888	0.03085	37108	216541
	Diamond Collisions	0.00101	0.00872	0.00026	305	1955
	Overspeed	0.02181	1.06692	0.01712	85607	243668
	Broken Rail	0.03046	1.44549	0.02320	115982	330127
	Work Zone Violation	0.00000	0.39582	0.03958	0	158328
	Grade Crossing Collisions	1.66225	4.96091	0.07367	480938	1198052
	Total, All Scenarios	1.76812	9.73658	0.22247	762747	2403825
Freight	Train-Train Collisions	0.00480	0.00413	0.00041	1182	2834
	Intrusion Collisions	0.01272	0.00298	0.00030	375	1569
	Diamond Collisions	0.00560	0.00198	0.00020	750	1542
	Overspeed	0.01290	0.00408	0.00041	7032	8666
	Broken Rail	0.04123	0.01267	0.00127	21807	26874
	Work Zone Violation	0.00000	0.06402	0.00640	0	25609
	Grade Crossing Collisions	0.22171	0.07805	0.00400	15570	35370
	Total, All Scenarios	0.29896	0.16791	0.01299	46716	102464
Total Passenger + Freight		**2.06708**	**9.90449**	**0.23546**	**809463**	**2506289**

Table R2a: Summer, Joliet (included in Full Year Table)

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Freight	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Total Passenger + Freight						

There are no seasonal traffic variations on the Joliet Sub-corridor. Therefore only one risk calculation is needed for the full year, and there is no separate summer calculation

Table R2b: Summer, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00178	0.09784	0.00373	4229	25203
	Intrusion Collisions	0.00333	0.08415	0.00299	3587	20969
	Diamond Collisions	0.00007	0.00060	0.00002	21	136
	Overspeed	0.00208	0.10221	0.00164	8275	23412
	Broken Rail	0.00291	0.13847	0.00222	11211	31719
	Work Zone Violation	0.00000	0.03748	0.00380	0	15156
	Grade Crossing Collisions	0.18544	0.51800	0.00770	50207	125113
	Total, All Scenarios	0.19561	0.97876	0.02210	77530	241707
Freight	Train-Train Collisions	0.00030	0.00024	0.00002	71	168
	Intrusion Collisions	0.00071	0.00016	0.00002	20	84
	Diamond Collisions	0.00038	0.00013	0.00001	51	104
	Overspeed	0.00072	0.00021	0.00002	377	461
	Broken Rail	0.00231	0.00065	0.00007	1169	1431
	Work Zone Violation	0.00000	0.00350	0.00035	0	1402
	Grade Crossing Collisions	0.01574	0.00494	0.00025	983	2235
	Total, All Scenarios	0.02016	0.00985	0.00074	2670	5885
Total Passenger + Freight		**0.21577**	**0.98860**	**0.02284**	**80200**	**247592**

Table R2c: Summer, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00252	0.13837	0.00526	5943	35575
	Intrusion Collisions	0.00512	0.12079	0.00429	5153	30087
	Diamond Collisions	0.00014	0.00124	0.00004	43	279
	Overspeed	0.00320	0.15179	0.00244	11888	34372
	Broken Rail	0.00447	0.20565	0.00330	16106	46569
	Work Zone Violation	0.00000	0.05643	0.00564	0	22570
	Grade Crossing Collisions	0.16832	0.49018	0.00728	47540	118387
	Total, All Scenarios	0.18378	1.16445	0.02824	86673	287838
Freight	Train-Train Collisions	0.00028	0.00023	0.00002	69	162
	Intrusion Collisions	0.00132	0.00032	0.00003	40	166
	Diamond Collisions	0.00080	0.00028	0.00003	107	219
	Overspeed	0.00134	0.00044	0.00004	746	923
	Broken Rail	0.00429	0.00137	0.00014	2315	2864
	Work Zone Violation	0.00000	0.00673	0.00067	0	2691
	Grade Crossing Collisions	0.01781	0.00677	0.00035	1350	3065
	Total, All Scenarios	0.02585	0.01614	0.00128	4626	10091
Total Passenger + Freight		**0.20963**	**1.18059**	**0.02952**	**91300**	**297929**

Table R2d: Summer, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00430	0.23621	0.00900	10172	60778
	Intrusion Collisions	0.00844	0.20495	0.00727	8740	51056
	Diamond Collisions	0.00021	0.00185	0.00005	65	414
	Overspeed	0.00529	0.25400	0.00407	20163	57784
	Broken Rail	0.00738	0.34412	0.00552	27318	78288
	Work Zone Violation	0.00000	0.09391	0.00945	0	37726
	Grade Crossing Collisions	0.35375	1.00818	0.01498	97746	243500
	Total, All Scenarios	0.37938	2.14320	0.05034	164203	529545
Freight	Train-Train Collisions	0.00058	0.00048	0.00005	139	330
	Intrusion Collisions	0.00204	0.00048	0.00005	60	251
	Diamond Collisions	0.00118	0.00041	0.00004	157	323
	Overspeed	0.00207	0.00065	0.00007	1123	1385
	Broken Rail	0.00660	0.00203	0.00020	3484	4294
	Work Zone Violation	0.00000	0.01023	0.00102	0	4093
	Grade Crossing Collisions	0.03355	0.01170	0.00060	2333	5300
	Total, All Scenarios	0.04601	0.02599	0.00203	7296	15977
Total Passenger + Freight		**0.42539**	**2.16919**	**0.05237**	**171500**	**545522**

Table R3a: All Year, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00474	0.28229	0.01082	12306	72991
	Intrusion Collisions	0.00941	0.25179	0.00895	10793	62812
	Diamond Collisions	0.00026	0.00226	0.00007	79	507
	Overspeed	0.00589	0.30214	0.00486	24896	69680
	Broken Rail	0.00823	0.40934	0.00658	33729	94404
	Work Zone Violation	0.00000	0.11143	0.01114	0	44572
	Grade Crossing Collisions	0.59710	1.92530	0.02857	186625	464876
	Total, All Scenarios	0.62565	3.28454	0.07099	268427	809842
Freight	Train-Train Collisions	0.00080	0.00069	0.00007	202	480
	Intrusion Collisions	0.00201	0.00047	0.00005	60	250
	Diamond Collisions	0.00149	0.00053	0.00005	200	411
	Overspeed	0.00204	0.00064	0.00006	1117	1372
	Broken Rail	0.00653	0.00198	0.00020	3465	4255
	Work Zone Violation	0.00000	0.01020	0.00102	0	4078
	Grade Crossing Collisions	0.04820	0.01713	0.00088	3426	7781
	Total, All Scenarios	0.06108	0.03164	0.00233	8469	18627
Total Passenger + Freight		0.68673	3.31617	0.07332	276897	828468

Table R3b: All Year, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00709	0.38801	0.01480	16777	99972
	Intrusion Collisions	0.01335	0.33753	0.01199	14388	84105
	Diamond Collisions	0.00031	0.00263	0.00008	92	590
	Overspeed	0.00836	0.40995	0.00657	33191	93905
	Broken Rail	0.01167	0.55541	0.00891	44968	127224
	Work Zone Violation	0.00000	0.15197	0.01525	0	60953
	Grade Crossing Collisions	0.74378	2.07769	0.03089	201378	501828
	Total, All Scenarios	0.78455	3.92319	0.08849	310795	968578
Freight	Train-Train Collisions	0.00198	0.00166	0.00017	471	1133
	Intrusion Collisions	0.00413	0.00093	0.00009	116	489
	Diamond Collisions	0.00165	0.00058	0.00006	221	454
	Overspeed	0.00419	0.00122	0.00012	2187	2676
	Broken Rail	0.01339	0.00380	0.00038	6781	8299
	Work Zone Violation	0.00000	0.02033	0.00203	0	8130
	Grade Crossing Collisions	0.09129	0.02865	0.00147	5700	12965
	Total, All Scenarios	0.11663	0.05716	0.00432	15476	34147
Total Passenger + Freight		0.90118	3.98035	0.09281	326271	1002725

Table R3c: All Year, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01022	0.55576	0.02117	23894	142968
	Intrusion Collisions	0.02052	0.48451	0.01719	20667	120679
	Diamond Collisions	0.00066	0.00567	0.00017	199	1272
	Overspeed	0.01285	0.60883	0.00977	47683	137868
	Broken Rail	0.01794	0.82486	0.01323	64602	186786
	Work Zone Violation	0.00000	0.22632	0.02263	0	90529
	Grade Crossing Collisions	0.67512	1.96610	0.02919	190682	474847
	Total, All Scenarios	0.73731	4.67205	0.11334	347727	1154950
Freight	Train-Train Collisions	0.00260	0.00226	0.00023	649	1552
	Intrusion Collisions	0.00861	0.00206	0.00021	258	1081
	Diamond Collisions	0.00364	0.00128	0.00013	487	1000
	Overspeed	0.00873	0.00288	0.00029	4851	6002
	Broken Rail	0.02791	0.00892	0.00089	15045	18614
	Work Zone Violation	0.00000	0.04373	0.00437	0	17494
	Grade Crossing Collisions	0.11578	0.04397	0.00225	8777	19924
	Total, All Scenarios	0.16726	0.10510	0.00836	30068	65667
Total Passenger + Freight		0.90457	4.77716	0.12170	377795	1220618

Table R3d: All Year, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.02205	1.22606	0.04678	52977	315931
	Intrusion Collisions	0.04329	1.07382	0.03812	45848	267597
	Diamond Collisions	0.00123	0.01056	0.00031	370	2369
	Overspeed	0.02709	1.32091	0.02120	105770	301452
	Broken Rail	0.03784	1.78961	0.02872	143300	408415
	Work Zone Violation	0.00000	0.48973	0.04903	0	196054
	Grade Crossing Collisions	2.01600	5.96909	0.08865	578685	1441552
	Total, All Scenarios	2.14750	11.87978	0.27281	926950	2933370
Freight	Train-Train Collisions	0.00538	0.00461	0.00046	1321	3165
	Intrusion Collisions	0.01475	0.00346	0.00035	434	1819
	Diamond Collisions	0.00678	0.00239	0.00024	908	1865
	Overspeed	0.01496	0.00474	0.00047	8155	10051
	Broken Rail	0.04783	0.01469	0.00147	25291	31168
	Work Zone Violation	0.00000	0.07426	0.00743	0	29702
	Grade Crossing Collisions	0.25526	0.08975	0.00460	17903	40670
	Total, All Scenarios	0.34497	0.19390	0.01501	54013	118440
Total Passenger + Freight		**2.49248**	**12.07368**	**0.28783**	**980962**	**3051811**

Worksheet 11:
CTC Reference Case

Results Summary: CTC Reference Case.

Table R1a: Full Year, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00533	0.25201	0.00956	10983	64849
	Intrusion Collisions	0.01232	0.33817	0.01201	14488	84337
	Diamond Collisions	0.00092	0.00989	0.00029	346	2218
	Overspeed	0.00589	0.30214	0.00486	24896	69680
	Broken Rail	0.00895	0.45870	0.00737	37796	105787
	Work Zone Violation	0.00000	0.11143	0.01114	0	44572
	Grade Crossing Collisions	0.59710	1.92530	0.02857	186625	464876
	Total, All Scenarios	0.63051	3.39763	0.07381	275134	836319
Freight	Train-Train Collisions	0.00536	0.00579	0.00058	1681	3996
	Intrusion Collisions	0.00294	0.00096	0.00010	121	505
	Diamond Collisions	0.00258	0.00135	0.00014	459	999
	Overspeed	0.00204	0.00064	0.00006	1117	1372
	Broken Rail	0.00710	0.00221	0.00022	3883	4768
	Work Zone Violation	0.00000	0.01020	0.00102	0	4078
	Grade Crossing Collisions	0.04820	0.01713	0.00088	3426	7781
	Total, All Scenarios	0.06822	0.03827	0.00300	10686	23500
Total Passenger + Freight		**0.69874**	**3.43590**	**0.07680**	**285821**	**859819**

Table R1b: Rest of Year, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.03538	2.41805	0.09223	104572	623076
	Intrusion Collisions	0.01311	0.34030	0.01208	14499	84774
	Diamond Collisions	0.00079	0.00844	0.00025	296	1894
	Overspeed	0.00627	0.30774	0.00493	24916	70493
	Broken Rail	0.00952	0.46721	0.00749	37827	107021
	Work Zone Violation	0.00000	0.11449	0.01145	0	45798
	Grade Crossing Collisions	0.55834	1.55969	0.02319	151171	376715
	Total, All Scenarios	0.62342	5.21593	0.15163	333281	1309770
Freight	Train-Train Collisions	0.01117	0.01176	0.00118	3334	8038
	Intrusion Collisions	0.00498	0.00155	0.00016	195	819
	Diamond Collisions	0.00219	0.00114	0.00011	388	843
	Overspeed	0.00347	0.00101	0.00010	1810	2215
	Broken Rail	0.01205	0.00352	0.00035	6289	7697
	Work Zone Violation	0.00000	0.01682	0.00168	0	6729
	Grade Crossing Collisions	0.07555	0.02371	0.00121	4717	10730
	Total, All Scenarios	0.10941	0.05952	0.00480	16732	37070
Total Passenger + Freight		**0.73283**	**5.27545**	**0.15643**	**350014**	**1346841**

Table R1c: Rest of Year, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.05130	3.47830	0.13251	149594	894949
	Intrusion Collisions	0.02016	0.48846	0.01732	20827	121637
	Diamond Collisions	0.00173	0.01861	0.00055	652	4175
	Overspeed	0.00964	0.45704	0.00733	35795	103495
	Broken Rail	0.01464	0.69387	0.01113	54343	157124
	Work Zone Violation	0.00000	0.16990	0.01699	0	67959
	Grade Crossing Collisions	0.50680	1.47592	0.02191	143142	356461
	Total, All Scenarios	0.60428	6.78210	0.20775	404353	1705799
		0.00000	0.00000	0.00000	0	0
Freight	Train-Train Collisions	0.01522	0.01669	0.00167	4768	11445
	Intrusion Collisions	0.01062	0.00352	0.00035	443	1853
	Diamond Collisions	0.00487	0.00253	0.00025	863	1874
	Overspeed	0.00739	0.00243	0.00024	4105	5079
	Broken Rail	0.02567	0.00846	0.00085	14265	17649
	Work Zone Violation	0.00000	0.03701	0.00370	0	14802
	Grade Crossing Collisions	0.09797	0.03721	0.00190	7427	16859
	Total, All Scenarios	0.16173	0.10785	0.00897	31870	69561
Total Passenger + Freight		**0.76601**	**6.88995**	**0.21671**	**436224**	**1775361**

Table R1d: Rest of Year, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.09202	6.14836	0.23430	265149	1582874
	Intrusion Collisions	0.04560	1.16693	0.04141	49814	290748
	Diamond Collisions	0.00344	0.03694	0.00110	1294	8287
	Overspeed	0.02181	1.06692	0.01712	85607	243668
	Broken Rail	0.03311	1.61977	0.02600	129967	369932
	Work Zone Violation	0.00000	0.39582	0.03958	0	158328
	Grade Crossing Collisions	1.66225	4.96091	0.07367	480938	1198052
	Total, All Scenarios	1.85822	15.39566	0.43318	1012769	3851889
Freight	Train-Train Collisions	0.03175	0.03424	0.00342	9783	23480
	Intrusion Collisions	0.01854	0.00604	0.00060	759	3177
	Diamond Collisions	0.00964	0.00502	0.00050	1709	3716
	Overspeed	0.01290	0.00408	0.00041	7032	8666
	Broken Rail	0.04482	0.01419	0.00142	24436	30114
	Work Zone Violation	0.00000	0.06402	0.00640	0	25609
	Grade Crossing Collisions	0.22171	0.07805	0.00400	15570	35370
	Total, All Scenarios	0.33936	0.20565	0.01676	59289	130131
Total Passenger + Freight		**2.19758**	**15.60130**	**0.44994**	**1072058**	**3982021**

Table R2a: Summer, Joliet (included in Full Year Table)

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Freight	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Total Passenger + Freight						

There are no seasonal traffic variations on the Joliet Sub-corridor. Therefore only one risk calculation is needed for the full year, and there is no separate summer calculation

Table R2b: Summer, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01186	0.81536	0.03108	35238	210025
	Intrusion Collisions	0.00436	0.11302	0.00401	4815	28155
	Diamond Collisions	0.00023	0.00252	0.00007	88	565
	Overspeed	0.00208	0.10221	0.00164	8275	23412
	Broken Rail	0.00316	0.15517	0.00249	12563	35543
	Work Zone Violation	0.00000	0.03748	0.00380	0	15156
	Grade Crossing Collisions	0.18544	0.51800	0.00770	50207	125113
	Total, All Scenarios	0.20713	1.74375	0.05080	111186	437969
Freight	Train-Train Collisions	0.00201	0.00203	0.00020	589	1402
	Intrusion Collisions	0.00104	0.00032	0.00003	41	171
	Diamond Collisions	0.00065	0.00034	0.00003	116	251
	Overspeed	0.00072	0.00021	0.00002	377	461
	Broken Rail	0.00251	0.00073	0.00007	1310	1603
	Work Zone Violation	0.00000	0.00350	0.00035	0	1402
	Grade Crossing Collisions	0.01574	0.00494	0.00025	983	2235
	Total, All Scenarios	0.02267	0.01208	0.00097	3415	7525
Total Passenger + Freight		**0.22980**	**1.75583**	**0.05177**	**114601**	**445494**

Table R2c: Summer, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01681	1.15306	0.04387	49525	296455
	Intrusion Collisions	0.00670	0.16222	0.00575	6917	40398
	Diamond Collisions	0.00049	0.00522	0.00016	183	1170
	Overspeed	0.00320	0.15179	0.00244	11888	34372
	Broken Rail	0.00486	0.23045	0.00370	18048	52184
	Work Zone Violation	0.00000	0.05643	0.00564	0	22570
	Grade Crossing Collisions	0.16832	0.49018	0.00728	47540	118387
	Total, All Scenarios	0.20037	2.24934	0.06883	134101	565536
Freight	Train-Train Collisions	0.00187	0.00195	0.00019	572	1350
	Intrusion Collisions	0.00193	0.00064	0.00006	81	337
	Diamond Collisions	0.00136	0.00071	0.00007	242	525
	Overspeed	0.00134	0.00044	0.00004	746	923
	Broken Rail	0.00467	0.00154	0.00015	2594	3209
	Work Zone Violation	0.00000	0.00673	0.00067	0	2691
	Grade Crossing Collisions	0.01781	0.00677	0.00035	1350	3065
	Total, All Scenarios	0.02899	0.01877	0.00155	5585	12102
Total Passenger + Freight		**0.22936**	**2.26811**	**0.07038**	**139686**	**577637**

Table R2d: Summer, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.02867	1.96842	0.07496	84763	506480
	Intrusion Collisions	0.01105	0.27524	0.00977	11732	68553
	Diamond Collisions	0.00072	0.00773	0.00023	271	1735
	Overspeed	0.00529	0.25400	0.00407	20163	57784
	Broken Rail	0.00802	0.38561	0.00618	30611	87727
	Work Zone Violation	0.00000	0.09391	0.00945	0	37726
	Grade Crossing Collisions	0.35375	1.00818	0.01498	97746	243500
	Total, All Scenarios	0.40750	3.99309	0.11964	245287	1003504
Freight	Train-Train Collisions	0.00388	0.00398	0.00040	1161	2752
	Intrusion Collisions	0.00297	0.00096	0.00010	121	507
	Diamond Collisions	0.00202	0.00105	0.00010	357	776
	Overspeed	0.00207	0.00065	0.00007	1123	1385
	Broken Rail	0.00718	0.00227	0.00023	3904	4812
	Work Zone Violation	0.00000	0.01023	0.00102	0	4093
	Grade Crossing Collisions	0.03355	0.01170	0.00060	2333	5300
	Total, All Scenarios	0.05166	0.03085	0.00251	9000	19627
Total Passenger + Freight		**0.45916**	**4.02394**	**0.12215**	**254287**	**1023131**

Table R3a: All Year, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00533	0.25201	0.00956	10983	64849
	Intrusion Collisions	0.01232	0.33817	0.01201	14488	84337
	Diamond Collisions	0.00092	0.00989	0.00029	346	2218
	Overspeed	0.00589	0.30214	0.00486	24896	69680
	Broken Rail	0.00895	0.45870	0.00737	37796	105787
	Work Zone Violation	0.00000	0.11143	0.01114	0	44572
	Grade Crossing Collisions	0.59710	1.92530	0.02857	186625	464876
	Total, All Scenarios	0.63051	3.39763	0.07381	275134	836319
Freight	Train-Train Collisions	0.00536	0.00579	0.00058	1681	3996
	Intrusion Collisions	0.00294	0.00096	0.00010	121	505
	Diamond Collisions	0.00258	0.00135	0.00014	459	999
	Overspeed	0.00204	0.00064	0.00006	1117	1372
	Broken Rail	0.00710	0.00221	0.00022	3883	4768
	Work Zone Violation	0.00000	0.01020	0.00102	0	4078
	Grade Crossing Collisions	0.04820	0.01713	0.00088	3426	7781
	Total, All Scenarios	0.06822	0.03827	0.00300	10686	23500
Total Passenger + Freight		**0.69874**	**3.43590**	**0.07680**	**285821**	**859819**

Table R3b: All Year, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.04725	3.23341	0.12332	139809	833101
	Intrusion Collisions	0.01747	0.45332	0.01609	19314	112929
	Diamond Collisions	0.00102	0.01096	0.00033	384	2459
	Overspeed	0.00836	0.40995	0.00657	33191	93905
	Broken Rail	0.01269	0.62237	0.00998	50390	142564
	Work Zone Violation	0.00000	0.15197	0.01525	0	60953
	Grade Crossing Collisions	0.74378	2.07769	0.03089	201378	501828
	Total, All Scenarios	0.83055	6.95968	0.20243	444467	1747739
Freight	Train-Train Collisions	0.01319	0.01379	0.00138	3923	9440
	Intrusion Collisions	0.00602	0.00188	0.00019	236	989
	Diamond Collisions	0.00284	0.00148	0.00015	504	1094
	Overspeed	0.00419	0.00122	0.00012	2187	2676
	Broken Rail	0.01456	0.00425	0.00043	7599	9300
	Work Zone Violation	0.00000	0.02033	0.00203	0	8130
	Grade Crossing Collisions	0.09129	0.02865	0.00147	5700	12965
	Total, All Scenarios	0.13208	0.07160	0.00576	20147	44595
Total Passenger + Freight		**0.96264**	**7.03128**	**0.20820**	**464615**	**1792334**

Table R3c: All Year, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.06811	4.63137	0.17638	199119	1191404
	Intrusion Collisions	0.02686	0.65068	0.02307	27744	162034
	Diamond Collisions	0.00222	0.02383	0.00071	835	5345
	Overspeed	0.01285	0.60883	0.00977	47683	137868
	Broken Rail	0.01950	0.92431	0.01483	72391	209308
	Work Zone Violation	0.00000	0.22632	0.02263	0	90529
	Grade Crossing Collisions	0.67512	1.96610	0.02919	190682	474847
	Total, All Scenarios	0.80466	9.03144	0.27658	538455	2271335
Freight	Train-Train Collisions	0.01709	0.01864	0.00186	5340	12796
	Intrusion Collisions	0.01255	0.00416	0.00042	523	2190
	Diamond Collisions	0.00623	0.00324	0.00032	1104	2399
	Overspeed	0.00873	0.00288	0.00029	4851	6002
	Broken Rail	0.03034	0.01000	0.00100	16859	20858
	Work Zone Violation	0.00000	0.04373	0.00437	0	17494
	Grade Crossing Collisions	0.11578	0.04397	0.00225	8777	19924
	Total, All Scenarios	0.19071	0.12662	0.01052	37455	81663
Total Passenger + Freight		**0.99537**	**9.15806**	**0.28709**	**575910**	**2352998**

Table R3d: All Year, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.12068	8.11678	0.30925	349912	2089355
	Intrusion Collisions	0.05665	1.44217	0.05118	61546	359300
	Diamond Collisions	0.00416	0.04468	0.00133	1565	10022
	Overspeed	0.02709	1.32091	0.02120	105770	301452
	Broken Rail	0.04113	2.00539	0.03218	160578	457659
	Work Zone Violation	0.00000	0.48973	0.04903	0	196054
	Grade Crossing Collisions	2.01600	5.96909	0.08865	578685	1441552
	Total, All Scenarios	2.26572	19.38875	0.55282	1258056	4855394
Freight	Train-Train Collisions	0.03563	0.03822	0.00382	10944	26232
	Intrusion Collisions	0.02151	0.00700	0.00070	880	3684
	Diamond Collisions	0.01165	0.00606	0.00061	2067	4492
	Overspeed	0.01496	0.00474	0.00047	8155	10051
	Broken Rail	0.05199	0.01647	0.00165	28340	34926
	Work Zone Violation	0.00000	0.07426	0.00743	0	29702
	Grade Crossing Collisions	0.25526	0.08975	0.00460	17903	40670
	Total, All Scenarios	0.39102	0.23650	0.01927	68289	149758
Total Passenger + Freight		**2.65674**	**19.62524**	**0.57209**	**1326345**	**5005152**

IDOT Risk Model: Basic PTC Case
Timeout 120 seconds,
Latency 10 seconds

Results Summary: Basic PTC Case, Timeout 120 seconds, Latency 10 seconds

PTC Normal Operating State

Table R1a: Full Year, PTC Normal, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00360	0.25533	0.00976	11112	65925
	Intrusion Collisions	0.01054	0.30131	0.01070	12912	75155
	Diamond Collisions	0.00025	0.00267	0.00008	93	598
	Overspeed	0.00118	0.06034	0.00097	4972	13916
	Broken Rail	0.00858	0.43970	0.00707	36231	101406
	Work Zone Violation	0.00000	0.05563	0.00556	0	22253
	Grade Crossing Collisions	0.57238	1.84557	0.02739	178897	445626
	Total, All Scenarios	0.59651	2.96055	0.06154	244217	724878
Freight	Train-Train Collisions	0.00097	0.00126	0.00013	335	837
	Intrusion Collisions	0.00248	0.00081	0.00008	102	427
	Diamond Collisions	0.00146	0.00063	0.00006	243	495
	Overspeed	0.00082	0.00026	0.00003	448	550
	Broken Rail	0.00688	0.00214	0.00021	3761	4619
	Work Zone Violation	0.00000	0.00637	0.00064	0	2549
	Grade Crossing Collisions	0.04669	0.01659	0.00085	3319	7537
	Total, All Scenarios	0.05930	0.02806	0.00200	8207	17013
Total Passenger + Freight		**0.65581**	**2.98861**	**0.06354**	**252424**	**741891**

Table R1b: Rest of Year, PTC Normal, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00471	0.29676	0.01126	12772	76227
	Intrusion Collisions	0.01122	0.30321	0.01077	12922	75544
	Diamond Collisions	0.00023	0.00243	0.00007	85	544
	Overspeed	0.00125	0.06146	0.00099	4976	14078
	Broken Rail	0.00913	0.44786	0.00718	36261	102589
	Work Zone Violation	0.00000	0.05716	0.00572	0	22865
	Grade Crossing Collisions	0.53522	1.49510	0.02223	144911	361115
	Total, All Scenarios	0.56176	2.66399	0.05821	211927	652962
Freight	Train-Train Collisions	0.00342	0.00400	0.00040	1074	2673
	Intrusion Collisions	0.00449	0.00140	0.00014	176	738
	Diamond Collisions	0.00125	0.00054	0.00005	208	422
	Overspeed	0.00216	0.00063	0.00006	1129	1381
	Broken Rail	0.01180	0.00345	0.00034	6162	7541
	Work Zone Violation	0.00000	0.01286	0.00129	0	5142
	Grade Crossing Collisions	0.07402	0.02323	0.00119	4622	10513
	Total, All Scenarios	0.09716	0.04610	0.00348	13370	28411
Total Passenger + Freight		**0.65892**	**2.71009**	**0.06169**	**225297**	**681373**

Table R1c: Rest of Year, PTC Normal, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00708	0.43706	0.01653	18685	111996
	Intrusion Collisions	0.01724	0.43523	0.01544	18561	108393
	Diamond Collisions	0.00049	0.00532	0.00016	186	1194
	Overspeed	0.00193	0.09127	0.00146	7148	20669
	Broken Rail	0.01403	0.66513	0.01067	52093	150618
	Work Zone Violation	0.00000	0.08482	0.00848	0	33929
	Grade Crossing Collisions	0.48582	1.41481	0.02100	137215	341700
	Total, All Scenarios	0.52660	3.13365	0.07375	233888	768499
		0.00000	0.00000	0.00000	0	0
Freight	Train-Train Collisions	0.00642	0.00806	0.00081	2155	5381
	Intrusion Collisions	0.01001	0.00332	0.00033	417	1746
	Diamond Collisions	0.00280	0.00120	0.00012	464	944
	Overspeed	0.00577	0.00190	0.00019	3207	3967
	Broken Rail	0.02535	0.00836	0.00084	14089	17431
	Work Zone Violation	0.00000	0.03192	0.00319	0	12769
	Grade Crossing Collisions	0.09676	0.03675	0.00188	7335	16651
	Total, All Scenarios	0.14711	0.09151	0.00736	27668	58889
Total Passenger + Freight		0.67371	3.22516	0.08111	261556	827388

Table R1d: Rest of Year, PTC Normal, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01539	0.98915	0.03755	42569	254147
	Intrusion Collisions	0.03900	1.03975	0.03691	44395	259092
	Diamond Collisions	0.00097	0.01042	0.00031	365	2336
	Overspeed	0.00436	0.21307	0.00342	17096	48662
	Broken Rail	0.03174	1.55270	0.02492	124585	354613
	Work Zone Violation	0.00000	0.19762	0.01976	0	79048
	Grade Crossing Collisions	1.59342	4.75548	0.07062	461023	1148441
	Total, All Scenarios	1.68487	8.75819	0.19350	690033	2146339
Freight	Train-Train Collisions	0.01081	0.01332	0.00133	3564	8890
	Intrusion Collisions	0.01698	0.00553	0.00055	695	2911
	Diamond Collisions	0.00552	0.00236	0.00024	915	1861
	Overspeed	0.00875	0.00279	0.00028	4783	5899
	Broken Rail	0.04403	0.01395	0.00139	24012	29591
	Work Zone Violation	0.00000	0.05115	0.00512	0	20460
	Grade Crossing Collisions	0.21747	0.07657	0.00392	15276	34701
	Total, All Scenarios	0.30356	0.16567	0.01283	49244	104313
Total Passenger + Freight		**1.98843**	**8.92386**	**0.20633**	**739277**	**2250652**

Table R2a: Summer, PTC Normal, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Freight	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Total Passenger + Freight						

There are no seasonal traffic variations on the Joliet Sub-corridor. Therefore only one risk calculation is needed for the full year, and there is no separate summer calculation

Table R2b: Summer, PTC Normal, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00134	0.08863	0.00337	3822	22799
	Intrusion Collisions	0.00373	0.10070	0.00358	4292	25089
	Diamond Collisions	0.00007	0.00072	0.00002	25	162
	Overspeed	0.00042	0.02041	0.00033	1653	4675
	Broken Rail	0.00303	0.14874	0.00238	12043	34072
	Work Zone Violation	0.00000	0.01898	0.00190	0	7594
	Grade Crossing Collisions	0.17776	0.49655	0.00738	48127	119932
	Total, All Scenarios	0.18633	0.87474	0.01896	69962	214324
Freight	Train-Train Collisions	0.00035	0.00042	0.00004	113	283
	Intrusion Collisions	0.00088	0.00027	0.00003	34	144
	Diamond Collisions	0.00037	0.00016	0.00002	62	126
	Overspeed	0.00029	0.00008	0.00001	151	185
	Broken Rail	0.00243	0.00071	0.00007	1269	1553
	Work Zone Violation	0.00000	0.00219	0.00020	0	824
	Grade Crossing Collisions	0.01524	0.00478	0.00024	952	2165
	Total, All Scenarios	0.01957	0.00863	0.00061	2581	5280
Total Passenger + Freight		0.20590	0.88337	0.01957	72544	219604

Table R2c: Summer, PTC Normal, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00183	0.12212	0.00464	5237	31364
	Intrusion Collisions	0.00573	0.14455	0.00513	6165	35999
	Diamond Collisions	0.00014	0.00149	0.00004	52	335
	Overspeed	0.00064	0.03031	0.00049	2374	6864
	Broken Rail	0.00466	0.22090	0.00354	17301	50023
	Work Zone Violation	0.00000	0.02817	0.00282	0	11269
	Grade Crossing Collisions	0.16135	0.46988	0.00697	45571	113484
	Total, All Scenarios	0.17435	1.01743	0.02363	76700	249338
Freight	Train-Train Collisions	0.00034	0.00043	0.00004	115	286
	Intrusion Collisions	0.00173	0.00057	0.00006	72	302
	Diamond Collisions	0.00079	0.00034	0.00003	130	265
	Overspeed	0.00081	0.00027	0.00003	449	555
	Broken Rail	0.00457	0.00151	0.00015	2538	3141
	Work Zone Violation	0.00000	0.00505	0.00050	0	2019
	Grade Crossing Collisions	0.01743	0.00662	0.00034	1322	3000
	Total, All Scenarios	0.02566	0.01478	0.00115	4626	9568
Total Passenger + Freight		0.20001	1.03221	0.02479	81326	258905

Table R2d: Summer, PTC Normal, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00317	0.21075	0.00801	9060	54163
	Intrusion Collisions	0.00945	0.24525	0.00870	10456	61089
	Diamond Collisions	0.00021	0.00221	0.00007	78	497
	Overspeed	0.00106	0.05072	0.00081	4027	11540
	Broken Rail	0.00769	0.36964	0.00593	29344	84094
	Work Zone Violation	0.00000	0.04716	0.00472	0	18862
	Grade Crossing Collisions	0.33910	0.96643	0.01436	93699	233417
	Total, All Scenarios	0.36068	1.89217	0.04259	146662	463661
Freight	Train-Train Collisions	0.00069	0.00085	0.00009	228	569
	Intrusion Collisions	0.00261	0.00085	0.00008	106	446
	Diamond Collisions	0.00116	0.00050	0.00005	192	390
	Overspeed	0.00110	0.00035	0.00004	600	740
	Broken Rail	0.00700	0.00222	0.00022	3807	4694
	Work Zone Violation	0.00000	0.00724	0.00071	0	2844
	Grade Crossing Collisions	0.03268	0.01141	0.00058	2273	5165
	Total, All Scenarios	0.04523	0.02341	0.00177	7207	14848
Total Passenger + Freight		**0.40591**	**1.91558**	**0.04436**	**153869**	**478509**

Table R3a: All Year, PTC Normal, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00360	0.25533	0.00976	11112	65925
	Intrusion Collisions	0.01054	0.30131	0.01070	12912	75155
	Diamond Collisions	0.00025	0.00267	0.00008	93	598
	Overspeed	0.00118	0.06034	0.00097	4972	13916
	Broken Rail	0.00858	0.43970	0.00707	36231	101406
	Work Zone Violation	0.00000	0.05563	0.00556	0	22253
	Grade Crossing Collisions	0.57238	1.84557	0.02739	178897	445626
	Total, All Scenarios	0.59651	2.96055	0.06154	244217	724878
Freight	Train-Train Collisions	0.00097	0.00126	0.00013	335	837
	Intrusion Collisions	0.00248	0.00081	0.00008	102	427
	Diamond Collisions	0.00146	0.00063	0.00006	243	495
	Overspeed	0.00082	0.00026	0.00003	448	550
	Broken Rail	0.00688	0.00214	0.00021	3761	4619
	Work Zone Violation	0.00000	0.00637	0.00064	0	2549
	Grade Crossing Collisions	0.04669	0.01659	0.00085	3319	7537
	Total, All Scenarios	0.05930	0.02806	0.00200	8207	17013
Total Passenger + Freight		0.65581	2.98861	0.06354	252424	741891

Table R3b: All Year, PTC Normal, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00605	0.38539	0.01463	16595	99026
	Intrusion Collisions	0.01494	0.40391	0.01434	17213	100633
	Diamond Collisions	0.00029	0.00315	0.00009	110	707
	Overspeed	0.00167	0.08187	0.00131	6629	18753
	Broken Rail	0.01216	0.59660	0.00957	48304	136661
	Work Zone Violation	0.00000	0.07615	0.00761	0	30459
	Grade Crossing Collisions	0.71298	1.99165	0.02961	193039	481047
	Total, All Scenarios	0.74809	3.53873	0.07717	281889	867286
Freight	Train-Train Collisions	0.00378	0.00442	0.00044	1187	2956
	Intrusion Collisions	0.00537	0.00168	0.00017	210	882
	Diamond Collisions	0.00163	0.00070	0.00007	270	548
	Overspeed	0.00245	0.00072	0.00007	1280	1566
	Broken Rail	0.01423	0.00416	0.00042	7430	9094
	Work Zone Violation	0.00000	0.01505	0.00149	0	5967
	Grade Crossing Collisions	0.08927	0.02802	0.00143	5574	12678
	Total, All Scenarios	0.11673	0.05473	0.00409	15951	33691
Total Passenger + Freight		0.86483	3.59345	0.08126	297841	900977

Table R3c: All Year, PTC Normal, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00891	0.55919	0.02117	23922	143360
	Intrusion Collisions	0.02297	0.57978	0.02056	24726	144393
	Diamond Collisions	0.00063	0.00681	0.00020	239	1528
	Overspeed	0.00257	0.12159	0.00195	9523	27533
	Broken Rail	0.01869	0.88604	0.01421	69394	200641
	Work Zone Violation	0.00000	0.11299	0.01130	0	45198
	Grade Crossing Collisions	0.64717	1.88469	0.02798	182786	455184
	Total, All Scenarios	0.70094	4.15108	0.09738	310588	1017836
Freight	Train-Train Collisions	0.00675	0.00849	0.00085	2270	5667
	Intrusion Collisions	0.01174	0.00389	0.00039	490	2048
	Diamond Collisions	0.00359	0.00153	0.00015	595	1208
	Overspeed	0.00658	0.00217	0.00022	3656	4523
	Broken Rail	0.02992	0.00986	0.00099	16628	20572
	Work Zone Violation	0.00000	0.03697	0.00370	0	14789
	Grade Crossing Collisions	0.11419	0.04337	0.00222	8657	19651
	Total, All Scenarios	0.17277	0.10629	0.00851	32294	68457
Total Passenger + Freight		0.87371	4.25737	0.10589	342882	1086293

Table R3d: All Year, PTC Normal, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01856	1.19991	0.04556	51628	308310
	Intrusion Collisions	0.04845	1.28500	0.04561	54851	320180
	Diamond Collisions	0.00117	0.01263	0.00038	442	2833
	Overspeed	0.00541	0.26379	0.00423	21123	60202
	Broken Rail	0.03943	1.92234	0.03085	153929	438707
	Work Zone Violation	0.00000	0.24478	0.02448	0	97910
	Grade Crossing Collisions	1.93252	5.72191	0.08498	554721	1381857
	Total, All Scenarios	2.04555	10.65036	0.23609	836695	2610000
Freight	Train-Train Collisions	0.01151	0.01417	0.00142	3792	9459
	Intrusion Collisions	0.01959	0.00638	0.00064	802	3357
	Diamond Collisions	0.00668	0.00286	0.00029	1107	2251
	Overspeed	0.00985	0.00314	0.00031	5383	6639
	Broken Rail	0.05103	0.01616	0.00162	27819	34285
	Work Zone Violation	0.00000	0.05839	0.00582	0	23304
	Grade Crossing Collisions	0.25014	0.08798	0.00451	17549	39866
	Total, All Scenarios	0.34880	0.18908	0.01460	56451	119161
Total Passenger + Freight		**2.39435**	**10.83944**	**0.25069**	**893146**	**2729161**

IDOT Risk Model: Basic PTC Case
Timeout 120 seconds,
Latency 10 seconds

PTC Timeout Operating State

Table R4a: Full Year, PTC Timeout, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00038	0.00001	16	98
	Intrusion Collisions	0.00002	0.00050	0.00002	21	124
	Diamond Collisions	0.00000	0.00001	0.00000	0	2
	Overspeed	0.00000	0.00022	0.00000	18	51
	Broken Rail	0.00001	0.00067	0.00001	56	155
	Work Zone Violation	0.00000	0.00012	0.00001	0	49
	Grade Crossing Collisions	0.00088	0.00283	0.00004	274	683
	Total, All Scenarios	0.00092	0.00473	0.00010	386	1162
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	1	1
	Intrusion Collisions	0.00000	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00000	0.00000	1	1
	Broken Rail	0.00001	0.00000	0.00000	6	7
	Work Zone Violation	0.00000	0.00001	0.00000	0	5
	Grade Crossing Collisions	0.00007	0.00003	0.00000	5	11
	Total, All Scenarios	0.00009	0.00005	0.00000	13	28
Total Passenger + Freight		**0.00101**	**0.00478**	**0.00010**	**399**	**1190**

Table R4b: Rest of Year, PTC Timeout, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00045	0.00002	19	116
	Intrusion Collisions	0.00002	0.00050	0.00002	21	125
	Diamond Collisions	0.00000	0.00001	0.00000	0	2
	Overspeed	0.00000	0.00023	0.00000	18	52
	Broken Rail	0.00001	0.00069	0.00001	56	157
	Work Zone Violation	0.00000	0.00013	0.00001	0	50
	Grade Crossing Collisions	0.00082	0.00229	0.00003	222	553
	Total, All Scenarios	0.00087	0.00429	0.00010	337	1055
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	2	5
	Intrusion Collisions	0.00001	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00000	0.00000	2	2
	Broken Rail	0.00002	0.00001	0.00000	9	11
	Work Zone Violation	0.00000	0.00002	0.00000	0	9
	Grade Crossing Collisions	0.00011	0.00003	0.00000	7	16
	Total, All Scenarios	0.00015	0.00007	0.00001	21	45
Total Passenger + Freight		**0**	**0**	**0**	**358**	**1100**

Table R4c: Rest of Year, PTC Timeout, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00054	0.00002	23	139
	Intrusion Collisions	0.00003	0.00072	0.00003	31	179
	Diamond Collisions	0.00000	0.00001	0.00000	0	3
	Overspeed	0.00001	0.00034	0.00001	26	76
	Broken Rail	0.00002	0.00102	0.00002	80	231
	Work Zone Violation	0.00000	0.00019	0.00002	0	75
	Grade Crossing Collisions	0.00074	0.00217	0.00003	210	524
	Total, All Scenarios	0	0	0	370	1226
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	4	9
	Intrusion Collisions	0.00002	0.00001	0.00000	1	3
	Diamond Collisions	0.00001	0.00000	0.00000	1	2
	Overspeed	0.00001	0.00000	0.00000	5	6
	Broken Rail	0.00004	0.00001	0.00000	21	26
	Work Zone Violation	0.00000	0.00005	0.00001	0	20
	Grade Crossing Collisions	0.00014	0.00005	0.00000	11	25
	Total, All Scenarios	0	0	0	42	91
Total Passenger + Freight		**0**	**0**	**0**	**413**	**1316**

Table R4d: Rest of Year, PTC Timeout, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00002	0.00137	0.00005	59	352
	Intrusion Collisions	0.00007	0.00171	0.00006	73	427
	Diamond Collisions	0.00000	0.00003	0.00000	1	7
	Overspeed	0.00002	0.00078	0.00001	63	179
	Broken Rail	0.00005	0.00238	0.00004	191	543
	Work Zone Violation	0.00000	0.00044	0.00004	0	174
	Grade Crossing Collisions	0.00244	0.00729	0.00011	706	1760
	Total, All Scenarios	0.00260	0.01400	0.00032	1093	3442
Freight	Train-Train Collisions	0.00002	0.00002	0.00000	6	15
	Intrusion Collisions	0.00003	0.00001	0.00000	1	5
	Diamond Collisions	0.00001	0.00000	0.00000	2	3
	Overspeed	0.00002	0.00000	0.00000	8	10
	Broken Rail	0.00007	0.00002	0.00000	36	44
	Work Zone Violation	0.00000	0.00008	0.00001	0	34
	Grade Crossing Collisions	0.00033	0.00011	0.00001	23	52
	Total, All Scenarios	0.00046	0.00026	0.00002	76	163
Total Passenger + Freight		**0.00306**	**0.01426**	**0.00034**	**1169**	**3606**

Table R5a: Summer, PTC Timeout, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Freight	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Total Passenger + Freight						

There are no seasonal traffic variations on the Joliet Sub-corridor. Therefore only one risk calculation is needed for the full year, and there is no separate summer calculation

Table R5b: Summer, PTC Timeout, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00013	0.00001	5.7	34.0
	Intrusion Collisions	0.00001	0.00017	0.00001	7.1	41.4
	Diamond Collisions	0.00000	0.00000	0.00000	0.1	0.4
	Overspeed	0.00000	0.00008	0.00000	6.1	17.2
	Broken Rail	0.00000	0.00023	0.00000	18.5	52.2
	Work Zone Violation	0.00000	0.00004	0.00000	0.0	16.8
	Grade Crossing Collisions	0.00027	0.00076	0.00001	73.7	183.8
	Total, All Scenarios	0.00029	0.00141	0.00003	111.1	345.8
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0.2	0.5
	Intrusion Collisions	0.00000	0.00000	0.00000	0.1	0.3
	Diamond Collisions	0.00000	0.00000	0.00000	0.1	0.2
	Overspeed	0.00000	0.00000	0.00000	0.3	0.4
	Broken Rail	0.00000	0.00000	0.00000	1.9	2.4
	Work Zone Violation	0.00000	0.00000	0.00000	0.0	1.0
	Grade Crossing Collisions	0.00004	0.00001	0.00000	2.3	5.2
	Total, All Scenarios	0.00004	0.00002	0.00000	4.9	10.0
Total Passenger + Freight		0.00033	0.00142	0.00003	116.1	355.7

Table R5c: Summer, PTC Timeout, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00018	0.00001	7.8	46.5
	Intrusion Collisions	0.00001	0.00024	0.00001	10.2	59.3
	Diamond Collisions	0.00000	0.00000	0.00000	0.1	0.9
	Overspeed	0.00000	0.00011	0.00000	8.7	25.2
	Broken Rail	0.00001	0.00034	0.00001	26.5	76.6
	Work Zone Violation	0.00000	0.00006	0.00000	0.0	18.9
	Grade Crossing Collisions	0.00025	0.00072	0.00001	69.8	173.9
	Total, All Scenarios	0.00027	0.00166	0.00004	123.1	401.4
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0.2	0.5
	Intrusion Collisions	0.00000	0.00000	0.00000	0.1	0.5
	Diamond Collisions	0.00000	0.00000	0.00000	0.2	0.5
	Overspeed	0.00000	0.00000	0.00000	0.8	1.0
	Broken Rail	0.00001	0.00000	0.00000	3.8	4.7
	Work Zone Violation	0.00000	0.00001	0.00000	0.0	3.5
	Grade Crossing Collisions	0.00003	0.00001	0.00000	2.0	4.5
	Total, All Scenarios	0.00004	0.00002	0.00000	7.1	15.1
Total Passenger + Freight		**0.00031**	**0.00168**	**0.00004**	**130.3**	**416.6**

Table R2d: Summer, PTC Timeout, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00000	0.00031	0.00001	13	81
	Intrusion Collisions	0.00002	0.00040	0.00001	17	101
	Diamond Collisions	0.00000	0.00001	0.00000	0	1
	Overspeed	0.00000	0.00019	0.00000	15	42
	Broken Rail	0.00001	0.00057	0.00001	45	129
	Work Zone Violation	0.00000	0.00010	0.00001	0	36
	Grade Crossing Collisions	0.00052	0.00148	0.00002	144	358
	Total, All Scenarios	0.00056	0.00306	0.00007	234	747
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	0	1
	Intrusion Collisions	0.00000	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00000	0.00000	1	1
	Broken Rail	0.00001	0.00000	0.00000	6	7
	Work Zone Violation	0.00000	0.00001	0.00000	0	4
	Grade Crossing Collisions	0.00006	0.00002	0.00000	4	10
	Total, All Scenarios	0.00008	0.00004	0.00000	12	25
Total Passenger + Freight		**0.00064**	**0.00310**	**0.00007**	**246**	**772**

Table R6a: All Year, PTC Timeout, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00038	0.00001	16	98
	Intrusion Collisions	0.00002	0.00050	0.00002	21	124
	Diamond Collisions	0.00000	0.00001	0.00000	0	2
	Overspeed	0.00000	0.00022	0.00000	18	51
	Broken Rail	0.00001	0.00067	0.00001	56	155
	Work Zone Violation	0.00000	0.00012	0.00001	0	49
	Grade Crossing Collisions	0.00088	0.00283	0.00004	274	683
	Total, All Scenarios	0.00092	0.00473	0.00010	386	1162
Freight	Train-Train Collisions	0.00000	0.00000	0.00000	1	1
	Intrusion Collisions	0.00000	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	0	1
	Overspeed	0.00000	0.00000	0.00000	1	1
	Broken Rail	0.00001	0.00000	0.00000	6	7
	Work Zone Violation	0.00000	0.00001	0.00000	0	5
	Grade Crossing Collisions	0.00007	0.00003	0.00000	5	11
	Total, All Scenarios	0.00009	0.00005	0.00000	13	28
bbb **Total Passenger + Freight**		0.00101	0.00478	0.00010	399	1190

Table R6b: All Year, PTC Timeout, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00058	0.00002	25	150
	Intrusion Collisions	0.00003	0.00067	0.00002	28	166
	Diamond Collisions	0.00000	0.00001	0.00000	0	2
	Overspeed	0.00001	0.00030	0.00000	24	69
	Broken Rail	0.00002	0.00091	0.00001	74	209
	Work Zone Violation	0.00000	0.00017	0.00002	0	67
	Grade Crossing Collisions	0.00109	0.00305	0.00005	296	737
	Total, All Scenarios	0.00115	0.00569	0.00013	448	1400
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	2	5
	Intrusion Collisions	0.00001	0.00000	0.00000	0	1
	Diamond Collisions	0.00000	0.00000	0.00000	1	1
	Overspeed	0.00000	0.00000	0.00000	2	3
	Broken Rail	0.00002	0.00001	0.00000	11	14
	Work Zone Violation	0.00000	0.00003	0.00000	0	10
	Grade Crossing Collisions	0.00015	0.00005	0.00000	9	21
	Total, All Scenarios	0.00019	0.00009	0.00001	26	55
Total Passenger + Freight		0.00135	0.00579	0.00013	474	1456

Table R6c: All Year, PTC Timeout, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00001	0.00072	0.00003	31	185
	Intrusion Collisions	0.00004	0.00096	0.00003	41	238
	Diamond Collisions	0.00000	0.00002	0.00000	1	4
	Overspeed	0.00001	0.00045	0.00001	35	101
	Broken Rail	0.00003	0.00136	0.00002	106	307
	Work Zone Violation	0.00000	0.00025	0.00002	0	94
	Grade Crossing Collisions	0.00099	0.00289	0.00004	280	697
	Total, All Scenarios	0.00108	0.00664	0.00016	494	1627
Freight	Train-Train Collisions	0.00001	0.00001	0.00000	4	9
	Intrusion Collisions	0.00002	0.00001	0.00000	1	3
	Diamond Collisions	0.00001	0.00000	0.00000	1	2
	Overspeed	0.00001	0.00000	0.00000	6	7
	Broken Rail	0.00004	0.00001	0.00000	25	31
	Work Zone Violation	0.00000	0.00006	0.00001	0	24
	Grade Crossing Collisions	0.00017	0.00006	0.00000	13	29
	Total, All Scenarios	0.00026	0.00016	0.00001	49	106
Total Passenger + Freight		0.00134	0.00680	0.00017	543	1733

Table R6d: All Year, PTC timeout, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00003	0.00169	0.00006	72	433
	Intrusion Collisions	0.00008	0.00212	0.00008	90	528
	Diamond Collisions	0.00000	0.00004	0.00000	1	8
	Overspeed	0.00002	0.00097	0.00002	78	221
	Broken Rail	0.00006	0.00295	0.00005	236	672
	Work Zone Violation	0.00000	0.00054	0.00005	0	210
	Grade Crossing Collisions	0.00296	0.00877	0.00013	850	2117
	Total, All Scenarios	0.00315	0.01706	0.00039	1328	4189
Freight	Train-Train Collisions	0.00002	0.00002	0.00000	6	16
	Intrusion Collisions	0.00003	0.00001	0.00000	1	5
	Diamond Collisions	0.00001	0.00001	0.00000	2	4
	Overspeed	0.00002	0.00001	0.00000	9	12
	Broken Rail	0.00008	0.00002	0.00000	42	51
	Work Zone Violation	0.00000	0.00010	0.00001	0	38
	Grade Crossing Collisions	0.00039	0.00014	0.00001	27	62
	Total, All Scenarios	0.00055	0.00030	0.00002	88	188
Total Passenger + Freight		**0.00370**	**0.01737**	**0.00041**	**1416**	**4378**

IDOT Risk Model: Basic PTC Case
Timeout 120 seconds,
Latency 10 seconds

PTC Totals, All Operating States, All Year

Table R7a: totals: All Year, All Operating States, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00360	0.25571	0.00977	11129	66022
	Intrusion Collisions	0.01056	0.30181	0.01072	12933	75279
	Diamond Collisions	0.00025	0.00268	0.00008	94	600
	Overspeed	0.00118	0.06056	0.00097	4990	13967
	Broken Rail	0.00859	0.44038	0.00708	36287	101562
	Work Zone Violation	0.00000	0.05576	0.00558	0	22302
	Grade Crossing Collisions	0.57325	1.84840	0.02743	179171	446309
	Total, All Scenarios	0.59743	2.96528	0.06164	244603	726040
Freight	Train-Train Collisions	0.00097	0.00126	0.00013	335	838
	Intrusion Collisions	0.00248	0.00081	0.00008	102	427
	Diamond Collisions	0.00146	0.00063	0.00006	243	496
	Overspeed	0.00082	0.00026	0.00003	449	551
	Broken Rail	0.00689	0.00215	0.00021	3767	4626
	Work Zone Violation	0.00000	0.00638	0.00064	0	2554
	Grade Crossing Collisions	0.04676	0.01662	0.00085	3324	7549
	Total, All Scenarios	0.05939	0.02811	0.00200	8219	17040
Total Passenger + Freight		0.65682	2.99339	0.06364	252823	743081

Table R7b: Totals: All Year, All Operating States, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00606	0.38598	0.01465	16620	99175
	Intrusion Collisions	0.01497	0.40458	0.01437	17242	100799
	Diamond Collisions	0.00029	0.00316	0.00009	111	709
	Overspeed	0.00167	0.08217	0.00132	6653	18822
	Broken Rail	0.01218	0.59752	0.00958	48378	136870
	Work Zone Violation	0.00000	0.07632	0.00763	0	30526
	Grade Crossing Collisions	0.71407	1.99470	0.02966	193335	481784
	Total, All Scenarios	0.74925	3.54442	0.07730	282337	868686
Freight	Train-Train Collisions	0.00379	0.00443	0.00044	1190	2961
	Intrusion Collisions	0.00538	0.00168	0.00017	211	884
	Diamond Collisions	0.00163	0.00070	0.00007	270	549
	Overspeed	0.00246	0.00072	0.00007	1282	1569
	Broken Rail	0.01426	0.00417	0.00042	7442	9108
	Work Zone Violation	0.00000	0.01507	0.00149	0	5976
	Grade Crossing Collisions	0.08942	0.02806	0.00144	5583	12699
	Total, All Scenarios	0.11692	0.05482	0.00410	15977	33746
Total Passenger + Freight		0.86617	3.59924	0.08140	298314	902432

Table R7c: Totals: All Year, All Operating States, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00893	0.55991	0.02120	23952	143545
	Intrusion Collisions	0.02301	0.58073	0.02060	24767	144631
	Diamond Collisions	0.00064	0.00683	0.00020	239	1532
	Overspeed	0.00257	0.12203	0.00196	9558	27634
	Broken Rail	0.01872	0.88739	0.01424	69500	200948
	Work Zone Violation	0.00000	0.11324	0.01132	0	45292
	Grade Crossing Collisions	0.64816	1.88757	0.02802	183066	455881
	Total, All Scenarios	0.70203	4.15772	0.09754	311082	1019463
Freight	Train-Train Collisions	0.00677	0.00851	0.00085	2274	5676
	Intrusion Collisions	0.01176	0.00390	0.00039	490	2051
	Diamond Collisions	0.00360	0.00154	0.00015	596	1211
	Overspeed	0.00659	0.00217	0.00022	3662	4530
	Broken Rail	0.02997	0.00988	0.00099	16652	20603
	Work Zone Violation	0.00000	0.03703	0.00370	0	14812
	Grade Crossing Collisions	0.11436	0.04343	0.00222	8669	19680
	Total, All Scenarios	0.17303	0.10646	0.00852	32343	68563
Total Passenger + Freight		0.87506	4.26418	0.10606	343425	1088026

Table R7d: Grand Total: All Year, All Operating States, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01859	1.20159	0.04563	51701	308743
	Intrusion Collisions	0.04854	1.28712	0.04569	54941	320708
	Diamond Collisions	0.00118	0.01267	0.00038	444	2841
	Overspeed	0.00543	0.26476	0.00425	21201	60423
	Broken Rail	0.03949	1.92529	0.03090	154164	439380
	Work Zone Violation	0.00000	0.24532	0.02453	0	98120
	Grade Crossing Collisions	1.93548	5.73068	0.08511	555571	1383975
	Total, All Scenarios	2.04870	10.66742	0.23648	838023	2614190
Freight	Train-Train Collisions	0.01153	0.01419	0.00142	3798	9475
	Intrusion Collisions	0.01962	0.00639	0.00064	803	3362
	Diamond Collisions	0.00669	0.00286	0.00029	1109	2255
	Overspeed	0.00987	0.00315	0.00031	5392	6650
	Broken Rail	0.05111	0.01619	0.00162	27860	34336
	Work Zone Violation	0.00000	0.05849	0.00583	0	23342
	Grade Crossing Collisions	0.25053	0.08811	0.00451	17576	39928
	Total, All Scenarios	0.34934	0.18938	0.01462	56539	119349
Total Passenger + Freight		**2.39805**	**10.85680**	**0.25110**	**894562**	**2733539**

Model Inputs: Basic PTC Case, Timeout 120 seconds, Latency 10 seconds

Table IN-1a: Braking Formula Inputs

Train/System Type	Parameter	Value
Freight	Coefficient P	0.035
	Appln Time (secs)	13.8
	Train Weight (lb)	37600000
	Brake Force (lb)	779683
Passenger	Coefficient A	0.666
	Coefficient B	0
	Safety Factor	1.25
Train Control	PTC Timeout (secs)	120
	PTC Latency (secs)	10
	ACS Response (secs)	0

Guilty Train Speed (mph): 15

Table IN-1b: Miscellaneous Inputs

Parameter		Value	Units
Sight Distance		2500	ft
Distribution of train location at time of	In Block	0.95	Probability
violation in Reference Case accidents	Previous Block	0.05	Probability
PTC Risk Increment in Zone C		2	Ratio
Potential danger length in Zone C		2500	ft
Unit Cost Per Casualty	Injury	100000	Dollars
	Fatality	3000000	Dollars

Table IN-1c:Traffic and Related Data

Train Type	One-Way Trips/Day Joliet Sub-Corridor Summer	Joliet Sub-Corridor Rest of Year	Bloomington Sub-Corridor Summer	Bloomington Sub-Corridor Rest of Year	Springfield Sub-Corridor Summer	Springfield Sub-Corridor Rest of Year
Passenger	6.00	6.00	6.00	6.00	6.00	6.00
Equipped Freight	1.07	1.07	1.07	1.07	0.86	0.86
Unequipped Freight	0.36	0.36	0.36	1.21	0.87	2.30
Operating Days	91.0	274.0	91.0	274.0	91.0	274.0

Percent Train-Miles in

Timeout (locks)	120	120	120
Normal Operating Mode	84.86	84.86	84.86
Timeout Mode	0.14	0.14	0.14
Pallback Mode	5.00	5.00	5.00

Passenger Train Occupancy

Seats	320	320	320
Occupancy Factor	0.6	0.6	0.6

Table IN-2a: Segment Definitions: Joliet Sub-Corridor: MP 62.7 (Mazonia) - MP 88.3 (Bunge)

Segment Number	Start (MP)	End (MP)	Type	Variant	Length Miles	Length Feet	Posted Speed (mph) Freight	Pass	HS Pass	Representative Speed (mph) Freight	Pass	HS Pass (Cross*)	HS Pass (Other)	Industry Siting Number	Name	Passenger Stops
1.0	62.60	64.80	CP-Adjacent (M)		2.20	11616	60.0	79.0	110	50	79	79	105	0		
2.0	64.80	66.56	Plain		1.75	9240	60.0	79.0	110	50	79	79	105	0		
3.0	66.56	68.23	Plain		1.68	8870.4	60.0	79.0	110	50	79	79	105	0		
4.0	68.23	70.17	CP-Adjacent (M)		1.94	10243.2	60.0	79.0	110	50	79	79	105	0		
5.0	70.17	72.80	Siding (M)	Dw spht (sspd)	2.63	13886.4	60.0	79.0	110	40	60	79	0	0		
6.0	72.80	72.80	Diamond		0.00	0	40.0	40.0	40	40	40	40	40	0		
7.0	72.80	74.94	CP-Adjacent (M)		2.14	11299.2	60.0	79.0	110	40	60	79	0	0		
8.0	74.94	77.27	Plain		2.33	12300.4	60.0	79.0	110	50	79	105	0	0		
9.0	77.27	80.13	Plain		2.86	15100.8	60.0	79.0	110	50	79	79	105	0		
10.0	80.13	81.99	CP-Adjacent (M)		1.86	9820.8	60.0	79.0	110	50	79	105	0	0		
11.0	81.99	84.65	Siding (M)	Odell (Sspd)	2.66	14044.8	60.0	79.0	110	50	79	79	105	0		
12.0	84.65	86.43	CP-Adjacent (M)		1.78	9398.4	60.0	79.0	110	50	79	79	105	0		
13.0	86.43	88.35	Plain		1.92	10137.6	60.0	79.0	110	50	79	105	0	0		
			Check Total		25.8											

Table IN-2b: Segment Definitions: Bloomington Sub-Corridor: MP 88.3 (Bunge) - MP 124.9 (Bloomington)

Segment Number	Start (MP)	End (MP)	Type	Variant	Length Miles	Length Feet	Posted Speed (mph) Freight	Pass	HS Pass	Representative Speed (mph) Freight	Pass	HS Pass (Cross*)	HS Pass (Other)	Industry Siting Number	Name	Passenger Stops
14.0	88.35	90.55	Plain		2.20	11616	60.0	79.0	110	50	79	79	105	1	Bunge	
15.0	90.55	92.47	CP-Adjacent (M)		1.92	10137.6	60.0	79.0	110	50	79	79	105	1	Dimmitey	
16.0	92.47	94.97	Siding (M)	Pontiac (Sspd)	2.50	13200	60.0	79.0	110	50	79	79	105	0	Pontiac	
17.0	94.97	96.81	CP-Adjacent (M)		1.84	9715.2	60.0	79.0	110	50	79	79	105	0	Occuya	
18.0	96.81	100.28	Plain		3.47	18321.6	60.0	79.0	110	50	79	79	105	0		
19.0	100.28	102.25	CP-Adjacent (M)		1.97	10401.6	60.0	79.0	110	40	60	79	0	0		
20.0	102.25	102.25	Diamond		0.00	0	40.0	40.0	40	40	40	40	40	0		
21.0	102.25	104.60	CP-Adjacent (M)		2.35	12408	60.0	79.0	110	40	60	60	0	0		
22.0	104.60	106.43	CP-Adjacent (M)		1.83	9662.4	60.0	79.0	110	50	79	79	105	0		
23.0	106.43	108.83	Siding (M)	Ballard (Sspd)	2.40	12672	60.0	79.0	110	50	79	79	105	0		
24.0	108.83	111.36	CP-Adjacent (M)		2.53	13358.4	60.0	79.0	110	50	79	79	105	0		
25.0	111.36	113.30	Plain		1.94	10243.2	60.0	79.0	110	50	79	79	105	0		
26.0	113.30	116.36	Plain		3.06	16166.4	60.0	79.0	110	50	79	79	105	0		
27.0	116.36	118.83	Plain		2.47	13041.6	60.0	79.0	110	50	79	79	105	1	Townlands	
28.0	118.83	121.45	CP-Adjacent (M)		2.57	13569.6	60.0	79.0	110	50	79	79	105	0		
29.0	121.40	123.57	Siding (M)	Bloomington Yard	2.17	11457.6	60.0	79.0	110	40	60	79	0	1	Bloomington	
30.0	123.57	124.38	Siding (M)	Bloomington Yard	0.81	4276.8	25.0	40.0	40	25	40	40	0	1	Bloomington	Bloomingtonm
31.0	124.38	124.86	Siding (M)	Bloomington Yard	0.48	2534.4	25.0	40.0	40	25	40	40	0	1	Bloomington	
			Check Total		36.5											

Table IN-2c: Segment Definitions: Springfield Sub-Corridor: MP 124.9 (Bloomington) - MP 181.0 (Ridgely)

Segment Number	Start (MP)	End (MP)	Type	Variant	Length Miles	Length Feet	Posted Speed (mph) Freight	Pass	HS Pass	Representative Speed (mph) Freight	Pass	HS Pass (Cross*)	HS Pass (Other)	Industry Siting Number	Name	Passenger Stops
32.0	124.86	126.50	CP-Adjacent (M)		1.6	8659.2	25.0	40.0	40	25	40	40	40	0	Bloom Yard	
33.0	126.50	126.50	Diamond		0.0	0	25.0	40.0	40	25	40	40	40	0		
34.0	126.50	128.76	CP-Adjacent (M)		2.3	11932.8	30.0	50.0	50	25	60	60	79	0		
35.0	128.76	130.96	Plain		2.2	11616	60.0	79.0	90	50	79	79	79	0		
36.0	130.96	133.72	Plain		2.8	14572.8	60.0	79.0	110	50	79	60	105	0		
37.0	133.72	136.90	Plain		3.2	16790.4	60.0	79.0	110	50	79	79	105	0		
38.0	136.90	138.63	CP-Adjacent (M)		1.7	9134.4	60.0	79.0	110	50	79	79	105	0		
39.0	138.63	141.30	Siding (M)	McLean (sspd)	2.7	14007.6	60.0	79.0	110	50	79	79	105	1	McLean	
40.0	141.30	143.35	CP-Adjacent (M)		2.0	10824	60.0	79.0	110	50	79	79	105	0		
41.0	143.35	146.30	Plain		5.0	26136	60.0	79.0	110	50	79	79	105	2	PTS Fertilizer, Atlanta	
42.0	146.30	150.96	Plain		2.7	14044.8	60.0	79.0	110	50	79	79	105	1	E.Lincoln Grain	
43.0	150.96	153.56	CP-Adjacent (U)		2.6	13728	60.0	79.0	110	50	79	79	105	1	Kruger	
44.0	153.56	155.57	Siding (U)	Elkhart (Unsp(d)	2.0	10612.8	60.0	79.0	110	50	60	60	79	0		
45.0	155.57	155.57	Diamond		0.0	0	40.0	40.0	40	40	40	40	40	0		
46.0	155.57	157.26	CP-Adjacent (U)		1.7	8923.2	50.0	70.0	70	50	60	60	79	1	Havana Ind.	Lincoln
47.0	157.26	160.06	Plain		2.8	14731.2	60.0	79.0	90	50	79	79	79	0		
48.0	160.05	162.11	Plain		2.1	10876.8	60.0	79.0	110	50	79	79	105	0		
49.0	162.11	164.04	Plain		1.9	10190.4	60.0	79.0	110	50	79	79	105	0		
50.0	164.04	166.16	Plain		2.1	11193.6	60.0	79.0	110	50	79	79	105	0		
51.0	166.16	168.34	CP-Adjacent (U)		2.2	11510.4	60.0	79.0	110	50	79	79	105	1	Elkhart Grain	
52.0	168.34	170.40	Siding (U)	Elkhart (Unsp(d)	2.1	10876.8	60.0	79.0	110	50	79	79	105	0		
53.0	170.40	172.34	CP-Adjacent (U)		1.9	10243.2	60.0	79.0	110	50	79	79	105	0		
54.0	172.34	176.84	Plain		3.5	18480	60.0	79.0	110	50	79	79	105	0		
55.0	175.84	179.49	Plain		3.7	19272	60.0	79.0	110	50	79	79	79	0		
56.0	179.49	180.99	CP-Adjacent (M)		1.5	7920	60.0	79.0	110	50	79	79	79	0		
			Check Total		56.1											

Table IN-3a: Crossing and Diamond Data, Joliet Sub-Corridor

Train Type	Representative Speed (mph)	Type of Grade-crossing	Number Crossings Passenger	HS Passenger	Freight	Number Diamonds
Passenger	40	Public_gates_lights	0	0		1
		Public_other	0	0		
		Private	0	0		
	60	Public_gates_lights	8	0		0
		Public_other	0	0		
		Private	0	0		
	79	Public_gates_lights	20	8		0
		Public_other	0	0		
		Private	0	0		
	105	Public_gates_lights	0	20		0
		Public_other	0	0		
		Private	0	0		
Freight	25	Public_gates_lights		0	0	
		Public_other		0		
		Private		0		
	40	Public_gates_lights		8	1	
		Public_other		0		
		Private		0		
	50	Public_gates_lights		20	0	
		Public_other		0		
		Private		1		
		Check Totals	29	29	29	

Table IN-3b: Crossing Data, Bloomington Sub-Corridor

Train Type	Representative Speed (mph)	Type of Grade-crossing	Number Crossings Passenger	HS Passenger	Freight	Number Diamonds
Passenger	40	Public_gates_lights	7	7		1
		Public_other				
		Private				
	60	Public_gates_lights	16			
		Public_other				
		Private	1			
	79	Public_gates_lights	16	16		
		Public_other	1			
		Private	6	1		
	105	Public_gates_lights		16		
		Public_other		1		
		Private		6		
Freight	25	Public_gates_lights			7	
		Public_other				
		Private				
	40	Public_gates_lights			16	1
		Public_other			1	
		Private			1	
	50	Public_gates_lights			16	
		Public_other			1	
		Private			6	
		Check Totals	47	47	47	

Table IN-3c: Crossing Data, Springfield Sub-Corridor

Train Type	Representative Speed (mph)	Type of Grade-crossing	Number Crossings Passenger	HS Passenger	Freight	Number Diamonds
Passenger	40	Public_gates_lights				2
		Public_other				
		Private				
	60	Public_gates_lights	14			
		Public_other				
		Private				
	79	Public_gates_lights	15	16		
		Public_other	5	1		
		Private	5	1		
	105	Public_gates_lights	13			
		Public_other	4			
		Private	4			
Freight	25	Public_gates_lights			3	
		Public_other				
		Private				
	40	Public_gates_lights			16	1
		Public_other			1	
		Private			1	
	50	Public_gates_lights			26	
		Public_other			5	
		Private			5	
		Check Totals	39	39	39	

Table IN-3d: Grade Crossings: Collision Frequency and Consequences

Train Type	Representative Speed (mph)	Type of Grade-crossing	Accident Frequency Per Million Crossing Passes Passenger	Freight	Crossing Collision Consequences Pass. Occup't Casualty Prob(accident) Injuries	Fatalities	Cost $/Acc't	Freight Trains (per accident) Injuries	Fatalities	Cost $
Passenger	40	Public_gates_lights	0.350		0.0028	0.000047	50,000			
		Public_other	0.300							
		Private	0.100							
	60	Public_gates_lights	0.600		0.0068	0.000112	113,000			
		Public_other	0.500							
		Private	0.200							
	79	Public_gates_lights	0.800		0.0105	0.000156	196,000			
		Public_other	0.650							
		Private	0.300							
	105	Public_gates_lights	1.100		0.0186	0.000276	346,000			
		Public_other	0.800							
		Private	0.300							
Freight	25	Public_gates_lights		0.150				0.12	0.005	20000
		Public_other		0.120						
		Private		0.050						
	40	Public_gates_lights		0.300				0.25	0.013	50000
		Public_other		0.250						
		Private		0.100						
	50	Public_gates_lights		0.360				0.39	0.02	78000
		Public_other		0.300						

Table IN-4: Consequences Look-up Tables (Data Sources: Previous ICF Passenger Corridor Project (passenger), FRA Accident Data 2001-5 (freight)

Passenger Trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 40 mph Injuries	Fatalities	Damage $	Representative Speed 60 mph Injuries	Fatalities	Damage $	Representative Speed 79 mph Injuries	Fatalities	Damage $	Representative Speed 105 mph Injuries	Fatalities	Damage $
	Train-Train Collision	Pass Loco hits Loco	0.083	0.0020	502000	0.139	0.0049	1142000	0.240	0.0085	1976000	0.425	0.0150	3495000
		Pass Loco hits Pass Car	0.034	0.0010	251000	0.056	0.0026	572000	0.097	0.0045	988000	0.171	0.0080	1747000
		Pass Loco hits Frt Car	0.034	0.0010	251000	0.056	0.0026	572000	0.097	0.0045	988000	0.171	0.0080	1747000
		Pass car hit by Loco	0.166	0.0050	1005000	0.275	0.0119	2284000	0.476	0.0206	3951000	0.841	0.0320	6989000
	Intrusion Collision (rollout)	Pass Loco hits Car	0.013	0.0005	113000	0.031	0.0011	257000	0.054	0.0019	449000	0.096	0.0034	798000
	Intrusion Collision (other)	Pass Loco hits Car	0.026	0.0009	226000	0.063	0.0022	514000	0.108	0.0038	898000	0.191	0.0068	1579000
	Overspeed		0.044	0.0004	667000	0.140	0.0019	1500000	0.210	0.0034	2600000	0.280	0.0045	4594000
	Broken Rail		0.044	0.0004	667000	0.140	0.0019	1500000	0.210	0.0034	2600000	0.280	0.0045	4594000
	Work Zone Violation		0.083	0.0083	0	0.125	0.0125	0	0.164	0.0164	0	0.218	0.0218	0

Freight trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 25 mph Injuries	Fatalities	Damage $	Representative Speed 40 mph Injuries	Fatalities	Damage $	Representative Speed 50 mph Injuries	Fatalities	Damage $
	Train-Train Collision	Frt Loco hits Loco	0.43	0.043	105000	1.1	0.11	270000	1.7	0.17	422000
		Frt Loco hits Car	0.35	0.035	88000	0.9	0.09	225000	1.4	0.14	352000
		Frt car hit by Loco	0	0	44000	0	0	112000	0	0	176000
	Intrusion Colln equip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Colln equip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Colln Unequip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Colln Unequip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Overspeed, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Overspeed, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Work Zone Viol'n, Equip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0
	Work Zone Viol'n, Unequip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0

Casualties and damage in Table IN-4 are per accident, except for Work Zone Violations which are per million train-miles

Table IN-5a: Reference Case Collision Accident Frequencies by Sub-Corridor and Season

Train-Train Collision Frequency by Segment Type, Sub Corridor and Season - (Collisions per Million Train Miles)

Segment Type	Joliet Sub-Corridor Summer	Joliet Sub-Corridor Rest of Year	Bloomington Sub-Corridor Summer	Bloomington Sub-Corridor Rest of Year	Springfield Sub-Corridor Summer	Springfield Sub-Corridor Rest of Year
Siding - Monitored	0.030	0.030	0.030	0.030	0.030	0.030
Siding - Unmonitored	0.040	0.040	0.040	0.040	0.040	0.040
CP-Adjacent, Monitored	0.050	0.050	0.050	0.050	0.050	0.050
CP-Adjacent, Unmonitored	0.060	0.060	0.060	0.060	0.060	0.060
Pass Track	0.006	0.006	0.006	0.006	0.006	0.006

Table IN-5b: Collision Distributions Between Head-on and Rear/Side by trains involved and Segment type

Head-on and Rear/Side Train-Train Collision Distributions by Segment Type

Segment Type	Passenger to Passenger Head-on	Passenger to Passenger Rear/Side	Passenger to Freight Head-on	Passenger to Freight RS P into F	Passenger to Freight RS F into P	Freight to Freight Head-on	Freight to Freight Rear/Side
Siding - Monitored	90%	90%	90%	90%	10%	90%	90%
Siding - Unmonitored	50%	90%	50%	40%	10%	90%	90%
CP-Adjacent, Monitored	90%	10%	80%	15%	5%	75%	25%
CP-Adjacent, Unmonitored	90%	10%	80%	15%	5%	75%	25%
Pass Track	80%	20%	70%	25%	5%	50%	50%

Table IN-5c: Reference Case Frequencies for Other Accident Types

Accident Type	Units	All Other Accident Frequencies Passenger	Freight
Intrusion Collision (rollout)	Per million train-miles	0.0086	0.0144
Intrusion Collision (other))	Per million train-miles	0.0144	0.0086
Overspeed	Per million train-miles	0.0110	0.0160
Broken Rail	Per million train-miles	0.0167	0.0556
Work Zone Violation	Per million train-miles	See Consequence Table	
Diamonds	Per million diamond passes	0.1000	0.1000

Table IN-5d: Reference Case Collision Distributions by Sub-Corridor and Train Type

Train-Train Collision Distributions by Train Types

Collision Types	Joliet Sub-Corridor Summer	Joliet Sub-Corridor Rest of Year	Bloomington Sub-Corridor Summer	Bloomington Sub-Corridor Rest of Year	Springfield Sub-Corridor Summer	Springfield Sub-Corridor Rest of Year
Passenger-Passenger	0.71	0.71	0.71	0.60	0.80	0.62
Passenger - Equip Freight	0.22	0.22	0.22	0.16	0.15	0.12
Passenger - Unequip Freight	0.07	0.07	0.07	0.14	0.05	0.18
Equip Freight - Equip Freight	0.00	0.00	0.00	0.00	0.00	0.00
Equip Freight - Unequip Freight	0.00	0.00	0.00	0.08	0.00	0.05
Unequip Freight - Unequip Freight	0.00	0.00	0.00	0.00	0.00	0.03
Checking	1.00	1.00	1.00	1.00	1.00	1.00

Table IN-6a: Preventability for Other Accident Types

Accident Type	Preventability Factors - PTC Normal Passenger	Freight	Prev'ty Factors - PTC Timeout Passenger	Freight
Intrusion Collision (rollout)	0.30	0.30	0.00	0.00
Intrusion Collision (other))	0.05	0.05	0.00	0.00
Overspeed	0.80	0.80	0.50	0.50
Broken Rail	0.04	0.04	0.00	0.00
Work Zone Violation	0.50	0.50	0.25	0.25
Grade Crossings	0.04	0.04	0.00	0.00

Equipped Train Preventability Values

	Collision Type	Preventability
Both TBE	Pass-Pass	0.9
	Pass-TBE Freight	0.9
	TBE Freight - TBE Freight	0.9
One TBE	Pass – NE Freight, Head -On	0.9
	Rear/Side, Pass into NE Frt	0.9
	Rear/Side NE Frt into Pass	0.9
	TBE Freight – NE Freight	0.9

Worksheet 1-JN: IDOT-PTC Risk Model: Braking Distances and Collision Zone Calculations, Joliet Sub-corridor, PTC Normal Operating State

Table 1.1: Stopping Distance Parameters and Calculations, Including Timeout and ACS Response Value

Braking Formula Inputs		
Train/System Type	Parameter	Value
Freight	Coefficient F	0.035
	Appl'n Time	9.0
	Train Weight	37800000
	Brake Force	775693
Passenger	Coefficient A	0.668
	Coefficient B	0
	Safety Factor	1.25
Train Control	Latency/T-out	15
	ACS Response	0
Guilty T'rain Speed (mph)		110

Braking Distance Calculations (ft) (including two running in TD)								Braking Duration (sec)		Guilty Train Distance		Total Zone Lengths	
Train Type	Speeds (mph)	To Stop	Reduction to RedCon²	RedCon² to Stop	Decel-eration (ft/sec²)			Reduction to RedCon²	RedCon² to Stop	Reduction to RedCon²	RedCon² to Stop	Reduction to RedCon²	Full Speed to Stop
Freight	25	1928	1928	0	0.668			65	0	1429	0	3356	0	3356
	40	4097	2039	2068	0.668			21	77	462	1692	2491	3760	6251
	50	5965	3898	2068	0.668			43	77	945	1692	4843	3760	8603
Passenger	40	1732	1732	0	1.293			55	0	1219	0	2951	0	2951
	60	3597	3597	0	1.293			78	0	1719	0	5316	0	5316
	79	5986	3589	2396	1.293			32	68	695	1499	4283	3896	8179
	105	10228	7831	2398	1.293			61	68	1344	1499	9175	3896	13071
	105	1370	NA	NA	1.293									

Blue cell/contain data imported from the Inputs worksheet

Sight Distance (ft): 2500

Note: RedCon refers to the speed at which collision consequences will be significantly reduced

60 mph for passenger trains and 35 mph for freight trains

If train speed is lower that this speed, then there are no reduced consequences and Zone A2 has zero length

Table 1.2: Segment Definitions- Sub-Corridor 1: MP 62.7 (Manhattan) - MP 86.3 (Bunge)

Segment Number	Start (MP)	End (MP)	Type	Variant	Length Miles	Length Feet	Posted Speed (mph) Freight	Posted Speed (mph) HS Pass	Posted Speed (mph) Freight	Posted Speed (mph) Pass	Posted Speed (mph) HS Pass	Posted Speed (mph) HS Pass (Comcp²)	Posted Speed (mph) HS Pass (Other)	Industry Siding Number	Industry Siding Name	Passenger Stops
1.0	62.8	64.8	OP Adjacent (M)		2.2	11616	60	79	110	50	79	79	105	0		
2.0	64.8	66.6	Plain		1.8	9240	60	79	110	50	79	79	105	0		
3.0	66.6	68.2	Plain		1.7	8970.4	60	79	110	50	79	79	105	0		
4.0	68.2	70.2	OP Adjacent (M)		1.9	10243.2	60	79	110	50	79	79	105	0		
5.0	70.2	72.8	Siding (M)	Depot (sg 0)	2.6	13886.4	60	79	110	50	79	79	105	0		
5.1	72.8	72.8	Siding (M)		0.0	0	45	45	45	45	45	45	45	0		
6.0	72.8	74.9	OP Adjacent (M)		2.1	11299.2	60	79	110	50	79	79	105	0		
7.0	74.9	77.3	OP Adjacent (M)		2.3	12302.4	60	79	110	50	79	79	105	0		
8.0	77.3	79.2	OP Adjacent (M)		2.0	10100.8	60	79	110	50	79	79	105	0		
9.0	79.2	80.9	Plain		1.9	9820.8	60	79	110	50	79	79	105	0		
10.0	80.9	82.6	OP Adjacent (M)	Oper (sg 0)	1.7	8971.2	60	79	110	50	79	79	105	0		
11.0	82.6	84.7	OP Adjacent (M)		2.2	11644.8	60	79	110	50	79	79	105	0		
12.0	84.7	86.3	OP Adjacent (M)		1.8	9398.4	60	79	110	50	79	79	105	0		
13.0	86.4	86.4	Plain		1.9	10137.6	60	79	110	50	79	79	105	0		
				CheckTotal	23.8											

Table 1.3: Mitigation and Prevention Zones - All Segments - Lengths in Feet

Zone A1: Limited Speed Reduction No Prevention or Mitigation			Zone A2: Reduced Speed to Stop Severity Mitigation			Zone B: Able to Stop Full Prevention			Overlap of Stopping Distance into Zone C			Distance in Timeout in Zone C			Overlap of Zone A1 into Zone C			Overlap of Zone A1 into Zone C w/in Sight Distance			Overlap of Zone A2 into Zone C w/in Sight Distance		
Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass
4843	4283	9175	3760	3896	2441	3013	3437	0	0	0	1455	0	0	1455	0	0	2.2	0	0	2.2	0	0	2.2
4843	4283	9175	3896	3896	65	501	1061	0	0	0	3831	0	0	1540	0	0	0	0	0	0	0	0	0
4843	4283	9873	3896	3896	0	131	692	0	0	0	4200	0	0	1540	0	0	304	0	0	304	0	0	1.75
4843	4283	9175	3896	3896	1099	1504	2064	0	0	0	2828	0	0	1540	0	0	0	0	0	0	0	0	1.94
2491	5316	4283	0	0	3896	11395	8571	5708	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.63
2491	5316	4283	0	0	3896	8658	5664	3135	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.14
4843	4283	9175	3896	3896	3128	3563	4124	0	0	0	768	0	0	0	0	0	0	0	0	0	0	0	2.33
4843	4283	9175	3896	3896	3896	6362	6602	3030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.86
4843	4283	9175	3896	3896	645	1082	1642	0	0	0	3250	0	0	1540	0	0	0	0	0	0	0	0	1.89
4843	4283	9175	3896	3896	3896	5336	5696	874	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.66
4843	4283	9175	3896	3896	224	659	1220	0	0	0	3672	0	0	1540	0	0	0	0	0	0	0	0	1.79
4843	4283	9175	3896	3896	963	1396	1959	0	0	0	2933	0	0	1540	0	0	0	0	0	0	0	0	1.92

Table 1.4: Breakdown of Segments Lengths by Representative Speed (miles)

Segment Number	Freight Speeds (mph) 25	40	50	Comcom² Pass Speeds (mph) 40	60	79	HS Pass. Speeds - ComCo Comcm. (mph) 40	60	79	105	HS Pass. Speeds - Other (mph) 40	60	79	105
1.0	0	0	2.2	0	0	2.2	0	0	2.2	0	0	0	0	2.2
2.0	0	0	1.75	0	0	1.75	0	0	1.75	0	0	0	0	1.75
3.0	0	0	1.68	0	0	1.68	0	0	1.68	0	0	0	0	1.68
4.0	0	0	1.94	0	0	1.94	0	0	1.94	0	0	0	0	1.94
5.0	0	2.63	0	0	2.63	0	0	0	2.63	0	0	0	0	2.63
6.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.0	0	2.14	0	0	2.14	0	0	0	2.14	0	0	0	0	2.14
8.0	0	2.33	0	0	2.33	0	0	0	2.33	0	0	0	0	2.33
9.0	0	2.86	0	0	2.86	0	0	0	2.86	0	0	0	0	2.86
10.0	0	0	1.89	0	0	1.89	0	0	1.89	0	0	0	0	1.89
11.0	0	2.66	0	0	2.66	0	0	0	2.66	0	0	0	0	2.66
12.0	0	0	1.79	0	0	1.79	0	0	1.79	0	0	0	0	1.79
13.0	0	0	1.92	0	0	1.92	0	0	1.92	0	0	0	0	1.92

Table 1.5: Aggregate Segment Length by Segment Type and Speed

Segment Type	Train Type	Repres-entative Speed (mph)	Aggregate Length of Segments by Train and Segment Types: Freight Miles	Freight Feet	Conv passenger Miles	Conv passenger Feet	High Speed Passenger Collision Comcp² Miles	High Speed Passenger Collision Comcp² Feet	High Speed Passenger Other Miles	High Speed Passenger Other Feet
Siding (mon)	Freight	25	0.0	0						
		40	2.6	13886.4						
		50	2.7	14044.8						
	Passenger	40			0.0	0	0.0	0	0.0	0
		60			2.6	13886.4	2.6	13886.4	0.0	0
		79			2.7	14044.8	2.7	14044.8	2.6	13886.4
		105					0.0	0	2.7	14044.8
Siding (unmon)	Freight	25	0.0	0						
		40	0.0	0						
		50	0.0	0						
	Passenger	40			0.0	0	0.0	0	0.0	0
		60			0.0	0	0.0	0	0.0	0
		79			0.0	0	0.0	0	0.0	0
		105					0.0	0	0.0	0
OP Adjacent (mon)	Freight	25	0.0							
		40	2.1	11299.2						
		50	7.8	41078.4						
	Passenger	40			0.0	0	0.0	0	0.0	0
		60			2.1	11299.2	2.1	11299.2	0.0	0
		79			7.8	41078.4	7.8	41078.4	2.1	11299.2
		105					0.0	0	7.8	41078.4
OP Adjacent (unmon)	Freight	25	0.0	0						
		40	0.0	0						
		50	0.0	0						
	Passenger	40			0.0	0	0.0	0	0.0	0
		60			0.0	0	0.0	0	0.0	0
		79			0.0	0	0.0	0	0.0	0
		105					0.0	0	0.0	0
Plain Track	Freight	25	0.0	0						
		40	0.0	0						
		50	10.5	55451.2						
	Passenger	40			0.0	0	0.0	0	0.0	0
		60			0.0	0	0.0	0	0.0	0
		79			10.5	55451.2	10.5	55451.2	0.0	0
		105					0.0	0	10.5	55451.2
CheckTotal			23.8		25.8		25.8		25.8	

PTmis speed is used to calculate collision consequences in collisions between an equipped and an unequipped train ("A-Y" reflecting the IDOT PTC speed selection when an equipped train nears an unequipped train

Yellow cell/contain data exported to the next worksheet in the sequence of three sheets that perform the calculations for one sub-corridor, weaker and operating date

Table 1.6a: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for Siding (M) Segments

Lengths in Zone C	A1	A2	B
Total Length, Siding (M) Segments (ft)	27931.2		
Number Siding (M) Segments	2		
Average distance in Zone C (ft): Freight	0	0	2500
Passenger	0	0	2500
HS Pass	0	0	2500

	Zone A1 Totals: Freight	Pass	HS Pass	Zone A2 Totals: Freight	Pass	HS Pass	Zone B Totals: Freight	Pass	HS Pass
Sum Zone Lengths A1, A2, B (ft)	7234	9598	13457	3896	3896	7792	18703	14437	9832
Fraction of total length in zone	0.243	0.344	0.482	0.139	0.139	0.279	0.536	0.517	0.299
Collision Accident Mitigation Probabilities: Combined All Zones.	0.249	0.326	0.458	0.133	0.133	0.265	0.668	0.591	0.327

Values transferred to Collision Matrix

Distribution of train location at time of initiation of Reference Case accidents: In Block 0.95; Previous Block 0.05

PTC Risk Increment in Zone C: 2

Potential danger length in Zone C (ft): 5020

Table 1.6b: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for Siding (U) Segments

Lengths in Zone C	A1	A2	B
Total Length, Siding (U) Segments (ft)	0		
Number Siding (M) Segments	0.001		
Average distance in Zone C (ft): Freight	0	0	2500
Passenger	0	0	2500
HS Pass	0	0	2500

	Zone A1 Totals: Freight	Pass	HS Pass	Zone A2 Totals: Freight	Pass	HS Pass	Zone B Totals: Freight	Pass	HS Pass
Sum Zone Lengths A1, A2, B (ft)	0	0	0	0	0	0	0	0	0
Fraction of total length in zone	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Collision Accident Mitigation Probabilities: Combined All Zones.	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100

Values transferred to Collision Matrix

Distribution of train location at time of initiation of Reference Case accidents: In Block 0.95; Previous Block 0.05

PTC Risk Increment in Zone C: 2

Potential danger length in Zone C (ft): 2500

Table 1.6c: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for CP Adjacent (M) Segments

Lengths in Zone C	A1	A2	B
Total Length, Siding (U) Segments (ft)	52377.6		
Number Siding (M) Segments	5		
Average distance in Zone C (ft): Freight	0	0	2500
Passenger	0	0	2500
HS Pass	0	1791	709

	Zone A1 Totals: Freight	Pass	HS Pass	Zone A2 Totals: Freight	Pass	HS Pass	Zone B Totals: Freight	Pass	HS Pass
Sum Zone Lengths A1, A2, B (ft)	21863	22446	40861	6278	15048	6278	15048	14347	9193
Fraction of total length in zone	0.417	0.429	0.782	0.295	0.298	0.158	0.286	0.274	0.060
Collision Accident Mitigation Probabilities: Combined All Zones.	0.317	0.407	0.743	0.260	0.283	0.222	0.373	0.360	0.065

Values transferred to Collision Matrix

Distribution of train location at time of initiation of Reference Case accidents: In Block 0.95; Previous Block 0.05

PTC Risk Increment in Zone C: 2

Potential danger length in Zone C (ft): 5020

Table 1.6d: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for CP Adjacent (U)Segments

Lengths in Zone C	A1	A2	B
Total Length, Siding (U) Segments (ft)	1		
Number Siding (M) Segments	0.001		
Average distance in Zone C (ft): Freight	0	0	2500
Passenger	0	0	2500
HS Pass	0	0	2500

	Zone A1 Totals: Freight	Pass	HS Pass	Zone A2 Totals: Freight	Pass	HS Pass	Zone B Totals: Freight	Pass	HS Pass
Sum Zone Lengths A1, A2, B (ft)	0	0	0	0	0	0	0	0	0
Fraction of total length in zone	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Collision Accident Mitigation Probabilities: Combined All Zones.	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100

Values transferred to Collision Matrix

Distribution of train location at time of initiation of Reference Case accidents: In Block 0.95; Previous Block 0.05

PTC Risk Increment in Zone C: 2

Potential danger length in Zone C (ft): 2500

Table 1.6e: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for Plain Track Segments

Lengths in Zone C	A1	A2	B
Total Length, Siding (U) Segments (ft)	55451.2		
Number Siding (M) Segments	5		
Average distance in Zone C (ft): Freight	0	0	2500
Passenger	0	0	2500
HS Pass	611	1993	848

	Zone A1 Totals: Freight	Pass	HS Pass	Zone A2 Totals: Freight	Pass	HS Pass	Zone B Totals: Freight	Pass	HS Pass
Sum Zone Lengths A1, A2, B (ft)	21863	22446	40861	0	0	0	0	0	0
Fraction of total length in zone	0.393	0.403	0.736	0.000	0.000	0.000	0.000	0.000	0.000
Collision Accident Mitigation Probabilities: Combined All Zones.	0.373	0.383	0.762	0.000	0.000	0.064	0.100	0.100	0.004

Values transferred to Collision Matrix

Distribution of train location at time of initiation of Reference Case accidents: In Block 0.95; Previous Block 0.05

PTC Risk Increment in Zone C: 2

Potential danger length in Zone C (ft): 2500

Table 1.6f: Distribution of Equipped Train Locations by Collision Preventability Zones - Values for Diamond Segments

Lengths in Zone C	A1	A2	B
Total Length, Siding (U) Segments (ft)	25185.6		
Number Siding (M) Segments	2		
Average distance in Zone C (ft): Freight	0	0	2500
Passenger	0	0	2500
HS Pass	0	0	2500

	Zone A1 Totals: Freight	Pass	HS Pass	Zone A2 Totals: Freight	Pass	HS Pass	Zone B Totals: Freight	Pass	HS Pass
Sum Zone Lengths A1, A2, B (ft)	4058	7194	7278	4155	0	4755	16691	17992	12214
Fraction of total length in zone	0.161	0.286	0.285	0.164	0.000	0.190	0.675	0.714	0.525
Collision Accident Mitigation Probabilities: Combined All Zones.	0.153	0.271	0.271	0.156	0.000	0.181	0.741	0.779	0.598

Distribution of train location at time of initiation of Reference Case accidents: In Block 0.95; Previous Block 0.05

PTC Risk Increment in Zone C: 2

Potential danger length in Zone C (ft): 5020

Worksheet 2 - J,N,R: Collision Frequencies Calculation - PTC 120 Sec. Timeout Case, Joliet Sub-corridor PTC Normal Operating State, Rest of Year

Table 2.1a: Collision Distribution Matrix (Fraction Accidents by Train Pair and Collision Type). Collisions Between Trains Operating on the IDOT Test Corridor Only (Not diamonds and intrusions)

Train Pairs in In Collision		Collision Scenario Prob (Top Level)	Siding - Monitored							Siding - Unmonitored								CP Adjacent - Monitored Siding								CP Adjacent - Unmonitored Siding								Plain Track							
			Collision Distribution		Head On		Rear End/Side			Collision Distribution		Head On		Rear End/Side				Collision Distribution		Head On		Rear End/Side				Collision Distribution		Head On		Rear End/Side				Collision Distribution		Head On		Rear End/Side			
			Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty		Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty			Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty			Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty			Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty		
Percent Guilty					100%	0%	100%	0%		100%	0%	100%	0%	100%	0%			100%	0%	100%	0%					100%	0%	100%	0%							100%	0%	100%	0%		
Both Trains TBE (Note 3)	Pass-Pass	0.71	0.50	0.50	0.355	0	0.355	0		0.5	0.5	0.355	0	0.355	0	0.8	0.2	0.568	0	0.142	0	0.8	0.2	0.568	0	0.142	0	0.70	0.30	0.497	0	0.213	0								
	Pass-TBE Freight	0.22	0.50	0.50	0.11	0	0.11	0		0.5	0.5	0.11	0	0.11	0	0.7	0.3	0.154	0	0.066	0	0.7	0.3	0.154	0	0.066	0	0.40	0.60	0.088	0	0.132	0								
	TBE Freight - TBE Freight	0.00	0.50	0.50	0	0	0	0		0.5	0.5	0	0	0	0	0.7	0.3	0	0	0	0	0.7	0.3	0	0	0	0	0.50	0.50	0	0	0	0								
One Train TBE	Percent Guilty				50%	50%	50%	50%				50%	50%	50%	50%			50%	50%	50%	50%					50%	50%	50%	50%							50%	50%	50%	50%		
	Pass - NE Freight, Head -On	0.07	1	0	0.0175	0.0175	0	0		1	0	0.0175	0.0175	0	0	1	0	0.028	0.028	0	0	1	0	0.028	0.028	0	0	1.00	0.00	0.0245	0.0245	0	0								
	Rear/Side, Pass into NE Frt		0	1	0	0	0.028	0		0	1	0	0	0.028	0	0	1	0	0	0.0105	0	0	1	0	0	0.0105	0	0.00	1.00	0	0	0.0175	0								
	Rear/Side NE Frt into Pass		0	1	0	0	0	0.007		0	1	0	0	0	0.007	0	1	0	0	0	0.0035	0	1	0	0	0	0.0035	0.00	1.00	0	0	0	0.0035							
	TBE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0		0.5	0.5	0	0	0	0	0.7	0.3	0	0	0	0	0.7	0.3	0	0	0	0	0.50	0.50	0	0	0	0								
Neither Train TBE	Percent Guilty				0%	100%	0%	100%				0%	100%	0%	100%			0%	100%	0%	100%					0%	100%	0%	100%							0%	100%	0%	100%		
	NE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0		0.5	0.5	0	0	0	0	0.7	0.3	0	0	0	0	0.7	0.3	0	0	0	0	0.50	0.50	0	0	0	0								
	Total Probability (checking)	1		1	0.4825	0.0175	0.493	0.007			1	0.4825	0.0175	0.493	0.007		1	0.75	0.028	0.2185	0.0035		1	0.75	0.028	0.2185	0.0035		1	0.6095	0.0245	0.3625	0.0035								

Quantity in cell C18 is for all collisions between a passenger train and an unequipped freight train

Table 2.2: Preventability Data For Unequipped train Guilty, One Train TBE

Segment Type	Not Prevented of Mitigated			Mitigated			Prevented		
	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass
Siding (M)	0.249	0.326	0.458	0.133	0.133	0.265	0.668	0.591	0.327
Siding (U)	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100
CP Adjacent (M)	0.397	0.407	0.743	0.260	0.283	0.222	0.373	0.360	0.085
CP Adjacent (U)	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100
Plain Track	0.373	0.383	0.702	0.000	0.000	0.064	0.100	0.100	0.034
Diamonds	0.153	0.271	0.271	0.156	0.000	0.181	0.741	0.779	0.598

Mauve cells contain data imported from previous worksheet in a group of three worksheets covering one sub-corridor, season and operating state.

Table 2.1b: Collision Type Distribution - Diamonds

Diamond Collisions Rear End/Side		Train Pairs in In Collision	Train Pair Type
Equip Guilty	Unequip Guilty		
		Percent Guilty	
		Pass-Pass	Both Trains TBE
		Pass-TBE Freight	
		TBE Freight - TBE Freight	
50%	50%	Percent Guilty	One Train TBE
0	0	Pass - NE Freight, Head -On	
0.25	0.25	Rear/Side, Pass into NE Frt	
0.05	0.05	Rear/Side NE Frt into Pass	
0.1	0.1	TBE Freight - NE Freight	
	100%	Percent Guilty	
0	0.2	NE Freight - NE Freight	Neither Train TBE
0.4	0.6	Total Probability (checking)	

Note: The gray cells on these rows are set at zero, because in every case, the condition represented by the cell does not exist - either because there are no unequipped passenger trains, or because of the kind of collision defined for the row.

Table 2.3a: Collision Preventability Matrix (Percent Accidents Preventable Relative to CTC Reference Case)

Train Pairs in In Collision		Preventability Equipped Train Guilty	Siding - Monitored				Siding - Unmonitored				CP Adjacent - Monitored Siding				CP Adjacent - Unmonitored Siding				Plain Track				Diamond Collisions Rear End/Side		Train Pairs in In Collision	Train Pair Type
			Head On		Rear End/Side		Head On		Rear End/Side		Head On		Rear End/Side		Head On		Rear End/Side		Collision Distribution	Head On		Rear End/Side				
					Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Head On	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty		
Both TBE	Pass-Pass	90%			90%		90%		90%		90%		90%		90%		90%			90%		90%				Pass-Pass	Both TBE
	Pass-TBE Freight	90%			90%		90%		90%		90%		90%		90%		90%			90%		90%				Pass-TBE Freight	
	TBE Freight - TBE Freight	90%			90%		90%		90%		90%		90%		90%		90%			90%		90%				TBE Freight - TBE Freight	
One TBE	Pass - NE Freight, Head -On	90%			90%	33%					90%	10%			90%	8%				90%	10%					Pass - NE Freight, Head -On	One TBE
	Rear/Side, Pass into NE Frt	90%					90%	33%					90%	10%			90%	8%				90%	10%			Rear/Side, Pass into NE Frt	
	Rear/Side NE Frt into Pass	90%					90%	0%					90%	0%			90%	0%				90%	0%			Rear/Side NE Frt into Pass	
	TBE Freight - NE Freight	90%			90%	67%	90%	0%			90%	10%	90%	0%			90%	10%		90%	10%	90%	0%			TBE Freight - NE Freight	
Neither TBE	NE Freight - NE Freight					0%		0%				0%		0%				0%					0%		0.00%	NE Freight - NE Freight	Neither TBE
Reference Case (CTC) Collision Accident Likelihood by Segment Type (collisions/million train miles)		0.030					0.040				0.050				0.060				0.006					Collisions/million diamond passes	0.1		

Table 2.3b: Collision Preventability Matrix - Diamonds

Train Pairs in In Collision		Train Pair Type
		Both TBE
		One TBE
0.002500	0.005534	Rear/Side, Pass into NE Frt
0.000500	0.001107	Rear/Side NE Frt into Pass
0.000000	0.000000	TBE Freight - NE Freight
0.00300	0.00664	NE Freight - NE Freight
		Neither TBE

Table 2.4a: Passenger Trains in Accidents (Collisions per Million Train-Miles Operated in Sub-Corridor)

Train Pairs in In Collision		Passenger Trains in Collisions	Siding - Monitored				Siding - Unmonitored				CP Adjacent - Monitored Siding				CP Adjacent - Unmonitored Siding				Plain Track				Diamond Collisions Rear End/Side		Train Pairs in In Collision	Train Pair Type
			Head On		Rear End/Side		Head On		Rear End/Side		Head On		Rear End/Side		Head On		Rear End/Side		Collision Distribution	Head On		Rear End/Side				
					Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Head On	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty		
Both TBE	Pass-Pass	2			0.0021		0.0021				0.0028		0.0028		0.0057		0.0014			0.0068		0.0017				Pass-Pass	Both TBE
	Pass-TBE Freight	1			0.0003		0.0003				0.0004		0.0004		0.0008		0.0003			0.0009		0.0004				Pass-TBE Freight	
	TBE Freight - TBE Freight	0																								TBE Freight - TBE Freight	
One TBE	Pass - NE Freight, Head -On	1			0.0001	0.0004					0.0001	0.0006			0.0001	0.0013				0.0002	0.0015					Pass - NE Freight, Head -On	One TBE
	Rear/Side, Pass into NE Frt	1					0.0001	0.0000					0.0001	0.0000			0.0001	0.0000				0.0001	0.0000			Rear/Side, Pass into NE Frt	
	Rear/Side NE Frt into Pass	1					0.0000	0.0002					0.0000	0.0003			0.0000	0.0002				0.0000	0.0002			Rear/Side NE Frt into Pass	
	TBE Freight - NE Freight	0																								TBE Freight - NE Freight	
Neither TBE	NE Freight - NE Freight	0																								NE Freight - NE Freight	Neither TBE
	Checking total				0.0025	0.0004	0.0025	0.0002			0.0034	0.0006	0.0034	0.0003	0.0066	0.0013	0.0018	0.0002		0.0079	0.0015	0.0022	0.0002				

Table 2.4b: Passenger Trains in Collisions at Diamonds

Diamond Collisions Rear End/Side		Train Pairs in In Collision	Train Pair Type
Equip Guilty	Unequip Guilty		
		Pass-Pass	Both TBE
		Pass-TBE Freight	
		TBE Freight - TBE Freight	
0.002500	0.005534	Rear/Side, Pass into NE Frt	One TBE
0.000500	0.001107	Rear/Side NE Frt into Pass	
0.000000	0.000000	TBE Freight - NE Freight	
	0.000000	NE Freight - NE Freight	Neither TBE
0.00300	0.00664		

Scenario Totals - Passenger	Tots. P-UF	Totals	Totals	Totals	Totals	Totals	Totals	Totals	Totals	Totals	Totals	Totals	Totals	Totals	Totals	Totals	Totals	Totals	Totals	Totals	Totals	Totals	Scenario Totals - Passenger
Pass Loco Hits Loco	0.0004	0.0029	0.0025	0.0004	0.0007	0.0040	0.0034	0.0006	0.0014	0.0079	0.0066	0.0013	0.0017	0.0094	0.0079	0.0015	0.0002	0.0008	0.0007	0.0001			Pass Loco Hits Loco
Pass Loco Hits Pass Car		0.0011				0.0014			0.0014	0.0007				0.0009				0.0001			0.0001		Pass Loco Hits Pass Car
Pass Loco Hits Freight Car	0.0001	0.0003			0.0001	0.0005			0.0005	0.0003	0.0001	0.0003	0.0001	0.0004			0.0000	0.0001			0.0001	0.002500	0.005534	0.008034	Pass Loco Hits Freight Car
Pass Car Hit by Loco	0.0002	0.0013			0.0003	0.0018			0.0015	0.0003	0.0002	0.0010	0.0002	0.0012			0.0000	0.0002			0.0001	0.000500	0.001107	0.001607	Pass Car Hit by Loco
Total		0.0056	0.0025	0.0004	0.0025	0.0077	0.0034	0.0006	0.0034	0.0098	0.0066	0.0013	0.0018	0.0002				0.0012	0.0007	0.0001	0.0003	0.003000	0.006641	0.009641	Total

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Table 2.5a: Freight trains In Accidents (Collisions per Million Train-Miles Operated in Sub-Corridor)

Train Pairs in In Collision		Freight Trains in Collisions	Siding - Monitored				Siding - Unmonitored				CP Adjacent - Monitored Siding				CP Adjacent - Unmonitored Siding				Plain Track				Diamond Collisions Rear End/Side		Train Pairs in In Collision	Train Pair Type
			Head On		Rear End/Side		Head On		Rear End/Side		Head On		Rear End/Side		Head On		Rear End/Side		Collision Distribution	Head On		Rear End/Side				
					Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Head On	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty		
Both TBE	Pass-Pass	0																								Pass-Pass	Both TBE
	Pass-TBE Freight	1			0.0003		0.0003				0.0004		0.0004		0.0008		0.0003			0.0009		0.0004				Pass-TBE Freight	
	TBE Freight - TBE Freight	2			0.0000		0.0000				0.0000		0.0000		0.0000		0.0000			0.0000		0.0000				TBE Freight - TBE Freight	
One TBE	Pass - NE Freight, Head -On	1			0.0001	0.0004					0.0001	0.0006			0.0001	0.0013				0.0002	0.0015					Pass - NE Freight, Head -On	One TBE
	Rear/Side, Pass into NE Frt	1					0.0001	0.0000					0.0001	0.0000			0.0001	0.0000				0.0001	0.0000			Rear/Side, Pass into NE Frt	
	Rear/Side NE Frt into Pass	1					0.0000	0.0002					0.0000	0.0003			0.0000	0.0002				0.0000	0.0002			Rear/Side NE Frt into Pass	
	TBE Freight - NE Freight	2			0.0000	0.0000	0.0000	0.0000			0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000	0.0000			TBE Freight - NE Freight	
Neither TBE	NE Freight - NE Freight	2				0.0000		0.0000				0.0000		0.0000		0.0000		0.0000			0.0000		0.0000		0.040000	NE Freight - NE Freight	Neither TBE
	Checking total				0.0004	0.0004	0.0004	0.0002			0.0005	0.0006	0.0006	0.0003	0.0009	0.0013	0.0004	0.0002		0.0011	0.0015	0.0005	0.0002			0.00500	0.05182	

Scenario Totals - Freight		Totals	Totals				Totals				Totals				Totals				Totals				Totals				Totals	Scenario Totals - Freight
Freight Loco Hits Loco	0.0004	0.0007	0.0004	0.0004			0.0011	0.0005	0.0006						0.0026	0.0011	0.0015		0.0002	0.0001	0.0001							Freight Loco Hits Loco
Freight Loco Hits Car	0.0002	0.0003			0.00007	0.00021	0.0004			0.00009	0.00028		0.0003			0.00008	0.00018		0.0003			0.00010	0.00021			0.00001	0.00002	0.003500	0.023698	0.027198	Freight Loco Hits Car
Freight Car Hit By Loco	0.0001	0.0003	b		0.00035	0.00000	0.0005			0.00046	0.00000		0.0003		0.0004		0.00030	0.00000	0.0004			0.00036	0.00000			0.00008	0.00000	0.001500	0.028125	0.029625	Freight Car Hit By Loco
Total		0.0014	0.0004	0.0004	0.0004	0.0002		0.0020	0.0005	0.0006	0.0006	0.0003	0.0000	0.0027	0.0009	0.0013	0.0004	0.0002		0.0033	0.0011	0.0015	0.0005	0.0002		0.0003	0.0001	0.0001	0.0001	0.0000	0.005000	0.051823	0.056823	Total

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Freight Plus Passenger Totals (check)	0.0600	0.0070					0.0800	0.0096					0.1000	0.0126					0.1200	0.0151					0.0015								

In rear-end/side collisions between like trains there is one loco hits car and one car hit by loco in each collision. In rear/side collisions between a passenger and freight trains, the ratio between passenger hits freight and freight loco hits passenger car are a function of the percentages given in Table IN-5b on the Inputs sheet. The values are given in the tables beneath the trains in collisions for each segment type.

Collision Ratios																																							
Collision Type	Like Trains		Unlike Trains				Collision Type	Like Trains		Unlike Trains				Collision Type	Like Trains		Unlike Trains				Collision Type	Like Trains		Unlike Trains				Collision Type	Like Trains		Unlike Trains				Collision Type	Like Trains		Unlike Trains			
	Loco hits car	car hit by loco	P loco hits F car	F loco hits P car				Loco hits car	car hit by loco	P loco hits F car	F loco hits P car				Loco hits car	car hit by loco	P loco hits F car	F loco hits P car				Loco hits car	car hit by loco	P loco hits F car	F loco hits P car				Loco hits car	car hit by loco	P loco hits F car	F loco hits P car				Loco hits car	car hit by loco	P loco hits F car	F loco hits P car		
Freight to Freight	0.50	0.50					Freight to Freight	0.50	0.50					Freight to Freight	0.50	0.50					Freight to Freight	0.50	0.50					Freight to Freight	0.50	0.50					Freight to Freight	0.50	0.50				
Passenger to Passenger	0.50	0.50					Passenger to Passenger	0.50	0.50					Passenger to Passenger	0.50	0.50					Passenger to Passenger	0.50	0.50					Passenger to Passenger	0.50	0.50					Passenger to Passenger	0.50	0.50				
Passenger to Freight			0.8	0.2			Passenger to Freight			0.80	0.20			Passenger to Freight			0.75	0.25			Passenger to Freight			0.75	0.25			Passenger to Freight			0.83	0.17								

Worksheet 3 - J,N,R: - Risk Calculations - PTC 120 Sec. Timeout Case, Joliet Subcorridor, Normal Operating State, Rest of Year

Table 3.1: Consequences Look-up Tables (Data Sources: Previous ICF Passenger Corridor Project (passenger), FRA Accident Data 2001-5 (freight)

Passenger Trains	Accident Scenario	Accident Sub-scenarios	Rep. Speed 40 mph Injuries	Rep. Speed 40 mph Fatalities	Rep. Speed 40 mph Damage $	Rep. Speed 60 mph Injuries	Rep. Speed 60 mph Fatalities	Rep. Speed 60 mph Damage $	Rep. Speed 79 mph Injuries	Rep. Speed 79 mph Fatalities	Rep. Speed 79 mph Damage $	Rep. Speed 105 mph Injuries	Rep. Speed 105 mph Fatalities	Rep. Speed 105 mph Damage $
	Train-Train Collision	Pass Loco hits Loco	0.083	0.002	502000	0.139	0.0049	1142000	0.24	0.0085	1976000	0.425	0.016	3495000
		Pass Loco hits Pass Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.008	1747000
		Pass Loco hits Frt Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.008	1747000
		Pass car hit by Loco	0.166	0.005	1005000	0.275	0.0119	2284000	0.476	0.0206	3951000	0.841	0.032	6988000
	Intrusion Collision (rollout)	Pass Loco hits Car	0.013	0.0005	113000	0.031	0.0011	257000	0.054	0.0019	445000	0.096	0.0034	786000
	Intrusion Collision (other))	Pass Loco hits Car	0.026	0.0009	226000	0.063	0.0022	514500	0.108	0.0038	889000	0.191	0.0068	1573000
	Overspeed		0.044	0.0004	667000	0.14	0.00186	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Broken Rail		0.044	0.0004	667000	0.14	0.00186	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Work Zone Violation		0.083	0.0083	0	0.125	0.0125	0	0.164	0.0164	0	0.218	0.0218	0

Freight trains	Accident Scenario	Accident Sub-scenarios	Rep. Speed 25 mph Injuries	Rep. Speed 25 mph Fatalities	Rep. Speed 25 mph Damage $	Rep. Speed 40 mph Injuries	Rep. Speed 40 mph Fatalities	Rep. Speed 40 mph Damage $	Rep. Speed 50 mph Injuries	Rep. Speed 50 mph Fatalities	Rep. Speed 50 mph Damage $
	Train-Train Collision	Frt Loco hits Loco	0.43	0.043	105000	1.1	0.11	270000	1.7	0.17	422000
		Frt Loco hits Car	0.35	0.035	88000	0.9	0.09	225000	1.4	0.14	352000
		Frt car hit by Loco	0	0	44000	0	0	112000	0	0	176000
	Intrusion Colln equip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Colln equip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Colln Unequip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Colln Unequip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Overspeed, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Overspeed, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Work Zone Viol'n, Equip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0
	Work Zone Viol'n, Unequip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0

Casualties and damage in Table 3.1 are per accident, except for Work Zone Violations which are per million train-miles

Table 3.2: Grade Crossing and Diamonds: Numbers by Representative Speed, Accident Frequency and Consequences

Train Type	Representative Speed (mph)	Type of Grade-crossing	Number Crossings: Passenger	Number Crossings: HS Passenger	Number Crossings: Freight	Accident Frequency per Million Crossing Passes: Passenger	Accident Frequency per Million Crossing Passes: Freight	Crossing Collision Consequences: Pass. Occup't Casualty Prob(accident): Injuries	Pass. Occup't Casualty Prob(accident): Fatalities	Pass. Occup't Casualty Prob(accident): Cost $/Accid't	Freight Trains (per accident): Injuries	Freight Trains (per accident): Fatalities	Freight Trains (per accident): Cost $	Number Diamonds
Passenger	40	Public gates lights	0	0		0.350		0.0029	0.000047	50000				1
		Public other	0	0		0.300								
		Private	0	0		0.100								
	60	Public gates lights	8	0		0.600		0.0068	0.000112	113000				0
		Public other	0	0		0.500								
		Private	0	0		0.200								
	79	Public gates lights	20	8		0.800		0.0105	0.000156	196000				0
		Public other	0	0		0.650								
		Private	1	0		0.300								
	105	Public gates lights	0	20		1.100		0.0188	0.000276	346000				0
		Public other	0	0		0.800								
		Private	0	1		0.300								
Freight	25	Public gates lights			0		0.150				0.12	0.005	20000	0
		Public other			0		0.120							
		Private			0		0.050							
	40	Public gates lights			8		0.300				0.25	0.013	50000	1
		Public other			0		0.250							
		Private			0		0.100							
	50	Public gates lights			20		0.350				0.39	0.02	74000	0
		Public other			0		0.300							
		Private			1		0.120							

Table 3.3a: Segment Data (for reference only, not used in calculations)

Segment Number	Start (Milepost)	End (Milepost)	Type	Length (miles)	Rep. Speed (mph): Freight	Pass	HS Pass-Cons	HS Pass
1.0	62.60	64.40	CP Adjacent (M	2.2	40	60	60	79
2.0	64.80	66.55	Plain	1.75	50	79	79	105
3.0	66.55	68.23	Plain	1.68	50	79	79	105
4.0	68.23	70.17	CP Adjacent (M	1.94	50	79	79	105
5.0	70.17	72.80	Siding (Mi	2.63	40	60	60	79
6.0	72.80	72.80	Diamond	0.00	40	40	40	40
7.0	72.80	74.94	CP Adjacent (M	2.14	40	60	60	79
8.0	74.94	77.27	Plain	2.33	50	79	79	105
9.0	77.27	80.13	Plain	2.86	50	79	79	105
10.0	80.13	81.99	CP Adjacent (M	1.86	50	79	79	105
11.0	81.99	84.65	Siding (Mi	2.66	50	79	79	105
12.0	84.65	86.43	CP Adjacent (M	1.78	50	79	79	105
13.0	86.43	88.35	Plain	1.92	50	79	79	105
	Length Check	70.2		18.2				

Table 3.3b: Aggregate Segment Data: SegmentsTypes, Train Types, Speeds, and Lengths

Aggregate Segment Length by Type and Speed Band (from Seg Def and Preventability)

Segment Type	Train Type	Represent've Speed (mph)	Freight (miles)	Reg Pass (miles)	HS Pass Collision (mi)	HS Pass Other (mi)
Siding (mon)	Freight	25	0.00			
		40	2.63			
		50	2.66			
	Passenger	40		0.00	0.00	0.00
		60		2.63	2.63	0.00
		79		2.66	2.66	2.63
		105		0.00	0.00	2.66
Siding (unmon)	Freight	25	0.00			
		40	0.00			
		50	0.00			
	Passenger	40		0.00	0.00	0.00
		60		0.00	0.00	0.00
		79		0.00	0.00	0.00
		105		0.00	0.00	0.00
CP Adjacent (mon)	Freight	25	0.00			
		40	2.14			
		50	7.78			
	Passenger	40		0.00	0.00	0.00
		60		2.14	2.14	0.00
		79		7.78	7.78	2.14
		105		0.00	0.00	7.78
CP Adjacent (unmon)	Freight	25	0.00			
		40	0.00			
		50	0.00			
	Passenger	40		0.00	0.00	0.00
		60		0.00	0.00	0.00
		79		0.00	0.00	0.00
		105		0.00	0.00	0.00
Plain Track	Freight	25	0.00			
		40	0.00			
		50	10.54			
	Passenger	40		0.00	0.00	0.00
		60		0.00	0.00	0.00
		79		10.54	10.54	0.00
		105		0.00	0.00	10.54
Totals All Types	Freight	25	0.00			
		40	4.77			
		50	20.98			
	Passenger	40		0.00	0.00	0.00
		60		4.77	4.77	0.00
		79		20.98	20.98	4.77
		105		0.00	0.00	20.98
		Checking Total		25.75	25.75	25.75	25.75

Table 3.4: Collision Frequencies by Segment Type and Collision Scenario (From Coll Matrix)

Scenarios	Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain	Diamond
Pass Loco Hits Loco	0.0029	0.0040	0.0079	0.0094	0.0098	0.000000
Pass Loco Hits Pass Car	0.0011	0.0014	0.0007	0.0009	0.0001	0.000000
Pass Loco Hits Freight Car	0.0003	0.0005	0.0003	0.0004	0.0001	0.008034
Pass Car Hit by Loco	0.0013	0.0018	0.0010	0.0012	0.0002	0.001607
Freight Loco Hits Loco	0.0007	0.0011	0.0022	0.0026	0.0002	0.000000
Freight Loco Hits Car	0.0003	0.0004	0.0003	0.0003	0.0000	0.027198
Freight Car Hit By Loco	0.0003	0.0005	0.0003	0.0004	0.0001	0.029625

Collision Frequency for Passenger + Unequipped Freight Train

Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain
0.0004	0.0007	0.0014	0.0017	0.0002
0.0001	0.0001	0.0001	0.0001	0.0000
0.0002	0.0003	0.0002	0.0002	0.0000

Mauve cells contain data imported from previous worksheet in a group of three worksheets covering one sub-corridor, season and operating state.

Weighted Collision Accident Frequencies by Representative Speed (mph)

Scenarios	Freight 25	Freight 40	Freight 50	Passenger 40	Passenger 60	Passenger 79	Passenger 105
Pass Loco Hits Loco				0.0000	0.0000	0.0015	0.0030
Pass Loco Hits Pass Car				0.0000	0.0000	0.0002	0.0005
Pass Loco Hits Freight Car				0.0000	0.0000	0.0001	0.0002
Pass Car Hit by Loco				0.0000	0.0000	0.0003	0.0005
Freight Loco Hits Loco	0.0000	0.0014	0.0010				
Freight Loco Hits Car	0.0000	0.0003	0.0001				
Freight Car Hit By Loco	0.0000	0.0003	0.0002				

All train-to-train collision frequencies are in units of **trains in collisions per million train miles operated in the sub-corridor by all train types..**

Table 3.5a: Risk Calculation - Passenger Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Freq. (per mill tm)	Preventability	Adjusted Rate	Trips/day	Trips per 10 years	Length of Track (miles)	Train-miles per 10 Years	Accidents per 10 years	Number seats per train	Occupancy Factor	Passengers per train	Injuries per 10 years	Fatalities per 10 years	Damage $ per 10 years
40	Train-Train Collision	Pass Loco hits Loco	0.00000	Incl	0.00000	7.43	25726	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Pass Car	0.00000	Incl	0.00000	7.43	25726	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Frt Car	0.00000	Incl	0.00000	7.43	25726	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00000	Incl	0.00000	7.43	25726	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.30	0.00602	6.00	20774	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (other))	Pass Loco hits intruder	0.01440	0.05	0.01368	6.00	20774	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Overspeed		0.01100	0.80	0.00220	6.00	20774	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Broken Rail		0.01670	0.04	0.01603	6.00	20774	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Work Zone Violation			0.50		6.00	20774	0	0					0.0000	0.00000	0
										0.00000				**0.00000**	**0.00000**	**0**
60	Train-Train Collision	Pass Loco hits Loco	0.00000	Incl	0.00000	7.43	25726	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Pass Car	0.00000	Incl	0.00000	7.43	25726	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Frt Car	0.00000	Incl	0.00000	7.43	25726	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00000	Incl	0.00000	7.43	25726	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.30	0.00602	6.00	20774	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.05	0.01368	6.00	20774	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Overspeed		0.01100	0.80	0.00220	6.00	20774	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Broken Rail		0.01670	0.04	0.01603	6.00	20774	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Work Zone Violation			0.50		6.00	20774	0	0					0.0000	0.00000	0
										0.00000				**0.00000**	**0.00000**	**0**
79	Train-Train Collision	Pass Loco hits Loco	0.00148	Incl	0.00148	7.43	25726	25.75	662436	0.00098	320	0.6	192	0.045	0.0016	1940
		Pass Loco hits Pass Car	0.00017	Incl	0.00017	7.43	25726	25.75	662436	0.00011	320	0.6	192	0.002	0.0001	110
		Pass Loco hits Frt Car	0.00009	Incl	0.00009	7.43	25726	25.75	662436	0.00006	320	0.6	192	0.001	0.0001	58
		Pass car hit by Loco	0.00030	Incl	0.00030	7.43	25726	25.75	662436	0.00020	320	0.6	192	0.018	0.0008	787
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.30	0.00602	6.00	20774	4.77	99094	0.00060	320	0.6	192	0.006	0.0002	265
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.05	0.01368	6.00	20774	4.77	99094	0.00136	320	0.6	192	0.028	0.0010	1205
	Overspeed		0.01100	0.80	0.00220	6.00	20774	4.77	99094	0.00022	320	0.6	192	0.009	0.0001	567
	Broken Rail		0.01670	0.04	0.01603	6.00	20774	4.77	99094	0.00159	320	0.6	192	0.064	0.0010	4131
	Work Zone Violation			0.50		6.00	20774	4.77	99094					0.008	0.0008	0
										0.00511				**0.18188**	**0.00573**	**9063**
105	Train-Train Collision	Pass Loco hits Loco	0.00303	Incl	0.00303	7.43	25726	20.98	539725	0.00164	320	0.6	192	0.133	0.0050	5715
		Pass Loco hits Pass Car	0.00046	Incl	0.00046	7.43	25726	20.98	539725	0.00025	320	0.6	192	0.008	0.0004	436
		Pass Loco hits Frt Car	0.00016	Incl	0.00016	7.43	25726	20.98	539725	0.00009	320	0.6	192	0.003	0.0001	149
		Pass car hit by Loco	0.00051	Incl	0.00051	7.43	25726	20.98	539725	0.00027	320	0.6	192	0.044	0.0017	1917
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.30	0.00602	6.00	20774	20.98	435848	0.00262	320	0.6	192	0.048	0.0017	2062
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.05	0.01368	6.00	20774	20.98	435848	0.00596	320	0.6	192	0.219	0.0078	9379
	Broken Rail		0.01100	0.80	0.00220	6.00	20774	20.98	435848	0.00096	320	0.6	192	0.052	0.0008	4405
	Broken Rail		0.01670	0.04	0.01603	6.00	20774	20.98	435848	0.00699	320	0.6	192	0.376	0.0060	32101
	Work Zone Violation			0.50		6.00	20774	20.98	435848					0.048	0.0048	0
	Total									**0.01878**				**0.93044**	**0.02834**	**56164**
	Overall Totals									**0.02389**				**1.11231**	**0.03407**	**65227**
	Totals All Speeds	**Train-train Collisions**								**0.00360**				**0.25533**	**0.00976**	**11112**
		Intrusion Collisions								**0.01054**				**0.30131**	**0.01070**	**12912**
		Overspeed								**0.00118**				**0.06034**	**0.00097**	**4972**
		Broken Rail								**0.00858**				**0.43970**	**0.00707**	**36231**
		Work Zone Violation								**0.00000**				**0.05563**	**0.00556**	**0**

Table 3.5b: Risk Calculation - Collisions at Diamonds - Passenger

Number Diamonds	Freq'y per mill passes	Collisions (millions)	Injuries	Fatalities	Damage
1	0.000000	0.000000	0.000000	0.000000	0.00
1	0.000000	0.000000	0.000000	0.000000	0.00
1	0.008034	0.000207	0.001349	0.000040	51.88
1	0.001607	0.000041	0.001317	0.000040	41.54
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.008034	0.000000	0.000000	0.000000	0.00
0	0.001607	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.008034	0.000000	0.000000	0.000000	0.00
0	0.001607	0.000000	0.000000	0.000000	0.00
		0.000000	**0.00000**	**0.00000**	**0.00**

Table 3.6a: Risk Calculation - Freight Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Freq (per mill tm)	Preventability	Adjusted Rate	Trips/day	Trips per 10 years	Length of Track (miles)	Per 10 years: Train-Miles	Accidents	Injuries	Fatalities	Damage $
25	Train-Train Collision	Frt Loco hits Loco	0	Incl	0.00000	7.43	25726	0	0	0.00000	0.00000	0.000000	$0
		Frt Loco hits Car	0	Incl	0.00000	7.43	25726	0	0	0.00000	0.00000	0.000000	$0
		Frt car hit by Loco	0	Incl	0.00000	7.43	25726	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Colln equip (rollout)	Frt Loco hits Car	0.014	0.30	0.01008	1.07	3705	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Colln equip (other)	Frt Loco hits Car	0.009	0.05	0.00817	1.07	3705	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Colln Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.36	1246	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Colln Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.36	1246	0	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.80	0.00320	1.07	3705	0	0	0.00000	0.00000	0.000000	$0
	Overspeed, Unequip		0.016	0.00	0.01600	0.36	1246	0	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.04	0.05338	1.07	3705	0	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Unequip		0.056	0.00	0.05560	0.36	1246	0	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.50		1.07	3705	0	0		0.00000	0.000000	$0
	Work Zone Viol'n, Unequip			0.00		0.36	1246	0	0		0.00000	0.000000	$0
										0.0000	**0.0000**	**0.000000**	**$0**
40	Train-Train Collision	Frt Loco hits Loco	0.0014	Incl	0.00139	7.43	25726	4.77	122712	0.00017	0.00019	0.000019	$46
		Frt Loco hits Car	0.0003	Incl	0.00027	7.43	25726	4.77	122712	0.00003	0.00003	0.000003	$7
		Frt car hit by Loco	0.0003	Incl	0.00033	7.43	25726	4.77	122712	0.00004	0.00000	0.000000	$4
	Intrusion Colln equip (rollout)	Frt Loco hits Car	0.014	0.30	0.01008	1.07	3705	4.77	17672	0.00018	0.00004	0.000004	$5
	Intrusion Colln equip (other)	Frt Loco hits Car	0.009	0.05	0.00817	1.07	3705	4.77	17672	0.00014	0.00003	0.000003	$4
	Intrusion Colln Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.36	1246	4.77	5946	0.00009	0.00002	0.000002	$2
	Intrusion Colln Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.36	1246	4.77	5946	0.00005	0.00001	0.000001	$1
	Overspeed, Equip		0.016	0.80	0.00320	1.07	3705	4.77	17672	0.00006	0.00001	0.000001	$21
	Overspeed, Unequip		0.016	0.00	0.01600	0.36	1246	4.77	5946	0.00010	0.00001	0.000000	$36
	Broken Rail, Equip		0.056	0.04	0.05338	1.07	3705	4.77	17672	0.00094	0.00014	0.000014	$354
	Broken Rail, Unequip		0.056	0.00	0.05560	0.36	1246	4.77	5946	0.00033	0.00005	0.000005	$124
	Work Zone Viol'n, Equip			0.50		1.07	3705	4.77	17672		0.00058	0.000058	$0
	Work Zone Viol'n, Unequip			0.00		0.36	1246	4.77	5946		0.00039	0.000039	$0
										0.00213	**0.0015**	**0.00015**	**9605**
50	Train-Train Collision	Frt Loco hits Loco	0.0010	Incl	0.00101	7.43	25726	20.98	539725	0.00055	0.00093	0.000093	$230
		Frt Loco hits Car	0.0001	Incl	0.00015	7.43	25726	20.98	539725	0.00008	0.00011	0.000011	$28
		Frt car hit by Loco	0.0002	Incl	0.00019	7.43	25726	20.98	539725	0.00010	0.00000	0.000000	$18
	Intrusion Colln equip (rollout)	Frt Loco hits Car	0.014	0.30	0.01008	1.07	3705	20.98	77726	0.00078	0.00027	0.000027	$34
	Intrusion Colln equip (other)	Frt Loco hits Car	0.009	0.05	0.00817	1.07	3705	20.98	77726	0.00064	0.00022	0.000022	$28
	Intrusion Colln Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.36	1246	20.98	26151	0.00038	0.00013	0.000013	$17
	Intrusion Colln Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.36	1246	20.98	26151	0.00022	0.00008	0.000008	$10
	Overspeed, Equip		0.016	0.80	0.00320	1.07	3705	20.98	77726	0.00025	0.00009	0.000009	$146
	Overspeed, Unequip		0.016	0.00	0.01600	0.36	1246	20.98	26151	0.00042	0.00015	0.000015	$245
	Broken Rail, Equip		0.056	0.04	0.05338	1.07	3705	20.98	77726	0.00415	0.00145	0.000145	$2,431
	Broken Rail, Unequip		0.056	0.00	0.05560	0.36	1246	20.98	26151	0.00145	0.00051	0.000051	$852
	Work Zone Viol'n, Equip			0.50		1.07	3705	20.98	77726		0.00323	0.000323	$0
	Work Zone Viol'n, Unequip			0.00		0.36	1246	20.98	26151		0.00217	0.000217	$0
										0.00902	**0.0093**	**0.00093**	**$4,040**
	Overall Totals									**0.01115**	**0.0108**	**0.0011**	**$4,645**
Totals All Speeds	**Train-Train Collisions**									**0.00097**	**0.00126**	**0.00013**	**335**
	Intrusion Collisions									**0.00248**	**0.00081**	**0.00008**	**102**
	Diamond Collisions									**0.00146**	**0.00063**	**0.00006**	**243**
	Overspeed									**0.00082**	**0.00026**	**0.00003**	**448**
	Broken Rail									**0.00688**	**0.00214**	**0.00021**	**3761**
	Work Zone Violation									**0.00000**	**0.00637**	**0.00064**	**0**
	Grade Crossing Collisions												

Table 3.6b: Risk Calculation - Collisions at Diamonds - Freight

Number Diamonds	Freq'y per mill passes	Collisions (millions)	Injuries	Fatalities	Damage
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.027198	0.000000	0.000000	0.000000	0.00
0	0.029625	0.000000	0.000000	0.000000	0.00
1	0.000000	0.000000	0.000000	0.000000	0.00
1	0.027198	0.000700	0.000630	0.000063	157.43
1	0.029625	0.000762	0.000000	0.000000	85.36
		0.001462	**0.000630**	**0.000063**	**243**

Table 3.7: Risk Calculations: Passenger and Freight Trains; Grade Crossings

| Train Type | Representative Speed | Type of Grade-crossing | Base Collision Frequency | Preventability Factor | Adjusted Collision Frequency | Trips per Day | Crossing Passes per Trip | Crossing Passes per 10 Years | Collisions per 10 Years | Seats per Train (Passenger) | Occupancy Factor | Passengers per Train | Passenger/ Crew Injuries per 10 Years | Passenger/ Crew Fatalities per 10 Years | Damage

Worksheet 1-J,T: IDOT-PTC Risk Model: Braking Distances and Collision Zone Calculations, Joliet Sub-corridor, PTC Timeout Operating State

Table 1.1: Stopping Distance Parameters and Calculations, Including Release and ACS Response Delay

Braking Formula Inputs		
TrainSystem Type	Parameter	Value
Freight	Coefficient F	0.035
	Appl'n Time (secs)	13.0
	Train Weight (lb)	67600000
	Brake Force (lb)	775693
Passenger	Coefficient A	0.068
	Coefficient B	0
	Safety Factor	1.25
Train Control	Latency(T-out) (sec)	120
	ACS Response	0
Gushy Train Speed (mph)		15

Braking Distance Calculations (ft) (including free running in TO)

Train Type	Speeds (mph)	To Stop	Reduction to RedCon²	RedCon² to Stop
Freight	25	5962	5962	0
	40	10552	8464	2068
	50	14034	11966	2068
Passenger	40	6132	6132	0
	60	10197	10197	0
	79	14676	12278	2398
	105	21776	19381	2398
Ert Red'd Consc	35	5205	NA	NA

Note: RedCon refers to the speed at which collision consequences will be significantly reduced
60 mph for passenger trains and 35 mph for freight trains
If train speed is lower that this speed, then there are no reduced consequences and Zone A2 has zero length

Braking Duration (secs)		
Deceleration (ft/sec²)	Reduction to RedCon²	RedCon² to Stop
0.668	175	0
0.668	135	77
0.668	153	77
1.293	165	0
1.293	188	0
1.293	142	68
1.293	171	68

Guilty Train Distance		
Reduction to RedCon²	RedCon² to Stop	Full Speed to Stop
3649	0	9811
2882	1692	11397
3366	1692	15332
3640	0	9772
4139	0	14336
3115	1499	15393
3764	1499	23145

Total Zone Lengths		
Reduction to RedCon²	RedCon² to Stop	Full Speed to Stop
9811	0	9811
11397	3760	15126
15332	3760	19092
9772	0	9772
14336	0	14336
15393	3696	19289
23145	3696	27041

Blue cell/constant data imported from the Inputs worksheet

Sight Distance (ft) 2500

Table 1.2: Segment Delineations: Sub-Corridor 1: MP 62.7 (Metairie) - MP 68.3 (Bunge)

Segment Number	Start (MP)	End (MP)	Type	Variant	Length Miles	Length Feet	Posted Speed (mph) Freight	Pass	HS Pass	Represented Speed mph) Freight	Pass	HS Pass (Consist)	HS Pass (Other)
25	1.0	62.8	64.8	CP Adjacent (M)	2.2	11616	60	79	110	50	79	79	105
27	2.0	64.8	66.8	Plain	1.8	9240	60	79	110	50	79	79	105
28	3.0	66.8	68.2	Plain	1.7	8670.4	60	79	110	50	79	79	105
29	4.0	68.2	70.2	CP Adjacent (M)	1.9	10243.2	60	79	110	50	79	79	105
30	5.0	70.2	72.6	Siding (M)	2.4	13886.4	60	79	110	50	79	79	105
31	6.0	72.6	72.6	Plain	0.0	0	60	79	110	50	79	79	105
32	7.0	72.6	74.8	CP Adjacent (M)	2.1	11299.2	60	79	110	50	79	79	105
33	8.0	74.8	77.1	CP Adjacent (M)	2.3	12302.4	60	79	110	50	79	79	105
34	9.0	77.1	80.0	Plain	2.9	15321.6	60	79	110	50	79	79	105
35	10.0	80.1	82.0	CP Adjacent (M)	1.9	9820.8	60	79	110	50	79	79	105
36	11.0	82.0	84.7	Siding (M)	2.7	14044.8	60	79	110	50	79	79	105
37	12.0	84.7	86.7	CP Adjacent (M)	1.9	9398.4	60	79	110	50	79	79	105
38	13.0	86.4	86.4	Plain	1.9	10137.6	60	79	110	50	79	79	105

Industry-Siding Number	Name	Steps	Passenger

Check Total 25.8

Table 1.3: Aggregate Segment Length by Segment Type and Speed

Segment Type	Train Type	Representative Speed (mph)	Aggregate Length of Segments by Train and Segment Types: Color passenger Miles	Color passenger Feet	High Speed Passenger: Collision Consc² Miles	Collision Consc² Feet	Other Miles	Other Feet
Siding (main)	Freight	25	0.00	0				
		40	2.63	13886				
		50	2.66	14045				
	Passenger	40			0.00	0	0.00	0
		60			2.63	13886	0.00	0
		79			2.66	14045	2.63	13886
		105					0.00	0
Siding (union)	Freight	25	0.00	0				
		40	0.00	0				
		50	0.00	0				
	Passenger	40			0.00	0	0.00	0
		60			0.00	0	0.00	0
		79			0.00	0	0.00	0
		105					0.00	0
CP Adjacent (main)	Freight	25	0.00	0				
		40	2.14	11299				
		50	7.78	41078				
	Passenger	40			0.00	0	0.00	0
		60			2.14	11299	0.00	0
		79			7.78	41078	2.14	11299
		105					0.00	0
CP Adjacent (union)	Freight	25	0.00	0				
		40	0.00	0				
		50	0.00	0				
	Passenger	40			0.00	0	0.00	0
		60			0.00	0	0.00	0
		79			0.00	0	0.00	0
		105					0.00	0
Plain Track	Freight	25	0.00	0				
		40	0.00	0				
		50	10.54	55651				
	Passenger	40			0.00	0	0.00	0
		60			0.00	0	0.00	0
		79			10.54	55651	0.00	0
		105					10.54	55651
Check Total			25.75		25.75		25.75	
		Checking	25.75		25.75		25.75	

*Is/speed is used to calculate collision consequences in collisions between an equipped and an unequipped train (Alk.Y, reflecting the IDOT PTC speed restriction when an equipped train nears an unequipped train

Table 1.3: Mitigation and Prevention Zones - All Segments - Lengths in Feet

Zone A1: Limited Speed Reduction No Prevention or Mitigation			Zone A2: Reduced Speed to Stop Severity Mitigation			Zone B: Able to Stop Full Prevention			Overlap of Stopping Distance Into Zone C			Distance in Timeout in Zone C			Overlap of Zone A1 into Zone C			Overlap of Zone A1 Into Zone C within Sight Distance			Overlap of Zone A2 into Zone C within Sight Distance		
Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass
11616	11616	11616	0	0	0	0	0	0	7476	7673	15425	7476	7673	15425	3716	3777	11529	2500	2500	2500	0	0	0
9240	9240	9240	0	0	0	0	0	0	9852	10049	17801	8802	10049	17801	6092	6153	13905	2500	2500	2500	0	0	0
8670	8670	8670	0	0	0	0	0	0	10221	10419	18171	8802	10419	18171	6462	6523	14275	2500	2500	2500	0	0	0
10243	10243	10243	0	0	0	0	0	0	8849	9046	16788	8802	9046	16788	5089	5150	12902	2500	2500	2500	0	0	0
13867	13886	13886	2520	0	0	0	0	0	1240	450	450	1240	450	450	0	450	0	1240	450	0	2.63	0	0
0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11299	11299	11299	0	0	0	0	0	0	3827	3037	7980	3827	3037	7980	47	3037	4094	47	2500	2500	2433	0	0
12302	12302	12302	0	0	0	0	0	0	6789	6987	14739	6789	6987	14739	3030	3091	10843	2500	2500	2500	0	0	0
15321	15321	15321	0	0	0	0	0	0	3991	4188	11940	3991	4188	11940	231	292	8044	231	292	2500	2298	2208	0
9821	9821	9821	0	0	0	0	0	0	6271	6468	17220	8802	6468	17220	5513	5572	13324	2500	2500	2500	0	0	0
14045	14045	14045	0	0	0	0	0	0	5047	5244	12906	5047	5244	12906	1267	1348	9100	1267	1348	2500	1213	1152	0
9398	9398	9398	0	0	0	0	0	0	9693	9891	17643	8802	9891	17643	5634	5695	13747	2500	2500	2500	0	0	0
10138	10138	10138	0	0	0	0	0	0	8954	9152	16904	8802	9152	16904	5194	5256	13008	2500	2500	2500	0	0	0

Yellow cell/constant data exported to the next worksheet in the sequence of three sheets that perform the calculations for one sub-corridor, season and operating state

Table 1.4: Breakdown of Segments Lengths, by Representative Speed (miles)

Segment Number	Freight Speeds (mph) 25	40	50	Convent'l Pass Speeds (mph) 40	60	79	HS Pass, Speeds - Colln Consqu. (mph) 40	60	79	105	HS Pass, Speeds - Other (mph) 40	60	79	105
1.0	0	0	2.2	0	0	2.2	0	0	2.2	0	0	0	0	2.2
2.0	0	0	1.75	0	0	1.75	0	0	1.75	0	0	0	0	1.75
3.0	0	0	1.68	0	0	1.68	0	0	1.68	0	0	0	0	1.68
4.0	0	0	1.94	0	0	1.94	0	0	1.94	0	0	0	0	1.94
5.0	0	2.63	0	0	2.63	0	0	2.63	0	0	0	0	2.63	0
6.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.0	0	2.14	0	0	2.14	0	0	2.14	0	0	0	0	2.14	0
8.0	0	0	2.33	0	0	2.33	0	0	2.33	0	0	0	0	2.33
9.0	0	0	2.86	0	0	2.86	0	0	2.86	0	0	0	0	2.86
10.0	0	0	1.89	0	0	1.89	0	0	1.89	0	0	0	0	1.89
11.0	0	0	2.68	0	0	2.68	0	0	2.68	0	0	0	0	2.68
12.0	0	0	1.78	0	0	1.78	0	0	1.78	0	0	0	0	1.78
13.0	0	0	1.92	0	0	1.92	0	0	1.92	0	0	0	0	1.92

Table 1.4a: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for Siding (M) Segments

Lengths in Zone C	A1	A2	B
Total Length, Siding (M) Segments (ft)	27321.2		
Number Siding (M) Segments	2		
Average distance in Zone C (ft) Freight	644	1226	630
Passenger	560	576	1565
HS Pass	500	525	1772

Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass
25411	27931	27931	2520	0	0	0	0	0
Zone lengths A1, A2, B (ft)								
0.910	1.000	1.000	0.090	0.000	0.000	0.000	0.000	0.000
Fraction of total length in zone								

Collision Accident Mitigation Probabilities: Combined All Zones									Values translanted to Collision Matrix
0.890	0.964	0.978	0.105	0.023	0.009	0.005	0.013	0.071	

Distribution of train location at time of	In Block	0.95
isolation in Reference Case accidents	Previous Block	0.05
PTC Risk Increment in Zone C		2
Potential danger length in Zone C (ft)		2500

Table 1.4b: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for Siding (U) Segments

Lengths in Zone C	A1	A2	B
Total Length, Siding (M) Segments (ft)	1		
Number Siding (M) Segments	0.001		
Average distance in Zone C (ft) Freight	0	0	2500
Passenger	0	0	2500
HS Pass	0	0	2500

Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass
0	0	0	0	0	0	0	0	0
Zone lengths A1, A2, B (ft)								
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fraction of total length in zone								

Collision Accident Mitigation Probabilities: Combined All Zones									Values translanted to Collision Matrix
0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100	

Distribution of train location at time of	In Block	0.95
isolation in Reference Case accidents	Previous Block	0.05
PTC Risk Increment in Zone C		2
Potential danger length in Zone C (ft)		2500

Table 1.4c: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for CP Adjacent (M) Segments

Lengths in Zone C	A1	A2	B
Total Length, Siding (M) Segments (ft)	52377.6		
Number Siding (M) Segments	5		
Average distance in Zone C (ft) Freight	3513	487	0
Passenger	2500	0	0
HS Pass	2500	0	0

Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass
52378	52378	52378	0	0	0	0	0	0
Zone lengths A1, A2, B (ft)								
1.000	1.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000
Fraction of total length in zone								

Collision Accident Mitigation Probabilities: Combined All Zones									Values translanted to Collision Matrix
1.031	1.050	1.050	0.019	0.000	0.000	0.000	0.000	0.000	

Distribution of train location at time of	In Block	0.95
isolation in Reference Case accidents	Previous Block	0.05
PTC Risk Increment in Zone C		2
Potential danger length in Zone C (ft)		2500

Table 1.4d: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for CP Adjacent (U)Segments

Lengths in Zone C	A1	A2	B
Total Length, Siding (M) Segments (ft)	1		
Number Siding (M) Segments	0.001		
Average distance in Zone C (ft) Freight	0	0	2500
Passenger	0	0	2500
HS Pass	0	0	2500

Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass
0	0	0	0	0	0	0	0	0
Zone lengths A1, A2, B (ft)								
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fraction of total length in zone								

Collision Accident Mitigation Probabilities: Combined All Zones									Values translanted to Collision Matrix
0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100	

Distribution of train location at time of	In Block	0.95
isolation in Reference Case accidents	Previous Block	0.05
PTC Risk Increment in Zone C		2
Potential danger length in Zone C (ft)		2500

Table 1.4e: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for Plain Track Segments

Lengths in Zone C	A1	A2	B
Total Length, Siding (M) Segments (ft)	55653.2		
Number Siding (M) Segments	5		
Average distance in Zone C (ft) Freight	2046	454	0
Passenger	2258	442	0
HS Pass	2500	0	0

Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass
52378	52378	52378	0	0	0	0	0	0
Zone lengths A1, A2, B (ft)								
0.941	0.941	0.941	0.000	0.000	0.000	0.000	0.000	0.000
Fraction of total length in zone								

Collision Accident Mitigation Probabilities: Combined All Zones									Values translanted to Collision Matrix
0.976	0.976	0.994	0.018	0.018	0.000	0.000	0.000	0.000	

Distribution of train location at time of	In Block	0.95
isolation in Reference Case accidents	Previous Block	0.05
PTC Risk Increment in Zone C		2
Potential danger length in Zone C (ft)		2500

Table 1.5f: Distribution of Equipped Train Locations by Collision Preventability Zones - Values for Diamond Segments

Lengths in Zone C	A1	A2	B
Total Length, Siding (M) Segments (ft)	25189.8		
Number Siding (M) Segments	2		
Average distance in Zone C (ft) Freight	0	0	2500
Passenger	0	0	2500
HS Pass	0	0	2500

Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass
16901	16967	18955	4135	0	4795	4149	8278	1435
Zone lengths A1, A2, B (ft)								
0.671	0.671	0.753	0.164	0.000	0.190	0.165	0.329	0.057
Fraction of total length in zone								

Collision Accident Mitigation Probabilities: Combined All Zones									Values translanted to Collision Matrix
0.838	0.838	0.715	0.166	0.000	0.181	0.257	0.412	0.154	

Distribution of train location at time of	In Block	0.95
isolation in Reference Case accidents	Previous Block	0.05
PTC Risk Increment in Zone C		2
Potential danger length in Zone C (ft)		2500

Worksheet 2-J,T,R: Collision Frequencies Calculation - PTC 120 Sec. Timeout Case, Joliet Sub-corridor, PTC Timeout Operating State, Rest of Year

Table 2.1a: Collision Distribution Matrix (Fraction Accidents by Train Pair and Collision Type). Collisions Between Trains Operating on the IDOT Test Corridor Only (Not diamonds and intrusions)

	Train Pairs in In Collision	Collision Scenario Prob (Top Level)	Siding - Monitored: Collision Distribution Head On	Siding - Monitored: Collision Distribution Rear End/Side	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty
	Percent Guilty				100%	0%	100%	0%
Both Trains TBE (Note 3)	Pass-Pass	0.71	0.50	0.50	0.355	0	0.355	0
	Pass-TBE Freight	0.22	0.50	0.50	0.11	0	0.11	0
	TBE Freight - TBE Freight	0.00	0.50	0.50	0	0	0	0
One Train TBE	**Percent Guilty**				50%	50%	50%	50%
	Pass - NE Freight, Head -On	0.07	1	0	0.0175	0.0175	0	0
	Rear/Side, Pass into NE Frt		0	1	0	0	0.028	0
	Rear/Side NE Frt into Pass		0	1	0	0	0	0.007
	TBE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0
Neither Train TBE	**Percent Guilty**				0%	100%	0%	100%
	NE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0
	Total Probability (checking)	1		1	0.4825	0.0175	0.493	0.007

	Siding - Unmonitored: Collision Distribution Head On	Siding - Unmonitored: Collision Distribution Rear End/Side	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
			100%	0%	100%	0%
Both Trains TBE (Note 3)	0.5	0.5	0.355	0	0.355	0
	0.5	0.5	0.11	0	0.11	0
	0.5	0.5	0	0	0	0
One Train TBE			50%	50%	50%	50%
	1	0	0.0175	0.0175	0	0
	0	1	0	0	0.028	0
	0	1	0	0	0	0.007
	0.5	0.5	0	0	0	0
Neither Train TBE			0%	100%	0%	100%
	0.5	0.5	0	0	0	0
		1	0.4825	0.0175	0.493	0.007

	CP Adjacent - Monitored Siding: Collision Distribution Head On	CP Adjacent - Monitored Siding: Collision Distribution Rear End/Side	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty
			100%	0%	100%	0%
Both Trains TBE (Note 3)	0.8	0.2	0.568	0	0.142	0
	0.7	0.3	0.154	0	0.066	0
	0.7	0.3	0	0	0	0
One Train TBE			50%	50%	50%	50%
	1	0	0.028	0.028	0	0
	0	1	0	0	0.0105	0
	0	1	0	0	0	0.0035
	0.7	0.3	0	0	0	0
Neither Train TBE			0%	100%	0%	100%
	0.7	0.3	0	0	0	0
		1	0.75	0.028	0.2185	0.0035

	CP Adjacent - Unmonitored Siding: Collision Distribution Head On	CP Adjacent - Unmonitored Siding: Collision Distribution Rear End/Side	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
			100%	0%	100%	0%
Both Trains TBE (Note 3)	0.8	0.2	0.568	0	0.142	0
	0.7	0.3	0.154	0	0.066	0
	0.7	0.3	0	0	0	0
One Train TBE			50%	50%	50%	50%
	1	0	0.028	0.028	0	0
	0	1	0	0	0.0105	0
	0	1	0	0	0	0.0035
	0.5	0.5	0	0	0	0
Neither Train TBE			0%	100%	0%	100%
	0.5	0.5	0	0	0	0
		1	0.75	0.028	0.2185	0.0035

	Plain Track: Collision Distribution Head On	Plain Track: Collision Distribution Rear/Side	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
			100%	0%	100%	0%
Both Trains TBE (Note 3)	0.70	0.30	0.497	0	0.213	0
	0.40	0.60	0.088	0	0.132	0
	0.50	0.50	0	0	0	0
One Train TBE			50%	50%	50%	50%
	1.00	0.00	0.0245	0.0245	0	0
	0.00	1.00	0	0	0.0175	0
	0.00	1.00	0	0	0	0.0035
	0.50	0.50	0	0	0	0
Neither Train TBE			0%	100%	0%	100%
	0.50	0.50	0	0	0	0
		1	0.6095	0.0245	0.3625	0.0035

Table 2.1b: Collision Type Distribution - Diamonds

	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty	Train Pairs in In Collision	Train Pair Type
			Percent Guilty	
Both Trains TBE (Note 3)			Pass-Pass	Both Trains TBE
			Pass-TBE Freight	
			TBE Freight - TBE Freight	
One Train TBE	50%	50%	**Percent Guilty**	One Train TBE
	0	0	Pass - NE Freight, Head -On	
	0.25	0.25	Rear/Side, Pass into NE Frt	
	0.05	0.05	Rear/Side NE Frt into Pass	
	0.1	0.1	TBE Freight - NE Freight	
Neither Train TBE		100%	**Percent Guilty**	
	0	0.2	NE Freight - NE Freight	Neither Train TBE
	0.4	0.6	Total Probability (checking)	

Note: The gray cells on these rows are set at zero, because in every case, the condition represented by the cell does not exist - either because there are no unequipped passenger trains, or because of the kind of collision defined for the row.

Quantity in cell C18 is for all collisions between a passenger train and an unequipped freight train

Table 2.2: Preventability Data For Unequipped train Guilty, One Train TBE

Segment Type	Not Prevented of Mitigated: Freight	Not Prevented of Mitigated: Pass	Not Prevented of Mitigated: HS Pass	Mitigated: Freight	Mitigated: Pass	Mitigated: HS Pass	Prevented: Freight	Prevented: Pass	Prevented: HS Pass
Siding (M)	0.890	0.964	0.970	0.135	0.023	0.009	0.025	0.063	0.071
Siding (U)	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100
CP Adjacent (M)	1.031	1.050	1.050	0.019	0.000	0.000	0.000	0.000	0.000
CP Adjacent (U)	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100
Plain Track	0.976	0.976	0.994	0.018	0.018	0.000	0.000	0.000	0.000
Diamonds	0.638	0.638	0.715	0.156	0.000	0.181	0.257	0.412	0.154

Mauve cells contain data imported from previous worksheet in a group of three worksheets covering one sub-corridor, season and operating state.

Table 2.3a: Collision Preventability Matrix (Percent Accidents Preventable Relative to CTC Reference Case)

	Preventability Equipped Train Guilty	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
Both TBE	90%	90%		90%		90%		90%	
	90%	90%		90%		90%		90%	
	90%	90%		90%		90%		90%	
One TBE	90%	90%	7%			90%	10%		
	90%			90%	7%			90%	10%
	90%			90%	0%			90%	0%
	90%	90%	3%	90%	0%	90%	10%	90%	0%
Neither TBE			0%		0%		0%		0%
Reference Case (CTC) Collision Accident Likelihood by Segment Type (collisions/million train miles)	0.030					0.040			

	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
Both TBE	90%		90%		90%		90%	
	90%		90%		90%		90%	
	90%		90%		90%		90%	
One TBE	90%	0%			90%	10%		
	90%		90%	0%			90%	0%
	90%		90%	0%			90%	0%
	90%	0%	90%	0%	90%	10%	90%	0%
Neither TBE		0%		0%		0%		0%
	0.050				0.060			

	Plain Track: Collision Distribution Head On	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
Both TBE		90%		90%	
		90%		90%	
		90%		90%	
One TBE		90%	0%		
				90%	0%
				90%	0%
		90%	0%	90%	0%
Neither TBE			0%		0%
	0.006				

Collisions/million diamond passes: 0.1

Table 2.3b: Collision Preventability Matrix - Diamonds

	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty	Train Pairs in In Collision	Train Pair Type
Both TBE			Pass-Pass	Both TBE
			Pass-TBE Freight	
			TBE Freight - TBE Freight	
One TBE			Pass - NE Freight, Head -On	One TBE
	90%	41.23%	Rear/Side, Pass into NE Frt	
	90%	41.23%	Rear/Side NE Frt into Pass	
	90%	25.65%	TBE Freight - NE Freight	
Neither TBE		0.00%	NE Freight - NE Freight	Neither TBE

Table 2.4a: Passenger Trains in Accidents (Collisions per Million Train-Miles Operated in Sub-Corridor)

	Passenger Trains in Collisions	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
Both TBE	2	0.0021		0.0021		0.0028		0.0028	
	1	0.0003		0.0003		0.0004		0.0004	
	0								
One TBE	1	0.0001	0.0005			0.0001	0.0006		
	1			0.0001	0.0000			0.0001	0.0000
	1			0.0000	0.0002			0.0000	0.0003
	0								
Neither TBE	0								
Checking total		0.0025	0.0005	0.0025	0.0002	0.0034	0.0006	0.0034	0.0003

	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
Both TBE	0.0057		0.0014		0.0068		0.0017	
	0.0008		0.0003		0.0009		0.0004	
One TBE	0.0001	0.0014			0.0002	0.0015		
			0.0001	0.0000			0.0001	0.0000
			0.0000	0.0002			0.0000	0.0002
Neither TBE								
	0.0066	0.0014	0.0018	0.0002	0.0079	0.0015	0.0022	0.0002

	Plain Track: Collision Distribution Head On	Plain Track: Collision Distribution Rear/Side	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
Both TBE			0.0006		0.0003	
			0.0001		0.0001	
One TBE			0.0000	0.0001		
					0.0000	0.0000
					0.0000	0.0002
Neither TBE						
			0.0007	0.0001	0.0003	0.0000

	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty	Train Pairs in In Collision	Train Pair Type
Both TBE			Pass-Pass	Both TBE
			Pass-TBE Freight	
			TBE Freight - TBE Freight	
One TBE			Pass - NE Freight, Head -On	One TBE
	0.002500	0.014694	Rear/Side, Pass into NE Frt	
	0.000500	0.002939	Rear/Side NE Frt into Pass	
	0.000000	0.000000	TBE Freight - NE Freight	
Neither TBE		0.000000	NE Freight - NE Freight	Neither TBE
	0.00300	0.01763		

Table 2.4b: Passenger Trains in Collisions at Diamonds

	Scenario Totals - Passenger	Tots. P-UF	Totals	Siding - Unmonitored: Totals	CP Adjacent - Monitored Siding: Totals	CP Adjacent - Unmonitored Siding: Totals	Plain Track: Totals	Totals	Scenario Totals - Passenger	Train Pairs in In Collision	Train Pair Type
	Pass Loco Hits Loco	0.0005	0.0030	0.0007	0.0015	0.0017	0.0002			Pass Loco Hits Loco	
	Pass Loco Hits Pass Car		0.0011							Pass Loco Hits Pass Car	
	Pass Loco Hits Freight Car	0.0001	0.0003	0.0001	0.0001	0.0001	0.0000			Pass Loco Hits Freight Car	
	Pass Car Hit by Loco	0.0002	0.0013	0.0003	0.0002	0.0002	0.0000			Pass Car Hit by Loco	
	Total		0.0058							Total	

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Table 2.5a: Freight trains In Accidents (Collisions per Million Train-Miles Operated in Sub-Corridor)

	Freight Trains in Collisions	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
Both TBE	0								
	1	0.0003		0.0003		0.0004		0.0004	
	2	0.0000		0.0000		0.0000		0.0000	
One TBE	1	0.0001	0.0005			0.0001	0.0006		
	1			0.0001	0.0000			0.0001	0.0000
	1			0.0000	0.0003			0.0000	0.0002
	2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Neither TBE	2				0.0000				0.0000
Checking total		0.0004	0.0005	0.0004	0.0002	0.0005	0.0006	0.0006	0.0003

	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
Both TBE	0.0008		0.0003		0.0009		0.0004	
	0.0000		0.0000		0.0000		0.0000	
One TBE	0.0001	0.0014			0.0002	0.0015		
			0.0001	0.0000			0.0001	0.0000
			0.0000	0.0002			0.0000	0.0002
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Neither TBE				0.0000				0.0000
	0.0009	0.0014	0.0004	0.0002	0.0011	0.0015	0.0005	0.0002

	Plain Track: Collision Distribution Head On	Plain Track: Collision Distribution Rear/Side	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
Both TBE						
			0.0001		0.0001	
			0.0000		0.0000	
One TBE						
					0.0000	0.0000
					0.0000	0.0000
			0.0000	0.0000	0.0000	0.0000
Neither TBE				0.0000		0.0000
			0.0001	0.0001	0.0001	0.0000

	Freight Trains in Collisions	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty	Train Pairs in In Collision	Train Pair Type
Both TBE	0			Pass-Pass	Both TBE
	1			Pass-TBE Freight	
	2			TBE Freight - TBE Freight	
One TBE	1			Pass - NE Freight, Head -On	One TBE
	1	0.002500	0.014694	Rear/Side, Pass into NE Frt	
	1	0.000500	0.002939	Rear/Side NE Frt into Pass	
	2	0.002000	0.014870	TBE Freight - NE Freight	
Neither TBE	2		0.040000	NE Freight - NE Freight	Neither TBE
Checking total		0.00500	0.07250		

	Scenario Totals - Freight	Totals	Siding - Unmonitored: Totals	CP Adjacent - Monitored Siding: Totals	CP Adjacent - Unmonitored Siding: Totals	Plain Track: Totals	Totals	Scenario Totals - Freight	Train Pairs in In Collision	Train Pair Type
	Freight Loco Hits Loco	0.0005	0.0011	0.0023	0.0026	0.0002	0.0001		Freight Loco Hits Loco	
	Freight Loco Hits Car	0.0002	0.0004	0.0003	0.0003	0.0000			Freight Loco Hits Car	
	Freight Car Hit By Loco	0.0001	0.0005	0.0003	0.0004	0.0001			Freight Car Hit By Loco	
	Total		0.0020	0.0029	0.0033	0.0003	0.0001			

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Freight Plus Passenger Totals (check)	0.0600	0.0072	0.0800	0.0096	0.1000	0.0128	0.1200	0.0151	0.0015			

In rear-end/side collisions between like trains there is one loco hits car and one car hit by loco in each collision. In rear/side collisions between a passenger and freight trains, the ratio between passenger hits freight and freight loco hits passenger car are a function of the percentages given in Table IN-5b on the Inputs sheet. The values are given in the tables beneath the trains in collisions for each segment type.

Siding - Monitored: Collision Ratios	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.8	0.2

Siding - Unmonitored: Collision Ratios	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.80	0.20

CP Adjacent - Monitored Siding: Collision Ratios	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.75	0.25

CP Adjacent - Unmonitored Siding: Collision Ratios	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.75	0.25

Plain Track: Collision Ratios	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.83	0.17

Table 2.5b: Freight Trains in Collisions at Diamonds

Worksheet 3-J,T,R: - Risk Calculations - PTC 120 sec Timeout Case, Joliet Subcorridor, Timeout Operating State, Rest of Year

Table 3.1: Consequences Look-up Tables (Data Sources: Previous ICF Passenger Corridor Project (passenger), FRA Accident Data 2001-5 (freight)

Passenger Trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 40 mph Injuries	Fatalities	Damage $	Representative Speed 60 mph Injuries	Fatalities	Damage $	Representative Speed 79 mph Injuries	Fatalities	Damage $	Representative Speed 105 mph Injuries	Fatalities	Damage $
	Train-Train Collision	Pass Loco hits Loco	0.083	0.002	502000	0.139	0.0049	1142000	0.24	0.0085	1976000	0.425	0.016	3495000
		Pass Loco hits Pass Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.008	1747000
		Pass Loco hits Frt Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.008	1747000
		Pass car hit by Loco	0.166	0.005	1005000	0.275	0.0119	2284000	0.476	0.0206	3951000	0.841	0.032	6983000
	Intrusion Collision (rollout)	Pass Loco hits Car	0.013	0.0005	113000	0.031	0.0011	257000	0.054	0.0019	445000	0.096	0.0034	786000
	Intrusion Collision (other))	Pass Loco hits Car	0.026	0.0009	226000	0.063	0.0022	514500	0.108	0.0038	889000	0.191	0.0068	1573000
	Overspeed		0.044	0.0004	667000	0.14	0.00186	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Broken Rail		0.044	0.0004	667000	0.14	0.00186	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Work Zone Violation		0.083	0.0083	0	0.125	0.0125	0	0.164	0.0164	0	0.218	0.0218	0

Freight trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 25 mph Injuries	Fatalities	Damage $	Representative Speed 40 mph Injuries	Fatalities	Damage $	Representative Speed 50 mph Injuries	Fatalities	Damage $
	Train-Train Collision	Frt Loco hits Loco	0.43	0.043	105000	1.1	0.11	270000	1.7	0.17	422000
		Frt Loco hits Car	0.35	0.035	88000	0.9	0.09	225000	1.4	0.14	352000
		Frt car hit by Loco	0	0	44000	0	0	112000	0	0	176000
	Intrusion Colln equip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Colln equip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Colln Unequip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Colln Unequip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Overspeed, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Overspeed, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Work Zone Viol'n, Equip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0
	Work Zone Viol'n, Unequip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0

Casualties and damage in Table 3.1 are per accident, except for Work Zone Violations which are per million train-miles

Table 3.2: Grade Crossing and Diamonds: Numbers by Representative Speed, Accident Frequency and Consequences

Train Type	Representative Speed (mph)	Type of Grade-crossing	Number Crossings: Passenger	HS Passenger	Freight	Accident Frequency Per Million Crossing Passes: Passenger	Freight	Crossing Collision Consequences: Pass. Occup'l Casualty Prob(accident)	Casualty Prob(accident)	Cost $/Accid't	Freight Trains (per accident): Injuries	Fatalities	Cost $	Number Diamonds
														1
Passenger	40	Public gates lights	0	0		0.350		0.0029	0.000047	50000				
		Public other	0	0		0.300								
		Private	0	0		0.100								
	60	Public gates lights	8	0		0.600		0.0068	0.000112	113000				0
		Public other	0	0		0.500								
		Private	0	0		0.200								
	79	Public gates lights	20	8		0.800		0.0105	0.000156	196000				0
		Public other	0	0		0.650								
		Private	1	0		0.300								
	105	Public gates lights	0	20		1.100		0.0188	0.000276	346000				0
		Public other	0	0		0.800								
		Private	0	1		0.300								
Freight	25	Public gates lights			0		0.150				0.12	0.005	20000	0
		Public other			0		0.120							
		Private			0		0.050							
	40	Public gates lights			0		0.300				0.25	0.013	50000	1
		Public other			0		0.250							
		Private			0		0.100							
	50	Public gates lights			20		0.360				0.39	0.02	74000	0
		Public other			0		0.300							
		Private			1		0.120							

Table 3.3a: Segment Data (for reference only, not used in calculations)

Segment Number	Start (Milepost)	End (Milepost)	Type	Length (miles)	Representative Speed (mph) Freight	Pass	HS Pass-Cons	HS Pass
1.0	62.60	64.40	CP Adjacent (M	2.2	40	79	79	105
2.0	64.80	66.55	Plain	1.75	50	79	79	105
3.0	66.55	68.23	Plain	1.68	50	79	79	105
4.0	68.23	70.17	CP Adjacent (M	1.94	50	79	79	105
5.0	70.17	72.80	Siding (M)	2.63	40	60	60	79
6.0	72.80	72.80	Diamond	0.00	40	40	40	40
7.0	72.80	74.94	CP Adjacent (M	2.14	40	60	60	79
8.0	74.94	77.27	Plain	2.33	50	79	79	105
9.0	77.27	80.13	Plain	2.86	50	79	79	105
10.0	80.13	81.99	CP Adjacent (M	1.86	50	79	79	105
11.0	81.99	84.65	Siding (M)	2.66	50	79	79	105
12.0	84.65	86.43	CP Adjacent (M	1.78	50	79	79	105
13.0	86.43	88.35	Plain	1.92	50	79	79	105
	Length Check	25.8		25.8				

Table 3.4a: Traffic Inputs to Risk Calculation

Trips/Day: Train Type	Summer	Rest of Year
Passenger	6.00	6.00
Equipped Freight	1.07	1.07
Unequipped Freight	0.36	0.36
Operating Day's	91.00	274.00

Percent Train-Miles in	
Timeout (secs)	120
Normal Operating Mode	94.86
Timeout Mode	0.14
Fallback Mode	5

Passenger Train Occupancy	
Seats	320
Occupancy Factor	0.6

Table 3.3b: Aggregate Segment Data: SegmentsTypes, Train Types, Speeds, and Lengths

Aggregate Segment Length by Type and Speed Band (from Seg Def and Preventability)

Segment Type	Train Type	Represent've Speed (mph)	Freight (miles)	Reg Pass (miles)	HS Pass Collision (mi)	HS Pass Other (mi)
Siding (mon)	Freight	25	0			
		40	2.63			
		50	2.66			
	Passenger	40		0	0	0
		60		2.63	2.63	0
		79		2.66	2.66	2.63
		105		0	0	2.66
Siding (unmon)	Freight	25	0			
		40	0			
		50	0			
	Passenger	40		0	0	0
		60		0	0	0
		79		0	0	0
		105		0	0	0
CP Adjacent (mon)	Freight	25	0			
		40	2.14			
		50	7.78			
	Passenger	40		0	0	0
		60		2.14	2.14	0
		79		7.78	7.78	2.14
		105		0	0	7.78
CP Adjacent (unmon)	Freight	25	0			
		40	0			
		50	0			
	Passenger	40		0	0	0
		60		0	0	0
		79		0	0	0
		105		0	0	0
Plain Track	Freight	25	0			
		40	0			
		50	10.54			
	Passenger	40		0	0	0
		60		0	0	0
		79		10.54	10.54	0
		105		0	0	10.54
Totals All Types	Freight	25	0			
		40	4.77			
		50	20.98			
	Passenger	40		0	0	0
		60		4.77	4.77	0
		79		20.98	20.98	4.77
		105		0	0	20.98
	Checking totals		25.75	25.75	25.75	25.75

Table 3.4: Collision Frequencies by Segment Type and Collision Scenario (From Coll Matrix)

Scenarios	Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain	Diamond
Pass Loco Hits Loco	0.0030	0.0040	0.0080	0.0094	0.0098	0.000000
Pass Loco Hits Pass Car	0.0011	0.0014	0.0007	0.0009	0.0001	0.000000
Pass Loco Hits Freight Car	0.0003	0.0005	0.0003	0.0004	0.0001	0.017194
Pass Car Hit by Loco	0.0013	0.0018	0.0010	0.0012	0.0002	0.003439
Freight Loco Hits Loco	0.0009	0.0011	0.0023	0.0026	0.0002	0.000000
Freight Loco Hits Car	0.0003	0.0004	0.0003	0.0003	0.0000	0.033874
Freight Car Hit By Loco	0.0003	0.0005	0.0003	0.0004	0.0001	0.043629

Collision Frequency for Passenger + Unequipped Freight Train

Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain
0.0005	0.0007	0.0015	0.0017	0.0002
0.0001	0.0001	0.0001	0.0001	0.0000
0.0002	0.0003	0.0002	0.0002	0.0000

Mauve cells contain data imported from previous w orksheet in a group of three w orksheets covering one sub-corridor, season and operating state.

All train-to-train collision frequencies are in units of trains in collisions per million train miles operated in the sub-corridor by all train types..

Weighted Collision Accident Frequencies by Representative Speed (mph)

Scenarios	Freight 25	Freight 40	Freight 50	Passenger 40	Passenger 60	Passenger 79	Passenger 105
Pass Loco Hits Loco				0.0000	0.0000	0.0016	0.0030
Pass Loco Hits Pass Car				0.0000	0.0000	0.0002	0.0005
Pass Loco Hits Freight Car				0.0000	0.0000	0.0001	0.0002
Pass Car Hit by Loco				0.0000	0.0000	0.0003	0.0005
Freight Loco Hits Loco	0.0000	0.0015	0.0011				
Freight Loco Hits Car	0.0000	0.0003	0.0001				
Freight Car Hit By Loco	0.0000	0.0003	0.0002				

Table 3.5a: Risk Calculation - Passenger Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Freq. per million tm	Preventability	Adjusted Frequency	Trips/day	Trips per 10 years	Length of Track (miles)	Train-miles per 10 years	Accidents per 10 years	Number seats per train	Occupancy Factor	Passengers per train	Injuries per 10 years	Fatalities per 10 years	Damage $ per 10 years
40	Train-Train Collision	Pass Loco hits Loco	0.00000	Incl	0.00000	7.43	38	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Pass Car	0.00000	Incl	0.00000	7.43	38	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Frt Car	0.00000	Incl	0.00000	7.43	38	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00000	Incl	0.00000	7.43	38	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.00	0.00860	6.00	31	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (other))	Pass Loco hits intruder	0.01440	0.00	0.01440	6.00	31	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Overspeed		0.01100	0.50	0.00550	6.00	31	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Broken Rail		0.01670	0.00	0.01670	6.00	31	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Work Zone Violation			0.25		6.00	31	0	0					0.0000	0.00000	0
										0.00000				**0.00000**	**0.00000**	**0**
60	Train-Train Collision	Pass Loco hits Loco	0.00000	Incl	0.00000	7.43	38	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Pass Car	0.00000	Incl	0.00000	7.43	38	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Frt Car	0.00000	Incl	0.00000	7.43	38	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00000	Incl	0.00000	7.43	38	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.00	0.00860	6.00	31	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.00	0.01440	6.00	31	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Overspeed		0.01100	0.50	0.00550	6.00	31	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Broken Rail		0.01670	0.00	0.01670	6.00	31	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Work Zone Violation			0.25	0.00000	6.00	31	0	0					0.0000	0.00000	0
										0.00000				**0.00000**	**0.00000**	**0**
79	Train-Train Collision	Pass Loco hits Loco	0.00156	Incl	0.00156	7.43	38	25.75	974	0.00000	320	0.6	192	0.0001	0.00000	3
		Pass Loco hits Pass Car	0.00017	Incl	0.00017	7.43	38	25.75	974	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Frt Car	0.00009	Incl	0.00009	7.43	38	25.75	974	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00030	Incl	0.00030	7.43	38	25.75	974	0.00000	320	0.6	192	0.0000	0.00000	1
	Intrusion Collision (rollout)	Pass Loco hits car	0.00850	0.00	0.00860	6.00	31	4.77	146	0.00000	320	0.6	192	0.0000	0.00000	1
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.00	0.01440	6.00	31	4.77	146	0.00000	320	0.6	192	0.0000	0.00000	2
	Overspeed		0.01100	0.50	0.00550	6.00	31	4.77	146	0.00000	320	0.6	192	0.0000	0.00000	2
	Broken Rail		0.01670	0.00	0.01670	6.00	31	4.77	146	0.00000	320	0.6	192	0.0001	0.00000	6
	Work Zone Violation			0.25		6.00	31	4.77	146					0.0000	0.00000	0
										0.00001				**0.00031**	**0.00001**	**15**
105	Train-Train Collision	Pass Loco hits Loco	0.00303	Incl	0.00303	7.43	38	20.98	794	0.00000	320	0.6	192	0.0002	0.00001	8
		Pass Loco hits Pass Car	0.00046	Incl	0.00046	7.43	38	20.98	794	0.00000	320	0.6	192	0.0000	0.00000	1
		Pass Loco hits Frt Car	0.00016	Incl	0.00016	7.43	38	20.98	794	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00051	Incl	0.00051	7.43	38	20.98	794	0.00000	320	0.6	192	0.0001	0.00000	3
	Intrusion Collision (rollout)	Pass Loco hits car	0.00850	0.00	0.00860	6.00	31	20.98	641	0.00001	320	0.6	192	0.0001	0.00000	4
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.00	0.01440	6.00	31	20.98	641	0.00001	320	0.6	192	0.0003	0.00001	15
	broken Rail		0.01100	0.50	0.00550	6.00	31	20.98	641	0.00000	320	0.6	192	0.0002	0.00000	16
	Broken Rail		0.01670	0.00	0.01670	6.00	31	20.98	641	0.00001	320	0.6	192	0.0006	0.00001	49
	Work Zone Violation			0.25		6.00	31	20.98	641					0.0001	0.00001	0
	Total									**0.00003**				**0.00159**	**0.00005**	**96**
	Overall Totals									**0.00004**				**0.00189**	**0.00006**	**112**
	Totals All Speeds	**Train-train Collisions**								**0.00001**				**0.00038**	**0.00001**	**16**
		Intrusion Collisions								**0.00002**				**0.00050**	**0.00002**	**21**
		Overspeed								**0.00000**				**0.00022**	**0.00000**	**18**
		Broken Rail								**0.00001**				**0.00057**	**0.00001**	**56**
		Work Zone Violation								**0.00000**				**0.00012**	**0.00001**	**0**

Table 3.5b: Risk Calculation - Collisions at Diamonds - Passenger

Number Diamonds	Freq'y per mill passes	Collisions (millions)	Injuries	Fatalities	Damage
1	0.000000	0.000000	0.000000	0.000000	0.00
1	0.000000	0.000000	0.000000	0.000000	0.00
1	0.017194	0.000001	0.000004	0.000000	0.16
1	0.003439	0.000000	0.000004	0.000000	0.13
			0.000001	**0.000008**	**0.000000**	**0.29**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.017194	0.000000	0.000000	0.000000	0.00
0	0.003439	0.000000	0.000000	0.000000	0.00
			0.000000	**0.000000**	**0.000000**	**0.00**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.017194	0.000000	0.000000	0.000000	0.00
0	0.003439	0.000000	0.000000	0.000000	0.00
			0.000000	**0.000000**	**0.000000**	**0.00**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.017194	0.000000	0.000000	0.000000	0.00
0	0.003439	0.000000	0.000000	0.000000	0.00
			0.000003	**0.000001**	**0.000000**	**$0**
			0.000003	**0.000001**	**0.000000**	**0.47**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.033874	0.000000	0.000000	0.000000	0.00
0	0.043629	0.000000	0.000000	0.000000	0.00
			0.000000	**0.000000**	**0.000000**	**0.00**
0	0.000000	0.000000	0.000000	0.000000	0.00
1	0.033874	0.000001	0.000001	0.000000	0.29
1	0.043629	0.000002	0.000002	0.000000	0.18
			0.000003	**0.000001**	**0.000000**	**$0**

Table 3.5a: Risk Calculation - Freight Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Freq. per million tm	Preventability	Adjusted Frequency	Trips/day	Trips per 10 years	Length of Track (miles)	Train-miles	Accidents	Per 10 years: Injuries	Fatalities	Damage $
25	Train-Train Collision	Frt Loco hits Loco	0	Incl	0.00000	7.43	37.84	0	0	0.00000	0.00000	0.000000	$0
		Frt Loco hits Car	0	Incl	0.00000	7.43	37.84	0	0	0.00000	0.00000	0.000000	$0
		Frt car hit by Loco	0	Incl	0.00000	7.43	37.84	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Colln equip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	1.07	5.45	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Colln equip (other)	Frt Loco hits Car	0.009	0.00	0.00860	1.07	5.45	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Colln Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.36	1.83	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Colln Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.36	1.83	0	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.50	0.00800	1.07	5.45	0	0	0.00000	0.00000	0.000000	$0
	Overspeed, Unequip		0.016	0.00	0.01600	0.36	1.83	0	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.00	0.05560	1.07	5.45	0	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Unequip		0.056	0.00	0.05560	0.36	1.83	0	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.25		1.07	5.45	0	0		0.00000	0.000000	$0
	Work Zone Viol'n, Unequip			0.00		0.36	1.83	0	0		0.00000	0.000000	$0
	Totals									**0.0000**	**0.0000**	**0.00000**	**$0**
40	Train-Train Collision	Frt Loco hits Loco	0.0015	Incl	0.00152	7.43	37.84	4.77	181	0.00000	0.00000	0.000000	$0
		Frt Loco hits Car	0.0003	Incl	0.00027	7.43	37.84	4.77	181	0.00000	0.00000	0.000000	$0
		Frt car hit by Loco	0.0003	Incl	0.00033	7.43	37.84	4.77	181	0.00000	0.00000	0.000000	$0
	Intrusion Colln equip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	1.07	5.45	4.77	26	0.00000	0.00000	0.000000	$0
	Intrusion Colln equip (other)	Frt Loco hits Car	0.009	0.00	0.00860	1.07	5.45	4.77	26	0.00000	0.00000	0.000000	$0
	Intrusion Colln Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.36	1.83	4.77	9	0.00000	0.00000	0.000000	$0
	Intrusion Colln Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.36	1.83	4.77	9	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.50	0.00800	1.07	5.45	4.77	26	0.00000	0.00000	0.000000	$0
	Overspeed, Unequip		0.016	0.00	0.01600	0.36	1.83	4.77	9	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.00	0.05560	1.07	5.45	4.77	26	0.00000	0.00000	0.000000	$1
	Broken Rail, Unequip		0.056	0.00	0.05560	0.36	1.83	4.77	9	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.25		1.07	5.45	4.77	26		0.00000	0.000000	$0
	Work Zone Viol'n, Unequip			0.00		0.36	1.83	4.77	9		0.00000	0.000000	$0
	Totals									**0.00001**	**0.0000**	**0.00000**	**$6**
	Overall Totals									**0.00002**	**0.0000**	**0.0000**	**$7**
Totals All Speeds	**Train-Train Collisions**									**0.00000**	**0.00000**	**0.00000**	**1**
	Intrusion Collisions									**0.00000**	**0.00000**	**0.00000**	**0**
	Diamond Collisions									**0.00000**	**0.00000**	**0.00000**	**0**
	Overspeed									**0.00000**	**0.00000**	**0.00000**	**1**
	Broken Rail									**0.00001**	**0.00000**	**0.00000**	**6**
	Work Zone Violation									**0.00000**	**0.00001**	**0.00000**	**0**
	Grade Crossing Collisions												

Table 3.6b: Risk Calculation - Collisions at Diamonds - Freight

Number Diamonds	Freq'y per mill passes	Collisions (millions)	Injuries	Fatalities	Damage
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.033874	0.000000	0.000000	0.000000	0.00
0	0.043629	0.000000	0.000000	0.000000	0.00
			0.000000	**0.000000**	**0.000000**	**0.00**

Table 3.7: Risk Calculations: Passenger and Freight Trains; Grade Crossings

Train Type	Representative Speed	Type of Grade-crossing	Base Collision Rate	Preventability Factor	Adjusted Collision Rate	Trips per Day	Crossing Passes per Trip	Crossing Passes per 10 Years	Collisions per 10 Years	Seats per Train (Passenger)	Occupancy Factor	Passengers per Train	Passenger/ Crew Injuries per 10 Years	Passenger/ Crew Fatalities per 10 Years	Damage per 10 Years ($)
Passenger	40	Public gates lights	0.35	0%	0.350	6.00	0	0.0	0.000	320	0.60	192	0.0000	0.0000	0
		Public other	0.30	0%	0.300	6.00	0	0.0	0.000	320	0.60	192	0.0000	0.0000	0
		Private	0.10	0%	0.100	6.00	0	0.0	0.000	320	0.60	192	0.0000	0.0000	0
	60	Public gates lights	0.60	0%	0.600	6.00	0	0.0	0.000	320	0.60	192	0.0000	0.0000	0
		Public other	0.50	0%	0.500	6.00	0	0.0	0.000	320	0.60	192	0.0000	0.0000	0
		Private	0.20	0%	0.200	6.00	0	0.0	0.000	320	0.60	192	0.0000	0.0000	0
	79	Public gates lights	0.80	0%	0.800	6.00	8	244.5	0.000	320	0.60	192	0.0004	0.0000	38
		Public other	0.65	0%	0.650	6.00	0	0.0	0.000	320	0.60	192	0.0000	0.0000	0
		Private	0.30	0%	0.300	6.00	0	0.0	0.000	320	0.60	192	0.0000	0.0000	0
	105	Public gates lights	1.10	0%	1.100

Worksheet 1-B,N: IDOT-PTC Risk Model: Braking Distances and Collision Zone Calculations, Bloomington Sub-corridor, PTC Normal Operating State

Table 1.1: Stopping Distance Parameters and Calculations, Including Relevant and ACS Response Delay

Braking Formula Inputs		
TrainSystem Type	Parameter	Value
Freight	Coefficient F	0.035
	Appl'n Time (sec)	9.0
	Train Weight (lb)	37800000
	Brake Force (lb)	775693
Passenger	Coefficient A	0.068
	Coefficient B	0
	Safety Factor	1.25
Train Control	Latency(T) out (sec)	10
	ACS Response	0
Guilty Train Speed (mph)		79

| Braking Distance Calculations (ft) (including time running in TD) | | |

Worksheet 2 - B,N,R: Collision Frequencies Calculation - PTC 120 Sec.Timeout Case, Bloomington Sub-corridor, PTC Normal Operating State, Rest of Year

Table 2.1a: Collision Distribution Matrix (Fraction Accidents by Train Pair and Collision Type). Collisions Between Trains Operating on the IDOT Test Corridor Only (Not diamonds and intrusions)

Train Pairs in In Collision	Collision Scenario Prob (Top Level)	Siding - Monitored: Collision Distribution Head On		Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty
		Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty
Percent Guilty				100%	0%	100%	0%
Both Trains TBE (Note 3) Pass-Pass	0.60	0.50	0.50	0.3	0	0.3	0
Pass-TBE Freight	0.16	0.50	0.50	0.08	0	0.08	0
TBE Freight - TBE Freight	0.00	0.50	0.50	0	0	0	0
Percent Guilty				50%	50%	50%	50%
One Train TBE Pass - NE Freight, Head -On	0.16	1	0	0.04	0.04	0	0
Rear/Side, Pass into NE Frt		0	1	0	0	0.064	0
Rear/Side NE Frt into Pass		0	1	0	0	0	0.016
TBE Freight - NE Freight	0.08	0.5	0.5	0.02	0.02	0.02	0.02
Percent Guilty				0%	100%	0%	100%
Neither Train TBE NE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0
Total Probability (checking)	1		1	0.44	0.06	0.464	0.036

Train Pairs in In Collision	Siding - Unmonitored: Collision Distribution Head On		Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
	Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty
Percent Guilty			100%	0%	100%	0%
Pass-Pass	0.5	0.5	0.3	0	0.3	0
Pass-TBE Freight	0.5	0.5	0.08	0	0.08	0
TBE Freight - TBE Freight	0.5	0.5	0	0	0	0
Percent Guilty			50%	50%	50%	50%
Pass - NE Freight, Head -On	1	0	0.04	0.04	0	0
Rear/Side, Pass into NE Frt	0	1	0	0	0.064	0
Rear/Side NE Frt into Pass	0	1	0	0	0	0.016
TBE Freight - NE Freight	0.5	0.5	0.02	0.02	0.02	0.02
Percent Guilty			0%	100%	0%	100%
NE Freight - NE Freight	0.5	0.5	0	0	0	0
Total Probability (checking)		1	0.44	0.06	0.464	0.036

Train Pairs in In Collision	CP Adjacent - Monitored Siding: Collision Distribution Head On		CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty
	Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty
Percent Guilty			100%	0%	100%	0%
Pass-Pass	0.8	0.2	0.48	0	0.12	0
Pass-TBE Freight	0.7	0.3	0.112	0	0.048	0
TBE Freight - TBE Freight	0.7	0.3	0	0	0	0
Percent Guilty			50%	50%	50%	50%
One Train TBE Pass - NE Freight, Head -On	1	0	0.064	0.064	0	0
Rear/Side, Pass into NE Frt	0	1	0	0	0.024	0
Rear/Side NE Frt into Pass	0	1	0	0	0	0.008
TBE Freight - NE Freight	0.7	0.3	0.028	0.028	0.012	0.012
Percent Guilty			0%	100%	0%	100%
Neither Train TBE NE Freight - NE Freight	0.7	0.3	0	0	0	0
Total Probability (checking)		1	0.684	0.092	0.204	0.02

Train Pairs in In Collision	CP Adjacent - Unmonitored Siding: Collision Distribution Head On		CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
	Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty
Percent Guilty			100%	0%	100%	0%
Pass-Pass	0.8	0.2	0.48	0	0.12	0
Pass-TBE Freight	0.7	0.3	0.112	0	0.048	0
TBE Freight - TBE Freight	0.7	0.3	0	0	0	0
Percent Guilty			50%	50%	50%	50%
Pass - NE Freight, Head -On	1	0	0.064	0.064	0	0
Rear/Side, Pass into NE Frt	0	1	0	0	0.024	0
Rear/Side NE Frt into Pass	0	1	0	0	0	0.008
TBE Freight - NE Freight	0.7	0.3	0.028	0.028	0.012	0.012
Percent Guilty			0%	100%	0%	100%
NE Freight - NE Freight	0.7	0.3	0	0	0	0
Total Probability (checking)		1	0.684	0.092	0.204	0.02

Train Pairs in In Collision	Plain Track: Collision Distribution Head On	Rear/Side	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
	Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty
Percent Guilty			100%	0%	100%	0%
Pass-Pass	0.70	0.30	0.42	0	0.18	0
Pass-TBE Freight	0.40	0.60	0.064	0	0.096	0
TBE Freight - TBE Freight	0.50	0.50	0	0	0	0
Percent Guilty			50%	50%	50%	50%
Pass - NE Freight, Head -On	1.00	0.00	0.056	0.056	0	0
Rear/Side, Pass into NE Frt	0.00	1.00	0	0	0.04	0
Rear/Side NE Frt into Pass	0.00	1.00	0	0	0	0.008
TBE Freight - NE Freight	0.50	0.50	0.02	0.02	0.02	0.02
Percent Guilty			0%	100%	0%	100%
NE Freight - NE Freight	0.50	0.50	0	0	0	0
Total Probability (checking)		1	0.56	0.076	0.336	0.028

Table 2.1b: Collision Type Distribution - Diamonds

Train Pairs in In Collision	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty	Train Pair Type
Percent Guilty			
Pass-Pass			Both Trains TBE
Pass-TBE Freight			
TBE Freight - TBE Freight			
Percent Guilty	50%	50%	One Train TBE
Pass - NE Freight, Head -On	0	0	
Rear/Side, Pass into NE Frt	0.25	0.25	
Rear/Side NE Frt into Pass	0.05	0.05	
TBE Freight - NE Freight	0.1	0.1	
Percent Guilty		100%	
NE Freight - NE Freight	0	0.2	Neither Train TBE
Total Probability (checking)	0.4	0.6	

Note: The gray cells on these rows are set at zero, because in every case, the condition represented by the cell does not exist - either because there are no unequipped passenger trains, or because of the kind of collision defined for the row.

Quantity in cell C18 is for all collisions between a passenger train and an unequipped freight train

Table 2.2: Preventability Data For Unequipped train Guilty, One Train TBE

Segment Type	Not Prevented of Mitigated: Freight	Not Prevented of Mitigated: Pass	Not Prevented of Mitigated: HS Pass	Mitigated: Freight	Mitigated: Pass	Mitigated: HS Pass	Prevented: Freight	Prevented: Pass	Prevented: HS Pass
Siding (M)	0.395	0.419	0.608	0.249	0.168	0.246	0.406	0.463	0.196
Siding (U)	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100
CP Adjacent (M)	0.322	0.396	0.594	0.230	0.187	0.274	0.498	0.467	0.182
CP Adjacent (U)	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100
Plain Track	0.368	0.453	0.678	0.000	0.000	0.032	0.100	0.100	0.068
Diamonds	0.169	0.300	0.299	0.172	0.000	0.200	0.709	0.750	0.551

Mauve cells contain data imported from previous worksheet in a group of three worksheets covering one sub-corridor, season and operating state.

Table 2.3a: Collision Preventability Matrix (Percent Accidents Preventable Relative to CTC Reference Case)

Train Pairs in In Collision	Preventability Equipped Train Guilty	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty
Both TBE Pass-Pass	90%			90%	
Pass-TBE Freight	90%			90%	
TBE Freight - TBE Freight	90%			90%	
One TBE Pass - NE Freight, Head -On	90%	90%	20%		
Rear/Side, Pass into NE Frt	90%			90%	20%
Rear/Side NE Frt into Pass	90%			90%	0%
TBE Freight - NE Freight	90%	90%	41%	90%	0%
Neither TBE NE Freight - NE Freight			0%		0%

Train Pairs in In Collision	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
Both TBE Pass-Pass	90%		90%	
Pass-TBE Freight	90%		90%	
TBE Freight - TBE Freight	90%		90%	
One TBE Pass - NE Freight, Head -On	90%	10%		
Rear/Side, Pass into NE Frt			90%	10%
Rear/Side NE Frt into Pass			90%	0%
TBE Freight - NE Freight	90%	10%	90%	0%
Neither TBE NE Freight - NE Freight		0%		0%

Train Pairs in In Collision	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty
Both TBE Pass-Pass	90%	90%	90%	90%
Pass-TBE Freight	90%	90%	90%	90%
TBE Freight - TBE Freight	90%	90%	90%	90%
One TBE Pass - NE Freight, Head -On	90%	18%		
Rear/Side, Pass into NE Frt			90%	18%
Rear/Side NE Frt into Pass			90%	0%
TBE Freight - NE Freight	90%	50%	90%	0%
Neither TBE NE Freight - NE Freight		0%		0%

Train Pairs in In Collision	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
Both TBE Pass-Pass	90%	90%	90%	90%
Pass-TBE Freight	90%	90%	90%	90%
TBE Freight - TBE Freight	90%	90%	90%	90%
One TBE Pass - NE Freight, Head -On	90%	10%		
Rear/Side, Pass into NE Frt			90%	10%
Rear/Side NE Frt into Pass			90%	0%
TBE Freight - NE Freight	90%	10%	90%	0%
Neither TBE NE Freight - NE Freight		0%		0%

Train Pairs in In Collision	Plain Track: Collision Distribution Head On	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
Both TBE Pass-Pass		90%		90%	
Pass-TBE Freight		90%		90%	
TBE Freight - TBE Freight		90%		90%	
One TBE Pass - NE Freight, Head -On		90%	7%		
Rear/Side, Pass into NE Frt				90%	7%
Rear/Side NE Frt into Pass				90%	0%
TBE Freight - NE Freight		90%	10%	90%	0%
Neither TBE NE Freight - NE Freight			0%		0%

Reference Case (CTC) Collision Accident Likelihood by Segment Type (collisions/million train miles)	Siding - Monitored	Siding - Unmonitored	CP Adjacent - Monitored Siding	CP Adjacent - Unmonitored Siding	Plain Track	Collisions/million diamond passes
	0.030	0.040	0.050	0.060	0.006	0.1

Table 2.3b: Collision Preventability Matrix - Diamonds

Train Pairs in In Collision	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty
Both TBE Pass-Pass		
Pass-TBE Freight		
TBE Freight - TBE Freight		
One TBE Pass - NE Freight, Head -On		
Rear/Side, Pass into NE Frt	90%	75.04%
Rear/Side NE Frt into Pass	90%	75.04%
TBE Freight - NE Freight	90%	70.87%
Neither TBE NE Freight - NE Freight		0.00%

Table 2.4a: Passenger Trains in Accidents (Collisions per Million Train-Miles Operated in Sub-Corridor)

Train Pairs in In Collision	Passenger Trains in Collisions	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty
Both TBE Pass-Pass	2			0.0018	
Pass-TBE Freight	1			0.0002	
TBE Freight - TBE Freight	0				
One TBE Pass - NE Freight, Head -On	1	0.0001	0.0010		
Rear/Side, Pass into NE Frt	1			0.0002	0.0000
Rear/Side NE Frt into Pass	1			0.0000	0.0005
TBE Freight - NE Freight	0				
Neither TBE NE Freight - NE Freight	0				
Checking total		0.0022	0.0010	0.0022	0.0005

Train Pairs in In Collision	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
Both TBE Pass-Pass	0.0024		0.0024	
Pass-TBE Freight	0.0003		0.0003	
TBE Freight - TBE Freight				
One TBE Pass - NE Freight, Head -On	0.0002	0.0014		
Rear/Side, Pass into NE Frt			0.0003	0.0000
Rear/Side NE Frt into Pass			0.0000	0.0006
TBE Freight - NE Freight				
Neither TBE NE Freight - NE Freight				
Checking total	0.0029	0.0014	0.0030	0.0006

Train Pairs in In Collision	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty
Both TBE Pass-Pass	0.0048		0.0012	
Pass-TBE Freight	0.0006		0.0002	
TBE Freight - TBE Freight				
One TBE Pass - NE Freight, Head -On	0.0003	0.0026		
Rear/Side, Pass into NE Frt			0.0001	0.0000
Rear/Side NE Frt into Pass			0.0000	0.0004
TBE Freight - NE Freight				
Neither TBE NE Freight - NE Freight				
Checking total	0.0057	0.0026	0.0016	0.0004

Train Pairs in In Collision	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
Both TBE Pass-Pass	0.0058		0.0014	
Pass-TBE Freight	0.0007		0.0003	
TBE Freight - TBE Freight				
One TBE Pass - NE Freight, Head -On	0.0004	0.0035		
Rear/Side, Pass into NE Frt			0.0001	0.0000
Rear/Side NE Frt into Pass			0.0000	0.0005
TBE Freight - NE Freight	0.0005	0.0013		
Neither TBE NE Freight - NE Freight				
Checking total	0.0068	0.0035	0.0019	0.0005

Train Pairs in In Collision	Plain Track: Collision Distribution Head On	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
Both TBE Pass-Pass		0.0005		0.0002	
Pass-TBE Freight		0.0000		0.0001	
TBE Freight - TBE Freight					
One TBE Pass - NE Freight, Head -On		0.0000	0.0003		
Rear/Side, Pass into NE Frt				0.0000	0.0000
Rear/Side NE Frt into Pass				0.0000	0.0000
TBE Freight - NE Freight		0.0000	0.0002	0.0000	0.0002
Neither TBE NE Freight - NE Freight			0.0000		0.0000
Checking total		0.0006	0.0003	0.0003	0.0000

Table 2.4b: Passenger Trains in Collisions at Diamonds

Train Pairs in In Collision	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty	Train Pair Type
Both TBE Pass-Pass			Both TBE
Pass-TBE Freight			
TBE Freight - TBE Freight			
One TBE Pass - NE Freight, Head -On			One TBE
Rear/Side, Pass into NE Frt	0.002500	0.006241	
Rear/Side NE Frt into Pass	0.000500	0.001248	
TBE Freight - NE Freight	0.000000	0.000000	
NE Freight - NE Freight		0.000000	Neither TBE
Checking total	0.00300	0.00749	

Scenario Totals - Passenger	Tots. P-UF	Totals
Pass Loco Hits Loco	0.0013	0.0031
Pass Loco Hits Pass Car		0.0009
Pass Loco Hits Freight Car	0.0002	0.0004
Pass Car Hit by Loco	0.0005	0.0014
Total		0.0058

	Totals
	0.0016
	0.0012
	0.0003
	0.0006
	0.0079

	Totals
	0.0029
	0.0043
	0.0012
	0.0005
	0.0019
	0.0029

	Totals
	0.0029
	0.0083
	0.0006
	0.0003
	0.0011
	0.0103

	Totals
	0.0057
	0.0026
	0.0006
	0.0003
	0.0004
	0.0057
	0.0026
	0.0016
	0.0004

	Totals
	0.0038
	0.0103
	0.0007
	0.0004
	0.0013
	0.0126

	Totals
	0.0068
	0.0035
	0.0007
	0.0004
	0.0008
	0.0019
	0.0068
	0.0035
	0.0019
	0.0005

	Totals
	0.0003
	0.0001
	0.0000
	0.0001
	0.0005
	0.0012
	0.0006
	0.0003
	0.0003
	0.0000

Train Pairs in In Collision	Totals
Pass Loco Hits Loco	0.008741
Pass Loco Hits Pass Car	
Pass Loco Hits Freight Car	0.008741
Pass Car Hit by Loco	0.001748
Total	0.010489

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Table 2.5a: Freight trains In Accidents (Collisions per Million Train-Miles Operated in Sub-Corridor)

Train Pairs in In Collision	Freight Trains in Collisions	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty
Both TBE Pass-Pass	0				
Pass-TBE Freight	1			0.0002	
TBE Freight - TBE Freight	2			0.0000	
One TBE Pass - NE Freight, Head -On	1	0.0001	0.0010		
Rear/Side, Pass into NE Frt	1			0.0002	0.0000
Rear/Side NE Frt into Pass	1			0.0000	0.0005
TBE Freight - NE Freight	2	0.0001	0.0007	0.0001	0.0012
Neither TBE NE Freight - NE Freight	2		0.0000		0.0000
Checking total		0.0005	0.0017	0.0006	0.0017

Train Pairs in In Collision	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
Both TBE Pass-Pass	0.0003		0.0003	
Pass-TBE Freight	0.0000		0.0000	
TBE Freight - TBE Freight				
One TBE Pass - NE Freight, Head -On	0.0002	0.0014		
Rear/Side, Pass into NE Frt			0.0003	0.0000
Rear/Side NE Frt into Pass			0.0000	0.0006
TBE Freight - NE Freight	0.0002	0.0014	0.0002	0.0016
Neither TBE NE Freight - NE Freight		0.0000		0.0000
Checking total	0.0006	0.0029	0.0007	0.0022

Train Pairs in In Collision	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty
Both TBE Pass-Pass	0.0006		0.0002	
Pass-TBE Freight	0.0000		0.0000	
TBE Freight - TBE Freight	0.0000		0.0000	
One TBE Pass - NE Freight, Head -On	0.0003	0.0026		
Rear/Side, Pass into NE Frt			0.0001	0.0000
Rear/Side NE Frt into Pass			0.0000	0.0004
TBE Freight - NE Freight	0.0003	0.0014	0.0001	0.0012
Neither TBE NE Freight - NE Freight		0.0000		0.0000
Checking total	0.0012	0.0040	0.0005	0.0016

Train Pairs in In Collision	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
Both TBE Pass-Pass	0.0007		0.0003	
Pass-TBE Freight	0.0000		0.0000	
TBE Freight - TBE Freight	0.0000		0.0000	
One TBE Pass - NE Freight, Head -On	0.0004	0.0035		
Rear/Side, Pass into NE Frt			0.0001	0.0000
Rear/Side NE Frt into Pass			0.0000	0.0005
TBE Freight - NE Freight	0.0003	0.0030	0.0001	0.0014
Neither TBE NE Freight - NE Freight		0.0000		0.0000
Checking total	0.0014	0.0065	0.0006	0.0019

Train Pairs in In Collision	Plain Track: Collision Distribution Head On	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
Both TBE Pass-Pass		0.0000		0.0001	
Pass-TBE Freight		0.0000		0.0000	
TBE Freight - TBE Freight		0.0000		0.0000	
One TBE Pass - NE Freight, Head -On		0.0000	0.0003		
Rear/Side, Pass into NE Frt				0.0000	0.0000
Rear/Side NE Frt into Pass				0.0000	0.0000
TBE Freight - NE Freight		0.0000	0.0002	0.0000	0.0002
Neither TBE NE Freight - NE Freight			0.0000		0.0000
Checking total		0.0001	0.0005	0.0001	0.0003

Scenario Totals - Freight	Totals
Freight Loco Hits Loco	0.0022
Freight Loco Hits Car	0.0012
Freight Car Hit By Loco	0.0010
Total	0.0044

	Totals
	0.0035
	0.0016
	0.0014

	Totals
	0.0052
	0.0011
	0.0010

	Totals
	0.0079
	0.0013
	0.0012

	Totals
	0.0006
	0.0002
	0.0002

Train Pairs in In Collision	Totals
Freight Loco Hits Loco	0.027661
Freight Loco Hits Car	0.030653
Freight Car Hit By Loco	
Total	0.058314

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Table 2.5b: Freight Trains in Collisions at Diamonds

Train Pairs in In Collision	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty	Train Pair Type
Both TBE Pass-Pass			Both TBE
Pass-TBE Freight			
TBE Freight - TBE Freight			
One TBE Pass - NE Freight, Head -On			One TBE
Rear/Side, Pass into NE Frt	0.002500	0.006241	
Rear/Side NE Frt into Pass	0.000500	0.001248	
TBE Freight - NE Freight	0.002000	0.005826	
NE Freight - NE Freight		0.040000	Neither TBE
Checking total	0.00500	0.05331	

Collision Ratios	Collision Type	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Siding - Monitored	Freight to Freight	0.50	0.50		
	Passenger to Passenger	0.50	0.50		
	Passenger to Freight			0.8	0.2
Siding - Unmonitored	Freight to Freight	0.50	0.50		
	Passenger to Passenger	0.50	0.50		
	Passenger to Freight			0.80	0.20
CP Adjacent - Monitored Siding	Freight to Freight	0.50	0.50		
	Passenger to Passenger	0.50	0.50		
	Passenger to Freight			0.75	0.25
CP Adjacent - Unmonitored Siding	Freight to Freight	0.50	0.50		
	Passenger to Passenger	0.50	0.50		
	Passenger to Freight			0.75	0.25
Plain Track	Freight to Freight	0.50	0.50		
	Passenger to Passenger	0.50	0.50		
	Passenger to Freight			0.83	0.17

In rear-end/side collisions between like trains there is one loco hits car and one car hit by loco in each collision. In rear/side collisions between a passenger and freight trains, the ratio between passenger hits freight and freight loco hits passenger car are a function of the percentages given in Table IN-5b on the Inputs sheet. The values are given in the tables beneath the trains in collisions for each segment type.

Worksheet 3 - B,N,R: - Risk Calculations - PTC 120 Sec. Timeout Case, Bloomington Sub-corridor, Normal Operating State, Rest of Year

Table 3.1: Consequences Look-up Tables (Data Sources: Previous ICF Passenger Corridor Project (passenger), FRA Accident Data 2001-5 (freight)

Passenger Trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 40 mph Injuries	Fatalities	Damage $	Representative Speed 60 mph Injuries	Fatalities	Damage $	Representative Speed 79 mph Injuries	Fatalities	Damage $	Representative Speed 105 mph Injuries	Fatalities	Damage $
	Train-Train Collision	Pass Loco hits Loco	0.083	0.002	502000	0.139	0.0049	1142000	0.24	0.0095	1976000	0.425	0.016	3499000
		Pass Loco hits Pass Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.008	1747000
		Pass Loco hits Frt Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.008	1747000
		Pass car hit by Loco	0.166	0.005	1005000	0.275	0.0119	2284000	0.476	0.0206	3951000	0.841	0.032	6989000
	Intrusion Collision (rollout)	Pass Loco hits Car	0.013	0.0005	112000	0.031	0.0011	257000	0.054	0.0019	445000	0.096	0.0034	788000
	Intrusion Collision (other))	Pass Loco hits Car	0.026	0.0009	226000	0.063	0.0022	514000	0.108	0.0038	889000	0.191	0.0068	1573000
	Overspeed		0.044	0.0004	667000	0.14	0.00186	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Broken Rail		0.044	0.0004	667000	0.14	0.00186	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Work Zone Violation		0.083	0.0083	0	0.125	0.0125	0	0.164	0.0164	0	0.218	0.0218	0

Freight trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 25 mph Injuries	Fatalities	Damage $	Representative Speed 40 mph Injuries	Fatalities	Damage $	Representative Speed 50 mph Injuries	Fatalities	Damage $
	Train-Train Collision	Frt Loco hits Loco	0.43	0.043	105000	1.1	0.11	270000	1.7	0.17	422000
		Frt Loco hits Car	0.35	0.035	88000	0.9	0.09	225000	1.4	0.14	352000
		Frt car hit by Loco	0	0	44000	0	0	112000	0	0	176000
	Intrusion Collsn equip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Collsn equip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Collsn Unequip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Collsn Unequip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Overspeed, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Overspeed, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Work Zone Viol'n, Equip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0
	Work Zone Viol'n, Unequip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0

Table 3.2: Grade Crossing and Diamonds: Numbers by Representative Speed, Accident Frequency and Consequences

Train Type	Representative Speed (mph)	Type of Grade-crossing	Number Crossings Passenger	HS Passenger	Freight	Accident Frequency per Million Crossing Passes Passenger	Freight	Crossing Collision Consequences Pass. Occup't Casualty Prob(accident) Injuries	Fatalities	Cost $/Accid't	Freight Trains (per accident) Injuries	Fatalities	Cost $	Number Diamonds
Passenger	40	Public_gates_lights	7	7		0.250		0.0028	0.000047	50000				1
		Public_other	0	0		0.300								
		Private	0	0		0.100								
	60	Public_gates_lights	16	0		0.600		0.0056	0.000112	113000				0
		Public_other	0	0		0.500								
		Private	1	0		0.200								
	79	Public_gates_lights	16	16		0.800		0.0105	0.000156	196000				0
		Public_other	1	0		0.650								
		Private	6	1		0.300								
	105	Public_gates_lights	0	16		1.100		0.0189	0.000276	346000				0
		Public_other	0	1		0.850								
		Private	0	6		0.300								
Freight	25	Public_gates_lights			7		0.150				0.12	0.005	20000	0
		Public_other			0		0.120							
		Private			0		0.050							
	40	Public_gates_lights			16		0.300				0.25	0.013	50000	1
		Public_other			0		0.250							
		Private			1		0.100							
	50	Public_gates_lights			16		0.360				0.39	0.02	78000	0
		Public_other			1		0.300							
		Private			6		0.120							

Table 3.3a: Segment Data (for reference only, not used in calculations)

Segment Number	Start (Milepost)	End (Milepost)	Type	Length (miles)	Representative Speed (mph) Freight	Pass	HS Pass-cons	HS Pass
14.0	88.35	90.55	Plain	2.20	50	79	79	105
15.0	90.55	92.47	CP Adjacent (Mon	1.92	40	60	60	79
16.0	92.47	94.97	Siding (M	2.50	50	79	79	105
17.0	94.97	96.81	CP Adjacent (M	1.84	50	79	79	105
18.0	96.81	100.28	Plain,	3.47	50	79	79	105
19.0	100.28	102.25	CP Adjacent (M	1.97	40	60	60	79
20.0	102.25	102.25	Diamond	0.00	40	40	40	40
21.0	102.25	104.60	CP Adjacent (M	2.35	40	60	60	79
22.0	104.60	106.43	CP Adjacent (M	1.83	50	79	79	105
23.0	106.43	108.83	Siding (M	2.40	50	79	79	105
24.0	108.83	111.36	CP Adjacent (M	2.53	50	79	79	105
25.0	111.36	113.30	Plain,	1.94	50	79	79	105
26.0	113.30	116.36	Plain,	3.06	50	79	79	105
27.0	116.36	118.83	Plain,	2.47	50	79	79	105
28.0	118.83	121.40	CP Adjacent (M	2.57	50	79	79	105
29.0	121.40	123.57	Siding (M	2.17	40	60	79	79
30.0	123.57	124.38	Siding (M	0.81	25	40	40	40
31.0	124.38	124.86	Siding (M	0.48	25	40	40	40
	Length Check	36.5		36.5				

Table 3.4a: Traffic Inputs to Risk Calculation

Train Type	Trips/Day Summer	Rest of Year
Passenger	6.00	6.00
Equipped Freight	1.07	1.07
Unequipped Freight	0.36	1.21
Operating Days	91.00	274.00

Percent Train-Miles in	
Timeout (secs)	120.00
Normal Operating Mode	94.86
Timeout Mode	0.14
Fallback Mode	5.00

Passenger Train Occupancy	
Seats	320.00
Occupancy Factor	0.60

Table 3.5a: Risk Calculation - Passenger Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Rate per million trn	Preventability Factor	Adjusted Rate	Trips/day	Trips per 10 years	Length of Track	Train-miles per 10 years	Accidents per 10 years	Number seats per train	Occupancy Factor	Passengers per train	Injuries per 10 years	Fatalities per 10 years	Damage $ per 10 years
40	Train-Train Collision	Pass Loco hits Loco	0.00312	Incl	0.00312	8.28	21521	1.29	27762	0.00009	320	0.6	192	0.0014	0.00003	0
		Pass Loco hits Pass Car	0.00090	Incl	0.00090	8.28	21521	1.29	27762	0.00002	320	0.6	192	0.0002	0.00000	0
		Pass Loco hits Frt Car	0.00038	Incl	0.00038	8.28	21521	1.29	27762	0.00001	320	0.6	192	0.0001	0.00000	0
		Pass car hit by Loco	0.00143	Incl	0.00143	8.28	21521	1.29	27762	0.00004	320	0.6	192	0.0013	0.00004	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.30	0.00602	6.00	15595	1.29	20118	0.00012	320	0.6	192	0.0003	0.00001	0
	Intrusion Collision (other))	Pass Loco hits intruder	0.01440	0.05	0.01368	6.00	15595	1.29	20118	0.00028	320	0.6	192	0.0014	0.00005	0
	Overspeed		0.01100	0.80	0.00220	6.00	15595	1.29	20118	0.00004	320	0.6	192	0.0004	0.00000	0
	Broken Rail		0.01670	0.04	0.01603	6.00	15595	1.29	20118	0.00032	320	0.6	192	0.0027	0.00002	0
	Work Zone Violation			0.50		6.00	15595	1.29	20118					0.0008	0.00008	0
										0.00093				**0.00849**	**0.00025**	**0**
60	Train-Train Collision	Pass Loco hits Loco	0.00000	Incl	0.00000	8.28	21521	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Pass Car	0.00000	Incl	0.00000	8.28	21521	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Frt Car	0.00000	Incl	0.00000	8.28	21521	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00000	Incl	0.00000	8.28	21521	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.30	0.00602	6.00	15595	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.05	0.01368	6.00	15595	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Overspeed		0.01100	0.80	0.00220	6.00	15595	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Broken Rail		0.01670	0.04	0.01603	6.00	15595	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Work Zone Violation			0.50		6.00	15595	0	0					0.0000	0.00000	0
										0.00000				**0.00000**	**0.00000**	**0**
79	Train-Train Collision	Pass Loco hits Loco	0.00267	Incl	0.00267	8.28	21521	35.22	757976	0.00203	320	0.6	192	0.093	0.0033	4006
		Pass Loco hits Pass Car	0.00016	Incl	0.00016	8.28	21521	35.22	757976	0.00012	320	0.6	192	0.002	0.0001	121
		Pass Loco hits Frt Car	0.00014	Incl	0.00014	8.28	21521	35.22	757976	0.00011	320	0.6	192	0.002	0.0001	107
		Pass car hit by Loco	0.00046	Incl	0.00046	8.28	21521	35.22	757976	0.00035	320	0.6	192	0.032	0.0014	1378
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.30	0.00602	6.00	15595	8.41	131154	0.00079	320	0.6	192	0.008	0.0003	351
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.05	0.01368	6.00	15595	8.41	131154	0.00179	320	0.6	192	0.037	0.0013	1595
	Overspeed		0.01100	0.80	0.00220	6.00	15595	8.41	131154	0.00029	320	0.6	192	0.012	0.0002	750
	Broken Rail		0.01670	0.04	0.01603	6.00	15595	8.41	131154	0.00210	320	0.6	192	0.085	0.0014	5467
	Work Zone Violation			0.50		6.00	15595	8.41	131154					0.011	0.0011	0
										0.00758				**0.28214**	**0.00911**	**13775**
105	Train-Train Collision	Pass Loco hits Loco	0.00239	Incl	0.00239	8.28	21521	26.81	576983	0.00138	320	0.6	192	0.113	0.0042	4823
		Pass Loco hits Pass Car	0.00041	Incl	0.00041	8.28	21521	26.81	576983	0.00024	320	0.6	192	0.008	0.0004	417
		Pass Loco hits Frt Car	0.00012	Incl	0.00012	8.28	21521	26.81	576983	0.00007	320	0.6	192	0.002	0.0001	118
		Pass car hit by Loco	0.00045	Incl	0.00045	8.28	21521	26.81	576983	0.00026	320	0.6	192	0.042	0.0016	1802
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.30	0.00602	6.00	15595	26.81	418104	0.00252	320	0.6	192	0.046	0.0016	1978
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.05	0.01368	6.00	15595	26.81	418104	0.00572	320	0.6	192	0.210	0.0075	8997
	broken Rail		0.01100	0.80	0.00220	6.00	15595	26.81	418104	0.00092	320	0.6	192	0.049	0.0008	4226
	Broken Rail		0.01670	0.04	0.01603	6.00	15595	26.81	418104	0.00670	320	0.6	192	0.360	0.0058	30794
	Work Zone Violation			0.50		6.00	15595	26.81	418104					0.046	0.0046	0
	Total									**0.01780**				**0.87583**	**0.02655**	**53155**
	Overall Totals									**0.02631**				**1.16645**	**0.03591**	**66931**

	Totals All Speeds	Train-train Collisions	**0.00471**	**0.29676**	**0.01126**	**12772**
		Intrusion Collisions	**0.01122**	**0.30321**	**0.01077**	**12922**
		Overspeed	**0.00125**	**0.06146**	**0.00099**	**4976**
		Broken Rail	**0.00913**	**0.44786**	**0.00718**	**36261**
		Work Zone Violation	**0.00000**	**0.05716**	**0.00572**	**0**

Table 3.6a: Risk Calculation - Freight Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Rate per million trn	Preventability Factor	Adjusted Rate	Trips/day	Trips per 10 years	Length of Track	Per 10 years Train-miles	Accidents	Injuries	Fatalities	Damage $
25	Train-Train Collision	Frt Loco hits Loco	0.00215563	Incl	0.00216	8.28	21521	1.29	27762	0.00006	0.00003	0.000003	$6
		Frt Loco hits Car	0.00118708	Incl	0.00119	8.28	21521	1.29	27762	0.00003	0.00001	0.000001	$3
		Frt car hit by Loco	0.00104391	Incl	0.00104	8.28	21521	1.29	27762	0.00003	0.00000	0.000000	$1
	Intrusion Collsn equip (rollout)	Frt Loco hits Car	0.014	0.30	0.01008	1.07	2781	1.29	3588	0.00004	0.00000	0.000000	$0
	Intrusion Collsn equip (other)	Frt Loco hits Car	0.009	0.05	0.00817	1.07	2781	1.29	3588	0.00003	0.00000	0.000000	$0
	Intrusion Collsn Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	1.21	3145	1.29	4057	0.00006	0.00001	0.000001	$1
	Intrusion Collsn Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	1.21	3145	1.29	4057	0.00003	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.80	0.00320	1.07	2781	1.29	3588	0.00001	0.00000	0.000000	$2
	Overspeed, Unequip		0.016	0.00	0.01600	1.21	3145	1.29	4057	0.00006	0.00000	0.000000	$10
	Broken Rail, Equip		0.056	0.04	0.05338	1.07	2781	1.29	3588	0.00019	0.00001	0.000001	$29
	Broken Rail, Unequip		0.056	0.00	0.05560	1.21	3145	1.29	4057	0.00023	0.00001	0.000001	$34
	Work Zone Viol'n, Equip			0.50		1.07	2781	1.29	3588		0.00008	0.000008	$0
	Work Zone Viol'n, Unequip			0.00		1.21	3145	1.29	4057		0.00017	0.000017	$0
	Totals									**0.0008**	**0.0003**	**0.00003**	**886**
40	Train-Train Collision	Frt Loco hits Loco	0.0044	Incl	0.00440	8.28	21521	8.41	180993	0.00080	0.00088	0.000088	$215
		Frt Loco hits Car	0.0011	Incl	0.00114	8.28	21521	8.41	180993	0.00021	0.00019	0.000019	$46
		Frt car hit by Loco	0.0010	Incl	0.00098	8.28	21521	8.41	180993	0.00018	0.00000	0.000000	$20
	Intrusion Collsn equip (rollout)	Frt Loco hits Car	0.014	0.30	0.01008	1.07	2781	8.41	23389	0.00024	0.00005	0.000005	$7
	Intrusion Collsn equip (other)	Frt Loco hits Car	0.009	0.05	0.00817	1.07	2781	8.41	23389	0.00019	0.00004	0.000004	$5
	Intrusion Collsn Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	1.21	3145	8.41	26449	0.00038	0.00009	0.000009	$11
	Intrusion Collsn Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	1.21	3145	8.41	26449	0.00023	0.00005	0.000005	$6
	Overspeed, Equip		0.016	0.80	0.00320	1.07	2781	8.41	23389	0.00007	0.00001	0.000001	$28
	Overspeed, Unequip		0.016	0.00	0.01600	1.21	3145	8.41	26449	0.00042	0.00006	0.000006	$139
	Broken Rail, Equip		0.056	0.04	0.05338	1.07	2781	8.41	23389	0.00125	0.00018	0.000018	$468
	Broken Rail, Unequip		0.056	0.00	0.05560	1.21	3145	8.41	26449	0.00147	0.00021	0.000021	$551
	Work Zone Viol'n, Equip			0.50		1.07	2781	8.41	23389		0.00077	0.000077	$0
	Work Zone Viol'n, Unequip			0.00		1.21	3145	8.41	26449		0.00175	0.000175	$0
	Totals									**0.00543**	**0.0043**	**0.00043**	**$1,517**
50	Train-Train Collision	Frt Loco hits Loco	0.0024	Incl	0.00240	8.28	21521	26.81	576983	0.00138	0.00235	0.000235	$584
		Frt Loco hits Car	0.0007	Incl	0.00068	8.28	21521	26.81	576983	0.00039	0.00055	0.000055	$137
		Frt car hit by Loco	0.0006	Incl	0.00060	8.28	21521	26.81	576983	0.00035	0.00000	0.000000	$61
	Intrusion Collsn equip (rollout)	Frt Loco hits Car	0.014	0.30	0.01008	1.07	2781	26.81	74562	0.00075	0.00026	0.000026	$33
	Intrusion Collsn equip (other)	Frt Loco hits Car	0.009	0.05	0.00817	1.07	2781	26.81	74562	0.00061	0.00021	0.000021	$27
	Intrusion Collsn Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	1.21	3145	26.81	84318	0.00121	0.00042	0.000042	$53
	Intrusion Collsn Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	1.21	3145	26.81	84318	0.00073	0.00025	0.000025	$32
	Overspeed, Equip		0.016	0.80	0.00320	1.07	2781	26.81	74562	0.00024	0.00008	0.000008	$140
	Overspeed, Unequip		0.016	0.00	0.01600	1.21	3145	26.81	84318	0.00135	0.00047	0.000047	$791
	Broken Rail, Equip		0.056	0.04	0.05338	1.07	2781	26.81	74562	0.00398	0.00139	0.000139	$2,332
	Broken Rail, Unequip		0.056	0.00	0.05560	1.21	3145	26.81	84318	0.00469	0.00164	0.000164	$2,747
	Work Zone Viol'n, Equip			0.50		1.07	2781	26.81	74562		0.00309	0.000309	$0
	Work Zone Viol'n, Unequip			0.00		1.21	3145	26.81	84318		0.00700	0.000700	$0
	Totals									**0.01568**	**0.0177**	**0.00177**	**$6,937**
	Overall Totals									**0.02188**	**0.0223**	**0.0022**	**$8,540**

	Totals All Speeds	Train-Train Collisions	**0.00342**	**0.00400**	**0.00040**	**1074**
		Intrusion Collisions	**0.00449**	**0.00140**	**0.00014**	**176**
		Diamond Collisions	**0.00125**	**0.00054**	**0.00005**	**208**
		Overspeed	**0.00216**	**0.00063**	**0.00006**	**1129**
		Broken Rail	**0.01180**	**0.00345**	**0.00034**	**6162**
		Work Zone Violation	**0.00000**	**0.01286**	**0.00129**	**0**
		Grade Crossing Collisions				

Table 3.7: Risk Calculations: Passenger and Freight Trains; Grade Crossings

Train Type	Representative Speed	Type of Grade-crossing	Base Collision Frequency	Preventability Factor	Adjusted Collision Frequency	Trips per Day	Crossing Passes per Trip	Crossing Passes per 10 Years	Collisions per 10 Years	Seats per Train (Passenger)	Occupancy Factor	Passengers per Train	Passenger/ Crew Injuries per 10 Years	Passenger/ Crew Fatalities per 10 Years	Damage $ per 10 Years ($)
Passenger	40	Public_gates_lights	0.35	4%	0.336	6.00	7	109165.4233	0.037	320	0.60	192	0.0197	0.0003	1834
		Public_other	0.30	4%	0.288	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Private	0.10	4%	0.096	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
	60	Public_gates_lights	0.60	4%	0.576	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Public_other	0.50	4%	0.480	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Private	0.20	4%	0.192	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
	79	Public_gates_lights	0.80	4%	0.768	6.00	16	249521	0.192	320	0.60	192	0.3863	0.0057	37560
		Public_other	0.65	4%	0.624	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Private	0.30	4%	0.288	6.00	1	15595	0.004	320	0.60	192	0.0091	0.0001	880
	105	Public_gates_lights	1.10	4%	1.056	6.00	16	249521	0.263	320	0.60	192	0.9410	0.0140	91169
		Public_other	0.80	4%	0.768	6.00	1	15595	0.012	320	0.60	192	0.0428	0.0006	4144
		Private	0.30	4%	0.288	6.00	6	93570	0.027	320	0.60	192	0.0962	0.0014	9324
Freight	25	Public_gates_lights	0.15	4%	0.144	1.07	7	19468	0.003				0.00034	0.00001	56
Equipped		Public_other	0.12	4%	0.115	1.07	0	0	0.000				0.00000	0.00000	0
		Private	0.05	4%	0.048	1.07	0	0	0.000				0.00000	0.00000	0
	40	Public_gates_lights	0.30	4%	0.288	1.07	16	44498	0.013				0.00320	0.00017	641
		Public_other	0.25	4%	0.240	1.07	0	0	0.000				0.00000	0.00000	0
		Private	0.10	4%	0.096	1.07	1	2781	0.000				0.00007	0.00000	13
	50	Public_gates_lights	0.36	4%	0.346	1.07	16	44498	0.015				0.00600	0.00031	1200
		Public_other	0.30	4%	0.288	1.07	1	2781	0.001				0.00031	0.00002	62
		Private	0.12	4%	0.115	1.07	6	16687	0.002				0.00075	0.00004	150
Freight	25	Public_gates_lights	0.15	0%	0.150	1.21	7	22015	0.003				0.00040	0.00002	66
Unequipped		Public_other	0.12	0%	0.120	1.21	0	0	0.000				0.00000	0.00000	0
		Private	0.05	0%	0.050	1.21	0	0	0.000				0.00000	0.00000	0
	40	Public_gates_lights	0.30	0%	0.300	1.21	16	50320	0.015				0.00377	0.00020	755
		Public_other	0.25	0%	0.250	1.21	0	0	0.000				0.00000	0.00000	0
		Private	0.10	0%	0.100	1.21	1	3145	0.000				0.00008	0.00000	16
	50	Public_gates_lights	0.36	0%	0.360	1.21	16	50320	0.018				0.00706	0.00036	1413
		Public_other	0.30	0%	0.300	1.21	1	3145	0.001				0.00037	0.00002	74
		Private	0.12	0%	0.120	1.21	6	18870	0.002				0.00088	0.00005	177
							Total - Passenger		**0.535**				**1.495**	**0.022**	**144911**
Risk Calculations: Passenger and Freight Trains; Diamonds							**Total - Freight**		**0.074**				**0.023**	**0.001**	**4622**
Train Type							**Totals - All Speeds**		**0.609**				**1.52**	**0.02**	**149533**

Table 3.8: Summary - All Risks

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00471	0.29676	0.01126	12772	76227
	Intrusion Collisions	0.01122	0.30321	0.01077	12922	75544
	Diamond Collisions	0.000226	0.00243	0.00007	85	544
	Overspeed	0.00125	0.06146	0.00099	4976	14078
	Broken Rail	0.00913	0.44786	0.00718	36261	102589
	Work Zone Violation	0.00000	0.05716	0.00572	0	22865
	Grade Crossing Collisions	0.53522	1.49510	0.02223	144911	361115
	Total, All Scenarios	0.56176	2.66389	0.05821	211927	652962
Freight	Train-Train Collisions	0.00342	0.00400	0.00040	1074	2673
	Intrusion Collisions	0.00449	0.00140	0.00014	176	738
	Diamond Collisions	0.00125	0.00054	0.00005	208	422
	Overspeed	0.00216	0.00063	0.00006	1129	1381
	Broken Rail	0.01180	0.00345	0.00034	6162	7541
	Work Zone Violation	0.00000

Worksheet 2 - B,N,R: Collision Frequencies Calculation - PTC 120 Sec.Timeout Case, Bloomington Sub-corridor, PTC Normal Operating State, Summer

Table 2.1a: Collision Distribution Matrix (Fraction Accidents by Train Pair and Collision Type). Collisions Between Trains Operating on the DOT Test Corridor Only (Non diamonds and intrusions)

Train Pairs in Collision	Collision Scenario Prob (Top Level)	Siding - Monitored: Collision Distribution	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty	Siding - Unmonitored: Collision Distribution	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty	CP Adjacent - Monitored Siding: Collision Distribution	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty	CP Adjacent - Unmonitored Siding: Collision Distribution	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty	Plain Track: Collision Distribution	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
Percent Guilt			100%	0%	100%	0%		100%	0%	100%	0%		100%	0%	100%	0%		100%	0%	100%	0%		100%	0%	100%	0%
Both Trains: Pass-Pass	0.72	0.50	0.50	0.355	0	0.355	0	0.5	0.5	0.355	0	0.355	0	0.142	0	0.8	0.2	0.568	0	0.142	0	0.70	0.35	0.497	0	0.212	0
Both TBE: Pass-TBE Freight	0.22	0.50	0.50	0.11	0	0.11	0	0.5	0.5	0.11	0	0.11	0	0.044	0	0.2	0.8	0.154	0	0.066	0	0.30	0.60	0.066	0	0.132	0
(Note 4) TBE Freight - TBE Freight	0.00	0.50	0.50	0	0	0	0	0.5	0.5	0	0	0	0	0	0	0.7	0.3	0	0	0	0	0.00	0.50	0	0	0	0
Percent Guilt			50%	50%	50%	50%		50%	50%	50%	50%		50%	50%	50%	50%		50%	50%	50%	50%		50%	50%	50%	50%
One Train TBE: Pass - NE Freight, Head -On	0.07	1	0	0.0175	0.0175	0	0	1	0	0.0175	0.0175	0	0	1	0	0.028	0.028	0	0	0	0	1.00	0.00	0.0245	0.0245	0	0
Rear/Side, Pass into NE Frt		0	1	0	0	0.028	0	0	1	0	0	0.028	0	0	0	0	0.028	0	1	0	0.028	0.00	1.00	0	0	0.0175	0
Rear/Side NE Frt into Pass		0	1	0	0	0	0.0028	0	1	0	0	0	0.028	0	1	0	0	0	1	0	0	0.00	1.00	0	0	0	0.0028
TBE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0	0.5	0.5	0	0	0	0	0.7	0.3	0	0	0	0	0	0	0.50	0.50	0	0	0	0
Percent Guilt			0%	100%	0%	100%				0%	100%	0%	100%			0%	100%	0%	100%	0%	100%			0%	100%	0%	100%
Neither Train: NE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0	0.5	0.5	0	0	0	0	0.7	0.3	0	0	0	0	0	0	0.50	0.50	0	0	0	0
TBE																											
Total Probability (checksum)	1	1	1	0.4825	0.0175	0.493	0.007	1	1	0.4825	0.0175	0.493	0.007	1	1	0.75	0.228	0.2185	0.0035	1	1	0.70	0.035	0.2485	0.0035	0.36	0.0035

Cell(s) in Cell C8 is for an Collision between a passenger train and an unequipped freight train.

Table 2.2: Preventability Data For Unequipped train Guilty, One Train TBE

Segment Type	Not Prevented or Mitigated: Freight	Not Prevented or Mitigated: Pass	Not Prevented or Mitigated: HS Pass	Mitigated: Freight	Mitigated: Pass	Mitigated: HS Pass	Prevented: Freight	Prevented: Pass	Prevented: HS Pass
Siding (M)	0.360	0.416	0.008	0.240	0.168	0.248	0.456	0.464	0.196
Siding (U)	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100
CP Adjacent (M)	0.312	0.396	0.044	0.230	0.197	0.274	0.458	0.467	0.190
CP Adjacent (U)	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100
Plain Track	0.368	0.452	0.074	0.000	0.000	0.002	0.100	0.100	0.098
Diamonds	0.189	0.269	0.269	0.172	0.000	0.000	0.759	0.752	0.551

Adjust cells contain data imported from previous worksheets. Changing these worksheets's training line-sub corridor, season and operating state.

Table 2.3a: Collision Preventability Matrix (Percent Accidents Preventable Relative to CTC Reference Case)

Preventability Equipped Train Guilty	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty	Plain Track: Collision Distribution Head On	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
Both TBE: Pass-Pass	90%								90%				90%				90%				90%	
Pass-TBE Freight	90%								90%				90%				90%				90%	
TBE Freight - TBE Freight	90%								90%				90%				90%				90%	
One TBE: Pass - NE Freight, Head -On	80%			90%	20%				90%	10%			80%	18%			90%	10%			90%	7%
Rear/Side, Pass into NE Frt	90%					90%	20%				90%	10%			90%	18%			90%	10%		
Rear/Side NE Frt into Pass	90%					90%	0%				90%	0%			90%	0%			90%	0%		
TBE Freight - NE Freight	95%			90%	41%	90%	0%			90%	10%			90%	59%	90%	0%			90%	10%	
Neither TBE: NE Freight - NE Freight					0%		0%				0%				0%		0%				0%	
Reference Case (CTC) Collision Accident Likelihood by Segment	0.450					0.440			0.554				0.550				0.455					
Collisions/million train miles																						

Table 2.3b: Collision Preventability Matrix - Diamonds

Diamond Collisions: Rear End/Side Equip Guilty	Diamond Collisions: Rear End/Side Unequip Guilty	Train Pairs in Collision	Train Pair Type
		Pass-Pass	Both TBE
		Pass-TBE Freight	
		TBE Freight - TBE Freight	
		Pass - NE Freight, Head -On	One TBE
		Rear/Side, Pass into NE Frt	
90%	75.06%	Rear/Side NE Frt into Pass	
90%	75.06%	TBE Freight - NE Freight	
90%	73.97%		
	0.00%	NE Freight - NE Freight	Neither TBE
	0.1		

Table 2.4a: Passenger Trains in Accidents (Collisions per Million Train-Miles Operated in Sub-Corridor)

Passenger Trains in Collisions	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty	Plain Track: Collision Distribution Head On	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
Both TBE: Pass-Pass	1	0.0002		0.0004					0.0007				0.0014				0.0007				0.0005	
Pass-TBE Freight	1	0.0003		0.0003					0.0004				0.0008				0.0011				0.0008	
TBE Freight - TBE Freight	0																					
One TBE: Pass - NE Freight, Head -On	1	0.0001	0.0004						0.0001	0.0006			0.0001	0.0011			0.0002	0.0016			0.0000	0.0000
Rear/Side, Pass into NE Frt	1			0.0003	0.0000						0.0001	0.0000			0.0001	0.0000			0.0001	0.0000		
Rear/Side NE Frt into Pass	1			0.0000	0.0002						0.0000	0.0003			0.0000	0.0002			0.0000	0.0000		
TBE Freight - NE Freight	0																					
Neither TBE: NE Freight - NE Freight	0																					
Checking total		0.0025	0.0004	0.0025	0.0002				0.0032	0.0007	0.0016	0.0000			0.0009	0.0001	0.0018	0.0002			0.0005	0.0000

Scenario Totals - Passenger	Data, PoiF	Totals
Pass Loco Hits Loco	0.0005	0.0029
Pass Loco Hits Pass Car		0.0014
Pass Loco Hits Freight Car	0.0001	0.0023
Pass Car Hit By Loco	0.0002	0.0013
Total		0.0057

Totals
0.0027
0.0014
0.0007
0.0004
0.0052

Totals
0.0027
0.0014
0.0007
0.0004
0.0052

Totals
0.0017
0.0009
0.0004
0.0002
0.0032

Totals
0.0005
0.0004
0.0001
0.0000
0.0010

Totals	Scenario Totals - Passenger
0.002500	0.0029
0.001400	0.0014
0.000700	0.0007
0.000400	0.0004
0.005200	0.0052

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Table 2.4b: Passenger Trains in Collisions at Diamonds

Diamond Collisions: Rear End/Side Equip Guilty	Diamond Collisions: Rear End/Side Unequip Guilty	Train Pairs in Collision	Train Pair Type
		Pass-Pass	Both TBE
		Pass-TBE Freight	
		TBE Freight - TBE Freight	
		Pass - NE Freight, Head -On	One TBE
		Rear/Side, Pass into NE Frt	
0.002500	0.0002418	Rear/Side NE Frt into Pass	
0.002500	0.0012148	TBE Freight - NE Freight	
0.000000	0.0000000		
	0.0000000	NE Freight - NE Freight	Neither TBE
0.00500	0.00740		

Totals	Scenario Totals - Passenger
0.0029	Pass Loco Hits Loco
0.0014	Pass Loco Hits Pass Car
0.00074	Pass Loco Hits Freight Car
0.00174	Pass Car Hit By Loco
0.00488	Total

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Table 2.5a: Freight trains in Accidents (Collisions per Million Train-Miles Operated in Sub-Corrid

Freight Trains in Collisions	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty	Plain Track: Collision Distribution Head On	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
Both TBE: Pass-Pass	1	0.0003		0.0003					0.0004		0.0004		0.0008	0.0003			0.0004				0.0001	
Pass-TBE Freight	2	0.0006		0.0006					0.0008		0.0008		0.0016	0.0006			0.0008				0.0002	
TBE Freight - TBE Freight	1	0.0003		0.0003					0.0004		0.0004		0.0008	0.0003			0.0004				0.0001	
One TBE: Pass - NE Freight, Head -On	1	0.0001	0.0004						0.0001	0.0006			0.0001	0.0011			0.0002	0.0016			0.0000	0.0000
Rear/Side, Pass into NE Frt	1			0.0003	0.0000						0.0001	0.0000			0.0001	0.0000			0.0001	0.0000		
Rear/Side NE Frt into Pass	1			0.0000	0.0002						0.0000	0.0002			0.0000	0.0002			0.0000	0.0000		
TBE Freight - NE Freight	2	0.0000	0.0000	0.0000	0.0000				0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Neither TBE: NE Freight - NE Freight	3			0.0000	0.0000						0.0000	0.0000			0.0000	0.0000			0.0000	0.0000		
Checking total		0.0013	0.0004	0.0012	0.0002				0.0017	0.0006	0.0013	0.0002	0.0033	0.0020	0.0000	0.0000	0.0007	0.0016	0.0000	0.0000	0.0003	0.0000

Scenario Totals - Freight	Totals
Freight Loco Hits Loco	0.0009
Freight Loco Hits Car	0.0004
Freight Car Hit By Loco	0.0001
Total	0.0014

Totals
0.0011
0.0004
0.0000
0.0016

Totals
0.0021
0.0009
0.0002
0.0032

Totals
0.0009
0.0004
0.0000
0.0013

Totals
0.0006
0.0011
0.0004
0.0000
0.0021

Totals
0.0002
0.0004
0.0000
0.0006

Totals	Scenario Totals - Freight
0.000500	0.0014
0.001400	Freight Loco Hits Car
0.000300	Freight Loco Hits Freight Car
0.000000	Freight Car Hit By Loco
0.002200	Total

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Table 2.5b: Freight Trains in Collisions at Diamond

Diamond Collisions: Rear End/Side Equip Guilty	Diamond Collisions: Rear End/Side Unequip Guilty	Train Pairs in Collision	Train Pair Type
		Pass-Pass	Both TBE
		Pass-TBE Freight	
		TBE Freight - TBE Freight	
		Pass - NE Freight, Head -On	One TBE
		Rear/Side, Pass into NE Frt	
0.002500	0.0241612	Rear/Side NE Frt into Pass	
0.002500	0.0012148	TBE Freight - NE Freight	
0.000000	0.0000000		
	0.0000000	NE Freight - NE Freight	Neither TBE
0.00500	0.02591		

Totals	Scenario Totals - Freight
0.0014	Freight Loco Hits Loco
0.02748	Freight Loco Hits Car
0.00300	Freight Loco Hits Freight Car
0.02915	Freight Car Hit By Loco
0.05963	Total

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Table 2.5c: Collision Type Distribution - Diamonds

Diamond Collisions: Rear End/Side Equip Guilty	Diamond Collisions: Rear End/Side Unequip Guilty	Train Pairs in Collision	Train Pair Type
		Pass-Pass	Both TBE
		Pass-TBE Freight	
		TBE Freight - TBE Freight	
		Pass - NE Freight, Head -On	One TBE
		Rear/Side, Pass into NE Frt	
0.05	0.25	Rear/Side NE Frt into Pass	
0.05	0.05	TBE Freight - NE Freight	
0.1	0.1		
	0.05	NE Freight - NE Freight	Neither TBE
0	0.2		

Note: The grayscale shaded cells are not used because these collisions are represented by the cell does not exist - either because there are no unequipped passenger trains, or because of the kind of collision defined for the row.

Table 2.6a: Collision Rates

Collision Type	Like Trains: Loco Hits Loco per Train-Mile	Like Trains: Car Hit by Loco per Train-Mile	Like Trains: P Loco Hit F car	Like Trains: P Loco Hit P car	Unlike Trains: P Loco Hit F car	Unlike Trains: P Loco Hit P car
Freight to Freight	0.50	0.50				
Passenger to Passenger	0.50	0.50				
Passenger to Freight					0.8	0.2

Collision Type	Like Trains: Loco Hits Loco per Train-Mile	Like Trains: Car Hit by Loco per Train-Mile	Like Trains: P Loco Hit F car	Like Trains: P Loco Hit P car	Unlike Trains: P Loco Hit F car	Unlike Trains: P Loco Hit P car
Freight to Freight	0.50	0.50				
Passenger to Passenger	0.50	0.50				
Passenger to Freight					0.80	0.20

Collision Type	Like Trains: Loco Hits Loco per Train-Mile	Like Trains: Car Hit by Loco per Train-Mile	Like Trains: P Loco Hit F car	Like Trains: P Loco Hit P car	Unlike Trains: P Loco Hit F car	Unlike Trains: P Loco Hit P car
Freight to Freight	0.50	0.50				
Passenger to Passenger	0.50	0.50				
Passenger to Freight					0.75	0.25

Collision Type	Like Trains: Loco Hits Loco per Train-Mile	Like Trains: Car Hit by Loco per Train-Mile	Like Trains: P Loco Hit F car	Like Trains: P Loco Hit P car	Unlike Trains: P Loco Hit F car	Unlike Trains: P Loco Hit P car
Freight to Freight	0.50	0.50				
Passenger to Passenger	0.50	0.50				
Passenger to Freight					0.75	0.25

Collision Type	Like Trains: Loco Hits Loco per Train-Mile	Like Trains: Car Hit by Loco per Train-Mile	Like Trains: P Loco Hit F car	Like Trains: P Loco Hit P car	Unlike Trains: P Loco Hit F car	Unlike Trains: P Loco Hit P car
Freight to Freight	0.50	0.50				
Passenger to Passenger	0.50	0.50				
Passenger to Freight					0.91	0.17

Enter collision rates between two trains in a row loco hits car and one car hit by loco in each collisions. In row loco collisions between a passenger and freight trains, the ratio between passenger hits freight and freight hits passenger should be the reciprocal of the percentages given in Table 4A-52 on the Vaults sheet. The values are given in the tables beneath the trains in collisions for each segment type.

Freight Plus Passenger Totals (check)

	0.0008	0.0071					0.0800	0.0098					0.1000	0.0123					0.1250	0.0151		
																					0.0010	

Worksheet 3 - B,N,S: - Risk Calculations - PTC 120 Sec. Timeout Case, Bloomington Sub-corridor, Normal Operating State, Summer

Table 3.1: Consequences Look-up Tables (Data Sources: Previous ICF Passenger Corridor Project (passenger), FRA Accident Data 2001-5 (freight)

Passenger Trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 40 mph Injuries	Fatalities	Damage $	Representative Speed 60 mph Injuries	Fatalities	Damage $	Representative Speed 79 mph Injuries	Fatalities	Damage $	Representative Speed 105 mph Injuries	Fatalities	Damage $
	Train-Train Collision	Pass Loco hits Loco	0.080	0.002	302800	0.139	0.0049	1142000	0.24	0.0085	1976800	0.425	0.016	3495000
		Pass Loco hits Pass Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.008	1747000
		Pass Loco hits Frt Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.008	1747000
		Pass car hit by Loco	0.186	0.005	1505000	0.275	0.0119	2284000	0.476	0.0206	3951000	0.841	0.032	6989000
	Intrusion Collision (rollout)	Pass Loco hits Car	0.013	0.0005	113000	0.031	0.0011	257000	0.054	0.0019	445000	0.096	0.0034	786000
	Intrusion Collision (other))	Pass Loco hits Car	0.026	0.0009	226000	0.063	0.0022	514000	0.108	0.0038	889000	0.191	0.0068	1573000
	Overspeed		0.044	0.0004	667000	0.14	0.00185	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Broken Rail		0.044	0.0004	667000	0.14	0.00185	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Work Zone Violation		0.083	0.0093	0	0.125	0.0125	0	0.164	0.0164	0	0.218	0.0218	0

Freight trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 25 mph Injuries	Fatalities	Damage $	Representative Speed 40 mph Injuries	Fatalities	Damage $	Representative Speed 50 mph Injuries	Fatalities	Damage $
	Train-Train Collision	Frt Loco hits Locs	0.45	0.045	105800	1.1	0.11	270000	1.7	0.17	422000
		Frt Loco hits Car	0.35	0.035	88000	0.9	0.09	225000	1.4	0.14	352000
		Frt car hit by Loco	0	0	44000	0	0	112000	0	0	176000
	Intrusion Collsn equip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Collsn equip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Collsn Unequip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Collsn Unequip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Overspeed, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Overspeed, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Work Zone Viol'n, Equip		0.042	0.0042	0	0.065	0.0068	0	0.083	0.0083	0
	Work Zone Viol'n, Unequip		0.042	0.0042	0	0.065	0.0068	0	0.083	0.0083	0

Casualties and damage in Table 3.1 are per accident, except for Work Zone Violationswhich are permillion train-miles

Table 3.2: Grade Crossing and Diamonds: Numbers by Speed and Accident Frequency

Train Type	Representative Speed (mph)	Type of Grade-crossing	Number Crossings Passenger	HS Passenger	Freight	Accident Frequency Per Million Crossing Passes Passenger	Freight	Crossing Collision Consequences Pass. Occup't Casualty Prob/accident) Injuries	Fatalities	Cost $/Accid't	Freight Trains (per accident) Injuries	Fatalities	Cost $	Number Diamonds
Passenger	40	Public_gates_lights	7	7		0.250		0.0025	0.000047	50000				1
		Public_other	0	1		0.300								
		Private	0	0		0.100								
	60	Public_gates_lights	16	0		0.400		0.0068	0.000112	113000				0
		Public_other	0	1		0.500								
		Private	1	0		0.200								
	79	Public_gates_lights	16	16		0.800		0.0305	0.000156	196000				0
		Public_other	1	0		0.650								
		Private	6	1		0.300								
	105	Public_gates_lights	0	16		1.100		0.0186	0.000276	346000				0
		Public_other	0	1		0.800								
		Private	0	6		0.300								
Freight	25	Public_gates_lights			7		0.150				0.12	0.005	20000	0
		Public_other			0		0.120							
		Private			0		0.050							
	40	Public_gates_lights			16		0.300				0.25	0.013	50000	1
		Public_other			0		0.250							
		Private			1		0.100							
	50	Public_gates_lights			16		0.350				0.39	0.02	78000	0
		Public_other			0		0.300							
		Private			4		0.120							

Table 3.3a: Segment Data (for reference only, not used in calculations)

Segment Number	Start (Milepost)	End (Milepost)	Type	Length (miles)	Representative Speed (mph) Freight	Pass	HS Pass-cons	HS Pass
14.0	88.35	90.55	Plain	2.20	50	79	79	105
15.0	90.55	92.47	CP Adjacent (M)	1.92	40	60	60	79
16.0	92.47	94.97	Siding (M)	2.50	50	79	79	105
17.0	94.97	96.81	CP Adjacent (M)	1.84	50	79	79	105
18.0	96.81	100.28	Plain	3.47	50	79	79	105
19.0	100.28	102.25	CP Adjacent (M)	1.97	40	60	60	79
20.0	102.25	102.25	Diamond	0.00	40	40	40	40
21.0	102.25	104.60	CP Adjacent (M)	2.35	40	60	60	79
22.0	104.60	106.43	CP Adjacent (M)	1.83	50	79	79	105
23.0	106.43	108.63	Siding (M)	2.40	50	79	79	105
24.0	108.63	111.36	CP Adjacent (M)	2.53	50	79	79	105
25.0	111.36	113.30	Plain	1.94	50	79	79	105
26.0	113.30	116.36	Plain	3.06	50	79	79	105
27.0	116.36	118.83	Plain	2.47	50	79	79	105
28.0	118.83	121.40	CP Adjacent (M)	2.57	50	79	79	105
29.0	121.40	123.57	Siding (M)	2.17	40	60	60	79
30.0	123.57	124.38	Siding (M)	0.81	25	40	40	40
31.0	124.38	124.86	Siding (M)	0.48	25	40	40	40
	Length Check	36.5		36.5				

Table 3.3b: Aggregate Segment Data: SegmentsTypes, Train Types, Speeds, and Lengths

Aggregate Segment Length by Type and Speed Band (from Seg Def and Preventability)

Segment Type	Train Type	Represent've Speed (mph)	Freight (miles)	Reg Pass (miles)	HS Pass Collision (mi)	HS Pass Other (mi)
Siding (mon)	Freight	25	1.29			
		40	2.17			
		50	4.9			
	Passenger	40		1.29	1.29	1.29
		60		2.17	0	0
		79		4.9	7.07	2.17
		105		0	0	4.9
Siding (unmon)	Freight	25	0			
		40	0			
		50	0			
	Passenger	40		0	0	0
		60		0	0	0
		79		0	0	0
		105		0	0	0
CP Adjacent (mon)	Freight	25	0			
		40	6.24			
		50	8.77			
	Passenger	40		0	0	0
		60		6.24	6.24	0
		79		8.77	8.77	6.24
		105		0	0	8.77
CP Adjacent (unmon)	Freight	25	0			
		40	0			
		50	0			
	Passenger	40		0	0	0
		60		0	0	0
		79		0	0	0
		105		0	0	0
Plain Track	Freight	25	0			
		40	0			
		50	13.14			
	Passenger	40		0	0	0
		60		0	0	0
		79		13.14	13.14	0
		105		0	0	13.14
Totals All Types	Freight	25	1.29			
		40	8.41			
		50	26.81			
	Passenger	40		1.29	1.29	1.29
		60		8.41	8.24	0
		79		26.81	26.98	8.41
		105		0	0	26.81
	Checking Totals		36.51	36.51	36.51	36.51

Table 3.4: Collision Frequencies by Segment Type and Collision Scenario (From Coll Mat'rix)

Scenarios	Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain	Diamond
Pass Loco Hits Loco	0.0029	0.0040	0.0077	0.0094	0.0008	0.000000
Pass Loco Hits Pass Car	0.0011	0.0014	0.0007	0.0009	0.0001	0.000000
Pass Loco Hits Freight Car	0.0003	0.0005	0.0003	0.0004	0.0001	0.000741
Pass Car Hit by Loco	0.0013	0.0018	0.0010	0.0012	0.0002	0.001748
Freight Loco Hits Loco	0.0008	0.0011	0.0021	0.0026	0.0002	0.000000
Freight Loco Hits Car	0.0003	0.0004	0.0003	0.0003	0.0000	0.027661
Freight Car Hit By Loco	0.0003	0.0005	0.0003	0.0004	0.0001	0.030653

Collision Rate for Passenger + Unequipped Freight Train					
Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain	
0.0005	0.0007	0.0013	0.0017	0.0002	
0.0001	0.0001	0.0001	0.0001	0.0000	
0.0002	0.0003	0.0002	0.0002	0.0000	

Mauve cells contain data imported from worksheet 2 in this group of three worksheets covering this sub-corridor, season and operating state.

All train-to-train collision frequencies are in units of **trains in collisions per million train miles operated in the sub-corridor by all train types.**

Weighted Collision Accident Frequencies by Representative Speed (mph)

Scenarios	Freight 25	Freight 40	Freight 50	Passenger 40	Passenger 60	Passenger 79	Passenger 105
Pass Loco Hits Loco				0.0029	0.0000	0.0020	0.0029
Pass Loco Hits Pass Car				0.0011	0.0000	0.0002	0.0005
Pass Loco Hits Freight Car				0.0003	0.0000	0.0001	0.0002
Pass Car Hit by Loco				0.0013	0.0000	0.0003	0.0005
Freight Loco Hits Loco	0.0008	0.0017	0.0009				
Freight Loco Hits Car	0.0003	0.0003	0.0002				
Freight Car Hit By Loco	0.0003	0.0003	0.0002				

Table 3.4a: Traffic Inputs to Risk Calculation

Train Type	Trips/Day Summer	Rest of Year
Passenger	5.00	6.00
Equipped Freight	1.07	1.07
Unequipped Freight	0.36	1.21
Operating Days	91.00	274.00

Percent Train-Miles in	
Timeout (secs)	120.00
Normal Operating Mode	84.80
Timeout Mode	0.14
Fallback Mode	5.06

Passenger Train Occupancy	
Seats	320.00
Occupancy Factor	0.60

Table 3.5a: Risk Calculation - Passenger Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Freq. (per mill trn)	Preventability	Adjusted Frequency	Trips/day	Trips per 10 years	Length of Track (miles)	Train-miles per 10 years	Accidents per 10 years	Number seats per train	Occupancy Factor	Passengers per train	Injuries per 10 years	Fatalities per 10 years	Damage $ per 10 years
40	Train-Train Collision	Pass Loco hits Loco	0.00293	Incl	0.00293	7.43	6414	1.29	8274	0.00002	320	0.6	192	0.0004	0.00001	0
		Pass Loco hits Pass Car	0.00106	Incl	0.00106	7.43	6414	1.29	8274	0.00001	320	0.6	192	0.0001	0.00000	0
		Pass Loco hits Frt Car	0.00035	Incl	0.00035	7.43	6414	1.29	8274	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00134	Incl	0.00134	7.43	6414	1.29	8274	0.00001	320	0.6	192	0.0004	0.00001	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00660	0.30	0.00662	6.00	5179	1.29	6681	0.00004	320	0.6	192	0.0001	0.00000	0
	Intrusion Collision (other))	Pass Loco hits intruder	0.01440	0.05	0.01368	6.00	5179	1.29	6681	0.00009	320	0.6	192	0.0005	0.00002	0
	Overspeed		0.01100	0.80	0.00220	6.00	5179	1.29	6681	0.00001	320	0.6	192	0.0001	0.00000	0
	Broken Rail		0.01670	0.04	0.01603	6.00	5179	1.29	6681	0.00011	320	0.6	192	0.0009	0.00001	0
	Work Zone Violation			0.50		6.00	5179	1.29	6681					0.0003	0.00003	0
										0.00030				**0.00268**	**0.00008**	**0**
60	Train-Train Collision	Pass Loco hits Loco	0.00000	Incl	0.00000	7.43	6414	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Pass Car	0.00000	Incl	0.00000	7.43	6414	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Frt Car	0.00000	Incl	0.00000	7.43	6414	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00000	Incl	0.00000	7.43	6414	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00660	0.30	0.00662	6.00	5179	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.05	0.01368	6.00	5179	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Overspeed		0.01100	0.80	0.00220	6.00	5179	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Broken Rail		0.01670	0.04	0.01603	6.00	5179	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Work Zone Violation			0.50		6.00	5179	0	0					0.0000	0.00000	0
										0.00000				**0.00000**	**0.00000**	**0**
79	Train-Train Collision	Pass Loco hits Loco	0.00199	Incl	0.00199	7.43	6414	35.22	225894	0.00045	320	0.6	192	0.021	0.0007	890
		Pass Loco hits Pass Car	0.00019	Incl	0.00019	7.43	6414	35.22	225894	0.00004	320	0.6	192	0.001	0.0000	43
		Pass Loco hits Frt Car	0.00010	Incl	0.00010	7.43	6414	35.22	225894	0.00002	320	0.6	192	0.000	0.0000	23
		Pass car hit by Loco	0.00033	Incl	0.00033	7.43	6414	35.22	225894	0.00008	320	0.6	192	0.007	0.0003	299
	Intrusion Collision (rollout)	Pass Loco hits car	0.00660	0.30	0.00662	6.00	5179	8.41	43559	0.00026	320	0.6	192	0.003	0.0001	117
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.05	0.01368	6.00	5179	8.41	43559	0.00060	320	0.6	192	0.012	0.0004	530
	Overspeed		0.01100	0.80	0.00220	6.00	5179	8.41	43559	0.00010	320	0.6	192	0.004	0.0001	249
	Broken Rail		0.01670	0.04	0.01603	6.00	5179	8.41	43559	0.00070	320	0.6	192	0.028	0.0005	1816
	Work Zone Violation			0.50		6.00	5179	8.41	43559					0.004	0.0004	0
										0.00224				**0.07957**	**0.00249**	**3966**
105	Train-Train Collision	Pass Loco hits Loco	0.00288	Incl	0.00288	7.43	6414	26.81	171954	0.00049	320	0.6	192	0.040	0.0015	1729
		Pass Loco hits Pass Car	0.00049	Incl	0.00049	7.43	6414	26.81	171954	0.00008	320	0.6	192	0.003	0.0001	147
		Pass Loco hits Frt Car	0.00016	Incl	0.00016	7.43	6414	26.81	171954	0.00003	320	0.6	192	0.001	0.0000	49
		Pass car hit by Loco	0.00054	Incl	0.00054	7.43	6414	26.81	171954	0.00009	320	0.6	192	0.015	0.0006	643
	Intrusion Collision (rollout)	Pass Loco hits car	0.00660	0.30	0.00662	6.00	5179	26.81	138859	0.00084	320	0.6	192	0.015	0.0005	657
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.05	0.01368	6.00	5179	26.81	138859	0.00160	320	0.6	192	0.031	0.0025	2988
	Broken Rail		0.01100	0.80	0.00220	6.00	5179	26.81	138859	0.00031	320	0.6	192	0.016	0.0003	1403
	Broken Rail		0.01670	0.04	0.01603	6.00	5179	26.81	138859	0.00223	320	0.6	192	0.120	0.0019	10227
	Work Zone Violation			0.50		6.00	5179	26.81	138859					0.015	0.0015	0
	Total									**0.00597**				**0.29522**	**0.00898**	**17644**
														0.000000	**0.00000**	**0.00000**	**0.00**
	Overall Totals									**0.00851**				**0.37747**	**0.01156**	**21809**
														0.000067	**0.000723**	**0.000022**	**25**
	Totals All Speeds	**Train-train Collisions**								**0.00134**				**0.00863**	**0.00337**	**3822**
		Intrusion Collisions								**0.00373**				**0.10070**	**0.00358**	**4292**
		Overspeed								**0.00042**				**0.02041**	**0.00033**	**1653**
		Broken Rail								**0.00303**				**0.14874**	**0.00238**	**12043**
		Work Zone Violation								**0.00000**				**0.01898**	**0.00190**	**0**

Table 3.5b: Risk Calculation - Collisions at Diamonds - Passenger

Number Diamonds	Freq'y per mill passes	Collisions (millions)	Injuries	Fatalities	Damage
1	0.000000	0.000000	0.000000	0.000000	0.00
1	0.000000	0.000000	0.000000	0.000000	0.00
1	0.008741	0.000056	0.000366	0.000011	14.07
1	0.001748	0.000011	0.000357	0.000011	11.27
		0.000067	**0.000723**	**0.000022**	**25.34**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.008741	0.000000	0.000000	0.000000	0.00
0	0.001748	0.000000	0.000000	0.000000	0.00
		0.000000	**0.00000**	**0.00000**	**0.00

Worksheet 1-B,N: IDOT-PTC Risk Model: Braking Distances and Collision Zone Calculations, Bloomington Sub-corridor, PTC Timeout Operating State

Table 1.1: Stopping Distance Parameters and Calculations Including Timeout and At-Crossings Data

Braking Formula Inputs		
Train/Speed Type	Parameter	Value
Freight	Coefficient F	0.045
	Appl'n Time (sec)	13.0
	Train Weight (lb)	27500000
	Brake Force (lb)	770693
Passenger	Coefficient A	0.000
	Coefficient B	0
	Safety Factor	1.25
Train Control	Latency? -cut (sec)	120
	NCS Response	0
Gutlty/Train Speed (mph)		79

Braking Distance Calculations (ft) (including free running in TO)				
Train Type	Speeds (mph)	To Stop	Reduction to RedCon*	RedCon* to Stop
Freight	20	6862	5862	2000
	40	19502	8664	2000
	60	44034	13464	2000
Passenger	40	6132	6132	0
	60	15297	15297	0
	79	14676	12276	2399
	105	21776	19361	2399
Tri-Rail/HiCorr	35	5200	N/A	N/A

*Note: RedCon refers to the speed at which collision consequences will be significantly reduced
60 mph for passenger trains and 35 mph for freight trains
If train speed is lower that this speed, then there are no reduced consequences and Zone A2 has zero length

Decel-eration (ft/sec²)
0.668
0.668
0.668
1.250
1.250
1.250
1.250

Braking Duration (sec)		Stuffy Train Distances			Total Zone Lengths		
Reduction to RedCon*	RedCon* to Stop	Reduction to RedCon*	RedCon* to Stop		Reduction to RedCon*	RedCon* to Stop	To Stop
175	0	3995	0		9811	0	9811
131	77	2992	1692		11957	3760	15130
112	77	3956	1692		15332	3760	19092
165	0	3640	0		9772	0	9772
165	0	4139	0		14230	0	14230
142	68	3115	1499		15263	3666	19099
171	68	3754	1499		20545	3666	27041

Blue cells contain data imported from the Inputs worksheet

Sight Distance (ft): 2,500

Table 1.2: Segment Definitions: Bloomington Sub-Corridor: MP 69.3 (Bunge) – MP 104.9 (Bloomington)

Segment Number	Start (MP)	End (MP)	Type	Variant	Length Miles	Length Feet	Posted Speed (mph) Freight	Pass	HS Pass	Representative Speed (mph) Freight	Pass	HS Pass	Industry Siding Number	Industry Siding Name	Passenger Stops
										(Consist*)		(Other)			
1	69.3	90.5	Plain		2.2	11616	80.0	79.0	110.0	79.0	79.0	105.0	1.0	Bunge	
2	90.5	93.0	CP Adjacent (NB)		1.0	231074	80.0	79.0	90.0	79.0	79.0	79.0	2.0	Bunge	
3	93.0	95.5	CP Adjacent (SB)	Portion Only*	2.5	13200	80.0	79.0	90.0	79.0	79.0	79.0	3.0	Bunge	Primary
4	95.5	96.8	CP Adjacent (NB)		1.8	9723	80.0	79.0	110.0	79.0	79.0	105.0	4.0	Chiron	
5	96.8	100.2	Plain		3.5	18321.6	80.0	79.0	110.0	79.0	79.0	105.0	0.0		
6	100.2	102.0	CP Adjacent (SB)		2.0	10401.6	80.0	79.0	90.0	79.0	79.0	79.0	0.0		
7	102.0	102.2	Diamond		0.0	0	40.0	40.0	40.0	40.0	40.0	40.0	0.0		
8	102.2	104.6	CP Adjacent (NB)		2.3	12408	80.0	79.0	90.0	79.0	79.0	79.0	0.0		
9	104.6	106.4	CP Adjacent (NB)		1.8	9462.4	80.0	79.0	110.0	79.0	79.0	105.0	0.0		
10	106.4	108.8	Plain	Railroad Overpass	2.4	12677	80.0	79.0	110.0	79.0	79.0	105.0	0.0		
11	108.8	111.4	CP Adjacent (NB)		2.5	13358.4	80.0	79.0	110.0	79.0	79.0	105.0	0.0		
12	111.4	113.6	Plain		1.9	10263.2	80.0	79.0	110.0	79.0	79.0	105.0	0.0		
13	113.6	116.4	Plain		3.1	16166.8	80.0	79.0	110.0	79.0	79.0	105.0	0.0		
14	116.4	118.6	Plain		2.3	12041.6	80.0	79.0	110.0	79.0	79.0	105.0	0.0		
15	118.6	121.4	CP Adjacent (NB)		2.6	14569.6	80.0	79.0	110.0	79.0	79.0	105.0	0.0		
16	121.4	122.4	Switch (NB)	Bloomington Yard	0.9	4747.2	40.0	40.0	40.0	40.0	40.0	40.0	1.0	Bloomington	
17	122.4	123.4	Switch (NB)	Bloomington Yard	0.8	4276.8	40.0	40.0	40.0	40.0	40.0	40.0	1.0	Bloomington	
18	123.4	123.5	Switch (NB)	Bloomington Yard	0.5	2524.4	40.0	40.0	40.0	40.0	40.0	40.0	1.0	Bloomington	Bloomington
			Check Total		36.5										

Table 1.3: Aggregate Segment Length by Segment Type and Speed

Segment Type	Train Type	Representative Speed (mph)	Aggregate Length of Segments by Train and Segment Type: Freight		Conv passenger		High Speed Passenger		
					Collision Control		Other		
			Miles	Feet	Miles	Feet	Miles	Feet	
Siding (max)	Freight	25	1.25	6611					
		40	2.17	11458					
		60	4.80	25272					
	Passenger	40			1.29	6811	1.29	$6,811	1.29	6811
		60			2.17	11455	0.00	$0	0.00	0
		79			4.90	25872	7.07	$37,395	2.17	11458
		105					0.00	$0	4.80	25272
Siding (unmon)	Freight	25	0.00	0					
		40	0.00	0					
		60	0.00	0					
	Passenger	40			0.00	0	0.00	$0	0.00	0
		60			0.00	0	0.00	$0	0.00	0
		79			0.00	0	0.00	$0	0.00	0
		105					0.00	$0	0.00	0
CP Adjacent (max)	Freight	25	0.00	0					
		40	6.24	32947					
		60	8.77	46305					
	Passenger	40			0.00	0	0.00	$0	0.00	0
		60			6.24	32947	6.24	$40,367	0.00	0
		79			8.77	46305	8.77	$46,366	6.24	32947
		105					0.00	$0	8.77	46305
CP Adjacent (unmon)	Freight	25	0.00	0					
		40	0.00	0					
		60	0.00	0					
	Passenger	40			0.00	0	0.00	$0	0.00	0
		60			0.00	0	0.00	$0	0.00	0
		79			0.00	0	0.00	$0	0.00	0
		105					0.00	$0	0.00	0
Plain Track	Freight	25	0.00	0					
		40	0.00	0					
		60	13.14	69379					
	Passenger	40			0.00	0	0.00	$0	0.00	0
		60			0.00	0	0.00	$0	0.00	0
		79			13.14	69379	13.14	$69,379	0.00	0
		105					0.00	$0	13.14	69379
Check Total			36.51		36.51		36.51		36.51	

PTMs speed is used to calculate collision consequences - so if a train segment is pre-equipped and an unequipped train ONLY reflecting the IDOT PTC speed restriction when an equipped train means an unequipped train

Yellow cells contain data exported to the next worksheet. In the sequence of three sheets that perform the calculations for one sub-corridor, season and operating

Table 1.4: Breakdown of Segments Lengths by Representative Speed (miles)

Segment Number	Freight Speed (mph) 25	40	60	Convent'l Pass Speed (mph) 40	60	79	HS Pass Speeds – Conflict Corridors, (mph) 40	60	79	105	HS Pass Speeds – Other (mph) 40	60	79	105
1	0	0	2.2	0	0	2.2	0	0	2.2	0	0	0	2.2	0
2	0	0	1.00	0	0	1.00	0	0	1.00	0	0	0	1.00	0
3	0	0	2.5	0	0	2.5	0	0	2.5	0	0	0	2.5	0
4	0	0	1.80	0	0	1.80	0	0	1.80	0	0	0	1.80	0
5	0	0	3.47	0	0	3.47	0	0	3.47	0	0	0	3.47	0
6	0	0	1.97	0	0	1.97	0	0	1.97	0	0	0	1.97	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	2.35	0	0	2.35	0	0	2.35	0	0	0	2.35	0
9	0	0	1.83	0	0	1.83	0	0	1.83	0	0	0	1.83	0
10	0	0	2.4	0	0	2.4	0	0	2.4	0	0	0	2.4	0
11	0	0	2.53	0	0	2.53	0	0	2.53	0	0	0	2.53	0
12	0	0	1.96	0	0	1.96	0	0	1.96	0	0	0	1.96	0
13	0	0	3.06	0	0	3.06	0	0	3.06	0	0	0	3.06	0
14	0	0	2.42	0	0	2.42	0	0	2.42	0	0	0	2.42	0
15	0	0	2.57	0	0	2.57	0	0	2.57	0	0	0	2.57	0
16	0	0	0.9	0	0	0.9	0	0	0.9	0	0	0	0.9	0
17	0	0	0.8	0	0	0.8	0	0	0.8	0	0	0	0.8	0
18	0	0	0.48	0	0	0.48	0	0	0.48	0	0	0	0.48	0

Table 1.5: Mitigation and Prevention Zones – All Segments – Length in Feet

Segment Number	Zone A1: Limited Speed Reduction, No Prevention or Mitigation Freight	Pass	HS Pass	Zone A2: Reduced Speed to Stop, Severity Mitigation Freight	Pass	HS Pass	Zone B: Able to Stop, Full Prevention Freight	Pass	HS Pass	Overlap of Stopping Distance into Zone C Freight	Pass	HS Pass	Distance in Timeout in Zone C Freight	Pass	HS Pass	Overlap of Zone A1 into Zone C within Sight Distance Freight	Pass	HS Pass	Overlap of Zone A1 into Zone C within Sight Distance Freight	Pass	HS Pass	Overlap of Zone A2 into Zone C within Sight Distance Freight	Pass	HS Pass
1	11616	11616	11616	0	0	0	0	0	0	7676	7673	10425	7676	7673	10425	3736	3777	11536	2500	2500	2500	0	0	0
2	10138	10138	10138	0	0	0	0	0	0	4689	4196	9052	4689	4196	9052	1228	1228	2500	2500	2500	2500	1271	0	0
3	13200	13200	13200	0	0	0	0	0	0	5882	6089	13841	5882	6089	13841	2132	2193	6945	2132	2193	2500	269	307	0
4	9715	9715	9715	0	0	0	0	0	0	5227	5674	17326	5802	5578	17326	5017	5429	13418	2500	2500	2500	0	0	0
5	15332	15260	18022	2690	2828	0	0	0	0	770	968	968	770	968	968	0	0	0	0	0	0	770	968	968
6	10402	10402	10402	0	0	0	0	0	0	4725	3835	8888	4725	3835	8888	963	3682	4962	963	2500	2500	1130	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	11367	12408	12408	1041	0	0	0	0	0	3718	1828	6861	3718	1828	6861	0	1828	2985	0	1828	2500	2500	0	0
9	9662	9662	9662	0	0	0	0	0	0	5429	6627	17379	6802	6627	17379	5670	5731	14498	2500	2500	2500	0	0	0
10	13072	13072	13072	0	0	0	0	0	0	5429	6627	14089	5429	6627	14089	2500	2701	10473	2500	2500	2500	0	0	0
11	13358	13358	13358	0	0	0	0	0	0	5733	5931	13863	5733	5931	13863	1978	2035	9797	1978	2035	2500	526	466	0
12	10263	10263	10263	0	0	0	0	0	0	5849	5646	16798	5802	5646	16798	5288	5302	13562	2500	2500	2500	0	0	0
13	15332	15260	16927	825	764	0	0	0	0	2905	3132	10884	2905	3132	10884	0	0	6988	0	0	2500	2500	0	0
14	11402	11402	11402	0	0	0	0	0	0	5053	5248	14002	5053	5248	14002	2290	2352	9104	2290	2352	2500	210	146	0
15	13570	13570	13570	0	0	0	0	0	0	5322	5720	13472	5322	5720	13472	1759	1824	9576	1759	1824	2500	739	676	0
16	11367	11459	11459	92	0	0	0	0	0	3669	2679	7692	3669	2679	7692	0	2679	3616	0	2500	2500	2500	0	0
17	4277	4277	4277	0	0	0	0	0	0	5344	5495	5495	4401	5495	5495	9144	5495	5495	2500	2500	2500	0	0	0
18	2534	2534	2534	0	0	0	0	0	0	7277	7237	7237	4401	7042	7042	7277	7237	7237	2500	2500	2500	0	0	0

Table 1.6: Breakdown of Segments Lengths by Representative Speed (miles)

Segment Number	Freight Speed (mph) 25	40	60	Convent'l Pass Speed (mph) 40	60	79	HS Pass Speeds – Conflict Corridors, (mph) 40	60	79	105	HS Pass Speeds – Other (mph) 40	60	79	105
1	0	0	2.2	0	0	2.2	0	0	2.2	0	0	0	2.2	0
2	0	0	1.00	0	0	1.00	0	0	1.00	0	0	0	1.00	0
3	0	0	2.5	0	0	2.5	0	0	2.5	0	0	0	2.5	0
4	0	0	1.80	0	0	1.80	0	0	1.80	0	0	0	1.80	0
5	0	0	3.47	0	0	3.47	0	0	3.47	0	0	0	3.47	0
6	0	0	1.97	0	0	1.97	0	0	1.97	0	0	0	1.97	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	2.35	0	0	2.35	0	0	2.35	0	0	0	2.35	0
9	0	0	1.83	0	0	1.83	0	0	1.83	0	0	0	1.83	0
10	0	0	2.4	0	0	2.4	0	0	2.4	0	0	0	2.4	0
11	0	0	2.53	0	0	2.53	0	0	2.53	0	0	0	2.53	0
12	0	0	1.96	0	0	1.96	0	0	1.96	0	0	0	1.96	0
13	0	0	3.06	0	0	3.06	0	0	3.06	0	0	0	3.06	0
14	0	0	2.42	0	0	2.42	0	0	2.42	0	0	0	2.42	0
15	0	0	2.57	0	0	2.57	0	0	2.57	0	0	0	2.57	0
16	0	0	0.9	0	0	0.9	0	0	0.9	0	0	0	0.9	0
17	0	0	0.8	0	0	0.8	0	0	0.8	0	0	0	0.8	0
18	0	0	0.48	0	0	0.48	0	0	0.48	0	0	0	0.48	0

Table 1.5a: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for Siding (M) Segments

Lengths in Zone C	A1	A2	B
Total Length, Siding (M) Segments (ft)	44143.8		
Number Siding (M) Segments	5		
Average distance in Zone C (ft) Freight	1928	574	0
Passenger	1742	61	897
HS Pass	1356	0	744

Sum Zone Lengths A1, A2, B (ft)	Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass
	44143	44143	44143	55	0	0	0	0	0
Fraction of total length in zone	0.999	1.000	1.000	0.002	0.000	0.000	0.000	0.000	0.000
Collision Accident Mitigation Probabilities: Combined All Zones	1.001	1.000	1.001	0.000	0.000	0.000	0.000	0.000	0.000

Values transferred to Collision Matrix

Distribution of train location at time of	In-Block	0.00
Isolation in Reference Case accidents	Previous Block	0.05
PTC Risk Increment in Zone C		2
Potential danger length in Zone C (ft)		2000

Table 1.5b: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for Siding (U) Segments

Lengths in Zone C	A1	A2	B
Total Length, Siding (M) Segments (ft)	0		
Number Siding (M) Segments	0.001		
Average distance in Zone C (ft) Freight	0	0	2500
Passenger	0	0	2500
HS Pass	0	0	2500

Sum Zone Lengths A1, A2, B (ft)	Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass
	0	0	0	0	0	0	0	0	0
Fraction of total length in zone	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Collision Accident Mitigation Probabilities: Combined All Zones	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Values transferred to Collision Matrix

Distribution of train location at time of	In-Block	0.00
Isolation in Reference Case accidents	Previous Block	0.05
PTC Risk Increment in Zone C		2
Potential danger length in Zone C (ft)		2000

Table 1.5c: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for CP Adjacent (M) Segments

Lengths in Zone C	A1	A2	B
Total Length, Siding (M) Segments (ft)	76252.8		
Number Siding (M) Segments	7		
Average distance in Zone C (ft) Freight	1501	609	0
Passenger	2266	303	80
HS Pass	2500	0	0

Sum Zone Lengths A1, A2, B (ft)	Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass
	76211	76252	76252	3041	0	0	0	0	0
Fraction of total length in zone	0.967	1.000	1.000	0.019	0.000	0.000	0.000	0.000	0.000
Collision Accident Mitigation Probabilities: Combined All Zones	1.000	1.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000

Values transferred to Collision Matrix

Distribution of train location at time of	In-Block	0.00
Isolation in Reference Case accidents	Previous Block	0.05
PTC Risk Increment in Zone C		2
Potential danger length in Zone C (ft)		2000

Table 1.5d: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for CP Adjacent (U) Segments

Lengths in Zone C	A1	A2	B
Total Length, Siding (M) Segments (ft)	0		
Number Siding (M) Segments	0.001		
Average distance in Zone C (ft) Freight	0	0	2500
Passenger	0	0	2500
HS Pass	0	0	2500

Sum Zone Lengths A1, A2, B (ft)	Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass
	0	0	0	0	0	0	0	0	0
Fraction of total length in zone	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Collision Accident Mitigation Probabilities: Combined All Zones	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Values transferred to Collision Matrix

Distribution of train location at time of	In-Block	0.00
Isolation in Reference Case accidents	Previous Block	0.05
PTC Risk Increment in Zone C		2
Potential danger length in Zone C (ft)		2000

Table 1.5e: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for Plain Track Segments

Lengths in Zone C	A1	A2	B
Total Length, Siding (M) Segments (ft)	69379.2		
Number Siding (M) Segments	7		
Average distance in Zone C (ft) Freight	1848	686	368
Passenger	1470	701	306
HS Pass	2500	284	906

Sum Zone Lengths A1, A2, B (ft)	Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass
	76211	76252	76252	0	0	0	0	0	0
Fraction of total length in zone	1.127	1.142	1.142	0.000	0.000	0.000	0.000	0.000	0.000
Collision Accident Mitigation Probabilities: Combined All Zones	1.128	1.142	1.142	0.000	0.000	0.000	0.000	0.000	0.000

Values transferred to Collision Matrix

Distribution of train location at time of	In-Block	0.00
Isolation in Reference Case accidents	Previous Block	0.05
PTC Risk Increment in Zone C		2
Potential danger length in Zone C (ft)		2000

Table 1.5f: Distribution of Equipped Train Locations by Collision Preventability Zones - Values for Diamond Segments

Lengths in Zone C	A1	A2	B
Total Length, Siding (M) Segments (ft)	0		
Number Siding (M) Segments	0		
Average distance in Zone C (ft) Freight	0	0	2500
Passenger	0	0	2500
HS Pass	0	0	2500

Sum Zone Lengths A1, A2, B (ft)	Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass
	69345	69379	69379	4149	0	4749	4573	6219	6149
Fraction of total length in zone	0.792	0.837	0.777	0.181	0.000	0.210	0.147	0.363	0.000
Collision Accident Mitigation Probabilities: Combined All Zones	0.967	0.836	0.986	0.119	0.000	0.000	0.231	0.636	0.000

Distribution of train location at time of	In-Block	0.00
Isolation in Reference Case accidents	Previous Block	0.05
PTC Risk Increment in Zone C		2
Potential danger length in Zone C (ft)		2000

Worksheet 2 - B,T,R: Collision Frequencies Calculation - PTC 120 Sec.Timeout Case, Bloomington Sub-corridor, PTC Timeout Operating State, Rest of Year

Table 2.1a: Collision Distribution Matrix (Fraction Accidents by Train Pair and Collision Type). Collisions Between Trains Operating on the IDOT Test Corridor Only (Not diamonds and intrusions)

Train Pairs in Collision	Collision Scenario Prob (Top Level)	Siding - Monitored				Siding - Unmonitored				CP Adjacent - Monitored Siding				CP Adjacent - Unmonitored Siding				Plain Track			
		Collision Distribution		Head On		Collision Distribution		Head On		Collision Distribution		Head On		Collision Distribution		Head On		Collision Distribution		Head On	
		Head On	Rear/Side	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty
Percent Guilty				100%	0%			100%	0%			100%	0%			100%	0%			100%	0%
Both Trains TBE (Note 3)	0.60	0.50	0.50	0.3	0	0.5	0.5	0.3	0	0.8	0.2	0.48	0	0.8	0.2	0.48	0	0.70	0.30	0.42	0
Pass-Pass	0.16	0.50	0.50	0.08	0	0.5	0.5	0.08	0	0.7	0.3	0.112	0	0.7	0.3	0.112	0	0.40	0.60	0.064	0
Pass-TBE Freight	0.16	0.50	0.50	0.08	0	0.5	0.5	0.08	0	0.7	0.3	0.112	0	0.7	0.3	0.112	0	0.40	0.60	0.064	0
TBE Freight - TBE Freight	0.00	0.50	0.50	0	0	0.5	0.5	0	0	0.7	0.3	0	0	0.7	0.3	0	0	0.50	0.50	0	0
Percent Guilty				50%	50%			50%	50%			50%	50%			50%	50%			50%	50%
One Train TBE	0.16	1	0	0.04	0.04	1	0	0.04	0.04	1	0	0.064	0.064	1	0	0.064	0.064	1.00	0.00	0.056	0.056
Pass - NE Freight, Head -On		1	0	0.04	0.04	1	0	0.04	0.04	1	0	0.064	0.064	1	0	0.064	0.064	1.00	0.00	0.056	0.056
Rear/Side, Pass into NE Frt		0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0.00	1.00	0	0
Rear/Side NE Frt into Pass		1	0	0.064	0	0	1	0.064	0	0	1	0.024	0	0	1	0.024	0	0.00	1.00	0.04	0
TBE Freight - NE Freight		0	1	0	0.016	0	1	0	0.016	0	1	0	0.008	0	1	0	0.008	0.00	1.00	0	0.008
	0.08	0.5	0.5	0.02	0.02	0.5	0.5	0.02	0.02	0.7	0.3	0.028	0.028	0.7	0.3	0.028	0.028	0.50	0.50	0.02	0.02
Percent Guilty				0%	100%			0%	100%			0%	100%			0%	100%			0%	100%
Neither Train TBE	0.00	0.5	0.5	0	0	0.5	0.5	0	0	0.7	0.3	0	0	0.7	0.3	0	0	0.50	0.50	0	0
NE Freight - NE Freight																					
Total Probability (checking)	1	1		0.44	0.06	1		0.44	0.06	1		0.684	0.092	1		0.684	0.092	1		0.56	0.076

Train Pairs in Collision	Train Pair Type	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty
Percent Guilty			
Pass-Pass	**Both Trains TBE**		
Pass-TBE Freight			
TBE Freight - TBE Freight			
Percent Guilty	**One Train TBE**	50%	50%
Pass - NE Freight, Head -On		0	0
Rear/Side, Pass into NE Frt		0.25	0.25
Rear/Side NE Frt into Pass		0.05	0.05
TBE Freight - NE Freight		0.1	0.1
Percent Guilty	**Neither Train TBE**		100%
NE Freight - NE Freight		0	0.2
Total Probability (checking)		0.4	0.6

Table 2.1b: Collision Type Distribution - Diamonds

Note: The gray cells on these rows are set at zero, because in every case, the condition represented by the cell does not exist - either because there are no unequipped passenger trains, or because of the kind of collision

Quarely in cell C18 is for all collisions between a passenger train and an unequipped freight train

Table 2.2: Preventability Data For Unequipped train Guilty, One Train TBE

Segment Type	Not Prevented of Mitigated Freight	Not Prevented of Mitigated Pass	Not Prevented of Mitigated HS Pass	Mitigated Freight	Mitigated Pass	Mitigated HS Pass	Prevented Freight	Prevented Pass	Prevented HS Pass
Siding (M)	1.025	1.020	1.021	0.025	0.002	0.000	0.000	0.028	0.029
Siding (U)	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100
CP Adjacent (M)	1.000	1.040	1.050	0.050	0.007	0.000	0.000	0.003	0.000
CP Adjacent (U)	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100
Plain Track	1.129	1.144	1.165	0.028	0.029	0.008	0.014	0.012	0.012
Diamonds	0.667	0.605	0.691	0.172	0.000	0.200	0.211	0.445	0.160

Mauve cells contain data imported from previous worksheet in a group of three worksheets covering one sub-corridor, season and operating

Table 2.3a: Collision Preventability Matrix (Percent Accidents Preventable Relative to CTC Reference Case)

Train Pairs in Collision	Preventability Equipped Train Guilty	Siding - Monitored Head On Equip Guilty	Siding - Monitored Head On Unequip Guilty	Siding - Monitored Rear End/Side Equip Guilty	Siding - Monitored Rear End/Side Unequip Guilty	Siding - Unmonitored Head On Equip Guilty	Siding - Unmonitored Head On Unequip Guilty	Siding - Unmonitored Rear End/Side Equip Guilty	Siding - Unmonitored Rear End/Side Unequip Guilty	CP Adjacent - Monitored Siding Head On Equip Guilty	CP Adjacent - Monitored Siding Head On Unequip Guilty	CP Adjacent - Monitored Siding Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding Rear End/Side Unequip Guilty	CP Adjacent - Unmonitored Siding Head On Equip Guilty	CP Adjacent - Unmonitored Siding Head On Unequip Guilty	CP Adjacent - Unmonitored Siding Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding Rear End/Side Unequip Guilty	Plain Track Collision Distribution Head On	Plain Track Collision Distribution Rear/Side	Plain Track Head On Equip Guilty	Plain Track Head On Unequip Guilty	Plain Track Rear End/Side Equip Guilty	Plain Track Rear End/Side Unequip Guilty
Both TBE	90%			90%				90%				90%				90%				90%		90%	
Pass-Pass	90%			90%				90%				90%				90%				90%		90%	
Pass-TBE Freight	90%			90%				90%				90%				90%				90%		90%	
TBE Freight - TBE Freight	90%			90%				90%				90%				90%				90%		90%	
One TBE	90%			90%	3%			90%	10%			90%	0%			90%	10%			90%	1%		
Pass - NE Freight, Head -On	90%																					90%	1%
Rear/Side, Pass into NE Frt	90%			90%	3%			90%	10%			90%	0%			90%	10%			90%	1%	90%	44.48%
Rear/Side NE Frt into Pass	90%			90%	0%			90%	0%			90%	0%			90%	0%			90%	0%	90%	44.48%
TBE Freight - NE Freight	90%			90%	0%			90%	10%			90%	0%			90%	0%			90%	1%	90%	21.12%
Neither TBE					0%				0%				0%				0%				0%		0.00%
NE Freight - NE Freight																							
Reference Case (CTC) Collision Accident Likelihood by Segment Type (collisions/million train miles)	**0.030**					**0.040**				**0.050**				**0.060**				**0.006**				**Collisions/million diamond passes**	**0.1**

Train Pairs in Collision	Train Pair Type	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty
Pass-Pass	**Both TBE**		
Pass-TBE Freight			
TBE Freight - TBE Freight			
Pass - NE Freight, Head -On	**One TBE**		
Rear/Side, Pass into NE Frt		0.002500	0.013881
Rear/Side NE Frt into Pass		0.000500	0.002776
TBE Freight - NE Freight		0.000000	0.000000
NE Freight - NE Freight	**Neither TBE**		0.000000

Table 2.3b: Collision Preventability Matrix - Diamonds

Table 2.4a: Passenger Trains in Accidents (Collisions per Million Train-Miles Operated in Sub-Corridor)

Train Pairs in Collision	Passenger Trains in Collisions	Siding - Monitored Head On Equip Guilty	Siding - Monitored Head On Unequip Guilty	Siding - Monitored Rear End/Side Equip Guilty	Siding - Monitored Rear End/Side Unequip Guilty	Siding - Unmonitored Head On Equip Guilty	Siding - Unmonitored Head On Unequip Guilty	Siding - Unmonitored Rear End/Side Equip Guilty	Siding - Unmonitored Rear End/Side Unequip Guilty	CP Adjacent - Monitored Siding Head On Equip Guilty	CP Adjacent - Monitored Siding Head On Unequip Guilty	CP Adjacent - Monitored Siding Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding Rear End/Side Unequip Guilty	CP Adjacent - Unmonitored Siding Head On Equip Guilty	CP Adjacent - Unmonitored Siding Head On Unequip Guilty	CP Adjacent - Unmonitored Siding Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding Rear End/Side Unequip Guilty	Plain Track Collision Distribution Head On	Plain Track Collision Distribution Rear/Side	Plain Track Head On Equip Guilty	Plain Track Head On Unequip Guilty	Plain Track Rear End/Side Equip Guilty	Plain Track Rear End/Side Unequip Guilty
Both TBE	2			0.0018				0.0024				0.0048	0.0012			0.0058				0.0005		0.0002	
Pass-Pass	1			0.0002				0.0003				0.0006	0.0002			0.0007				0.0000		0.0001	
Pass-TBE Freight	0																						
TBE Freight - TBE Freight																							
One TBE	1			0.0001	0.0012			0.0002	0.0014			0.0003	0.0032			0.0004	0.0035			0.0000	0.0003		
Pass - NE Freight, Head -On	1												0.0001									0.0000	0.0000
Rear/Side, Pass into NE Frt	1			0.0002	0.0000			0.0003	0.0000				0.0000			0.0001	0.0000					0.0000	0.0000
Rear/Side NE Frt into Pass	1			0.0000	0.0005			0.0000	0.0006				0.0000			0.0000	0.0005					0.0000	0.0000
TBE Freight - NE Freight	0																					0.000000	0.000000
Neither TBE	0																					0.000000	
NE Freight - NE Freight																							
Checking total				0.0022	0.0012	0.0022	0.0005	0.0029	0.0014	0.0030	0.0006	0.0057	0.0032	0.0016	0.0004	0.0068	0.0035	0.0019	0.0005	0.0006	0.0003	0.0003	0.0000

Train Pairs in Collision	Train Pair Type	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty
Pass-Pass	**Both TBE**		
Pass-TBE Freight			
TBE Freight - TBE Freight			
Pass - NE Freight, Head -On	**One TBE**		
Rear/Side, Pass into NE Frt		0.002500	0.013881
Rear/Side NE Frt into Pass		0.000500	0.002776
TBE Freight - NE Freight		0.000000	0.000000
NE Freight - NE Freight	**Neither TBE**		0.000000
Checking total		0.00300	0.01666

Table 2.4b: Passenger Trains in Collisions at Diamonds

Scenario Totals - Passenger	Tots. P-UF	Totals
Pass Loco Hits Loco	0.0013	0.0033
Pass Loco Hits Pass Car		0.0009
Pass Loco Hits Freight Car	0.0002	0.0004
Pass Car Hit by Loco	0.0005	0.0014
Total		0.0060

Scenario Totals - Passenger	Totals
Pass Loco Hits Loco	0.0009
Pass Loco Hits Pass Car	0.0001
Pass Loco Hits Freight Car	0.000500 0.002776 0.003276
Pass Car Hit by Loco	0.0001 0.0000
Total	0.003000 0.016657 0.019657

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Table 2.5a: Freight trains in Accidents (Collisions per Million Train-Miles Operated in Sub-Corrid

Train Pairs in Collision	Freight Trains in Collisions	Siding - Monitored Head On Equip Guilty	Siding - Monitored Head On Unequip Guilty	Siding - Monitored Rear End/Side Equip Guilty	Siding - Monitored Rear End/Side Unequip Guilty	Siding - Unmonitored Head On Equip Guilty	Siding - Unmonitored Head On Unequip Guilty	Siding - Unmonitored Rear End/Side Equip Guilty	Siding - Unmonitored Rear End/Side Unequip Guilty	CP Adjacent - Monitored Siding Head On Equip Guilty	CP Adjacent - Monitored Siding Head On Unequip Guilty	CP Adjacent - Monitored Siding Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding Rear End/Side Unequip Guilty	CP Adjacent - Unmonitored Siding Head On Equip Guilty	CP Adjacent - Unmonitored Siding Head On Unequip Guilty	CP Adjacent - Unmonitored Siding Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding Rear End/Side Unequip Guilty	Plain Track Collision Distribution Head On	Plain Track Collision Distribution Rear/Side	Plain Track Head On Equip Guilty	Plain Track Head On Unequip Guilty	Plain Track Rear End/Side Equip Guilty	Plain Track Rear End/Side Unequip Guilty
Both TBE	0																						
Pass-Pass	1			0.0002				0.0003				0.0006	0.0002			0.0007				0.0000		0.0001	
Pass-TBE Freight	2			0.0000				0.0000				0.0000	0.0000			0.0000				0.0000		0.0000	
TBE Freight - TBE Freight																							
One TBE	1			0.0001	0.0012			0.0002	0.0014			0.0003	0.0032			0.0004	0.0035			0.0000	0.0003		
Pass - NE Freight, Head -On	1												0.0001									0.0000	0.0000
Rear/Side, Pass into NE Frt	1			0.0002	0.0000			0.0003	0.0000				0.0000			0.0001	0.0000					0.0000	0.0000
Rear/Side NE Frt into Pass	1			0.0000	0.0005			0.0000	0.0006				0.0000			0.0000	0.0004					0.0000	0.0000
TBE Freight - NE Freight	2			0.0001	0.0012			0.0002	0.0016			0.0003	0.0028			0.0003	0.0030			0.0001	0.0014		
Neither TBE	2				0.0000				0.0000				0.0000				0.0000				0.0000		0.0000
NE Freight - NE Freight																							
Checking total				0.0005	0.0024	0.0006	0.0017	0.0006	0.0029	0.0007	0.0022	0.0012	0.0060	0.0005	0.0016	0.0014	0.0065	0.0006	0.0019	0.0001	0.0006	0.0001	0.0003

Train Pairs in Collision	Train Pair Type	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty
Pass-Pass	**Both TBE**		
Pass-TBE Freight			
TBE Freight - TBE Freight			
Pass - NE Freight, Head -On	**One TBE**		
Rear/Side, Pass into NE Frt		0.002500	0.013881
Rear/Side NE Frt into Pass		0.000500	0.002776
TBE Freight - NE Freight		0.002000	0.015775
NE Freight - NE Freight	**Neither TBE**		0.040000
Checking total		0.00500	0.07243

Table 2.5b: Freight Trains in Collisions at Diamond

Scenario Totals - Freight	Totals
Freight Loco Hits Loco	0.0028
Freight Loco Hits Car	0.0012
Freight Car Hit By Loco	0.0010
Total	0.0051

Scenario Totals - Freight	Totals
Freight Loco Hits Loco	0.0035
Freight Loco Hits Car	0.0016
Freight Car Hit By Loco	0.0014
Total	0.0065

Scenario Totals - Freight	Totals
Freight Loco Hits Loco	0.0027
Freight Loco Hits Car	0.0013
Freight Car Hit By Loco	0.0010
Total	0.0050

Scenario Totals - Freight	Totals
Freight Loco Hits Loco	0.0007
Freight Loco Hits Car	0.0002
Freight Car Hit By Loco	0.0002
Total	0.0011

Scenario Totals - Freight	Totals
Freight Loco Hits Loco	0.0007
Freight Loco Hits Car	0.0002
Freight Car Hit By Loco	0.0002
Total	0.0011

Train Pairs in Collision	Train Pair Type	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty
Pass-Pass	**Both TBE**		
Pass-TBE Freight			
TBE Freight - TBE Freight			
Pass - NE Freight, Head -On	**One TBE**		
Rear/Side, Pass into NE Frt		0.002500	0.013881
Rear/Side NE Frt into Pass		0.000500	0.002776
TBE Freight - NE Freight		0.002000	0.015775
NE Freight - NE Freight	**Neither TBE**		0.040000
Checking total		0.00500	0.07243

Scenario Totals - Freight	Totals
Freight Loco Hits Loco	0.0007
Freight Loco Hits Car	0.034164
Freight Car Hit By Loco	0.043268
Total	0.077432

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Freight Plus Passenger Totals (check	0.0600	0.0111			0.0800	0.0144			0.1000	0.0201			0.1200	0.0230			0.0923					

In rear-end/side collisions between like trains there is one loco hits car and one car hit by loco in each collision. In rear/side collisions between a passenger and freight trains, the ratio between passenger hits freight and freight loco hits passenger car are a function of the percentages given in Table IN-5b on the Inputs sheet. The values are given in the tables beneath the trains in collisions for each segment type.

Collision Ratios	Collision Type	Like Trains Loco hits car	Like Trains car hit by loco	Unlike Trains P loco hits F car	Unlike Trains F loco hits P car
Siding - Monitored	Freight to Freight	0.50	0.50		
	Passenger to Passenger	0.50	0.50		
	Passenger to Freight			0.8	0.2
Siding - Unmonitored	Freight to Freight	0.50	0.50		
	Passenger to Passenger	0.50	0.50		
	Passenger to Freight			0.80	0.20
CP Adjacent - Monitored Siding	Freight to Freight	0.50	0.50		
	Passenger to Passenger	0.50	0.50		
	Passenger to Freight			0.75	0.25
CP Adjacent - Unmonitored Siding	Freight to Freight	0.50	0.50		
	Passenger to Passenger	0.50	0.50		
	Passenger to Freight			0.75	0.25
Plain Track	Freight to Freight	0.50	0.50		
	Passenger to Passenger	0.50	0.50		
	Passenger to Freight			0.83	0.17

Worksheet 3-B,T,R: - Risk Calculations - PTC Normal Case, Bloomington Subcorridor, Timeout Operating State, Rest of Year

Table 3.1: Consequences Look-up Tables (Data Sources: Previous ICF Passenger Corridor Project (passenger), FRA Accident Data 2001-5 (freight)

Passenger Trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 40 mph Injuries	Fatalities	Damage $	Representative Speed 60 mph Injuries	Fatalities	Damage $	Representative Speed 79 mph Injuries	Fatalities	Damage $	Representative Speed 105 mph Injuries	Fatalities	Damage $
	Train-Train Collision	Pass Loco hits Loco	0.080	0.002	352000	0.139	0.0049	1142000	0.24	0.0085	1976000	0.425	0.016	3495000
		Pass Loco hits Pass Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.008	1747000
		Pass Loco hits Frt Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.008	1747000
		Pass car hit by Loco	0.186	0.005	1505000	0.275	0.0119	2284000	0.476	0.0206	3951000	0.841	0.032	6989000
	Intrusion Collision (rollout)	Pass Loco hits Car	0.013	0.0005	113000	0.031	0.0011	257000	0.054	0.0019	445000	0.096	0.0034	786000
	Intrusion Collision (other))	Pass Loco hits Car	0.026	0.0009	226000	0.063	0.0022	514000	0.108	0.0038	889000	0.191	0.0066	1573000
	Overspeed		0.044	0.0004	667000	0.14	0.00185	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Broken Rail		0.044	0.0004	667000	0.14	0.00185	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Work Zone Violation		0.083	0.0093	0	0.125	0.0125	0	0.164	0.0164	0	0.218	0.0218	0

Freight trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 25 mph Injuries	Fatalities	Damage $	Representative Speed 40 mph Injuries	Fatalities	Damage $	Representative Speed 50 mph Injuries	Fatalities	Damage $
	Train-Train Collision	Frt Loco hits Locos	0.45	0.045	105800	1.1	0.11	270000	1.7	0.17	422000
		Frt Loco hits Car	0.35	0.035	88000	0.9	0.09	225000	1.4	0.14	352000
		Frt car hit by Loco	0	0	44000	0	0	112000	0	0	176000
	Intrusion CollVn equip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion CollVn equip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion CollVn Unequip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion CollVn Unequip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Overspeed, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Overspeed, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Work Zone Vio'ln, Equip		0.042	0.0042	0	0.065	0.0068	0	0.083	0.0083	0
	Work Zone Vio'ln, Unequip		0.042	0.0042	0	0.065	0.0068	0	0.083	0.0083	0

Casualties and damage in Table 3.1 are per accident, except for Work Zone Violations which are per million train-miles

Table 3.2: Grade Crossing and Diamonds: Numbers by Speed, Accident Frequency and Consequences

Train Type	Representative Speed (mph)	Type of Grade-crossing	Number Crossings Passenger	HS Passenger	Freight	Accident Frequency Per Million Crossing Passes Passenger	Freight	Crossing Collision Consequences Pass. Occup't Casualty Prob/accident) Injuries	Fatalities	Cost $/Accdt	Freight Trains (per accident) Injuries	Fatalities	Cost $	Number Diamonds
Passenger	40	Public_gates_lights	7	7		0.250		0.0025	0.000247	50000				1
		Public_other	0	1		0.300								
		Private	0	0		0.100								
	60	Public_gates_lights	16	0		0.400		0.0068	0.000112	113000				0
		Public_other	0	1		0.500								
		Private	1	0		0.200								
	79	Public_gates_lights	16	16		0.800		0.0305	0.000156	196000				0
		Public_other	1	0		0.650								
		Private	6	1		0.300								
	105	Public_gates_lights	0	16		1.100		0.0186	0.000276	346000				0
		Public_other	0	1		0.800								
		Private	0	6		0.300								
Freight	25	Public_gates_lights			7		0.150				0.12	0.005	20000	0
		Public_other			0		0.120							
		Private			0		0.050							
	40	Public_gates_lights			16		0.300				0.25	0.013	50000	1
		Public_other			0		0.250							
		Private			1		0.100							
	50	Public_gates_lights			16		0.360				0.39	0.02	78000	0
		Public_other			0		0.300							
		Private			1		0.120							

bbbbbb

Table 3.3a: Segment Data (for reference only, not used in calculations)

Segment Number	Start (Milepost)	End (Milepost)	Type	Length (miles)	Representative Speed (mph) Freight	Pass	HS Pass-cons	HS Pass
14.0	88.35	90.55	Plain	2.20	50	79	79	105
15.0	90.55	92.47	CP Adjacent (M)	1.92	40	50	60	79
16.0	92.47	94.97	Siding (M)	2.50	50	79	79	105
17.0	94.97	96.81	CP Adjacent (M)	1.84	50	79	79	105
18.0	96.81	100.28	Plain	3.47	50	79	79	105
19.0	100.28	102.25	CP Adjacent (M)	1.97	40	60	60	79
20.0	102.25	102.25	Diamond	0.00	40	40	40	40
21.0	102.25	104.60	CP Adjacent (M)	2.35	40	60	60	79
22.0	104.60	106.43	CP Adjacent (M)	1.83	50	79	79	105
23.0	106.43	108.63	Siding (M)	2.40	50	79	79	105
24.0	108.63	111.36	CP Adjacent (M)	2.53	50	79	79	105
25.0	111.36	113.30	Plain	1.94	50	79	79	105
26.0	113.30	116.36	Plain	3.06	50	79	79	105
27.0	116.36	118.63	Plain	2.47	50	79	79	105
28.0	118.63	121.40	CP Adjacent (M)	2.57	50	79	79	105
29.0	121.40	123.57	Siding (M)	2.17	40	50	79	79
30.0	123.57	124.38	Siding (M)	0.81	25	40	40	40
31.0	124.38	124.86	Siding (M)	0.48	25	40	40	40
	Length Check	28.6		28.6				

Table 3.3b: Aggregate Segment Data: SegmentsTypes, Train Types, Speeds, and Lengths

Aggregate Segment Length by Type and Speed Band (from Seg Def and Preventability)

Segment Type	Train Type	Represent've Speed (mph)	Freight (miles)	Reg Pass (miles)	HS Pass Collision (mi)	HS Pass Other (mi)
Siding (mon)	Freight	25	1.29			
		40	2.17			
		50	4.9			
	Passenger	40		1.29	1.29	1.29
		60		2.17	0	0
		79		4.9	7.07	2.17
		105		0	0	4.9
Siding (unmon)	Freight	25	0			
		40	0			
		50	0			
	Passenger	40		0	0	0
		60		0	0	0
		79		0	0	0
		105		0	0	0
CP Adjacent (mon)	Freight	25	0			
		40	6.24			
		50	8.77			
	Passenger	40		0	0	0
		60		6.24	6.24	0
		79		8.77	8.77	6.24
		105		0	0	8.77
CP Adjacent (unmon)	Freight	25	0			
		40	0			
		50	0			
	Passenger	40		0	0	0
		60		0	0	0
		79		0	0	0
		105		0	0	0
Plain Track	Freight	25	0			
		40	0			
		50	13.14			
	Passenger	40		0	0	0
		60		0	0	0
		79		13.14	13.14	0
		105		0	0	13.14
Totals All Types	Freight	25	1.29			
		40	8.41			
		50	26.81			
	Passenger	40		1.29	1.29	1.29
		60		8.41	8.24	0
		79		26.81	26.98	8.41
		105		0	0	26.81
Check Totals			36.51	36.51	36.51	36.51

Table 3.4: Collision Frequencies by Segment Type and Collision Scenario (From Coll Mat'rx)

Scenarios	Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain	Diamond
Pass Loco Hits Loco	0.0033	0.0043	0.0089	0.0103	0.0009	0.000000
Pass Loco Hits Pass Car	0.0009	0.0012	0.0006	0.0007	0.0001	0.000000
Pass Loco Hits Freight Car	0.0004	0.0005	0.0003	0.0004	0.0001	0.016381
Pass Car Hit by Loco	0.0014	0.0018	0.0011	0.0013	0.0002	0.003276
Freight Loco Hits Loco	0.0038	0.0035	0.0072	0.0079	0.0007	0.000000
Freight Loco Hits Car	0.0012	0.0016	0.0011	0.0013	0.0002	0.034164
Freight Car Hit By Loco	0.0010	0.0014	0.0010	0.0012	0.0002	0.043268

Collision Frequency for Passenger + Unequipped Freight Train

Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain
0.0013	0.0016	0.0035	0.0038	0.0004
0.0002	0.0003	0.0001	0.0001	0.0000
0.0005	0.0006	0.0004	0.0005	0.0000

Mauve cells contain data imported from previous worksheet in a group of three worksheets covering one sub-corridor, season and operating state.

Table 3.4a: Traffic Inputs to Risk Calculation

Train Type	Trips/Day Summer	Rest of Year
Passenger	5.00	6.00
Equipped Freight	1.07	1.07
Unequipped Freight	0.36	1.21
Operating Days	91.00	274.00
Percent Train-Miles in		
Timeout (secs)	120.00	
Normal Operating Mode	94.80	
Timeout Mode	0.14	
Fallback Mode	5.06	
Passenger Train Occupancy		
Seats	320.00	
Occupancy Factor	0.60	

Table 3.5a: Risk Calculation - Passenger Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Freq. (per mill tm)	Preventability	Adjusted Frequency	Trips/day	Trips per 10 years	Length of Track (miles)	Train-miles per 10 years	Accidents per 10 years	Number seats per train	Occupancy Factor	Passengers per train	Injuries per 10 years	Fatalities per 10 years	Damage $ per 10 years
40	Train-Train Collision	Pass Loco hits Loco	0.00332	Incl	0.00332	8.28	32	1.29	41	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Pass Car	0.00090	Incl	0.00090	8.28	32	1.29	41	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Frt Car	0.00038	Incl	0.00038	8.28	32	1.29	41	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00143	Incl	0.00143	8.28	32	1.29	41	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.00	0.00860	6.00	23	1.29	30	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (other))	Pass Loco hits intruder	0.01440	0.00	0.01440	6.00	23	1.29	30	0.00000	320	0.6	192	0.0000	0.00000	0
	Overspeed		0.01100	0.50	0.00550	6.00	23	1.29	30	0.00000	320	0.6	192	0.0000	0.00000	0
	Broken Rail		0.01670	0.00	0.01670	6.00	23	1.29	30	0.00000	320	0.6	192	0.0000	0.00000	0
	Work Zone Violation			0.25		6.00	23	1.29	30					0.0000	0.00000	0
										0.00000				**0.00001**	**0.00000**	**0**
60	Train-Train Collision	Pass Loco hits Loco	0.00000	Incl	0.00000	8.28	32	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Pass Car	0.00000	Incl	0.00000	8.28	32	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Frt Car	0.00000	Incl	0.00000	8.28	32	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00000	Incl	0.00000	8.28	32	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.00	0.00860	6.00	23	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.00	0.01440	6.00	23	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Overspeed		0.01100	0.50	0.00550	6.00	23	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Broken Rail		0.01670	0.00	0.01670	6.00	23	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Work Zone Violation			0.25		6.00	23	0	0					0.0000	0.00000	0
										0.00000				**0.00000**	**0.00000**	**0**
79	Train-Train Collision	Pass Loco hits Loco	0.00297	Incl	0.00297	8.28	32	35.22	1115	0.00000	320	0.6	192	0.0002	0.00001	7
		Pass Loco hits Pass Car	0.00016	Incl	0.00016	8.28	32	35.22	1115	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Frt Car	0.00014	Incl	0.00014	8.28	32	35.22	1115	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00046	Incl	0.00046	8.28	32	35.22	1115	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.00	0.00860	6.00	23	8.41	193	0.00000	320	0.6	192	0.0000	0.00000	1
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.00	0.01440	6.00	23	8.41	193	0.00000	320	0.6	192	0.0001	0.00000	2
	Overspeed		0.01100	0.50	0.00550	6.00	23	8.41	193	0.00000	320	0.6	192	0.0000	0.00000	3
	Broken Rail		0.01670	0.00	0.01670	6.00	23	8.41	193	0.00000	320	0.6	192	0.0001	0.00000	8
	Work Zone Violation			0.25		6.00	23	8.41	193					0.0000	0.00000	
										0.00001				**0.00048**	**0.00002**	**23**
105	Train-Train Collision	Pass Loco hits Loco	0.00239	Incl	0.00239	8.28	32	26.81	849	0.00000	320	0.6	192	0.0002	0.00001	7
		Pass Loco hits Pass Car	0.00041	Incl	0.00041	8.28	32	26.81	849	0.00000	320	0.6	192	0.0000	0.00000	1
		Pass Loco hits Frt Car	0.00012	Incl	0.00012	8.28	32	26.81	849	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00045	Incl	0.00045	8.28	32	26.81	849	0.00000	320	0.6	192	0.0001	0.00000	3
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.00	0.00860	6.00	23	26.81	615	0.00001	320	0.6	192	0.0001	0.00000	4
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.00	0.01440	6.00	23	26.81	615	0.00001	320	0.6	192	0.0003	0.00001	14
	Broken Rail		0.01100	0.50	0.00550	6.00	23	26.81	615	0.00000	320	0.6	192	0.0002	0.00000	16
	Broken Rail		0.01670	0.00	0.01670	6.00	23	26.81	615	0.00001	320	0.6	192	0.0006	0.00001	47
	Work Zone Violation			0.25		6.00	23	26.81	615					0.0001	0.00001	0
	Total									**0.00003**				**0.00150**	**0.00005**	**91**
	Overall Totals									**0.00005**				**0.00199**	**0.00006**	**115**

Totals All Speeds	Train-train Collisions	0.00001	0.00045	0.00002	19
	Intrusion Collisions	**0.00002**	**0.00050**	**0.00002**	**21**
	Overspeed	**0.00000**	**0.00023**	**0.00000**	**18**
	Broken Rail	**0.00001**	**0.00069**	**0.00001**	**56**
	Work Zone Violation	**0.00000**	**0.00013**	**0.00001**	**6**
	Grade Crossing Collisions				

Table 3.5b: Risk Calculation - Collisions at Diamonds - Passenger

Number Diamonds	Freq'y per mill passes	Collisions (millions)	Injuries	Fatalities	Damage
1	0.000000	0.000000	0.000000	0.000000	0.00
1	0.000000	0.000000	0.000000	0.000000	0.00
1	0.016381	0.000001	0.000003	0.000000	0.13
1	0.003276	0.000000	0.000003	0.000000	0.10
		0.000001	**0.000007**	**0.000000**	**0.23**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.016381	0.000000	0.000000	0.000000	0.00
0	0.003276	0.000000	0.000000	0.000000	0.00
		0.000000	**0.00000**	**0.00000**	**0.00

Worksheet 2 - B,T,S Collision Frequencies Calculation - PTC 120 Sec.Timeout Case, Bloomington Sub-corridor, PTC Timeout Operating State, Summer

Table 2.1a: Collision Distribution Matrix (Fraction Accidents by Train Pair and Collision Type). Collisions Between Trains Operating on the IDOT Test Corridor Only (Not diamonds and intrusions)

Train Pairs in Collision		Collision Scenario Prob (Top Level)	Siding - Monitored				Siding - Unmonitored				CP Adjacent - Monitored Siding				CP Adjacent - Unmonitored Siding				Plain Track			
			Collision Distribution		Head On	Rear End/Side	Collision Distribution		Head On	Rear End/Side	Collision Distribution		Head On	Rear End/Side	Collision Distribution		Head On	Rear End/Side	Collision Distribution		Head On	Rear End/Side
			Head On	Rear/Side	Equip Guilty / Unequip Guilty	Equip Guilty / Unequip Guilty	Head On	Rear/Side	Equip Guilty / Unequip Guilty	Equip Guilty / Unequip Guilty	Head On	Rear/Side	Equip Guilty / Unequip Guilty	Equip Guilty / Unequip Guilty	Head On	Rear/Side	Equip Guilty / Unequip Guilty	Equip Guilty / Unequip Guilty	Head On	Rear/Side	Equip Guilty / Unequip Guilty	Equip Guilty / Unequip Guilty
Percent Guilty					100% 0%	100% 0%	100% 0%	100% 0%			100% 0%	100% 0%	100% 0%	100% 0%			100% 0%	100% 0%			100% 0%	100% 0%
Both Trains TBE	Pass-Pass	0.71	0.50	0.50	0.355 0	0.355 0	0.5	0.5	0.355 0	0.355 0	0.8	0.2	0.568 0	0.142 0	0.8	0.2	0.568 0	0.142 0	0.70	0.30	0.497 0	0.213 0
	Pass-TBE Freight	0.22	0.50	0.50	0.11 0	0.11 0	0.5	0.5	0.11 0	0.11 0	0.7	0.3	0.154 0	0.066 0	0.7	0.3	0.154 0	0.066 0	0.40	0.60	0.088 0	0.132 0
(Note 3)	TBE Freight - TBE Freight	0.00	0.50	0.50	0 0	0 0	0.5	0.5	0 0	0 0	0.7	0.3	0 0	0 0	0.7	0.3	0 0	0 0	0.50	0.50	0 0	0 0
Percent Guilty					50% 50%	50% 50%			50% 50%	50% 50%			50% 50%	50% 50%			50% 50%	50% 50%			50% 50%	50% 50%
One Train TBE	Pass - NE Freight, Head -On	0.07	1	0	0.0175 0.0175	0 0	1	0	0.0175 0.0175	0 0	1	0	0.028 0.028	0 0	1	0	0.028 0.028	0 0	1.00	0.00	0.0245 0.0245	0 0
	Rear/Side, Pass into NE Frt		0	1	0 0	0.028 0	0	1	0 0	0.028 0	0	1	0 0	0.0105 0	0	1	0 0	0.0105 0	0.00	1.00	0 0	0.0175 0
	Rear/Side NE Frt into Pass		0	1	0 0	0 0.007	0	1	0 0	0 0.007	0	1	0 0	0 0.0035	0	1	0 0	0 0.0035	0.00	1.00	0 0	0 0.0035
	TBE Freight - NE Freight	0.00	0.5	0.5	0 0	0 0	0.5	0.5	0 0	0 0	0.7	0.3	0 0	0 0	0.7	0.3	0 0	0 0	0.50	0.50	0 0	0 0
Percent Guilty					0% 100%	0% 100%			0% 100%	0% 100%			0% 100%	0% 100%			0% 100%	0% 100%			0% 100%	0% 100%
Neither Train TBE	NE Freight - NE Freight	0.00	0.5	0.5	0 0	0 0	0.5	0.5	0 0	0 0	0.7	0.3	0 0	0 0	0.7	0.3	0 0	0 0	0.50	0.50	0 0	0 0
	Total Probability (checking)	1		1	0.4825 0.0175	0.493 0.007		1	0.4825 0.0175	0.493 0.007		1	0.75 0.028	0.2185 0.0035		1	0.75 0.028	0.2185 0.0035		1	0.6095 0.0245	0.3625 0.0035

Quarely in cell C18 is for all collisions between a passenger train and an unequipped freight train

Table 2.2: Preventability Data For Unequipped train Guilty, One Train TBE

Segment Type	Not Prevented of Mitigated			Mitigated			Prevented		
	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass
Siding (M)	1.025	1.020	1.021	0.025	0.002	0.000	0.000	0.028	0.029
Siding (U)	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100
CP Adjacent (M)	1.000	1.040	1.050	0.050	0.007	0.000	0.000	0.003	0.000
CP Adjacent (U)	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100
Plain Track	1.129	1.144	1.165	0.028	0.029	0.008	0.014	0.012	0.012
Diamonds	0.667	0.605	0.691	0.172	0.000	0.200	0.211	0.445	0.160

Mauve cells contain data imported from Worksheet 1 in this group of three worksheets covering this sub-corridor, season and operating state.

Table 2.3a: Collision Preventability Matrix (Percent Accidents Preventable Relative to CTC Reference Case)

Train Pairs in Collision		Preventability Equipped Train Guilty	Siding - Monitored				Siding - Unmonitored				CP Adjacent - Monitored Siding				CP Adjacent - Unmonitored Siding				Plain Track			
					Head On	Rear End/Side			Head On	Rear End/Side			Head On	Rear End/Side			Head On	Rear End/Side	Collision Distribution		Head On	Rear End/Side
					Equip Guilty / Unequip Guilty	Equip Guilty / Unequip Guilty			Equip Guilty / Unequip Guilty	Equip Guilty / Unequip Guilty			Equip Guilty / Unequip Guilty	Equip Guilty / Unequip Guilty			Equip Guilty / Unequip Guilty	Equip Guilty / Unequip Guilty	Head On	Rear/Side	Equip Guilty / Unequip Guilty	Equip Guilty / Unequip Guilty
Both TBE	Pass-Pass	90%			90%	90%			90%	90%			90%	90%			90%	90%			90%	90%
	Pass-TBE Freight	90%			90%	90%			90%	90%			90%	90%			90%	90%			90%	90%
	TBE Freight - TBE Freight	90%			90%	90%			90%	90%			90%	90%			90%	90%			90%	90%
One TBE	Pass - NE Freight, Head -On	90%			90% 3%				90% 10%				90% 0%				90% 10%				90% 1%	
	Rear/Side, Pass into NE Frt	90%				90% 3%				90% 10%				90% 0%				90% 10%				90% 1%
	Rear/Side NE Frt into Pass	90%				90% 0%				90% 0%				90% 0%				90% 0%				90% 0%
	TBE Freight - NE Freight	90%			90% 0%	90% 0%			90% 10%	90% 0%			90% 0%	90% 0%			90% 10%	90% 0%			90% 1%	90% 0%
Neither TBE	NE Freight - NE Freight				0%	0%			0%	0%			0%	0%			0%	0%			0%	0%
Reference Case (CTC) Collision Accident Likelihood by Segment Type (collisions/million train miles)		**0.030**					**0.040**				**0.050**				**0.060**				**0.006**			

Collisions/million diamond passes: **0.1**

Table 2.4a: Passenger Trains in Accidents (Collisions per Million Train-Miles Operated in Sub-Corridor)

Train Pairs in Collision		Passenger Trains in Collisions	Siding - Monitored				Siding - Unmonitored				CP Adjacent - Monitored Siding				CP Adjacent - Unmonitored Siding				Plain Track			
					Head On	Rear End/Side			Head On	Rear End/Side			Head On	Rear End/Side			Head On	Rear End/Side	Collision Distribution		Head On	Rear End/Side
					Equip Guilty / Unequip Guilty	Equip Guilty / Unequip Guilty			Equip Guilty / Unequip Guilty	Equip Guilty / Unequip Guilty			Equip Guilty / Unequip Guilty	Equip Guilty / Unequip Guilty			Equip Guilty / Unequip Guilty	Equip Guilty / Unequip Guilty	Head On	Rear/Side	Equip Guilty / Unequip Guilty	Equip Guilty / Unequip Guilty
Both TBE	Pass-Pass	2			0.0021	0.0021			0.0028	0.0028			0.0057	0.0014			0.0068	0.0017			0.0068	0.0017
	Pass-TBE Freight	1			0.0003	0.0003			0.0004	0.0004			0.0008	0.0003			0.0009	0.0004			0.0001	0.0001
	TBE Freight - TBE Freight	0																				
One TBE	Pass - NE Freight, Head -On	1			0.0001	0.0005			0.0001	0.0006			0.0001	0.0014			0.0002	0.0015			0.0000	0.0001
	Rear/Side, Pass into NE Frt	1				0.0001	0.0000			0.0001	0.0000			0.0001	0.0000			0.0001	0.0000			0.0000
	Rear/Side NE Frt into Pass	1				0.0000	0.0002			0.0000	0.0003			0.0000	0.0002			0.0000	0.0002			0.0000
	TBE Freight - NE Freight	0																				
Neither TBE	NE Freight - NE Freight	0																				
	Checking total				0.0025	0.0005	0.0025	0.0002	0.0034	0.0006	0.0034	0.0003	0.0066	0.0014	0.0018	0.0002	0.0079	0.0015	0.0022	0.0002	0.0007	0.0001	0.0003	0.0000

Scenario Totals - Passenger	Tots, P-UF	Totals			Totals			Totals			Totals			Totals			Totals			Totals
Pass Loco Hits Loco	0.0006	0.0030	0.0025	0.0005			0.0007	0.0040	0.0034	0.0006			0.0015	0.0080	0.0066	0.0014			0.0079	0.0015			0.0002	0.0008	0.0007	0.0001
Pass Loco Hits Pass Car		0.0011			0.0011			0.0014			0.0014			0.0007			0.0009				0.0009		0.0001			0.0001	
Pass Loco Hits Freight Car	0.0001	0.0003			0.0003		0.0001	0.0005			0.0005		0.0001	0.0003			0.0004		0.0001	0.0004			0.0000	0.0001			0.0001	
Pass Car Hit by Loco	0.0002	0.0013			0.0011	0.0002	0.0003	0.0018			0.0015	0.0003	0.0002	0.0010			0.0008	0.0002	0.0002	0.0012			0.0000	0.0002			0.0001	0.0000
Total		0.0058	0.0025	0.0005	0.0025	0.0002		0.0077	0.0034	0.0006	0.0034	0.0003		0.0100	0.0066	0.0014	0.0018	0.0002		0.0118	0.0079	0.0015	0.0022	0.0002		0.0012	0.0007	0.0001	0.0003	0.0000

Table 2.5a: Freight trains in Accidents (Collisions per Million Train-Miles Operated in Sub-Corrid

Train Pairs in Collision		Freight Trains in Collisions	Siding - Monitored				Siding - Unmonitored				CP Adjacent - Monitored Siding				CP Adjacent - Unmonitored Siding				Plain Track			
					Head On	Rear End/Side			Head On	Rear End/Side			Head On	Rear End/Side			Head On	Rear End/Side	Collision Distribution		Head On	Rear End/Side
					Equip Guilty / Unequip Guilty	Equip Guilty / Unequip Guilty			Equip Guilty / Unequip Guilty	Equip Guilty / Unequip Guilty			Equip Guilty / Unequip Guilty	Equip Guilty / Unequip Guilty			Equip Guilty / Unequip Guilty	Equip Guilty / Unequip Guilty	Head On	Rear/Side	Equip Guilty / Unequip Guilty	Equip Guilty / Unequip Guilty
Both TBE	Pass-Pass	0																				
	Pass-TBE Freight	1			0.0003	0.0003			0.0004	0.0004			0.0008	0.0003			0.0009	0.0004			0.0001	0.0001
	TBE Freight - TBE Freight	2			0.0000	0.0000			0.0000	0.0000			0.0000	0.0000			0.0000	0.0000			0.0000	0.0000
One TBE	Pass - NE Freight, Head -On	1			0.0001	0.0005			0.0001	0.0006			0.0001	0.0014			0.0002	0.0015			0.0000	0.0001
	Rear/Side, Pass into NE Frt	1				0.0001	0.0000			0.0001	0.0000			0.0001	0.0000			0.0001	0.0000			0.0000
	Rear/Side NE Frt into Pass	1				0.0000	0.0002			0.0000	0.0003			0.0000	0.0002			0.0000	0.0002			0.0000
	TBE Freight - NE Freight	2			0.0000	0.0000	0.0000	0.0000			0.0000	0.0000			0.0000	0.0000			0.0000	0.0000			0.0000	0.0000
Neither TBE	NE Freight - NE Freight	2				0.0000		0.0000				0.0000		0.0000				0.0000				0.0000
	Checking total				0.0004	0.0005	0.0004	0.0002			0.0005	0.0006	0.0006	0.0003			0.0011	0.0015	0.0005	0.0002		

Scenario Totals - Freight	Totals						Totals				Totals				Totals				Totals				Totals				Totals
Freight Loco Hits Loco	0.0006	0.0009	0.0004	0.0005			0.0011		0.0005	0.0006			0.0023	0.0009	0.0014		0.0028		0.0011	0.0015			0.0002		0.0001	0.0001		
Freight Loco Hits Car	0.0002	0.0003			0.00007	0.00021	0.0004				0.00009	0.00028	0.0003				0.0003				0.00010	0.00021	0.0000			0.00001	0.00002	
Freight Car Hit By Loco	0.0001	0.0003	b		0.00035	0.00000	0.0005		0.00046	0.00000			0.0003				0.0004				0.00036	0.00000	0.0001			0.00008	0.00000	
Total		0.0015	0.0004	0.0005	0.0004	0.0002		0.0020	0.0005	0.0006	0.0006	0.0003	0.0000	0.0029	0.0009	0.0014	0.0004	0.0002		0.0033	0.0011	0.0015	0.0005	0.0002		0.0003	0.0001	0.0001	0.0001	0.0000
Freight Plus Passenger Totals (check	0.0600	0.0073					0.0800	0.0096					0.1000	0.0128					0.1200	0.0151					0.0015				

In rear-end/side collisions between like trains there is one loco hits car and one car hit by loco in each collision. In rear/side collisions between a passenger and freight trains, the ratio between passenger hits freight and freight loco hits passenger car are a function of the percentages given in Table IN-5b on the Inputs sheet. The values are given in the tables beneath the trains in collisions for each segment type.

Collision Ratios	Siding - Monitored				Siding - Unmonitored				CP Adjacent - Monitored Siding				CP Adjacent - Unmonitored Siding				Plain Track			
Collision Type	Like Trains		Unlike Trains		Like Trains		Unlike Trains		Like Trains		Unlike Trains		Like Trains		Unlike Trains		Like Trains		Unlike Trains	
	Loco hits car	car hit by loco	P loco hits F car	F loco hits P car	Loco hits car	car hit by loco	P loco hits F car	F loco hits P car	Loco hits car	car hit by loco	P loco hits F car	F loco hits P car	Loco hits car	car hit by loco	P loco hits F car	F loco hits P car	Loco hits car	car hit by loco	P loco hits F car	F loco hits P car
Freight to Freight	0.50	0.50			0.50	0.50			0.50	0.50			0.50	0.50			0.50	0.50		
Passenger to Passenger	0.50	0.50			0.50	0.50			0.50	0.50			0.50	0.50			0.50	0.50		
Passenger to Freight			0.8	0.2			0.80	0.20			0.75	0.25			0.75	0.25			0.83	0.17

Table 2.1b: Collision Type Distribution - Diamonds

Diamond Collisions		Train Pairs in Collision	Train Pair Type
Rear End/Side			
Equip Guilty	Unequip Guilty		
		Percent Guilty	
		Pass-Pass	**Both Trains TBE**
		Pass-TBE Freight	
		TBE Freight - TBE Freight	
50%	50%	**Percent Guilty**	**One Train TBE**
0	0	Pass - NE Freight, Head -On	
0.25	0.25	Rear/Side, Pass into NE Frt	
0.05	0.05	Rear/Side NE Frt into Pass	
0.1	0.1	TBE Freight - NE Freight	
	100%	**Percent Guilty**	
0	0.2	NE Freight - NE Freight	**Neither Train TBE**
0.4	0.6	Total Probability (checking)	

Note: The gray cells on these rows are set at zero, because in every case, the condition represented by the cell does not exist - either because there are no unequipped passenger trains, or because of the kind of collision

Table 2.3b: Collision Preventability Matrix - Diamonds

Diamond Collisions		Train Pairs in Collision	Train Pair Type
Rear End/Side			
Equip Guilty	Unequip Guilty		
		Pass-Pass	**Both TBE**
		Pass-TBE Freight	
		TBE Freight - TBE Freight	
		Pass - NE Freight, Head -On	**One TBE**
		Rear/Side, Pass into NE Frt	
		Rear/Side NE Frt into Pass	
		TBE Freight - NE Freight	
		NE Freight - NE Freight	**Neither TBE**

Table 2.4b: Passenger Trains in Collisions at Diamonds

Diamond Collisions		Train Pairs in Collision	Train Pair Type
Rear End/Side			
Equip Guilty	Unequip Guilty		
		Pass-Pass	**Both TBE**
		Pass-TBE Freight	
		TBE Freight - TBE Freight	
0.002500	0.013881	Pass - NE Freight, Head -On	**One TBE**
0.000500	0.002776	Rear/Side, Pass into NE Frt	
0.000500	0.002776	Rear/Side NE Frt into Pass	
0.000000	0.000000	TBE Freight - NE Freight	
	0.000000	NE Freight - NE Freight	**Neither TBE**
0.00300	0.01666		

Totals	Scenario Totals - Passenger
	Pass Loco Hits Loco
	Pass Loco Hits Pass Car
0.016381	Pass Loco Hits Freight Car
0.003276	Pass Car Hit by Loco
0.019657	Total

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Table 2.5b: Freight Trains in Collisions at Diamond

Diamond Collisions		Train Pairs in Collision	Train Pair Type
Rear End/Side			
Equip Guilty	Unequip Guilty		
		Pass-Pass	**Both TBE**
		Pass-TBE Freight	
		TBE Freight - TBE Freight	
		Pass - NE Freight, Head -On	**One TBE**
		Rear/Side, Pass into NE Frt	
		Rear/Side NE Frt into Pass	
		TBE Freight - NE Freight	
		NE Freight - NE Freight	**Neither TBE**
0.00500	0.07243		

Totals	Scenario Totals - Freight
	Freight Loco Hits Loco
0.034164	Freight Loco Hits Car
0.043268	Freight Car Hit By Loco
0.077432	Total

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Worksheet 2 - Sp,N,S: Collision Frequencies Calculation - PTC 120 Sec. Timeout Case, Springfield Sub-corridor PTC Normal Operating State, Summer

Table 2.1a: Collision Distribution Matrix (Fraction Accidents by Train Pair and Collision Type). Collisions Between Trains Operating on the IDOT Test Corridor Only (Not diamonds and intrusions)

Train Pairs in Collision	Collision Scenario Prob (Top Level)	Siding - Monitored				Siding - Unmonitored				CP Adjacent - Monitored Siding				CP Adjacent - Unmonitored Siding				Plain Track			
		Collision Distribution		Head On		Collision Distribution		Head On		Collision Distribution		Head On		Collision Distribution		Head On		Collision Distribution		Head On	
		Head On	Rear/Side	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty
Percent Guilty				100%	0%	100%	0%	100%	0%			100%	0%			100%	0%			100%	0%
Both Trains TBE	0.80	0.50	0.50	0.4	0	0.4	0	0.4	0	0.8	0.2	0.64	0	0.8	0.2	0.64	0	0.70	0.30	0.56	0
Pass-Pass																					
Pass-TBE Freight	0.15	0.50	0.50	0.075	0	0.075	0	0.075	0	0.7	0.3	0.105	0	0.7	0.3	0.105	0	0.40	0.60	0.06	0
(Note 3) TBE Freight - TBE Freight	0.00	0.50	0.50	0	0	0	0	0	0	0.7	0.3	0	0	0.7	0.3	0	0	0.50	0.50	0	0
Percent Guilty				50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
One Train TBE Pass - NE Freight, Head -On	0.05	1	0	0.0125	0.0125	0	0	1	0	0.02	0.02	0	0	1	0	0.02	0.02	1.00	0.00	0.0175	0.0175
Rear/Side, Pass into NE Frt		0	1	0	0	0.02	0	0	1	0	0	0.0075	0	0	1	0	0	0.00	1.00	0	0
Rear/Side NE Frt into Pass		1	0	0	0	0	0.005	0	1	0	0	0	0.0025	0	1	0	0	0.00	1.00	0	0
TBE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0	0.5	0.5	0	0	0	0	0.7	0.3	0	0	0.50	0.50	0	0
Percent Guilty				0%	100%	0%	100%			0%	100%	0%	100%			0%	100%			0%	100%
Neither Train TBE NE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0	0.5	0.5	0	0	0	0	0.7	0.3	0	0	0.50	0.50	0	0
Total Probability (checking)	1		1	0.4875	0.0125	0.495	0.005		1	0.4875	0.0125	0.495	0.005		1	0.765	0.02	0.2125	0.0025		1

Train Pairs in Collision	Train Pair Type
Percent Guilty	
Pass-Pass	**Both Trains TBE**
Pass-TBE Freight	
TBE Freight - TBE Freight	
Percent Guilty	**One Train TBE**
Pass - NE Freight, Head -On	
Rear/Side, Pass into NE Frt	
Rear/Side NE Frt into Pass	
TBE Freight - NE Freight	
Percent Guilty	
NE Freight - NE Freight	**Neither Train TBE**
Total Probability (checking)	

Note: The gray cells on these rows are set at zero, because in every case, the condition represented by the cell does not exist - either because there are no unequipped passenger trains, or because of the kind of collision

Table 2.1b: Collision Type Distribution - Diamonds

Diamond Collisions		Train Pairs in Collision	Train Pair Type
Rear End/Side			
Equip Guilty	Unequip Guilty		
		Percent Guilty	
		Pass-Pass	**Both Trains TBE**
		Pass-TBE Freight	
		TBE Freight - TBE Freight	
50%	50%	**Percent Guilty**	**One Train TBE**
0	0	Pass - NE Freight, Head -On	
0.25	0.25	Rear/Side, Pass into NE Frt	
0.05	0.05	Rear/Side NE Frt into Pass	
0.1	0.1	TBE Freight - NE Freight	
	100%	**Percent Guilty**	
0	0.2	NE Freight - NE Freight	**Neither Train TBE**
0.4	0.6	Total Probability (checking)	

Quarely in cell C18 is for all collisions between a passenger train and an unequipped freight train

Table 2.2: Preventability Data For Unequipped train Guilty, One Train TBE

Segment Type	Not Prevented of Mitigated			Mitigated			Prevented		
	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass
Siding (M)	0.326	0.289	0.618	0.263	0.263	0.263	0.461	0.499	0.169
Siding (U)	0.428	0.424	0.595	0.166	0.172	0.291	0.456	0.453	0.164
CP Adjacent (M)	0.416	0.414	0.585	0.218	0.226	0.220	0.415	0.410	0.245
CP Adjacent (U)	0.414	0.389	0.680	0.325	0.250	0.280	0.311	0.411	0.089
Plain Track	0.120	0.119	0.169	0.000	0.000	0.024	0.100	0.100	0.076
Diamonds	0.276	0.296	0.296	0.098	0.000	0.170	0.676	0.754	0.584

Mauve cells contain data imported from Worksheet ! in a group of worksheets covering one sub-corridor, and operating state.

Table 2.3a: Collision Preventability Matrix (Percent Accidents Preventable Relative to CTC Reference Case)

Preventability Equipped Train Guilty	Siding - Monitored				Siding - Unmonitored				CP Adjacent - Monitored Siding				CP Adjacent - Unmonitored Siding				Plain Track			
	Head On		Rear End/Side		Head On		Rear End/Side		Head On		Rear End/Side		Head On		Rear End/Side		Collision Distribution		Head On	
	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty
Both TBE Pass-Pass	90%		90%		90%		90%		90%		90%		90%		90%				90%	
Pass-TBE Freight	90%		90%		90%		90%		90%		90%		90%		90%				90%	
TBE Freight - TBE Freight	90%		90%		90%		90%		90%		90%		90%		90%				90%	
One TBE Pass - NE Freight, Head -On	90%		90%	17%	90%	16%	90%	25%	90%	9%	90%	8%								
Rear/Side, Pass into NE Frt	90%		90%	17%	90%	16%	90%	25%	90%	9%	90%	8%								
Rear/Side NE Frt into Pass	90%		90%	0%	90%	0%	90%	0%	90%	0%	90%	0%								
TBE Freight - NE Freight	90%		90%	46%	90%	0%	90%	46%	90%	0%	90%	42%	90%	0%	90%	31%	90%	10%	90%	0%
Neither TBE NE Freight - NE Freight				0%		0%		0%		0%		0%		0%		0%				0%

Diamond Collisions		Train Pairs in Collision	Train Pair Type
Rear End/Side			
Equip Guilty	Unequip Guilty		
		Pass-Pass	**Both TBE**
		Pass-TBE Freight	
		TBE Freight - TBE Freight	
		Pass - NE Freight, Head -On	**One TBE**
90%	75.35%	Rear/Side, Pass into NE Frt	
90%	75.35%	Rear/Side NE Frt into Pass	
90%	67.63%	TBE Freight - NE Freight	
	0.00%	NE Freight - NE Freight	**Neither TBE**

Reference Case (CTC) Collision Accident Likelihood by Segment Type (collisions/million train miles): 0.030 | 0.040 | 0.050 | 0.060 | 0.006

Collisions/million diamond passes: 0.1

Table 2.4a: Passenger Trains in Accidents (Collisions per Million Train-Miles Operated in Sub-Corridor)

Passenger Trains in Collisions	Siding - Monitored				Siding - Unmonitored				CP Adjacent - Monitored Siding				CP Adjacent - Unmonitored Siding				Plain Track			
	Head On		Rear End/Side		Head On		Rear End/Side		Head On		Rear End/Side		Head On		Rear End/Side		Collision Distribution		Head On	
	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty
Both TBE Pass-Pass	2		0.0024		0.0032		0.0032		0.0064		0.0018		0.0077		0.0019				0.0007	
Pass-TBE Freight	1		0.0002		0.0003		0.0003		0.0005		0.0002		0.0006		0.0003				0.0000	
TBE Freight - TBE Freight	0																			
One TBE Pass - NE Freight, Head -On	1		0.0000	0.0003		0.0001	0.0004		0.0001	0.0008			0.0001	0.0011					0.0000	0.0001
Rear/Side, Pass into NE Frt	1				0.0001	0.0000				1	0.0000	0.0000			0.0000	0.0000				
Rear/Side NE Frt into Pass	1				0.0000	0.0002					0.0000	0.0001			0.0000	0.0002				
TBE Freight - NE Freight	0																			
Neither TBE NE Freight - NE Freight	0																			
Checking total			0.0027	0.0003	0.0027	0.0002			0.0036	0.0004	0.0036	0.0002			0.0070	0.0008	0.0019	0.0001		
Scenario Totals - Passenger		Tots, P-UF	Totals					Totals						Totals						Totals	
Pass Loco Hits Loco		0.0003	0.0030	0.0027	0.0003			0.0005	0.0040	0.0036	0.0004		0.0009	0.0078	0.0070	0.0008			0.0012	0.0099
Pass Loco Hits Pass Car			0.0012			0.0012		0.0016				0.0016		0.0008			0.0008			0.0010
Pass Loco Hits Freight Car		0.0001	0.0002			0.0002		0.0001	0.0003			0.0003		0.0002			0.0002			0.0002
Pass Car Hit by Loco		0.0002	0.0014			0.0012	0.0002	0.0002	0.0019			0.0017	0.0002	0.0010	0.0001	0.0010			0.0002	0.0012
Total			0.0058	0.0027	0.0003	0.0027	0.0002		0.0077	0.0036	0.0004	0.0036	0.0002		0.0098	0.0070	0.0008	0.0019	0.0001		

Diamond Collisions		Train Pairs in Collision	Train Pair Type
Rear End/Side			
Equip Guilty	Unequip Guilty		
		Pass-Pass	**Both TBE**
		Pass-TBE Freight	
		TBE Freight - TBE Freight	
		Pass - NE Freight, Head -On	**One TBE**
0.002500	0.006162	Rear/Side, Pass into NE Frt	
0.000500	0.001232	Rear/Side NE Frt into Pass	
0.000000	0.000000	TBE Freight - NE Freight	
	0.000000	NE Freight - NE Freight	**Neither TBE**
0.00300	0.00739		
		Scenario Totals - Passenger	
0.002500	0.006162	Pass Loco Hits Loco	
0.000500	0.001232	Pass Loco Hits Pass Car	
0.000500	0.001232	Pass Loco Hits Freight Car	
0.000500	0.001232	Pass Car Hit by Loco	
0.003000	0.007394	Total	

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Table 2.5a: Freight trains in Accidents (Collisions per Million Train-Miles Operated in Sub-Corric

Freight Trains in Collisions	Siding - Monitored				Siding - Unmonitored				CP Adjacent - Monitored Siding				CP Adjacent - Unmonitored Siding				Plain Track			
	Head On		Rear End/Side		Head On		Rear End/Side		Head On		Rear End/Side		Head On		Rear End/Side		Collision Distribution		Head On	
	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty
Both TBE Pass-Pass	0																			
Pass-TBE Freight	1		0.0002		0.0003		0.0003		0.0005		0.0002		0.0006		0.0003				0.0000	
TBE Freight - TBE Freight	2		0.0000		0.0000		0.0000		0.0000		0.0000		0.0000		0.0000				0.0000	
One TBE Pass - NE Freight, Head -On	1		0.0000	0.0003		0.0001	0.0004		0.0001	0.0008			0.0001	0.0011					0.0000	0.0001
Rear/Side, Pass into NE Frt	1				0.0001	0.0000					0.0000	0.0000			0.0000	0.0000				
Rear/Side NE Frt into Pass	1				0.0000	0.0002					0.0000	0.0001			0.0000	0.0002				
TBE Freight - NE Freight	2		0.0000	0.0000	0.0000	0.0000			0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000			0.0000	0.0000
Neither TBE NE Freight - NE Freight	2			0.0000		0.0000				0.0000		0.0000		0.0000		0.0000				0.0000
Checking total			0.0003	0.0003	0.0003	0.0002			0.0004	0.0004	0.0004	0.0002			0.0006	0.0008	0.0003	0.0002		
Scenario Totals - Freight		Totals					Totals						Totals						Totals	
Freight Loco Hits Loco	0.0003	0.0006	0.0003	0.0003			0.0006		0.0004	0.0004			0.0014	0.0006	0.0008				0.0001	
Freight Loco Hits Car	0.0002	0.0002			0.00005	0.00015	0.0003				0.00006	0.00020	0.0002			0.00006	0.00013			0.0002
Freight Car Hit By Loco	0.0001	0.0002	b		0.00024	0.00000	0.0003				0.00032	0.00000	0.0002			0.00021	0.00000			0.0002
Total		0.0010	0.0003	0.0003	0.0003	0.0002		0.0013	0.0004	0.0004	0.0004	0.0002	0.0014	0.0006	0.0008	0.0003	0.0001		0.0018	0.0008
Freight Plus Passenger Totals (check	0.0600	0.0068			0.0800	0.0091			0.1000	0.0115			0.1200	0.0142					0.0014	

Diamond Collisions		Train Pairs in Collision	Train Pair Type
Rear End/Side			
Equip Guilty	Unequip Guilty		
		Pass-Pass	**Both TBE**
		Pass-TBE Freight	
		TBE Freight - TBE Freight	
		Pass - NE Freight, Head -On	**One TBE**
0.002500	0.006162	Rear/Side, Pass into NE Frt	
0.000500	0.001232	Rear/Side NE Frt into Pass	
0.002000	0.006475	TBE Freight - NE Freight	
	0.040000	NE Freight - NE Freight	**Neither TBE**
0.00500	0.05387		
		Scenario Totals - Freight	
		Freight Loco Hits Loco	
0.003500	0.024470	Freight Loco Hits Car	
0.001500	0.029399	Freight Car Hit By Loco	
0.005000	0.053869	Total	

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

In rear-end/side collisions between like trains there is one loco hits car and one car hit by loco in each collision. In rear/side collisions between a passenger and freight trains, the ratio between passenger hits freight and freight loco hits passenger car are a function of the percentages given in Table IN-5b on the Inputs sheet. The values are given in the tables beneath the trains in collisions for each segment type.

Collision Ratios	Siding - Monitored				Siding - Unmonitored				CP Adjacent - Monitored Siding				CP Adjacent - Unmonitored Siding				Plain Track			
Collision Type	Like Trains		Unlike Trains		Like Trains		Unlike Trains		Like Trains		Unlike Trains		Like Trains		Unlike Trains		Like Trains		Unlike Trains	
	Loco hits car	car hit by loco	P loco hits F car	F loco hits P car	Loco hits car	car hit by loco	P loco hits F car	F loco hits P car	Loco hits car	car hit by loco	P loco hits F car	F loco hits P car	Loco hits car	car hit by loco	P loco hits F car	F loco hits P car	Loco hits car	car hit by loco	P loco hits F car	F loco hits P car
Freight to Freight	0.50	0.50			0.50	0.50			0.50	0.50			0.50	0.50			0.50	0.50		
Passenger to Passenger	0.50	0.50			0.50	0.50			0.50	0.50			0.50	0.50			0.50	0.50		
Passenger to Freight			0.8	0.2			0.80	0.20			0.75	0.25			0.75	0.25			0.83	0.17

Worksheet 1-Sp,N: IDOT-PTC Risk Model: Braking Distances and Collision Zone Calculations, Springfield Sub-corridor, PTC Normal Operating State

Table 1.1: Stopping Distance Parameters and Calculations, Including Timerul and ACS Response Delay

Braking Formula Inputs		
Train/System Type	Parameter	Value
Freight	Coefficient F	0.035
	Appl'n Time (sec)	13.0
	Train Weight (lb)	12500000
	Brake Force (lb)	778650
Passenger	Coefficient A	0.650
	Coefficient B	0
	Safety Factor	1.25
Train Control	Latency/T-out (sec)	10
	ACS Response	0
Guilty Train Speed (mph)		110

Braking Distance Calculations (ft) (including free running in TD)						Decceleration (ft/sec^)	Braking Duration (secs)		Guilty Train Distance		Total Zone Lengths		
Train Type	Speeds (mph)		Reduction to RedCon^	RedCon^ to Stop	RedCon^ to Stop		Reduction to RedCon^	RedCon^ to Stop	Reduction to RedCon^	RedCon^ to Stop	Reduction to RedCon^	RedCon^ to Stop	Full Speed to Stop
Freight	25	1028	1028	0	0.668		65	0	1429	0	3356	0	3356
	40	4097	2050	2068	0.668		21	77	462	1692	2451	3760	6251
	50	5965	3898	2068	0.668		43	77	945	1692	4843	3760	8603
Passenger	40	1732	1732	0	1.293		55	0	1219	0	2951	0	2951
	60	3597	3597	0	1.293		78	0	1719	0	5316	0	5316
	79	5986	3598	2388	1.293		92	68	695	1499	4261	3896	8179
	105	10228	7831	2398	1.293		61	68	1344	1499	9175	3896	13071
Fn RedU Consp	35	1370	NA	NA	1.293								

^Note: RedCon refers to the speed at which collision consequences will be significantly reduced
60 mph for passenger trains and 35 mph for freight trains
If train speed is lower that this speed, then there are no reduced consequences and Zone A2 has zero length

Blue cells contain data imported from the Inputs worksheet

Sight Distance (ft): 2500

Table 1.2: Segment Definitions: Springfield Sub-Corridor: MP 124.0 (Bloomington) - MP 181.0 (Hulpetp)

Segment Number	Start (MP)	End (MP)	Type	Variant	Length Miles	Length Feet	Posted Speed (mph) Freight	Pass	HS Pass	Representative Speed (mph) Freight	Pass	HS Pass	HS Pass (Consv)*	HS Pass (Other)	Industry Siding Number	Name	Stops	Passenger Stops
25	32.0	124.0	124.0	CP Adjacent (M)	1.0	5555.2	25.0	40.0	40.0	25.0	40.0	40.0	40.0	40.0		Bloom Yard		
27	33.0	126.5	126.5	Diamond	0.0	0.0	25.0	40.0	40.0	25.0	40.0	40.0	40.0	40.0				
29	34.0	126.5	126.5	CP Adjacent (M)	2.3	13332.0	50.0	50.0	50.0	25.0	50.0	50.0	50.0	79.0				
29	35.0	128.8	131.0	Plain	2.2	11616.0	60.0	79.0	90.0	50.0	79.0	79.0	79.0	79.0				
31	37.0	131.2	133.1	Plain	1.9	10032.0	60.0	79.0	90.0	50.0	79.0	79.0	79.0	105.0				
31	37.0	133.1	136.0	Plain	2.9	15296.4	60.0	79.0	110.0	50.0	79.0	79.0	79.0	105.0				
33	38.0	136.0	136.5	CP Adjacent (M)	0.5	2184.0	60.0	79.0	110.0	50.0	79.0	79.0	79.0	105.0				
33	38.0	136.5	141.1	McLean (Split)	4.7	24807.6	60.0	79.0	110.0	50.0	79.0	79.0	79.0	105.0	1.0	McLean		
35	39.0	141.1	144.4	CP Adjacent (M)	3.3	17402.4	60.0	79.0	110.0	50.0	79.0	79.0	79.0	105.0				
36	41.0	144.4	148.1	Plain	3.7	19536.0	60.0	79.0	110.0	50.0	79.0	79.0	79.0	105.0	2.0	Rohlfser Allerton		
37	42.0	148.1	153.5	Plain	5.4	28483.2	60.0	79.0	110.0	50.0	79.0	79.0	79.0	105.0	2.0	Kincaid		
37	43.0	153.5	155.6	CP Adjacent (U)	2.1	11278.5	60.0	79.0	110.0	50.0	79.0	79.0	79.0	105.0		Assmar		
38	44.0	155.6	155.6	Siding (Stag)	0.0	0.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0				
38	45.0	155.6	155.6	Siding (Stag)	0.0	0.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0				
39	45.0	155.6	157.1	Diamond	0.0	0.0	25.0	40.0	40.0	25.0	40.0	40.0	40.0	40.0				
40	46.0	157.1	157.3	CP Adjacent (U)	0.3	1584.0	60.0	79.0	110.0	50.0	79.0	79.0	79.0	105.0	2.0	Pawnee (W)	Lincoln (E)	
40	47.0	157.3	162.4	Plain	5.1	27151.2	60.0	79.0	110.0	50.0	79.0	79.0	79.0	105.0				
42	48.0	162.4	164.1	Plain	1.8	9676.8	60.0	79.0	110.0	50.0	79.0	79.0	79.0	105.0				
42	49.0	164.1	164.2	Plain	0.1	528.0	60.0	79.0	110.0	50.0	79.0	79.0	79.0	105.0				
43	50.0	164.2	166.2	CP Adjacent (U)	2.0	10193.4	60.0	79.0	110.0	50.0	79.0	79.0	79.0	105.0				
43	51.0	166.2	168.3	CP Adjacent (U)	2.1	11616.0	60.0	79.0	110.0	50.0	79.0	79.0	79.0	105.0	1.0	Walnut Grove		
44	52.0	168.3	170.3	Siding (U)	2.1	10978.5	60.0	79.0	110.0	50.0	79.0	79.0	79.0	105.0				
44	53.0	170.4	172.7	CP Adjacent (U)	2.3	12043.2	60.0	79.0	110.0	50.0	79.0	79.0	79.0	105.0				
46	54.0	172.3	175.0	Plain	3.5	18660.0	60.0	79.0	110.0	50.0	79.0	79.0	79.0	105.0				
46	55.0	175.0	176.9	Plain	1.7	10272.0	60.0	79.0	110.0	50.0	79.0	79.0	79.0	79.0				
Nd	56.0	176.9	181.0	CP Adjacent (M)	1.9	7920.0	60.0	79.0	110.0	50.0	79.0	79.0	79.0	79.0				
				Check Total	96.1													

*This speed is used to calculate collision consequences in collisions between an equipped and an unequipped train (CRA.Y, reflecting the IDOT PTC speed restriction when an equipped train nears an unequipped train

Table 1.3: Mitigation and Prevention Zones - All Segments - Length in Feet

Zone A1: Limited Speed Reduction No Prevention or Mitigation			Zone A2: Reduced Speed to Stop Severity Mitigation			Zone B: Able to Stop Full Prevention			Overlap of Stopping Distance Into Zone C			Distance in Timeout in Zone C			Overlap of Zone A1 into Zone C			Overlap of Zone A1 into Zone C within Sight Distance			Overlap of Zone A2 into Zone C within Sight Distance			Overlap of Zone A2 into Zone C within Sight Distance		
Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass
3356	2951	2951	0	0	0	5303	5708	5708	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3356	5316	4283	0	0	3896	8576	6617	3754	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4843	4283	4283	3896	3896	3896	2877	3437	3437	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4843	4283	9175	3896	3896	3896	5834	6394	1592	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4843	4283	9175	3760	3896	3896	8188	8612	3720	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4843	4283	9124	3896	3896	0	195	356	0	0	0	0	3936	0	0	0	1540	0	40	0	0	0	2460	0	0	0	0
4843	4283	9175	3896	3896	3896	5358	5619	1027	0	0	0	0	0	0	0	0	0	0	0	0	0	2667	0	0	0	0
4843	4283	9175	3896	3896	3896	3085	3645	0	0	2247	0	0	0	0	0	1540	0	0	0	0	0	2247	0	0	0	0
4843	5316	4283	0	0	3896	21203	20820	17957	0	0	0	0	0	0	0	0	0	0	0	0	0	4.95	0	4.95	0	0
4843	4283	9175	3760	3896	3896	5306	5498	574	0	0	0	0	0	0	0	0	0	0	0	0	0	2.66	0	0	0	2.66
4843	4283	9175	3896	3896	3896	4999	5549	657	0	0	0	0	0	0	0	0	0	0	0	0	0	2.8	0	0	0	2.8
4843	5316	4283	0	0	3896	5770	5297	2434	0	0	0	0	0	0	0	0	0	0	0	0	0	2.01	0	2.01	0	0
4843	5316	4283	3760	0	3896	320	3608	148	0	0	0	0	0	0	0	0	0	0	0	0	0	1.68	0	1.68	0	1.68
4843	4283	4283	3760	3896	3896	6126	6552	6552	0	0	0	0	0	0	0	0	0	0	0	0	0	2.79	0	0	0	2.79
4843	4283	9175	3760	3896	1702	2274	2698	0	0	0	0	2194	0	0	1540	0	0	0	0	0	2194	0	2.06	0	0	2.06
4843	4283	9175	3760	3896	3760	2274	2698	0	0	0	0	2194	0	0	1540	0	0	0	0	0	2194	0	2.06	0	0	2.06
4843	4283	9175	3760	3896	2010	2685	3012	0	0	0	0	1877	0	0	1540	0	0	0	0	0	1877	0	2.12	0	0	2.12
4843	4283	9175	3760	3896	2332	2906	3032	0	0	0	0	1968	0	0	1540	0	0	0	0	0	1960	0	2.18	0	0	2.18
4843	4283	9175	3760	3896	1702	2274	2698	0	0	0	0	2194	0	0	1540	0	0	0	0	0	2194	0	2.06	0	0	2.06
4843	4283	9175	3760	3896	1960	1607	2004	0	0	2628	0	0	0	0	0	1540	0	0	0	0	2500	0	1.94	0	0	1.94
4843	4283	9175	3760	3896	3896	9677	10301	5408	0	0	0	0	0	0	0	0	0	0	0	0	0	3.5	0	3.5	0	3.5
4843	4283	4283	3760	3896	3896	10669	11093	11093	0	0	0	0	0	0	0	0	0	0	0	0	0	3.65	0	3.65	0	3.65
4843	4283	4283	3077	3637	3637	0	0	0	683	259	259	683	259	259	0	0	0	0	0	0	683	259	259	0	0	0

Yellow cells contain data exported to the next worksheet in the sequence of three sheets that perform the calculations for one sub-corridor, season and operating plan.

Table 1.4: Breakdown of Segments Lengths by Representative Speed (miles)

Segment Number	Freight Speeds (mph) 25	40	50	60	79	Consert'l Pass Speeds (mph) 40	60	79	105	HS Pass, Speeds - Cnsl'n Consrvs. (mph) 40	60	79	105	HS Pass, Speeds - Other (mph) 40	60	79	105
25	0	1.64	0	0	1.64	0	0	1.64	0	0	0	1.64	0	0	0	1.64	0
27																	
29	0	2.26	0	0	2.26	0	0	2.26	0	0	0	2.26	0	0	0	2.26	0
29	0	0	2.2	0	0	2.2	0	0	2.2	0	0	0	2.2	0	0	0	2.2
31	0	0	2.78	0	0	2.78	0	0	2.78	0	0	0	2.78	0	0	0	2.78
31	0	0	3.18	0	0	3.18	0	0	3.18	0	0	0	3.18	0	0	0	3.18
33	0	0	0.73	0	0	0.73	0	0	0.73	0	0	0	0.73	0	0	0	0.73
33	0	0	2.67	0	0	2.67	0	0	2.67	0	0	0	2.67	0	0	0	2.67
35	0	0	2.045	0	0	2.045	0	0	2.045	0	0	0	2.045	0	0	0	2.045
36	0	4.95	0	4.95	0	0	4.95	0	0	0	4.95	0	0	0	4.95	0	0
37	0	2.66	0	0	2.66	0	0	2.66	0	0	0	2.66	0	0	0	2.66	0
37	0	2.8	0	0	2.8	0	0	2.8	0	0	0	2.8	0	0	0	2.8	0
38	0	2.01	0	0	2.01	0	0	2.01	0	0	0	2.01	0	0	0	2.01	0
38																	
39																	
40	0	1.68	0	0	1.68	0	0	1.68	0	0	0	1.68	0	0	0	1.68	0
40	0	2.79	0	0	2.79	0	0	2.79	0	0	0	2.79	0	0	0	2.79	0
42	0	2.06	0	0	2.06	0	0	2.06	0	0	0	2.06	0	0	0	2.06	0
42	0	0.05	0	0	0.05	0	0	0.05	0	0	0	0.05	0	0	0	0.05	0
43	0	2.12	0	0	2.12	0	0	2.12	0	0	0	2.12	0	0	0	2.12	0
43	0	2.18	0	0	2.18	0	0	2.18	0	0	0	2.18	0	0	0	2.18	0
44	0	2.06	0	0	2.06	0	0	2.06	0	0	0	2.06	0	0	0	2.06	0
44	0	2.12	0	0	2.12	0	0	2.12	0	0	0	2.12	0	0	0	2.12	0
46	0	3.5	0	0	3.5	0	0	3.5	0	0	0	3.5	0	0	0	3.5	0
46	0	1.7	0	0	1.7	0	0	1.7	0	0	0	1.7	0	0	0	1.7	0
Nd	0	1.5	0	0	1.5	0	0	1.5	0	0	0	1.5	0	0	0	1.5	0

Worksheet 2 - Sp,N,R: Collision Frequencies Calculation - PTC 120 Sec. Timeout Case, Springfield Sub-corridor PTC Normal Operating State, Rest of Year

Table 2.1a: Collision Distribution Matrix (Fraction Accidents by Train Pair and Collision Type). Collisions Between Trains Operating on the IDOT Test Corridor Only (Not diamonds and intrusions)

Train Pairs in Collision		Collision Scenario Prob (Top Level)	Siding - Monitored				Siding - Unmonitored				CP Adjacent - Monitored Siding				CP Adjacent - Unmonitored Siding				Plain Track			
			Collision Distribution		Head On		Rear End/Side		Collision Distribution		Head On		Rear End/Side		Collision Distribution		Head On		Rear End/Side		Collision Distribution		Head On	
			Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty
Percent Guilty					100%	0%	100%	0%	100%	0%	100%	0%			100%	0%	100%	0%			100%	0%	100%	0%
Both Trains TBE	Pass-Pass	0.62	0.50	0.50	0.31	0	0.31	0	0.5	0.5	0.31	0	0.31	0	0.8	0.2	0.496	0	0.124	0	0.8	0.2	0.496	0
	Pass-TBE Freight	0.12	0.50	0.50	0.06	0	0.06	0	0.5	0.5	0.06	0	0.06	0	0.7	0.3	0.084	0	0.036	0	0.7	0.3	0.084	0
(Note 3)	TBE Freight - TBE Freight	0.00	0.50	0.50	0	0	0	0	0.5	0.5	0	0	0	0	0.7	0.3	0	0	0	0	0	0	0	0
Percent Guilty					50%	50%	50%	50%			50%	50%	50%	50%			50%	50%	50%	50%			50%	50%
One Train TBE	Pass - NE Freight, Head -On	0.18	1	0	0.045	0.045	0	0	1	0	0.045	0.045	0	0	1	0	0.072	0.072	0	0	1.00	0.00	0.063	0.063
	Rear/Side, Pass into NE Frt		0	1	0	0	0.072	0	0	1	0	0	0.072	0	0	1	0	0	0.027	0	0.00	1.00	0	0
	Rear/Side NE Frt into Pass		0	1	0	0	0	0.018	0	1	0	0	0	0.009	0	1	0	0	0	0.009	0.00	1.00	0	0
	TBE Freight - NE Freight	0.05	0.5	0.5	0.0125	0.0125	0.0125	0.0125	0.5	0.5	0.0125	0.0125	0.0125	0.0125	0.7	0.3	0.0175	0.0175	0.0075	0.0075	0.50	0.50	0.0125	0.0125
Percent Guilty					0%	100%	0%	100%			0%	100%	0%	100%			0%	100%	0%	100%			0%	100%
Neither Train TBE	NE Freight - NE Freight	0.03	0.5	0.5	0	0.015	0	0.015	0.5	0.5	0	0.015	0	0.015	0.7	0.3	0	0.021	0	0.009	0.7	0.3	0	0.021
	Total Probability (checking)	1	1		0.4275	0.0725	0.4545	0.0455		1	0.4275	0.0725	0.4545	0.0455		1	0.6695	0.1105	0.1945	0.0255		1	0.6695	0.1105

Train Pairs in Collision	Train Pair Type
Percent Guilty	
Pass-Pass	**Both Trains TBE**
Pass-TBE Freight	
TBE Freight - TBE Freight	
Percent Guilty	**One Train TBE**
Pass - NE Freight, Head -On	
Rear/Side, Pass into NE Frt	
Rear/Side NE Frt into Pass	
TBE Freight - NE Freight	
Percent Guilty	**Neither Train TBE**
NE Freight - NE Freight	
Total Probability (checking)	

Diamond Collisions		Plain Track			
		Head On		Rear End/Side	
Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty
		0.434	0	0.186	0
		0.048	0	0.072	0
		0	0	0	0
50%	50%				
0	0	0.063	0.063	0	0
0.25	0.25	0	0	0.045	0
0.05	0.05	0	0	0	0.009
0.1	0.1				
	1.00%				
0	0.2				

Note: The gray cells on these rows are set at zero, because in every case, the condition represented by the cell does not exist - either because there are no unequipped passenger trains, or because of the kind of collision

Quarterly in cell C18 is for all collisions between a passenger train and an unequipped freight train

Table 2.2: Preventability Data For Unequipped train Guilty, One Train TBE

Segment Type	Not Prevented of Mitigated			Mitigated			Prevented		
	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass
Siding (M)	0.326	0.289	0.618	0.263	0.263	0.263	0.461	0.499	0.169
Siding (U)	#########!	0.424	0.595	0.166	0.172	0.291	0.456	0.453	0.164
CP Adjacent (M)	0.416	0.414	0.585	0.218	0.228	0.220	0.415	0.410	0.245
CP Adjacent (U)	0.414	0.389	0.680	0.325	0.250	0.280	0.311	0.411	0.089
Plain Track	0.120	0.119	0.169	0.000	0.000	0.024	0.100	0.100	0.076
Diamonds	0.276	0.296	0.296	0.098	0.000	0.170	0.676	0.754	0.584

Mauve cells contain data imported from previous worksheet in a group of three worksheets covering one sub-corridor, season and operating

Table 2.3a: Collision Preventability Matrix (Percent Accidents Preventable Relative to CTC Reference Case)

Train Pairs in Collision		Preventability Equipped Train Guilty	Siding - Monitored				Siding - Unmonitored				CP Adjacent - Monitored Siding				CP Adjacent - Unmonitored Siding				Plain Track			
					Head On		Rear End/Side				Head On		Rear End/Side				Head On		Rear End/Side		Collision Distribution		Head On	
					Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty
Both TBE	Pass-Pass	90%			90%		90%				90%		90%				90%		90%				90%	
	Pass-TBE Freight	90%			90%		90%				90%		90%				90%		90%				90%	
	TBE Freight - TBE Freight	90%			90%		90%				90%		90%				90%		90%				90%	
One TBE	Pass - NE Freight, Head -On	90%			90%	17%					90%	16%					90%	25%					90%	9%
	Rear/Side, Pass into NE Frt	90%					90%	17%					90%	16%					90%	25%				
	Rear/Side NE Frt into Pass	90%					90%	0%					90%	0%					90%	0%				
	TBE Freight - NE Freight	90%			90%	46%	90%	0%			90%	46%	90%	0%			90%	42%	90%	0%			90%	31%
Neither TBE	NE Freight - NE Freight					0%		0%				0%		0%				0%		0%				0%
Reference Case (CTC) Collision Accident Likelihood by Segment Type (collisions/million train miles)		0.030							0.040						0.050						0.060			

Diamond Collisions		Plain Track			
		Head On		Rear End/Side	
Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty
		0.0000	0.0003		
		0.0000	0.0005		
		0.0000	0.0001		
		0.0000	0.0000		
		0.0000	0.0000		
		0.0000	0.0000

Worksheet 3 - Sp,N,R: - Risk Calculations - PTC 120 Sec. Timeout Case, Springfield Subcorridor, Normal Operating State, Rest of Year

Table 3.1: Consequences Look-up Tables (Data Sources: Previous ICF Passenger Corridor Project (passenger), FRA Accident Data 2001-5 (freight)

Passenger Trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 40 mph Injuries	Fatalities	Damage $	Representative Speed 60 mph Injuries	Fatalities	Damage $	Representative Speed 79 mph Injuries	Fatalities	Damage $	Representative Speed 105 mph Injuries	Fatalities	Damage $
	Train-Train Collision	Pass Loco hits Loco	0.085	0.002	353000	0.139	0.0040	1142000	0.24	0.0065	1676000	0.425	0.016	3495000
		Pass Loco hits Pass Car	0.034	0.001	251000	0.056	0.0020	571000	0.097	0.0045	989000	0.171	0.008	1747000
		Pass Loco hits Frt Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	989000	0.171	0.008	1747000
		Pass car hit by Loco	0.196	0.005	1505000	0.275	0.0110	2264000	0.474	0.0200	3951000	0.841	0.032	6948000
	Intrusion Collision (rollout)	Pass Loco hits Car	0.013	0.0035	113000	0.031	0.0011	257000	0.054	0.0019	445000	0.096	0.0034	786000
	Intrusion Collision (other))	Pass Loco hits Car	0.026	0.0069	226000	0.063	0.0022	514000	0.108	0.0038	889000	0.191	0.0068	1573000
	Overspeed		0.044	0.0004	667000	0.14	0.00186	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Broken Rail		0.044	0.0004	667000	0.14	0.00186	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Work Zone Violation		0.083	0.0083	0	0.125	0.0125	0	0.164	0.0164	0	0.218	0.0218	0

Freight trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 25 mph Injuries	Fatalities	Damage $	Representative Speed 40 mph Injuries	Fatalities	Damage $	Representative Speed 50 mph Injuries	Fatalities	Damage $
	Train-Train Collision	Frt Loco hits Loco	0.43	0.043	305000	1.1	0.11	270000	1.7	0.17	422000
		Frt Loco hits Car	0.35	0.035	89000	2.9	0.09	225000	1.4	0.14	352000
		Frt car hit by Loco	0	0	44000	0	0	112000	0	0	176000
	Intrusion Collrn equip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Collrn equip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Collrn Unequip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Collrn Unequip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Overspeed, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Overspeed, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Work Zone Violtn, Equip		0.042	0.0042	0	0.068	0.0068	0	0.083	0.0083	0
	Work Zone Violtn, Unequip		0.042	0.0042	0	0.068	0.0068	0	0.083	0.0083	0

Casualties and damage in Table 3.1 are per accident, except for Work Zone Violations which are per million train-miles

Table 3.2: Grade Crossing and Diamonds: Numbers by Speed, Accident Frequency and Consequences

Train Type	Representative Speed (mph)	Type of Grade-crossing	Number Crossings Passenger	HS Passenger	Freight	Accident Frequency Per Million Crossing Passes Passenger	Freight	Crossing Collision Consequences Pass. Occupt Casualty Probliaccident) Injuries	Fatalities	Cost $/Accid't	Freight Trains (per accident) Injuries	Fatalities	Cost $	Number Diamonds
Passenger	40	Public_gates_lights	0	0		0.200		0.0023	0.000047	5600				2
		Public_other	0	0		0.300								
		Private	0	0		0.100								
	60	Public_gates_lights	14	0		0.600		0.0068	0.000112	113000				0
		Public_other	0	0		0.500								
		Private	0	0		0.200								
	79	Public_gates_lights	15	0		0.800		0.0405	0.000156	196000				0
		Public_other	5	1		0.650								
		Private	5	1		0.300								
	105	Public_gates_lights	0	13		1.100		0.0186	0.000276	346000				0
		Public_other	0	4		0.800								
		Private	0	4		0.300								
Freight	25	Public_gates_lights			3		0.150				0.12	0.005	20000	0
		Public_other			0		0.120							
		Private			0		0.050							
	40	Public_gates_lights			0		0.300				0.25	0.013	50000	2
		Public_other			0		0.250							
		Private			0		0.120							
	50	Public_gates_lights			26		0.360				0.39	0.02	78000	0
		Public_other			5		0.300							
		Private			5		0.120							

Table 3.3a: Segment Data (for reference only, not used in calculations)

Segment Number	Start (Milepost)	End (Milepost)	Type	Length (miles)	Freight	Representative Speed (mph) Pass	HS Pass-cons	HS Pass
000	124.85	126.5	CP Adjacent (M	1.64	25	40	40	40
33	126.5	126.5	Diamond	0	25	40	40	40
34	126.5	128.76	CP Adjacent (M	2.26	25	60	60	79
35	128.76	130.98	Plain	2.2	50	79	79	79
36	130.98	133.72	Plain	2.76	50	79	79	105
37	133.72	136.9	Plain	3.18	50	79	79	105
38	136.9	138.63	CP Adjacent (M	1.73	50	79	79	105
39	138.63	140.3	Siding (M)	1.67	50	79	79	105
40	140.3	143.35	CP Adjacent (M	2.05	50	79	79	105
41	143.35	146.3	Plain	4.95	50	60	79	79
42	146.3	150.96	Plain	2.66	50	79	79	105
43	150.96	153.56	CP Adjacent (U	2.6	50	79	79	105
44	153.56	155.57	Siding (U)	2.01	50	60	60	79
45	155.57	155.57	Diamond	0	40	40	40	40
46	155.57	157.26	CP Adjacent (U	1.69	50	60	60	79
47	157.26	160.05	Plain	2.79	50	79	79	79
48	160.05	162.11	Plain	2.06	50	79	79	105
49	162.11	164.04	Plain	1.93	50	79	79	105
50	164.04	166.16	Plain	2.12	50	79	79	105
51	166.16	168.34	CP Adjacent (U	2.18	50	79	79	105
52	168.34	170.4	Siding (U)	2.06	50	79	79	105
53	170.4	172.34	CP Adjacent (U	1.94	50	79	79	105
54	172.34	175.84	Plain	3.5	50	79	79	105
55	175.84	179.49	Plain	3.65	50	79	79	79
56	179.49	180.99	CP Adjacent (M	1.5	50	79	79	79

Table 3.3b: Aggregate Segment Data: SegmentsTypes, Train Types, Speeds, and Lengths

Aggregate Segment Length by Type and Speed Band (from Seg Def and Preventability)

Segment Type	Train Type	Represent've Speed (mph)	Freight (miles)	Reg Pass (miles)	HS Pass Collision (mi)	HS Pass Other (mi)
Siding (mon)	Freight	25	0			
		40	0			
		50	2.67			
	Passenger	40		0	0	0
		60		0	0	0
		79		2.67	2.67	0
		105		0	0	2.67
Siding (unmon)	Freight	25	0			
		40	0			
		50	4.07			
	Passenger	40		0	0	0
		60		2.01	2.01	0
		79		2.06	2.06	2.01
		105		0	0	2.06
CP Adjacent (mon)	Freight	25	3.9			
		40	0			
		50	5.28			
	Passenger	40		1.64	1.64	1.64
		60		2.26	2.26	0
		79		5.28	5.28	3.76
		105		0	0	3.78
CP Adjacent (unmon)	Freight	25	0			
		40	0			
		50	8.41			
	Passenger	40		0	0	0
		60		1.69	1.69	0
		79		6.72	6.72	1.69
		105		0	0	6.72
Plain Track	Freight	25	0			
		40	0			
		50	31.8			
	Passenger	40		0	0	0
		60		4.95	2.76	0
		79		26.85	29.04	13.59
		105		0	0	18.21
Totals All Types	Freight	25	3.9			
		40	0			
		50	52.23			
	Passenger	40		1.64	1.64	1.64
		60		10.91	8.72	0
		79		43.58	45.77	21.05
		105		0	0	33.44
	Check Totals		56.13	56.13	56.13	56.13

Table 3.4a: Traffic Inputs to Risk Calculation

Train Type	b Summer	Rest of Year
Passenger	6.00	6.00
Equipped Freight	0.86	0.86
Unequipped Freight	2.30	2.30
Operating Days	91	274

Percent Train-Miles in	
Timeout (secs)	120
Normal Operating Mode	94.86
Timeout Mode	0.14
Fallback Mode	5

Passenger Train Occupancy	
Seats	320
Occupancy Factor	0.60

Table 3.4: Collision Frequencies by Segment Type and Collision Scenario (From Coll Matrix)

Scenarios	Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain	Diamond
Pass Loco Hits Loco	0.0033	0.0044	0.0085	0.0108	0.0009	0.000000
Pass Loco Hits Pass Car	0.0009	0.0012	0.0006	0.0007	0.0001	0.000000
Pass Loco Hits Freight Car	0.0004	0.0005	0.0003	0.0003	0.0001	0.008662
Pass Car Hit by Loco	0.0015	0.0020	0.0011	0.0013	0.0002	0.001732
Freight Loco Hits Loco	0.0028	0.0038	0.0068	0.0090	0.0007	0.000000
Freight Loco Hits Car	0.0014	0.0019	0.0014	0.0016	0.0002	0.027970
Freight Car Hit By Loco	0.0012	0.0016	0.0011	0.0014	0.0002	0.030899

Collision Frequency for Passenger + Unequipped Freight Train

Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain
0.0013	0.0017	0.0031	0.0044	0.0004
0.0002	0.0003	0.0001	0.0002	0.0000
0.0005	0.0007	0.0005	0.0005	0.0001

Weighted Collision Accident Frequencies by Representative Speed (mph)

Scenarios	Freight 25	Freight 40	Freight 50	Passenger 40	Passenger 60	Passenger 79	Passenger 105
Pass Loco Hits Loco				0.0085	0.0000	0.0023	0.0025
Pass Loco Hits Pass Car				0.0005	0.0000	0.0001	0.0004
Pass Loco Hits Freight Car				0.0003	0.0000	0.0001	0.0001
Pass Car Hit by Loco				0.0011	0.0000	0.0004	0.0005
Freight Loco Hits Loco	0.0068	0.0000	0.0030				
Freight Loco Hits Car	0.0014	0.0000	0.0008				
Freight Car Hit By Loco	0.0011	0.0000	0.0007				

Mauve cells contain data imported from previous worksheet in a group of three worksheets covering one sub-corridor, season and operating state.

All train-to-train collision frequencies are in units of **trains in collisions per million train miles operated in the sub-corridor by all train types.**

Table 3.5a: Risk Calculation - Passenger Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Freq. (per mill trn)	Preventability	Adjusted Frequency	Trips/day	Trips per 10 years	Length of Track (miles)	Train-miles per 10 years	Accidents per 10 years	Number seats per train	Occupancy Factor	Passengers per Train	Injuries per 10 years	Fatalities per 10 years	Damage $ per 10 years
40	Train-Train Collision	Pass Loco hits Loco	0.00845	Incl	0.00845	9.16	23808	1.64	39046	0.00033	320	0.6	192	0.0053	0.00013	0
		Pass Loco hits Pass Car	0.00062	Incl	0.00062	9.16	23808	1.64	39046	0.00002	320	0.6	192	0.0002	0.00000	0
		Pass Loco hits Frt Car	0.00027	Incl	0.00027	9.16	23808	1.64	39046	0.00001	320	0.6	192	0.0001	0.00000	0
		Pass car hit by Loco	0.00111	Incl	0.00111	9.16	23808	1.64	39046	0.00004	320	0.6	192	0.0014	0.00004	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.03960	0.30	0.00662	6.00	15595	1.64	25576	0.00015	320	0.6	192	0.0004	0.00001	0
	Intrusion Collision (other))	Pass Loco hits intruder	0.01440	0.05	0.01368	6.00	15595	1.64	25576	0.00035	320	0.6	192	0.0017	0.00006	0
	Overspeed		0.01100	0.80	0.00220	6.00	15595	1.64	25576	0.00006	320	0.6	192	0.0005	0.00000	0
	Broken Rail		0.01670	0.04	0.01603	6.00	15595	1.64	25576	0.00041	320	0.6	192	0.0035	0.00003	0
	Work Zone Violation			0.90		6.00	15595	1.64	25576					0.0011	0.00011	0
										0.00138				**0.01400**	**0.00039**	**1**
60	Train-Train Collision	Pass Loco hits Loco	0.00000	Incl	0.00000	9.16	23808	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Pass Car	0.00000	Incl	0.00000	9.16	23808	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Frt Car	0.00000	Incl	0.00000	9.16	23808	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00000	Incl	0.00000	9.16	23808	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00660	0.30	0.00662	6.00	15595	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.05	0.01368	6.00	15595	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Overspeed		0.01100	0.80	0.00220	6.00	15595	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Broken Rail		0.01670	0.04	0.01603	6.00	15595	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Work Zone Violation			0.90		6.00	15595	0	0					0.0000	0.00000	0
										0.00000				**0.00000**	**0.00000**	**0**
79	Train-Train Collision	Pass Loco hits Loco	0.00232	Incl	0.00232	9.16	23808	54.49	1297323	0.00301	320	0.6	192	0.139	0.0049	5952
		Pass Loco hits Pass Car	0.00014	Incl	0.00014	9.16	23808	54.49	1297323	0.00018	320	0.6	192	0.003	0.0002	179
		Pass Loco hits Frt Car	0.00012	Incl	0.00012	9.16	23808	54.49	1297323	0.00016	320	0.6	192	0.003	0.0001	156
		Pass car hit by Loco	0.00041	Incl	0.00041	9.16	23808	54.49	1297323	0.00053	320	0.6	192	0.048	0.0021	2077
	Intrusion Collision (rollout)	Pass Loco hits car	0.00660	0.30	0.00662	6.00	15595	21.05	328276	0.00198	320	0.6	192	0.020	0.0007	879
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.05	0.01368	6.00	15595	21.05	328276	0.00449	320	0.6	192	0.093	0.0033	3992
	Overspeed		0.01100	0.80	0.00220	6.00	15595	21.05	328276	0.00072	320	0.6	192	0.029	0.0005	1878
	Broken Rail		0.01670	0.04	0.01603	6.00	15595	21.05	328276	0.00526	320	0.6	192	0.212	0.0034	13684
	Work Zone Violation			0.90		6.00	15595	21.05	328276					0.027	0.0027	0
										0.01633				**0.57499**	**0.01786**	**26796**
105	Train-Train Collision	Pass Loco hits Loco	0.00254	Incl	0.00254	9.16	23808	33.44	796155	0.00202	320	0.6	192	0.165	0.0060	7054
		Pass Loco hits Pass Car	0.00043	Incl	0.00043	9.16	23808	33.44	796155	0.00034	320	0.6	192	0.011	0.0005	599
		Pass Loco hits Frt Car	0.00009	Incl	0.00009	9.16	23808	33.44	796155	0.00007	320	0.6	192	0.002	0.0001	126
		Pass car hit by Loco	0.00046	Incl	0.00046	9.16	23808	33.44	796155	0.00036	320	0.6	192	0.059	0.0022	2541
	Intrusion Collision (rollout)	Pass Loco hits car	0.00660	0.30	0.00662	6.00	15595	33.44	521499	0.00314	320	0.6	192	0.058	0.0025	2468
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.05	0.01368	6.00	15595	33.44	521499	0.00713	320	0.6	192	0.262	0.0093	11222
	broken Rail		0.01100	0.80	0.00220	6.00	15595	33.44	521499	0.00115	320	0.6	192	0.062	0.0010	5271
	Broken Rail		0.01670	0.04	0.01603	6.00	15595	33.44	521499	0.00836	320	0.6	192	0.449	0.0072	38409
	Work Zone Violation			0.90		6.00	15595	33.44	521499					0.057	0.0057	0
	Total									**0.02258**				**1.12453**	**0.03434**	**67690**
														0.000000	**0.00000**	**0.00000**	**0.00**
	Overall Totals									**0.04029**				**1.71352**	**0.05259**	**96487**
														0.000495	**0.005322**	**0.000158**	**186**
Totals All Speeds		**Train-train Collisions**								**0.00708**				**0.43706**	**0.01653**	**18685**
		Intrusion Collisions								**0.01724**				**0.43523**	**0.01544**	**18561**
		Overspeed								**0.00193**				**0.09127**	**0.00146**	**7148**
		Broken Rail								**0.01403**				**0.66513**	**0.01067**	**52093**
		Work Zone Violation								**0.00000**				**0.08482**	**0.00948**	**0**

Table 3.5b: Risk Calculation - Collisions at Diamonds - Passenger

Number Diamonds	Freq'y per mill passes	Collisions (millions)	Injuries	Fatalities	Damage
2	0.000000	0.000000	0.000000	0.000000	0.00
2	0.000000	0.000000	0.000000	0.000000	0.00
2	0.008662	0.000412	0.002692	0.000079	103.52
2	0.001732	0.000082	0.002629	0.000079	82.90
		0.000495	**0.005322**	**0.000158**	**186.43**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.008662	0.000000	0.000000	0.000000	0.00
0	0.001732	0.000000	0.000000	0.000000	0.00
		0.000000	**0.00000**	**0.00000**	**0.00**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.008662	0.000000	0.000000	0.000000	0.00
0	0.001732	0.000000	0.000000	0.000000	0.00
		0.000000	**0.00000**	**0.00000**	**0.00**

Table 3.6a: Risk Calculation - Freight Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Freq. (per mill trn)	Preventability	Adjusted Frequency	Trips/day	Trips per 10 years	Length of Track (miles)	Train-miles	Per 10 years Accidents	Injuries	Fatalities	Damage $
25	Train-Train Collision	Frt Loco hits Loco	0.006793223	Incl	0.00679	9.16	23808	3.9	92853	0.00063	0.00027	0.000027	$66
		Frt Loco hits Car	0.001357152	Incl	0.00136	9.16	23808	3.9	92853	0.00013	0.00004	0.000004	$11
		Frt car hit by Loco	0.00113221	Incl	0.00113	9.16	23808	3.9	92853	0.00011	0.00000	0.000000	$5
	Intrusion Collrn equip (rollout)	Frt Loco hits Car	0.014	0.30	0.01008	0.86	2235	3.9	8718	0.00009	0.00001	0.000001	$1
	Intrusion Collrn equip (other)	Frt Loco hits Car	0.009	0.05	0.00817	0.86	2235	3.9	8718	0.00007	0.00001	0.000001	$1
	Intrusion Collrn Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	2.30	5978	3.9	23315	0.00034	0.00003	0.000003	$4
	Intrusion Collrn Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	2.30	5978	3.9	23315	0.00020	0.00002	0.000002	$2
	Overspeed, Equip		0.010	0.80	0.00320	0.86	2235	3.9	8718	0.00003	0.00000	0.000000	$4
	Overspeed, Unequip		0.016	0.00	0.01600	2.30	5978	3.9	23315	0.00037	0.00002	0.000002	$56
	Broken Rail, Equip		0.056	0.04	0.05338	0.86	2235	3.9	8718	0.00047	0.00003	0.000003	$70
	Broken Rail, Unequip		0.056	0.00	0.05560	2.30	5978	3.9	23315	0.00130	0.00007	0.000007	$194
	Work Zone Violtn, Equip			0.50		0.86	2235	3.9	8718	0.00018	0.00018	0.000018	$0
	Work Zone Violtn, Unequip			0.00		2.30	5978	3.9	23315	0.00098	0.00098	0.000098	$0
		Totals								**0.0037**	**0.0017**	**0.00017**	**$414**
40	Train-Train Collision	Frt Loco hits Loco	0.0000	Incl	0.00000	9.16	23808	0	0	0.00000	0.00000	0.000000	$0
		Frt Loco hits Car	0.0000	Incl	0.00000	9.16	23808	0	0	0.00000	0.00000	0.000000	$0
		Frt car hit by Loco	0.0000	Incl	0.00000	9.16	23808	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Collrn equip (rollout)	Frt Loco hits Car	0.014	0.30	0.01008	0.86	2235	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Collrn equip (other)	Frt Loco hits Car	0.009	0.05	0.00817	0.86	2235	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Collrn Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	2.30	5978	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Collrn Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	2.30	5978	0	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.010	0.80	0.00320	0.86	2235	0	0	0.00000	0.00000	0.000000	$0
	Overspeed, Unequip		0.016	0.00	0.01600	2.30	5978	0	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.04	0.05338	0.86	2235	0	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Unequip		0.056	0.00	0.05560	2.30	5978	0	0	0.00000	0.00000	0.000000	$0
	Work Zone Violtn, Equip		0.000	0.50		0.86	2235	0	0	0.00000	0.00000	0.000000	$0
	Work Zone Violtn, Unequip			0.00		2.30	5978	0	0	0.00000	0.00000	0.000000	$0
		Totals								**0.00000**	**0.0000**	**0.00000**	**$0**
50	Train-Train Collision	Frt Loco hits Loco	0.0030	Incl	0.00304	9.16	23808	52.23	1243516	0.00377	0.00642	0.000642	$1,593
		Frt Loco hits Car	0.0008	Incl	0.00076	9.16	23808	52.23	1243516	0.00095	0.00133	0.000133	$335
		Frt car hit by Loco	0.0007	Incl	0.00067	9.16	23808	52.23	1243516	0.00083	0.00000	0.000000	$146
	Intrusion Collrn equip (rollout)	Frt Loco hits Car	0.014	0.30	0.01008	0.86	2235	52.23	116749	0.00118	0.00041	0.000041	$52
	Intrusion Collrn equip (other)	Frt Loco hits Car	0.009	0.05	0.00817	0.86	2235	52.23	116749	0.00073	0.00033	0.000033	$42
	Intrusion Collrn Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	2.30	5978	52.23	312237	0.00450	0.00157	0.000157	$198
	Intrusion Collrn Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	2.30	5978	52.23	312237	0.00269	0.00094	0.000094	$118
	Overspeed, Equip		0.010	0.80	0.00320	0.86	2235	52.23	116749	0.00037	0.00013	0.000013	$219
	Overspeed, Unequip		0.016	0.00	0.01600	2.30	5978	52.23	312237	0.00500	0.00175	0.000175	$2,928
	Broken Rail, Equip		0.056	0.04	0.05338	0.86	2235	52.23	116749	0.00623	0.00218	0.000218	$3,652
	Broken Rail, Unequip		0.056	0.00	0.05560	2.30	5978	52.23	312237	0.01736	0.00608	0.000608	$10,173
	Work Zone Violtn, Equip			0.50		0.86	2235	52.23	116749		0.00485	0.000485	$0
	Work Zone Violtn, Unequip			0.00		2.30	5978	52.23	312237		0.02592	0.002592	$0
		Totals								**0.04383**	**0.0519**	**0.00519**	**$19,455**
		Overall Totals								**0.04755**	**0.0536**	**0.0054**	**$19,868**
Totals All Speeds	**Train-Train Collisions**									**0.00642**	**0.00806**	**0.00081**	**2155**
	Intrusion Collisions									**0.01001**	**0.00332**	**0.00033**	**417**
	Diamond Collisions									**0.00280**	**0.00120**	**0.00012**	**464**
	Overspeed									**0.00577**	**0.00190**	**0.00019**	**3207

Worksheet 3 - Sp,N,S: - Risk Calculations - PTC 120 Sec. Timeout Case, Springfield Subcorridor, Normal Operating State, Summer

Table 3.1: Consequences Look-up Tables (Data Sources: Previous ICF Passenger Corridor Project (passenger), FRA Accident Data 2001-5 (freight)

Passenger Trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 40 mph			Representative Speed 60 mph			Representative Speed 79 mph			Representative Speed 105 mph		
			Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Pass Loco hits Loco	0.083	0.002	502000	0.139	0.0049	1142000	0.24	0.0085	1976000	0.425	0.016	3495000
		Pass Loco hits Pass Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.008	1747000
		Pass Loco hits Frt Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.008	1747000
		Pass car hit by Loco	0.166	0.005	1005000	0.275	0.0119	2284000	0.476	0.0206	3951000	0.841	0.032	6989000
	Intrusion Collision (rollout)	Pass Loco hits Car	0.013	0.0005	113000	0.031	0.0011	257000	0.054	0.0019	445000	0.096	0.0034	786000
	Intrusion Collision (other))	Pass Loco hits Car	0.026	0.0009	226000	0.063	0.0022	514000	0.108	0.0038	889000	0.191	0.0068	1573000
	Overspeed		0.044	0.0004	667000	0.14	0.00186	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Broken Rail		0.044	0.0004	667000	0.14	0.00186	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Work Zone Violation		0.083	0.0083	0	0.125	0.0125	0	0.164	0.0164	0	0.218	0.0218	0

Freight trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 25 mph			Representative Speed 40 mph			Representative Speed 50 mph		
			Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Frt Loco hits Loco	0.43	0.043	105000	1.1	0.11	270000	1.7	0.17	422000
		Frt Loco hits Car	0.35	0.035	88000	0.9	0.09	225000	1.4	0.14	352000
		Frt car hit by Loco	0	0	44000	0	0	112000	0	0	176000
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Overspeed, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Overspeed, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Work Zone Viol'n, Equip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0
	Work Zone Viol'n, Unequip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0

Casualties and damage in Table 3.1 are per accident, except for Work Zone Violations which are per million train-miles

Table 3.2: Grade Crossing and Diamonds: Numbers by Speed, Accident Frequency and Consequences

Train Type	Representative Speed (mph)	Type of Grade-crossing	Number Crossings			Accident Frequency Per Million Crossing Passes		Crossing Collision Consequences						Number Diamonds
			Passenger	HS Passenger	Freight	Passenger	Freight	Pass. Injuries	Occup't Casualty Prob Fatalities	Prob/accident) Cost $/Accid't	Freight Trains (per accident) Injuries	Fatalities	Cost $	
Passenger	40	Public_gates_lights	0	0		0.250		0.0028	0.000047	50000				2
		Public_other	0	0		0.300								
		Private	0	0		0.100								
	60	Public_gates_lights	14	0		0.600		0.0068	0.000112	113000				0
		Public_other	0	0		0.500								
		Private	0	0		0.200								
	79	Public_gates_lights	15	16		0.800		0.0105	0.000156	196000				0
		Public_other	5	1		0.650								
		Private	5	1		0.300								
	105	Public_gates_lights	0	13		1.100		0.0186	0.000276	346000				0
		Public_other	0	4		0.800								
		Private	0	4		0.300								
Freight	25	Public_gates_lights			3		0.150				0.12	0.005	20000	0
		Public_other			0		0.120							
		Private			0		0.050							
	40	Public_gates_lights			0		0.300				0.25	0.013	50000	2
		Public_other			0		0.250							
		Private			0		0.100							
	50	Public_gates_lights			26		0.360				0.39	0.02	78000	0
		Public_other			5		0.300							
		Private			5		0.120							

Table 3.3a: Segment Data (for reference only, not used in calculations)

Segment Number	Start (Milepost)	End (Milepost)	Type	Length (miles)	Representative Speed (mph) Freight	Pass	HS Pass-cons	HS Pass
bbb	124.86	126.5	CP Adjacent (M	1.64	25	40	40	40
33	126.5	126.5	Diamond	0	25	40	40	40
34	126.5	128.76	CP Adjacent (M	2.26	25	60	60	79
35	128.76	130.96	Plain	2.2	50	79	79	79
36	130.96	133.72	Plain	2.76	50	79	60	105
37	133.72	136.9	Plain	3.18	50	79	79	105
38	136.9	138.63	CP Adjacent (M	1.73	50	79	79	105
39	138.63	141.3	Siding (M)	2.67	50	79	79	105
40	141.3	143.35	CP Adjacent (M	2.05	50	79	79	105
41	143.35	148.3	Plain	4.95	50	60	79	79
42	148.3	150.96	Plain	2.66	50	79	79	105
43	150.96	153.56	CP Adjacent (U	2.6	50	79	79	105
44	153.56	155.57	Siding (U)	2.01	50	60	60	79
45	155.57	155.57	Diamond	0	40	40	40	40
46	155.57	157.26	CP Adjacent (U	1.69	50	60	60	79
47	157.26	160.05	Plain	2.79	50	79	79	79
48	160.05	162.11	Plain	2.06	50	79	79	105
49	162.11	164.04	Plain	1.93	50	79	79	105
50	164.04	166.16	Plain	2.12	50	79	79	105
51	166.16	168.34	CP Adjacent (U	2.18	50	79	79	105
52	168.34	170.4	Siding (U)	2.06	50	79	79	105
53	170.4	172.34	CP Adjacent (U	1.94	50	79	79	105
54	172.34	175.84	Plain	3.5	50	79	79	105
55	175.84	179.49	Plain	3.65	50	79	79	79
56	179.49	180.99	CP Adjacent (M	1.5	50	79	79	79

Table 3.3b: Aggregate Segment Data: SegmentsTypes, Train Types, Speeds, and Lengths

Aggregate Segment Length by Type and Speed Band (from Seg Def and Preventability)

Segment Type	Train Type	Represent've Speed (mph)	Freight (miles)	Reg Pass (miles)	HS Pass Collision (mi)	HS Pass Other (mi)
Siding (mon)	Freight	25	0			
		40	0			
		50	2.67			
	Passenger	40		0	0	0
		60		0	0	0
		79		2.67	2.67	0
		105		0	0	2.67
Siding (unmon)	Freight	25	0			
		40	0			
		50	4.07			
	Passenger	40		0	0	0
		60		2.01	2.01	0
		79		2.06	2.06	2.01
		105		0	0	2.06
CP Adjacent (mon)	Freight	25	3.9			
		40	0			
		50	5.28			
	Passenger	40		1.64	1.64	1.64
		60		2.26	2.26	0
		79		5.28	5.28	3.76
		105		0	0	3.78
CP Adjacent (unmon)	Freight	25	0			
		40	0			
		50	8.41			
	Passenger	40		0	0	0
		60		1.69	1.69	0
		79		6.72	6.72	1.69
		105		0	0	6.72
Plain Track	Freight	25	0			
		40	0			
		50	31.8			
	Passenger	40		0	0	0
		60		4.95	2.76	0
		79		26.85	29.04	13.59
		105		0	0	18.21
Totals All Types	Freight	25	3.9			
		40	0			
		50	52.23			
	Passenger	40		1.64	1.64	1.64
		60		10.91	8.72	0
		79		43.58	45.77	21.05

Table 3.4a: Traffic Inputs to Risk Calculation

Train Type	Trips/Day Summer	Rest of Year
Passenger	6.00	6.00
Equipped Freight	0.86	0.86
Unequipped Freight	0.87	2.30
Operating Days	91	274

Percent Train-Miles in	
Timeout (secs)	120
Normal Operating Mode	94.86
Timeout Mode	0.14
Fallback Mode	5

Passenger Train Occupancy

bbbbbbbbbbbb

Table 3.4: Collision Frequencies by Segment Type and Collision Scenario (From Coll Matrix)

Scenarios	Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain	Diamond
Pass Loco Hits Loco	0.0030	0.0040	0.0078	0.0095	0.0008	0.000000
Pass Loco Hits Pass Car	0.0012	0.0016	0.0008	0.0010	0.0001	0.000000
Pass Loco Hits Freight Car	0.0002	0.0003	0.0002	0.0002	0.0001	0.008662
Pass Car Hit by Loco	0.0014	0.0019	0.0010	0.0012	0.0002	0.001732
Freight Loco Hits Loco	0.0006	0.0008	0.0014	0.0018	0.0001	0.000000
Freight Loco Hits Car	0.0002	0.0003	0.0002	0.0002	0.0000	0.027970
Freight Car Hit By Loco	0.0002	0.0003	0.0002	0.0002	0.0001	0.030899

Mauve cells contain data imported from Worksheet 2 in this group of three worksheets covering this sub-corridor, season and operating state.

Weighted Collision Accident Frequencies by Representative Speed (mph)

Scenarios	Freight 25	Freight 40	Freight 50	Passenger 40	Passenger 60	Passenger 79	Passenger 105
Pass Loco Hits Loco				0.0078	0.0000	0.0015	0.0033
Pass Loco Hits Pass Car				0.0008	0.0000	0.0002	0.0006
Pass Loco Hits Freight Car				0.0002	0.0000	0.0001	0.0001
Pass Car Hit by Loco				0.0010	0.0000	0.0003	0.0006
Freight Loco Hits Loco	0.0014	0.0000	0.0006				
Freight Loco Hits Car	0.0002	0.0000	0.0001				
Freight Car Hit By Loco	0.0002	0.0000	0.0001				

All train-to-train collision frequencies are in units of **trains in collisions per million train miles operated in the sub-corridor by all train types..**

Collision Frequency for Passenger + Unequipped Freight Train

Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain
0.0003	0.0005	0.0009	0.0012	0.0001
0.0001	0.0001	0.0000	0.0000	0.0000
0.0002	0.0002	0.0001	0.0002	0.0000

Seats	320	
Occupancy Factor	0.60	

Table 3.5a: Risk Calculation - Passenger Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Freq. (per mill tm)	Preventability	Adjusted Frequency	Trips/day	Trips per 10 years	Length of Track (miles)	Train-miles per 10 years	Accidents per 10 years	Number seats per train	Occupancy Factor	Passengers per train	Injuries per 10 years	Fatalities per 10 years	Damage $ per 10 years
											Check Totals	105	56.13	56.13	56.13	56.13
40	Train-Train Collision	Pass Loco hits Loco	0.00777	Incl	0.00777	7.73	6673	1.64	10943	0.00009	320	0.6	192	0.0014	0.00003	0
		Pass Loco hits Pass Car	0.00080	Incl	0.00080	7.73	6673	1.64	10943	0.00001	320	0.6	192	0.0001	0.00000	0
		Pass Loco hits Frt Car	0.00021	Incl	0.00021	7.73	6673	1.64	10943	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00098	Incl	0.00098	7.73	6673	1.64	10943	0.00001	320	0.6	192	0.0003	0.00001	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.30	0.00602	6.00	5179	1.64	8494	0.00005	320	0.6	192	0.0001	0.00000	0
	Intrusion Collision (other))	Pass Loco hits intruder	0.01440	0.05	0.01368	6.00	5179	1.64	8494	0.00012	320	0.6	192	0.0006	0.00002	0
	Overspeed		0.01100	0.80	0.00220	6.00	5179	1.64	8494	0.00002	320	0.6	192	0.0002	0.00000	0
	Broken Rail		0.01670	0.04	0.01603	6.00	5179	1.64	8494	0.00014	320	0.6	192	0.0012	0.00001	0
	Work Zone Violation			0.50		6.00	5179	1.64	8494					0.0004	0.00004	0
										0.00043				**0.00414**	**0.00012**	**0**
60	Train-Train Collision	Pass Loco hits Loco	0.00000	Incl	0.00000	7.73	6673	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Pass Car	0.00000	Incl	0.00000	7.73	6673	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Frt Car	0.00000	Incl	0.00000	7.73	6673	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00000	Incl	0.00000	7.73	6673	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.30	0.00602	6.00	5179	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.05	0.01368	6.00	5179	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Overspeed		0.01100	0.80	0.00220	6.00	5179	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Broken Rail		0.01670	0.04	0.01603	6.00	5179	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Work Zone Violation			0.50		6.00	5179	0	0					0.0000	0.00000	0
										0.00000				**0.00000**	**0.00000**	**0**
79	Train-Train Collision	Pass Loco hits Loco	0.00146	Incl	0.00146	7.73	6673	54.49	363599	0.00053	320	0.6	192	0.024	0.0009	1050
		Pass Loco hits Pass Car	0.00018	Incl	0.00018	7.73	6673	54.49	363599	0.00007	320	0.6	192	0.001	0.0001	65
		Pass Loco hits Frt Car	0.00006	Incl	0.00006	7.73	6673	54.49	363599	0.00002	320	0.6	192	0.000	0.0000	23
		Pass car hit by Loco	0.00026	Incl	0.00026	7.73	6673	54.49	363599	0.00010	320	0.6	192	0.009	0.0004	376
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.30	0.00602	6.00	5179	21.05	109026	0.00066	320	0.6	192	0.007	0.0002	292
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.05	0.01368	6.00	5179	21.05	109026	0.00149	320	0.6	192	0.031	0.0011	1326
	Overspeed		0.01100	0.80	0.00220	6.00	5179	21.05	109026	0.00024	320	0.6	192	0.010	0.0002	624
	Broken Rail		0.01670	0.04	0.01603	6.00	5179	21.05	109026	0.00175	320	0.6	192	0.070	0.0011	4545
	Work Zone Violation			0.50		6.00	5179	21.05	109026					0.009	0.0009	0
										0.00485				**0.16165**	**0.00483**	**8300**
105	Train-Train Collision	Pass Loco hits Loco	0.00326	Incl	0.00326	7.73	6673	33.44	223137	0.00073	320	0.6	192	0.059	0.0022	2545
		Pass Loco hits Pass Car	0.00056	Incl	0.00056	7.73	6673	33.44	223137	0.00012	320	0.6	192	0.004	0.0002	217
		Pass Loco hits Frt Car	0.00011	Incl	0.00011	7.73	6673	33.44	223137	0.00003	320	0.6	192	0.001	0.0000	44
		Pass car hit by Loco	0.00059	Incl	0.00059	7.73	6673	33.44	223137	0.00013	320	0.6	192	0.021	0.0008	917
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.30	0.00602	6.00	5179	33.44	173199	0.00104	320	0.6	192	0.019	0.0007	820
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.05	0.01368	6.00	5179	33.44	173199	0.00237	320	0.6	192	0.087	0.0031	3727
	broken Rail		0.01100	0.80	0.00220	6.00	5179	33.44	173199	0.00038	320	0.6	192	0.020	0.0003	1750
	Broken Rail		0.01670	0.04	0.01603	6.00	5179	33.44	173199	0.00278	320	0.6	192	0.149	0.0024	12756
	Work Zone Violation			0.50		6.00	5179	33.44	173199					0.019	0.0019	0
	Total									**0.00758**				**0.38027**	**0.01166**	**22777**
	Overall Totals									**0.01286**				**0.54606**	**0.01661**	**31077**
	Totals All Speeds	**Train-train Collisions**								**0.00183**				**0.12212**	**0.00464**	**5237**
		Intrusion Collisions								**0.00573**				**0.14455**	**0.00513**	**6165**
		Overspeed								**0.00064**				**0.03031**	**0.00049**	**2374**
		Broken Rail								**0.00466**				**0.22090**	**0.00354**	**17301**
		Work Zone Violation								**0.00000**				**0.02817**	**0.00282**	**0**

Table 3.5b: Risk Calculation - Collisions at Diamonds - Passenger

Number Diamonds	Freq'y per mill passes	Collisions (millions)	Injuries	Fatalities	Damage
2	0.000000	0.000000	0.000000	0.000000	0.00
2	0.000000	0.000000	0.000000	0.000000	0.00
2	0.008662	0.000116	0.000755	0.000022	29.01
2	0.001732	0.000023	0.000737	0.000022	23.23
		0.000139	**0.001491**	**0.000044**	**52.25**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.008662	0.000000	0.000000	0.000000	0.00
0	0.001732	0.000000	0.000000	0.000000	0.00
		0.000000	**0.00000**	**0.00000**	**0.00**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.008662	0.000000	0.000000	0.000000	0.00
0	0.001732	0.000000	0.000000	0.000000	0.00
		0.000000	**0.00000**	**0.00000**	**0.00**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.008662	0.000000	0.000000	0.000000	0.00
0	0.001732	0.000000	0.000000	0.000000	0.00
		0.000000	**0.00000**	**0.00000**	**0.00**

Table 3.6a: Risk Calculation - Freight Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Freq. (per mill tm)	Preventability	Adjusted Frequency	Trips/day	Trips per 10 years	Length of Track (miles)	Per 10 years: Train-miles	Accidents	Injuries	Fatalities	Damage $
25	Train-Train Collision	Frt Loco hits Loco	0.001379234	Incl	0.00138	7.73	6673	3.9	26024	0.00004	0.00002	0.000002	$4
		Frt Loco hits Car	0.000181204	Incl	0.00018	7.73	6673	3.9	26024	0.00000	0.00000	0.000000	$0
		Frt car hit by Loco	0.000206197	Incl	0.00021	7.73	6673	3.9	26024	0.00001	0.00000	0.000000	$0
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.30	0.01008	0.86	742	3.9	2895	0.00003	0.00000	0.000000	$0
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.05	0.00817	0.86	742	3.9	2895	0.00002	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.87	751	3.9	2929	0.00004	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.87	751	3.9	2929	0.00003	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.80	0.00320	0.86	742	3.9	2895	0.00001	0.00000	0.000000	$1
	Overspeed, Unequip		0.016	0.00	0.01600	0.87	751	3.9	2929	0.00005	0.00000	0.000000	$7
	Broken Rail, Equip		0.056	0.04	0.05338	0.86	742	3.9	2895	0.00015	0.00001	0.000001	$23
	Broken Rail, Unequip		0.056	0.00	0.05560	0.87	751	3.9	2929	0.00016	0.00001	0.000001	$24
	Work Zone Viol'n, Equip			0.50		0.86	742	3.9	2895		0.00006	0.000006	$0
	Work Zone Viol'n, Unequip			0.00		0.87	751	3.9	2929		0.00012	0.000012	$0
	Totals									**0.0005**	**0.0002**	**0.00002**	**$62**
40	Train-Train Collision	Frt Loco hits Loco	0.0000	Incl	0.00000	7.73	6673	0	0	0.00000	0.00000	0.000000	$0
		Frt Loco hits Car	0.0000	Incl	0.00000	7.73	6673	0	0	0.00000	0.00000	0.000000	$0
		Frt car hit by Loco	0.0000	Incl	0.00000	7.73	6673	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.30	0.01008	0.86	742	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.05	0.00817	0.86	742	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.87	751	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.87	751	0	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.80	0.00320	0.86	742	0	0	0.00000	0.00000	0.000000	$0
	Overspeed, Unequip		0.016	0.00	0.01600	0.87	751	0	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.04	0.05338	0.86	742	0	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Unequip		0.056	0.00	0.05560	0.87	751	0	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.50		0.86	742	0	0		0.00000	0.000000	$0
	Work Zone Viol'n, Unequip			0.00		0.87	751	0	0		0.00000	0.000000	$0
	Totals									**0.0000**	**0.0000**	**0.00000**	**$0**
50	Train-Train Collision	Frt Loco hits Loco	0.0006	Incl	0.00061	7.73	6673	52.23	348519	0.00021	0.00036	0.000036	$90
		Frt Loco hits Car	0.0001	Incl	0.00010	7.73	6673	52.23	348519	0.00003	0.00005	0.000005	$12
		Frt car hit by Loco	0.0001	Incl	0.00013	7.73	6673	52.23	348519	0.00005	0.00000	0.000000	$8
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.30	0.01008	0.86	742	52.23	38774	0.00039	0.00014	0.000014	$17
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.05	0.00817	0.86	742	52.23	38774	0.00032	0.00011	0.000011	$14
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.87	751	52.23	39225	0.00056	0.00020	0.000020	$25
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.87	751	52.23	39225	0.00034	0.00012	0.000012	$15
	Overspeed, Equip		0.016	0.80	0.00320	0.86	742	52.23	38774	0.00012	0.00004	0.000004	$73
	Overspeed, Unequip		0.016	0.00	0.01600	0.87	751	52.23	39225	0.00063	0.00022	0.000022	$368
	Broken Rail, Equip		0.056	0.04	0.05338	0.86	742	52.23	38774	0.00207	0.00072	0.000072	$1,213
	Broken Rail, Unequip		0.056	0.00	0.05560	0.87	751	52.23	39225	0.00218	0.00076	0.000076	$1,278
	Work Zone Viol'n, Equip			0.50		0.86	742	52.23	38774		0.00161	0.000161	$0
	Work Zone Viol'n, Unequip			0.00		0.87	751	52.23	39225		0.00326	0.000326	$0
	Totals									**0.00691**	**0.0076**	**0.00076**	**$3,112**

Table 3.6b: Risk Calculation - Collisions at Diamonds - Freight

Number Diamonds	Freq'y per mill passes	Collisions (millions)	Injuries	Fatalities	Damage
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.027970	0.000000	0.000000	0.000000	0.00
0	0.030899	0.000000	0.000000	0.000000	0.00
		0.000000	**0.000000**	**0.000000**	**0.00**
2	0.000000	0.000000	0.000000	0.000000	0.00
2	0.027970	0.000373	0.000336	0.000034	83.99
2	0.030899	0.000412	0.000000	0.000000	46.18
		0.000786	**0.000336**	**0.000034**	**130.17**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.027970	0.000000	0.000000	0.000000	0.00
0	0.030899	0.000000	0.000000	0.000000	0.00
		0.000000	**0.000000**	**0.000000**	**0.00**

228		**Overall Totals**									**0.00744**	**0.0078**	**0.0008**	**$3,174**																							
229																																					
230																																					
231	**Totals All Speeds**	**Train-Train Collisions**									**0.00034**	**0.00043**	**0.00004**	**115**																							
232		**Intrusion Collisions**									**0.00173**	**0.00057**	**0.00006**	**72**																							
233		**Diamond Collisions**									**0.00079**	**0.00034**	**0.00003**	**130**																							
234		**Overspeed**									**0.00081**	**0.00027**	**0.00003**	**449**																							
235		**Broken Rail**									**0.00457**	**0.00151**	**0.00015**	**2538**																							
236		**Work Zone Violation**									**0.00000**	**0.00505**	**0.00050**	**0**																							
237		**Grade Crossing Collisions**																																			
238																																					
239																																					
240																																					
241		**Table 3.7: Risk Calculations: Passenger and Freight Trains; Grade Crossings**																																				
242																																					
243	**Train Type**	**Representative Speed**	**Type of Grade-crossing**	**Base Collision Frequency**	**Preventability Factor**	**Adjusted Collision Frequency**	**Trips per Day**	**Crossing Passes per Trip**	**Crossing Passes per 10 Years**	**Collisions per 10 Years**	**Seats per Train (Passenger)**	**Occupancy Factor**	**Passengers per Train**	**Passenger/ Crew Injuries per 10 Years**	**Passenger/ Crew Fatalities per 10 Years**	**Damage per 10 Years ($)**																							
244																																					
245																																					
246	**Passenger**	40	Public_gates_lights	0.35	4%	0.336	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0																						
247			Public_other	0.30	4%	0.288	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0																						
248			Private	0.10	4%	0.096	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0																						
249		60	Public_gates_lights	0.60	4%	0.576	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0																						
250			Public_other	0.50	4%	0.480	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0																						
251			Private	0.20	4%	0.192	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0																						
252		79	Public_gates_lights	0.80	4%	0.768	6.00	16	82870	0.064	320	0.60	192	0.1283	0.0019	12474																						
253			Public_other	0.65	4%	0.624	6.00	1	5179	0.003	320	0.60	192	0.0065	0.0001	633																						
254			Private	0.30	4%	0.288	6.00	1	5179	0.001	320	0.60	192	0.0030	0.0000	292																						
255		105	Public_gates_lights	1.10	4%	1.056	6.00	13	67332	0.071	320	0.60	192	0.2539	0.0038	24601																						
256			Public_other	0.80	4%	0.768	6.00	4	20718	0.016	320	0.60	192	0.0568	0.0008	5505																						
257			Private	0.30	4%	0.288	6.00	4	20718	0.006	320	0.60	192	0.0213	0.0003	2064																						
258	**Freight**	25	Public_gates_lights	0.15	4%	0.144	0.86	3	2227	0.000				0.00004	0.00000	6																						
259	**Equipped**		Public_other	0.12	4%	0.115	0.86	0	0	0.000				0.00000	0.00000	0																						
260			Private	0.05	4%	0.048	0.86	0	0	0.000				0.00000	0.00000	0																						
261		40	Public_gates_lights	0.30	4%	0.288	0.86	0	0	0.000				0.00000	0.00000	0																						
262			Public_other	0.25	4%	0.240	0.86	0	0	0.000				0.00000	0.00000	0																						
263			Private	0.10	4%	0.096	0.86	0	0	0.000				0.00000	0.00000	0																						
264		50	Public_gates_lights	0.36	4%	0.346	0.86	26	19302	0.007				0.00260	0.00013	520																						
265			Public_other	0.30	4%	0.288	0.86	5	3712	0.001				0.00042	0.00002	83																						
266			Private	0.12	4%	0.115	0.86	5	3712	0.000				0.00017	0.00001	33																						
267	**Freight**	25	Public_gates_lights	0.15	0%	0.150	0.87	3	2253	0.000				0.00004	0.00000	7																						
268	**Unequipped**		Public_other	0.12	0%	0.120	0.87	0	0	0.000				0.00000	0.00000	0																						
269			Private	0.05	0%	0.050	0.87	0	0	0.000				0.00000	0.00000	0																						
270		40	Public_gates_lights	0.30	0%	0.300	0.87	0	0	0.000				0.00000	0.00000	0																						
271			Public_other	0.25	0%	0.250	0.87	0	0	0.000				0.00000	0.00000	0																						
272			Private	0.10	0%	0.100	0.87	0	0	0.000				0.00000	0.00000	0																						
273		50	Public_gates_lights	0.36	0%	0.360	0.87	26	19526	0.007				0.00274	0.00014	548																						
274			Public_other	0.30	0%	0.300	0.87	5	3755	0.001				0.00044	0.00002	88																						
275			Private	0.12	0%	0.120	0.87	5	3755	0.000				0.00018	0.00001	35																						
276																																					
277									**Total - Passenger**	**0.161**				**0.470**	**0.007**	**45571**																						
278	Risk Calculations: Passenger and Freight Trains; Diamonds								**Total - Freight**	**0.017**				**0.007**	**0.000**	**1322**																						
279																																					
280	Train Type								**Totals - All Speeds**	**0.179**				**0.48**	**0.01**	**46893**																						
281																																					

Table 3.8: Summary - All Risks

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00183	0.12212	0.00464	5237	31364
	Intrusion Collisions	0.00573	0.14455	0.00513	6165	35999
	Diamond Collisions	0.000139	0.00149	0.00004	52	335
	Overspeed	0.00064	0.03031	0.00049	2374	6864
	Broken Rail	0.00466	0.22090	0.00354	17301	50023
	Work Zone Violation	0.00000	0.02817	0.00282	0	11269
	Grade Crossing Collisions	0.16135	0.46988	0.00697	45571	113484
	Total, All Scenarios	0.17435	1.01743	0.02363	76700	249338
Freight	Train-Train Collisions	0.00034	0.00043	0.00004	115	286
	Intrusion Collisions	0.00173	0.00057	0.00006	72	302
	Diamond Collisions	0.00079	0.00034	0.00003	130	265
	Overspeed	0.00081	0.00027	0.00003	449	555
	Broken Rail	0.00457	0.00151	0.00015	2538	3141
	Work Zone Violation	0.00000	0.00505	0.00050	0	2019
	Grade Crossing Collisions	0.01743	0.00662	0.00034	1322	3000
	Total, All Scenarios	0.02566	0.01478	0.00115	4626	9568
	Total Passenger + Freight	**0.20001**	**1.03221**	**0.02479**	**81326**	**258905**
	Unit Costs ($/Casualty)		100000	3000000		

Data exported to the Results Summary worksheet

Worksheet 1-Sp,T: IDOT-PTC Risk Model: Braking Distances and Collision Zone Calculations, Springfield Sub-corridor, PTC Timeout Operating State

Table 1.1: Stopping Distance Parameters and Calculations, Including Timeout and ACS Response Delay

Braking Formula Inputs		
Train/System Type	Parameter	Value
Freight	Coefficient F	0.035
	AppTr Time (sec)	13.0
	Train Weight (lb)	12500000
	Brake Force (lb)	778650
Passenger	Coefficient A	0.650
	Coefficient B	0
	Safety Factor	1.25
Train Control	Latency/T-out (sec)	3.00
	ACS Response	0
Guilty Train Speed (mph)		110

| Braking Distance Calculations (ft) (including free running in TO) | | |

Worksheet 2 - Sp,T,R: Collision Frequencies Calculation - PTC 120 Sec. Timeout Case, Springfield Sub-corridor, PTC Timeout Operating State, Rest of Year

Table 2.1a: Collision Distribution Matrix (Fraction Accidents by Train Pair and Collision Type). Collisions Between Trains Operating on the IDOT Test Corridor Only (Not diamonds and intrusions)

Train Pairs in Collision	Collision Scenario Prob (Top Level)	Siding - Monitored				Siding - Unmonitored				CP Adjacent - Monitored Siding				CP Adjacent - Unmonitored Siding				Plain Track			
		Collision Distribution		Head On		Collision Distribution		Head On		Collision Distribution		Head On		Collision Distribution		Head On		Collision Distribution		Head On	
		Head On	Rear/Side	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty
Percent Guilty				100%	0%	100%	0%	100%	0%			100%	0%			100%	0%			100%	0%
Both Trains TBE Pass-Pass	0.62	0.50	0.50	0.31	0	0.31	0	0.5	0.5	0.31	0	0.31	0	0.8	0.2	0.496	0	0.124	0	0.8	0.2
Pass-TBE Freight	0.12	0.50	0.50	0.06	0	0.06	0	0.5	0.5	0.06	0	0.06	0	0.7	0.3	0.084	0	0.036	0	0.7	0.3
(Note 3) TBE Freight - TBE Freight	0.00	0.50	0.50	0	0	0	0	0.5	0.5	0	0	0	0	0.7	0.3	0	0	0	0	0	0
Percent Guilty				50%	50%	50%	50%			50%	50%	50%	50%			50%	50%	50%	50%	50%	50%
One Train TBE Pass - NE Freight, Head -On	0.18	1	0	0.045	0.045	0	0	1	0	0.072	0.072	0	0	1	0	0.072	0.072	0	0	0.063	0.063
Rear/Side, Pass into NE Frt		0	1	0	0	0.072	0	0	1	0	0	0.027	0	0	1	0	0	0.027	0	0	0
Rear/Side NE Frt into Pass		0	1	0	0	0	0.018	0	1	0	0	0	0.009	0	1	0	0	0	0.009	0	0
TBE Freight - NE Freight	0.05	0.5	0.5	0.0125	0.0125	0.0125	0.0125	0.5	0.5	0.0125	0.0125	0.0125	0.0125	0.7	0.3	0.0175	0.0175	0.0075	0.0075	0.7	0.3
Percent Guilty				0%	100%	0%	100%			0%	100%	0%	100%			0%	100%	0%	100%	0%	100%
Neither Train TBE NE Freight - NE Freight	0.03	0.5	0.5	0	0.015	0	0.015	0.5	0.5	0	0.015	0	0.015	0.7	0.3	0	0.021	0	0.009	0.7	0.3
Total Probability (checking)	1		1	0.4275	0.0725	0.4545	0.0455		1	0.4275	0.0725	0.4545	0.0455		1	0.6695	0.1105	0.1945	0.0255		1

Train Pairs in Collision	Train Pair Type	Diamond Collisions		Plain Track			
		Rear End/Side		Head On		Rear End/Side	
		Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty
Percent Guilty							
Pass-Pass	**Both Trains TBE**						
Pass-TBE Freight							
TBE Freight - TBE Freight							
Percent Guilty	**One Train TBE**	50%	50%				
Pass - NE Freight, Head -On		0	0				
Rear/Side, Pass into NE Frt		0.25	0.25				
Rear/Side NE Frt into Pass		0.05	0.05				
TBE Freight - NE Freight		0.1	0.1				
Percent Guilty			100%				
NE Freight - NE Freight	**Neither Train TBE**	0	0.2				
Total Probability (checking)		0.4	0.6				

Note: The gray cells on these rows are set at zero, because in every case, the condition represented by the cell does not exist - either because there are no unequipped passenger trains, or because of the kind of collision

Table 2.1b: Collision Type Distribution - Diamonds

Train Pairs in Collision	Train Pair Type	Percent Guilty
Pass-Pass	**Both Trains TBE**	
Pass-TBE Freight		
TBE Freight - TBE Freight		
Percent Guilty	**One Train TBE**	
Pass - NE Freight, Head -On		0
Rear/Side, Pass into NE Frt		0.25
Rear/Side NE Frt into Pass		0.05
TBE Freight - NE Freight		0.1
Percent Guilty		
NE Freight - NE Freight	**Neither Train TBE**	0
Total Probability (checking)		0.4

Quarely in cell C18 is for all collisions between a passenger train and an unequipped freight train

Table 2.2: Preventability Data For Unequipped train Guilty, One Train TBE

Segment Type	Not Prevented of Mitigated			Mitigated			Prevented		
	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass
Siding (M)	0.999	0.960	0.970	0.051	0.048	0.000	0.000	0.041	0.080
Siding (U)	1.050	1.050	1.050	0.000	0.000	0.000	0.000	0.000	0.000
CP Adjacent (M)	0.978	1.038	1.039	0.042	0.000	0.000	0.031	0.012	0.011
CP Adjacent (U)	1.041	1.042	1.050	0.009	0.008	0.000	0.000	0.000	0.000
Plain Track	0.308	0.321	0.340	0.028	0.029	0.007	0.026	0.024	0.027
Diamonds	0.558	0.570	0.643	0.098	0.000	0.170	0.394	0.480	0.237

Mauve cells contain data imported from previous worksheet in a group of three worksheets covering one sub-corridor, season and operating

Table 2.3a: Collision Preventability Matrix (Percent Accidents Preventable Relative to CTC Reference Case)

Train Pairs in Collision	Preventability Equipped Train Guilty	Siding - Monitored				Siding - Unmonitored				CP Adjacent - Monitored Siding				CP Adjacent - Unmonitored Siding				Plain Track			
				Head On				Head On				Head On				Head On				Head On	
				Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty
Both TBE Pass-Pass	90%			90%				90%				90%				90%				90%	
Pass-TBE Freight	90%			90%				90%				90%				90%				90%	
TBE Freight - TBE Freight	90%			90%				90%				90%				90%				90%	
One TBE Pass - NE Freight, Head -On	90%			90%	8%			90%	0%			90%	1%			90%	0%			90%	3%
Rear/Side, Pass into NE Frt	90%																				
Rear/Side NE Frt into Pass	90%																				
TBE Freight - NE Freight	90%			90%	0%			90%	0%			90%	3%			90%	0%			90%	3%
Neither TBE NE Freight - NE Freight					0%				0%				0%				0%				0%

Train Pairs in Collision	Train Pair Type	Diamond Collisions		Plain Track			
		Rear End/Side		Head On		Rear End/Side	
		Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty
Pass-Pass	**Both TBE**						
Pass-TBE Freight							
TBE Freight - TBE Freight							
Pass - NE Freight, Head -On	**One TBE**						
Rear/Side, Pass into NE Frt		0.002500	0.012997				
Rear/Side NE Frt into Pass		0.000500	0.002599				
TBE Freight - NE Freight		0.000000	0.000000				
NE Freight - NE Freight	**Neither TBE**		0.00%				

Reference Case (CTC) Collision Accident Likelihood by Segment Type (collisions/million train miles)	**0.030**					**0.040**				**0.050**				**0.060**				**0.006**			

Collisions/million diamond passes: **0.1**

Table 2.3b: Collision Preventability Matrix - Diamonds

Table 2.4a: Passenger Trains in Accidents (Collisions per Million Train-Miles Operated in Sub-Corridor)

Train Pairs in Collision	Passenger Trains in Collisions	Siding - Monitored				Siding - Unmonitored				CP Adjacent - Monitored Siding				CP Adjacent - Unmonitored Siding				Plain Track			
				Head On				Head On				Head On				Head On				Head On	
				Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty
Both TBE Pass-Pass	2			0.0019				0.0025				0.0050				0.0060				0.0000	
Pass-TBE Freight	1			0.0002				0.0002				0.0004				0.0005				0.0000	
TBE Freight - TBE Freight	0																				
One TBE Pass - NE Freight, Head -On	1			0.0001	0.0012			0.0002	0.0018			0.0004	0.0036			0.0004	0.0043			0.0000	0.0004
Rear/Side, Pass into NE Frt	1																				
Rear/Side NE Frt into Pass	1																				
TBE Freight - NE Freight	0																				
Neither TBE NE Freight - NE Freight	0																				
Checking total				0.0022	0.0012	0.0023	0.0005	0.0029	0.0018	0.0030	0.0007	0.0057	0.0036	0.0016	0.0005	0.0069	0.0043	0.0019	0.0005	0.0006	0.0004
Scenario Totals - Passenger		**Tots, P-UF**	**Totals**						**Totals**				**Totals**				**Totals**				
Pass Loco Hits Loco		0.0014	0.0034	0.0022	0.0012			0.0020	0.0047	0.0029	0.0018			0.0039	0.0093	0.0057	0.0036			0.0048	0.0112
Pass Loco Hits Pass Car			0.0009			0.0009			0.0012			0.0012			0.0006			0.0006			0.0007
Pass Loco Hits Freight Car		0.0002	0.0004			0.0004		0.0003	0.0005			0.0005		0.0001	0.0003			0.0003		0.0002	0.0003
Pass Car Hit by Loco		0.0005	0.0015			0.0010	0.0005	0.0007	0.0020			0.0013	0.0007	0.0005	0.0011			0.0007	0.0005	0.0005	0.0013
Total			0.0062	0.0022	0.0012	0.0023	0.0005		0.0084	0.0029	0.0018	0.0030	0.0007		0.0113	0.0057	0.0036	0.0016	0.0005		0.0136

Train Pairs in Collision	Train Pair Type	Diamond Collisions		Plain Track			
		Rear End/Side		Head On		Rear End/Side	
		Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty
Pass-Pass	**Both TBE**						
Pass-TBE Freight							
TBE Freight - TBE Freight							
Pass - NE Freight, Head -On	**One TBE**						
Rear/Side, Pass into NE Frt		0.002500	0.012997				
Rear/Side NE Frt into Pass		0.000500	0.002599				
TBE Freight - NE Freight		0.000000	0.000000				
NE Freight - NE Freight	**Neither TBE**		0.000000				
		0.00300	0.01560				
Scenario Totals - Passenger				**Totals**			
Pass Loco Hits Loco							
Pass Loco Hits Pass Car							
Pass Loco Hits Freight Car		0.002500	0.012997	0.015497			
Pass Car Hit by Loco		0.000500	0.002599	0.003099			
Total		0.003000	0.015596	0.018596			

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Table 2.5a: Freight trains in Accidents (Collisions per Million Train-Miles Operated in Sub-Corrid

Train Pairs in Collision	Freight Trains in Collisions	Siding - Monitored				Siding - Unmonitored				CP Adjacent - Monitored Siding				CP Adjacent - Unmonitored Siding				Plain Track			
				Head On				Head On				Head On				Head On				Head On	
				Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty
Both TBE Pass-Pass	0																				
Pass-TBE Freight	1			0.0002				0.0002				0.0004				0.0005				0.0000	
TBE Freight - TBE Freight	2			0.0000				0.0000				0.0000				0.0000				0.0000	
One TBE Pass - NE Freight, Head -On	1			0.0001	0.0012			0.0002	0.0018			0.0004	0.0036			0.0004	0.0043			0.0000	0.0004
Rear/Side, Pass into NE Frt	1																				
Rear/Side NE Frt into Pass	1																				
TBE Freight - NE Freight	2			0.0001	0.0008			0.0001	0.0010			0.0002	0.0017			0.0002	0.0021			0.0000	0.0001
Neither TBE NE Freight - NE Freight	2				0.0009				0.0012				0.0021				0.0025				0.0002
Checking total				0.0004	0.0029	0.0005	0.0022	0.0005	0.0040	0.0006	0.0029	0.0010	0.0074	0.0004	0.0021	0.0011	0.0089	0.0005	0.0025	0.0001	0.0007
Scenario Totals - Freight			**Totals**						**Totals**				**Totals**				**Totals**				
Freight Loco Hits Loco		0.0014	0.0033	0.0004	0.0029				0.0045	0.0005	0.0040		0.0083	0.0010	0.0074			0.0103	0.0011	0.0089	
Freight Loco Hits Car		0.0005	0.0014			0.00007	0.00137		0.0019			0.00010	0.00182		0.0014			0.0016			
Freight Car Hit By Loco		0.0002	0.0012	b		0.00040	0.00083		0.0016			0.00053	0.00110		0.0011			0.0014			
Total			0.0059	0.0004	0.0029	0.0005	0.0022		0.0081	0.0005	0.0040	0.0006	0.0029	0.0000	0.0108	0.0010	0.0074	0.0004	0.0021		0.0131
Freight Plus Passenger Totals (check		0.0600	0.0122					0.0800	0.0165					0.1000	0.0221					0.1200	0.0267

Train Pairs in Collision	Train Pair Type	Diamond Collisions		Plain Track			
		Rear End/Side		Head On		Rear End/Side	
		Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty
Pass-Pass	**Both TBE**						
Pass-TBE Freight							
TBE Freight - TBE Freight							
Pass - NE Freight, Head -On	**One TBE**						
Rear/Side, Pass into NE Frt		0.002500	0.012997				
Rear/Side NE Frt into Pass		0.000500	0.002599				
TBE Freight - NE Freight		0.002000	0.012121				
NE Freight - NE Freight	**Neither TBE**		0.040000				
		0.00500	0.06772				
Scenario Totals - Freight				**Totals**			
Freight Loco Hits Loco							
Freight Loco Hits Car		0.003500	0.028660	0.032160			
Freight Car Hit By Loco		0.001500	0.039057	0.040557			
Total		0.005000	0.067717	0.072717			

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Collision Ratios	Siding - Monitored		Siding - Unmonitored		CP Adjacent - Monitored Siding		CP Adjacent - Unmonitored Siding		Plain Track	
Collision Type	Like Trains	Unlike Trains	Like Trains	Unlike Trains	Like Trains	Unlike Trains	Like Trains	Unlike Trains	Like Trains	Unlike Trains
	Loco hits car	car hit by loco	P loco hits F car	F loco hits P car						
Freight to Freight	0.50	0.50			0.50	0.50	0.50	0.50	0.50	0.50
Passenger to Passenger	0.50	0.50			0.50	0.50	0.50	0.50	0.50	0.50
Passenger to Freight			0.8	0.2			0.80	0.20	0.75	0.25

In rear-end/side collisions between like trains there is one loco hits car and one car hit by loco in each collision. In rear/side collisions between a passenger and freight trains, the ratio between passenger hits freight and freight loco hits passenger car are a function of the percentages given in Table IN-5b on the Inputs sheet. The values are given in the tables beneath the trains in collisions for each segment type.

Table 2.5b: Freight Trains in Collisions at Diamond

Train Pairs in Collision	Train Pair Type	Diamond Collisions		Plain Track			
		Rear End/Side		Head On		Rear End/Side	
		Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty
Pass-Pass	**Both TBE**						
Pass-TBE Freight							
TBE Freight - TBE Freight							
Pass - NE Freight, Head -On	**One TBE**						
Rear/Side, Pass into NE Frt		0.002500	0.012997				
Rear/Side NE Frt into Pass		0.000500	0.002599				
TBE Freight - NE Freight		0.000000	0.000000				
NE Freight - NE Freight	**Neither TBE**		0.000000				
		0.00300	0.01560				
Scenario Totals - Freight				**Totals**			
Freight Loco Hits Loco							
Freight Loco Hits Car		0.00001	0.00022	0.00023			
Freight Car Hit By Loco		0.00007	0.00017	0.00024			
Total		0.0001	0.0004	0.0005			

Collision Ratios	Siding - Monitored		Siding - Unmonitored		CP Adjacent - Monitored Siding		CP Adjacent - Unmonitored Siding		Plain Track	
Collision Type	Like Trains	Unlike Trains	Like Trains	Unlike Trains	Like Trains	Unlike Trains	Like Trains	Unlike Trains	Like Trains	Unlike Trains
	Loco hits car	car hit by loco	P loco hits F car	F loco hits P car						
Freight to Freight	0.50	0.50			0.50	0.50	0.50	0.50	0.50	0.50
Passenger to Passenger	0.50	0.50			0.50	0.50	0.50	0.50	0.50	0.50
Passenger to Freight			0.75	0.25			0.75	0.25	0.83	0.17

Worksheet 3-Sp,T,R: - Risk Calculations - PTC Normal Case, Springfield Subcorridor, Timeout Operating State, Rest of Year

Table 3.1: Consequences Look-up Tables (Data Sources: Previous ICF Passenger Corridor Project (passenger), FRA Accident Data 2001-5 (freight)

Passenger Trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 40 mph Injuries	Fatalities	Damage $	Representative Speed 60 mph Injuries	Fatalities	Damage $	Representative Speed 79 mph Injuries	Fatalities	Damage $	Representative Speed 105 mph Injuries	Fatalities	Damage $
	Train-Train Collision	Pass Loco hits Loco	0.080	0.002	302800	0.139	0.0049	1142000	0.24	0.0085	1976800	0.425	0.016	3495000
		Pass Loco hits Pass Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.008	1747000
		Pass Loco hits Frt Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.008	1747000
		Pass car hit by Loco	0.186	0.005	1505000	0.275	0.0119	2284000	0.476	0.0206	3951000	0.841	0.032	6989000
	Intrusion Collision (rollout)	Pass Loco hits Car	0.013	0.0005	113000	0.031	0.0011	257000	0.054	0.0019	445000	0.096	0.0034	786000
	Intrusion Collision (other))	Pass Loco hits Car	0.026	0.0009	226000	0.063	0.0022	514000	0.108	0.0038	889000	0.191	0.0066	1573000
	Overspeed		0.044	0.0004	667000	0.14	0.00188	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Broken Rail		0.044	0.0004	667000	0.14	0.00188	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Work Zone Violation		0.083	0.0093	0	0.125	0.0125	0	0.164	0.0164	0	0.218	0.0218	0

Freight trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 25 mph Injuries	Fatalities	Damage $	Representative Speed 40 mph Injuries	Fatalities	Damage $	Representative Speed 50 mph Injuries	Fatalities	Damage $
	Train-Train Collision	Frt Loco hits Locos	0.45	0.045	105800	1.1	0.11	270000	1.7	0.17	402000
		Frt Loco hits Car	0.35	0.035	88000	0.9	0.09	225000	1.4	0.14	352000
		Frt car hit by Loco	0	0	44000	0	0	112000	0	0	176000
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.090	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.090	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Overspeed, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Overspeed, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Work Zone Viol'n, Equip		0.042	0.0042	0	0.065	0.0066	0	0.083	0.0083	0
	Work Zone Viol'n, Unequip		0.042	0.0042	0	0.065	0.0066	0	0.083	0.0083	0

Casualties and damage in Table 3.1 are per accident, except for Work Zone Violations which are per million train-miles

Table 3.2: Grade Crossing and Diamonds: Numbers by Speed, Accident Frequency and Consequences

Train Type	Representative Speed (mph)	Type of Grade-crossing	Number Crossings Passenger	HS Passenger	Freight	Accident Frequency Per Million Crossing Passes Passenger	Freight	Crossing Collision Consequences Pass. Occup't Casualty Prob/accident Injuries	Fatalities	Cost $/Accid't	Freight Trains (per accident) Injuries	Fatalities	Cost $	Number Diamonds
Passenger	40	Public_gates_lights	0	0		0.250		0.0025	0.000047	15000				2
		Public_other	0	0		0.300								
		Private	0	0		0.100								
	60	Public_gates_lights	14	0		0.400		0.0068	0.000112	113000				0
		Public_other	0	0		0.500								
		Private	0	0		0.200								
	79	Public_gates_lights	15	16		0.800		0.0305	0.000156	196000				0
		Public_other	5	5		0.650								
		Private	5	5		0.300								
	105	Public_gates_lights	0	13		1.100		0.0186	0.000276	346000				0
		Public_other	0	4		0.800								
		Private	0	4		0.300								
Freight	25	Public_gates_lights			3		0.150				0.12	0.005	20000	0
		Public_other			0		0.120							
		Private			0		0.050							
	40	Public_gates_lights			0		0.300				0.25	0.013	50000	2
		Public_other			0		0.250							
		Private			0		0.100							
	50	Public_gates_lights			26		0.360				0.39	0.02	78000	0
		Public_other			5		0.300							
		Private			5		0.120							

Table 3.2a: Segment Data (for reference only, not used in calculations)

Segment Number	Start (Milepost)	End (Milepost)	Type	Length (miles)	Freight	Pass	HS Pass-cons	HS Pass
32	124.85	126.5	CP Adjacent (M)	1.64	25	40	40	40
33	126.5	126.5	Diamond	0	25	40	40	40
34	126.5	128.76	CP Adjacent (M)	2.26	25	60	60	79
35	128.75	130.96	Plain	2.2	50	79	79	79
36	130.96	133.72	Plain	2.76	50	79	60	105
37	133.72	136.9	Plain	3.18	50	79	79	105
38	136.9	138.63	CP Adjacent (M)	1.73	50	79	79	105
39	138.63	141.3	Siding (M)	2.67	50	79	79	105
40	141.3	143.35	CP Adjacent (M)	2.05	50	79	79	105
41	143.35	146.3	Plain	4.95	50	60	79	79
42	148.3	150.96	Plain	2.66	50	79	79	105
43	150.96	153.56	CP Adjacent (U)	2.6	50	79	79	105
44	153.56	155.57	Siding (U)	2.01	50	60	60	79
45	155.57	155.57	Diamond	0	40	40	40	40
46	155.57	157.26	CP Adjacent (U)	1.69	50	60	60	79
47	157.26	160.05	Plain	2.79	50	79	79	79
48	160.05	162.11	Plain	2.06	50	79	79	105
49	162.11	164.04	Plain	1.93	50	79	79	105
50	164.04	166.16	Plain	2.12	50	79	79	105
51	166.16	168.34	CP Adjacent (U)	2.18	50	79	79	105
52	168.34	170.4	Siding (U)	2.06	50	79	79	105
53	170.4	172.34	CP Adjacent (U)	1.94	50	79	79	105
54	172.34	175.84	Plain	3.5	50	79	79	105
55	175.84	179.49	Plain	3.65	50	79	79	79
56	179.49	180.99	CP Adjacent (M)	1.5	50	79	79	79

Table 3.3b: Aggregate Segment Data: Segments Types, Train Types, Speeds, and Lengths

Aggregate Segment Length by Type and Speed Band (from Seg Def and Preventability)

Segment Type	Train Type	Represent've Speed (mph)	Freight (miles)	Reg Pass (miles)	HS Pass Collision (mi)	HS Pass Other (mi)
Siding (mon)	Freight	25	0.00			
		40	0.00			
		50	2.67			
	Passenger	40		0	0	0
		60		0	0	0
		79		2.67	2.67	0
		105		0	0	2.67
Siding (unmon)	Freight	25	0.00			
		40	0.00			
		50	4.07			
	Passenger	40		0	0	0
		60		2.01	2.01	0
		79		2.06	2.06	2.01
		105		0	0	2.06
CP Adjacent (mon)	Freight	25	3.90			
		40	0.00			
		50	5.28			
	Passenger	40		1.64	1.64	1.64
		60		2.26	2.26	0
		79		5.28	5.28	3.76
		105		0	0	3.78
CP Adjacent (unmon)	Freight	25	0.00			
		40	0.00			
		50	8.41			
	Passenger	40		0	0	0
		60		1.69	1.69	0
		79		6.72	6.72	1.69
		105		0	0	6.72
Plain Track	Freight	25	0.00			
		40	0.00			
		50	31.80			
	Passenger	40		0	0	0
		60		4.95	2.76	0
		79		26.85	29.04	13.59
		105		0	0	16.21
Totals All Types	Freight	25	3.90			
		40	0.00			
		50	52.23			
	Passenger	40		1.64	1.64	1.64
		60		10.91	8.72	0.00
		79		43.58	45.77	21.05
		105		0.00	0.00	33.44
Check Totals			56.13	56.13	56.13	56.13

Weighted Collision Accident Frequencies by Representative Speed (mph)

Scenarios	Freight 25	Freight 40	Freight 50	Passenger 40	Passenger 60	Passenger 79	Passenger 105
Pass Loco Hits Loco				0.0093	0.0000	0.0025	0.0025
Pass Loco Hits Pass Car				0.0026	0.0000	0.0001	0.0004
Pass Loco Hits Freight Car				0.0003	0.0000	0.0001	0.0001
Pass Car Hit by Loco				0.0011	0.0000	0.0004	0.0005
Freight Loco Hits Loco	0.0083	0.0000	0.0035				
Freight Loco Hits Car	0.0014	0.0000	0.0008				
Freight Car Hit By Loco	0.0011	0.0000	0.0007				

Table 3.4: Collision Frequencies by Segment Type and Collision Scenario (From Coll Mat'rx)

Scenarios	Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain	Diamond
Pass Loco Hits Loco	0.0034	0.0047	0.0093	0.0112	0.0010	0.000000
Pass Loco Hits Pass Car	0.0009	0.0012	0.0006	0.0007	0.0001	0.000000
Pass Loco Hits Freight Car	0.0004	0.0005	0.0003	0.0003	0.0001	0.015497
Pass Car Hit by Loco	0.0015	0.0020	0.0011	0.0013	0.0002	0.003099
Freight Loco Hits Loco	0.0033	0.0045	0.0083	0.0101	0.0008	0.000000
Freight Loco Hits Car	0.0014	0.0019	0.0014	0.0016	0.0002	0.032160
Freight Car Hit By Loco	0.0012	0.0016	0.0011	0.0014	0.0002	0.040557

Collision Frequencies for Passenger + Unequipped Freight Train

Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain
0.0014	0.0020	0.0039	0.0048	0.0004
0.0002	0.0003	0.0001	0.0002	0.0000
0.0005	0.0007	0.0005	0.0005	0.0001

Mauve cells contain data imported from previous worksheet in a group of three worksheets covering one sub-corridor, season and operating state.

All train-to-train collision frequencies are in units of **trains in collisions per million train miles operated in the sub-corridor by all train types.**

Table 3.5a: Risk Calculation - Passenger Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Freq (per million trn)	Preventability	Adjusted Frequency	Trips/day	Trips per 10 years	Length of Track (miles)	Train-miles per 10 years	Accidents per 10 years	Number seats per train	Occupancy Factor	Passengers per train	Injuries per 10 years	Fatalities per 10 years	Damage $ per 10 years
40	Train-Train Collision	Pass Loco hits Loco	0.00929	Incl	0.00929	9.16	35	1.64	57	0.00000	320	0.6	192	0.00001	0.000000	0
		Pass Loco hits Pass Car	0.00062	Incl	0.00062	9.16	35	1.64	57	0.00000	320	0.6	192	0.00000	0.000000	0
		Pass Loco hits Frt Car	0.00027	Incl	0.00027	9.16	35	1.64	57	0.00000	320	0.6	192	0.00000	0.000000	0
		Pass car hit by Loco	0.00111	Incl	0.00111	9.16	35	1.64	57	0.00000	320	0.6	192	0.00000	0.000000	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00360	0.00	0.00860	6.00	23	1.64	38	0.00000	320	0.6	192	0.00000	0.000000	0
	Intrusion Collision (other))	Pass Loco hits intruder	0.01440	0.00	0.01440	6.00	23	1.64	38	0.00000	320	0.6	192	0.00000	0.000000	0
	Overspeed		0.01100	0.50	0.00550	6.00	23	1.64	38	0.00000	320	0.6	192	0.00000	0.000000	0
	Broken Rail		0.01670	0.00	0.01670	6.00	23	1.64	38	0.00000	320	0.6	192	0.00001	0.000000	0
	Work Zone Violation	Saw	Consequence Tbl	0.25	#VALUE!	6.00	23	1.64	38					0.00000	0.000000	0
										0.00000				**0.00002**	**0.000001**	**0**
60	Train-Train Collision	Pass Loco hits Loco	0.00000	Incl	0.00000	9.16	35	0	0	0.00000	320	0.6	192	0.00000	0.000000	0
		Pass Loco hits Pass Car	0.00000	Incl	0.00000	9.16	35	0	0	0.00000	320	0.6	192	0.00000	0.000000	0
		Pass Loco hits Frt Car	0.00000	Incl	0.00000	9.16	35	0	0	0.00000	320	0.6	192	0.00000	0.000000	0
		Pass car hit by Loco	0.00000	Incl	0.00000	9.16	35	0	0	0.00000	320	0.6	192	0.00000	0.000000	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.00	0.00860	6.00	23	0	0	0.00000	320	0.6	192	0.00000	0.000000	0
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.00	0.01440	6.00	23	0	0	0.00000	320	0.6	192	0.00000	0.000000	0
	Overspeed		0.01100	0.50	0.00550	6.00	23	0	0	0.00000	320	0.6	192	0.00000	0.000000	0
	Broken Rail		0.01670	0.00	0.01670	6.00	23	0	0	0.00000	320	0.6	192	0.00000	0.000000	0
	Work Zone Violation	Saw	Consequence Tbl	0.25	#VALUE!	6.00	23	0	0					0.00000	0.000000	0
										0.00000				**0.00000**	**0.000000**	**0**
79	Train-Train Collision	Pass Loco hits Loco	0.00254	Incl	0.00254	9.16	35	54.49	1908	0.00000	320	0.6	192	0.00022	0.000008	10
		Pass Loco hits Pass Car	0.00014	Incl	0.00014	9.16	35	54.49	1908	0.00000	320	0.6	192	0.00000	0.000000	0
		Pass Loco hits Frt Car	0.00012	Incl	0.00012	9.16	35	54.49	1908	0.00000	320	0.6	192	0.00000	0.000000	0
		Pass car hit by Loco	0.00041	Incl	0.00041	9.16	35	54.49	1908	0.00000	320	0.6	192	0.00007	0.000003	3
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.00	0.00860	6.00	23	21.05	483	0.00001	320	0.6	192	0.00004	0.000002	2
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.00	0.01440	6.00	23	21.05	483	0.00001	320	0.6	192	0.00014	0.000005	6
	Overspeed		0.01100	0.50	0.00550	6.00	23	21.05	483	0.00000	320	0.6	192	0.00011	0.000002	7
	Broken Rail		0.01670	0.00	0.01670	6.00	23	21.05	483	0.00001	320	0.6	192	0.00033	0.000005	21
	Work Zone Violation	Saw	Consequence Tbl	0.25	#VALUE!	6.00	23	21.05	483					0.00006	0.000006	0
										0.00003				**0.00098**	**0.000031**	**49**
105	Train-Train Collision	Pass Loco hits Loco	0.00254	Incl	0.00254	6.00	23	33.44	767	0.00000	320	0.6	192	0.00016	0.000006	7
		Pass Loco hits Pass Car	0.00043	Incl	0.00043	6.00	23	33.44	767	0.00000	320	0.6	192	0.00001	0.000001	1
		Pass Loco hits Frt Car	0.00009	Incl	0.00009	6.00	23	33.44	767	0.00000	320	0.6	192	0.00000	0.000000	0
		Pass car hit by Loco	0.00046	Incl	0.00046	6.00	23	33.44	767	0.00000	320	0.6	192	0.00006	0.000002	2
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.00	0.00860	6.00	23	33.44	767	0.00001	320	0.6	192	0.00012	0.000004	5
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.00	0.01440	6.00	23	33.44	767	0.00001	320	0.6	192	0.00041	0.000014	17
	Broken Rail		0.01100	0.50	0.00550	6.00	23	33.44	767	0.00000	320	0.6	192	0.00023	0.000004	19
	Broken Rail		0.01670	0.00	0.01670	6.00	23	33.44	767	0.00001	320	0.6	192	0.00069	0.000011	59
	Work Zone Violation	Saw	Consequence Tbl	0.25	#VALUE!	6.00	23	33.44	767					0.00013	0.000013	0
	Total									**0.00004**				**0.00180**	**0.000055**	**111**
														0.000000	**0.000000**	**0.00**
	Overall Totals									**0.00007**				**0.00280**	**0.00009**	**160**
														0.000001	**0.000014**	**0.000000**	**0**
Totals All Speeds		**Train-train Collisions**								**0.00001**				**0.00054**	**0.00002**	**23**
		Intrusion Collisions								**0.00003**				**0.00072**	**0.00003**	**31**
		Overspeed								**0.00001**				**0.00034**	**0.00001**	**26**
		Broken Rail								**0.00002**				**0.00102**	**0.00002**	**80**
		Work Zone Violation								**0.00000**				**0.00019**	**0.00002**	**0**

Table 3.5b: Risk Calculation - Collisions at Diamonds - Passenger

Number Diamonds	Freq'y per mill passes	Collisions (millions)	Injuries	Fatalities	Damage
2	0.000000	0.000000	0.000000	0.000000	0.00
2	0.000000	0.000000	0.000000	0.000000	0.00
2	0.015497	0.000031	0.000007	0.000000	0.27
2	0.003099	0.000000	0.000007	0.000000	0.22
		0.000001	**0.000014**	**0.000000**	**0.49**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.015497	0.000000	0.000000	0.000000	0.00
0	0.003099	0.000000	0.000000	0.000000	0.00
		0.000000	**0.000000**	**0.000000**	**0.00**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.015497	0.000000	0.000000	0.000000	0.00
0	0.003099	0.000000	0.000000	0.000000	0.00
		0.000000	**0.000000**	**0.000000**	**0.00**

Table 3.6a: Risk Calculation - Freight Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Freq (per million trn)	Preventability	Adjusted Frequency	Trips/day	Trips per 10 years	Length of Track (miles)	Train-miles	Per 10 years Accidents	Injuries	Fatalities	Damage $
25	Train-Train Collision	Frt Loco hits Locos	0.00831	Incl	0.00831	9.16	35	3.9	137	0.00000	0.00000	0.000000	$0
		Frt Loco hits Car	0.00136	Incl	0.00136	9.16	35	3.9	137	0.00000	0.00000	0.000000	$0
		Frt car hit by Loco	0.00113	Incl	0.00113	9.16	35	3.9	137	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.86	3	3.9	13	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.86	3	3.9	13	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	2.30	9	3.9	34	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	2.30	9	3.9	34	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.010	0.50	0.00800	0.86	3	3.9	13	0.00000	0.00000	0.000000	$0
	Overspeed, Unequip		0.016	0.00	0.01600	2.30	9	3.9	34	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.00	0.05560	0.86	3	3.9	13	0.00000	0.00000	0.000000	$0
	Broken Rail, Unequip		0.056	0.00	0.05560	2.30	9	3.9	34	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.25		0.86	3	3.9	13	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Unequip			0.00		2.30	9	3.9	34	0.00000	0.00000	0.000000	$0
	Totals									**0.0000**	**0.0000**	**0.00000**	**$1**
40	Train-Train Collision	Frt Loco hits Locos	0.0000	Incl	0.00000	9.16	35	0	0	0.00000	0.00000	0.000000	$0
		Frt Loco hits Car	0.0000	Incl	0.00000	9.16	35	0	0	0.00000	0.00000	0.000000	$0
		Frt car hit by Loco	0.0000	Incl	0.00000	9.16	35	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.86	3	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.86	3	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	2.30	9	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	2.30	9	0	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.010	0.50	0.00800	0.86	3	0	0	0.00000	0.00000	0.000000	$0
	Overspeed, Unequip		0.016	0.00	0.01600	2.30	9	0	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.00	0.05560	0.86	3	0	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Unequip		0.056	0.00	0.05560	2.30	9	0	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.25		0.86	3	0	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Unequip			0.00		2.30	9	0	0	0.00000	0.00000	0.000000	$0
	Totals									**0.00000**	**0.0000**	**0.00000**	**$0**
50	Train-Train Collision	Frt Loco hits Locos	0.0035	Incl	0.00346	9.16	35	52.23	1829	0.00001	0.00001	0.000001	$3
		Frt Loco hits Car	0.0008	Incl	0.00076	9.16	35	52.23	1829	0.00000	0.00000	0.000000	$0
		Frt car hit by Loco	0.0007	Incl	0.00067	9.16	35	52.23	1829	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.86	3	52.23	172	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.86	3	52.23	172	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	2.30	9	52.23	459	0.00001	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	2.30	9	52.23	459	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.010	0.50	0.00800	0.86	3	52.23	172	0.00000	0.00000	0.000000	$1
	Overspeed, Unequip		0.016	0.00	0.01600	2.30	9	52.23	459	0.00001	0.00000	0.000000	$4
	Broken Rail, Equip		0.056	0.00	0.05560	0.86	3	52.23	172	0.00001	0.00000	0.000000	$6
	Broken Rail, Unequip		0.056	0.00	0.05560	2.30	9	52.23	459	0.00003	0.00001	0.000001	$15
	Work Zone Viol'n, Equip			0.25		0.86	3	52.23	172		0.00001	0.000001	$0
	Work Zone Viol'n, Unequip			0.00		2.30	9	52.23	459		0.00004	0.000004	$0
	Totals									**0.00007**	**0.0001**	**0.00001**	**$30**
	Overall Totals									**0.00007**	**0.0001**	**0.0000**	**$30**
Totals All Speeds	**Train-Train Collisions**									**0.00001**	**0.00001**	**0.00000**	**4**
	Intrusion Collisions									**0.00002**	**0.00001**	**0.00000**	**1**
	Diamond Collisions									**0.00001**	**0.00000**	**0.00000**	**1**
	Overspeed									**0.00001**	**0.00000**	**0.00000**	**5**
	Broken Rail									**0.00004**	**0.00001**	**0.00000**	**21**
	Work Zone Violation									**0.00000**	**0.00005**	**0.00001**	**0**
	Grade Crossing Collisions												

Table 3.6b: Risk Calculation - Collisions at Diamonds - Freight

Number Diamonds	Freq'y per mill passes	Collisions (millions)	Injuries	Fatalities	Damage
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.032160	0.000000	0.000000	0.000000	0.00
0	0.040557	0.000000	0.000000	0.000000	0.00

Worksheet 2 - Sp,T,S: Collision Frequencies Calculation - PTC 120 Sec. Timeout Case, Springfield Sub-corridor, PTC Timeout Operating State, Summer

Table 2.1a: Collision Distribution Matrix (Fraction Accidents by Train Pair and Collision Type). Collisions Between Trains Operating on the IDOT Test Corridor Only (Not diamonds and intrusions)

Train Pairs in Collision	Collision Scenario Prob (Top Level)	Siding - Monitored							Siding - Unmonitored								CP Adjacent - Monitored Siding								CP Adjacent - Unmonitored Siding								Plain Track							
		Collision Distribution		Head On			Rear End/Side		Collision Distribution		Head On			Rear End/Side			Collision Distribution		Head On			Rear End/Side			Collision Distribution		Head On			Rear End/Side			Collision Distribution		Head On			Rear End/Side		
		Head On	Rear/Side	Equip Guilty	Unequip Guilty		Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty		Equip Guilty	Unequip Guilty		Head On	Rear/Side	Equip Guilty	Unequip Guilty		Equip Guilty	Unequip Guilty		Head On	Rear/Side	Equip Guilty	Unequip Guilty		Equip Guilty	Unequip Guilty		Head On	Rear/Side	Equip Guilty	Unequip Guilty		Equip Guilty	Unequip Guilty	
Percent Guilty				100%	0%	100%	0%	100%	0%	100%	0%	100%	0%	100%	0%	100%	0%			100%	0%	100%	0%			100%	0%	100%	0%			100%	0%	100%	0%						
Both Trains TBE Pass-Pass	0.80	0.50	0.50	0.4	0	0.4	0	0.5	0.5	0.4	0	0.4	0	0.8	0.2	0.64	0	0.16	0	0.8	0.2	0.64	0	0.16	0	0.70	0.30	0.56	0	0.24	0								
Pass-TBE Freight	0.15	0.50	0.50	0.075	0	0.075	0	0.5	0.5	0.075	0	0.075	0	0.7	0.3	0.105	0	0.045	0	0.7	0.3	0.105	0	0.045	0	0.40	0.60	0.06	0	0.09	0								
(Note 3) TBE Freight - TBE Freight	0.00	0.50	0.50	0	0	0	0	0.5	0.5	0	0	0	0	0.7	0.3	0	0	0	0	0.7	0.3	0	0	0	0	0.50	0.50	0	0	0	0								
Percent Guilty				50%	50%	50%	50%			50%	50%	50%	50%			50%	50%	50%	50%			50%	50%	50%	50%			50%	50%	50%	50%								
One Train TBE Pass - NE Freight, Head -On	0.05	1	0	0.0125	0.0125	0	0	1	0	0.0125	0.0125	0	0	1	0	0.02	0.02	0	0	1	0	0.02	0.02	0	0	1.00	0.00	0.0175	0.0175	0	0								
Rear/Side, Pass into NE Frt		0	1	0	0	0.02	0	0	1	0	0	0.02	0	0	1	0	0	0.0075	0	0	1	0	0	0.0075	0	0.00	1.00	0	0	0.0125	0								
Rear/Side NE Frt into Pass		0	1	0	0	0	0.005	0	1	0	0	0	0.005	0	1	0	0	0	0.0025	0	1	0	0	0	0.0025	0.00	1.00	0	0	0	0.0025								
TBE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0	0.5	0.5	0	0	0	0	0.7	0.3	0	0	0	0	0.7	0.3	0	0	0	0	0.50	0.50	0	0	0	0								
Percent Guilty				0%	100%	0%	100%			0%	100%	0%	100%			0%	100%	0%	100%			0%	100%	0%	100%			0%	100%	0%	100%								
Neither Train TBE NE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0	0.5	0.5	0	0	0	0	0.7	0.3	0	0	0	0	0.7	0.3	0	0	0	0	0.50	0.50	0	0	0	0								
Total Probability (checking)	1		1	0.4875	0.0125	0.495	0.005		1	0.4875	0.0125	0.495	0.005		1	0.765	0.02	0.2125	0.0025		1	0.765	0.02	0.2125	0.0025		1	0.6375	0.0175	0.3425	0.0025								

Table 2.1b: Collision Type Distribution - Diamonds

Diamond Collisions		Train Pairs in Collision	Train Pair Type
Rear End/Side			
Equip Guilty	Unequip Guilty		
		Percent Guilty	
		Pass-Pass	**Both Trains TBE**
		Pass-TBE Freight	
		TBE Freight - TBE Freight	
50%	50%	**Percent Guilty**	**One Train TBE**
0	0	Pass - NE Freight, Head -On	
0.25	0.25	Rear/Side, Pass into NE Frt	
0.05	0.05	Rear/Side NE Frt into Pass	
0.1	0.1	TBE Freight - NE Freight	
	100%	**Percent Guilty**	
0	0.2	NE Freight - NE Freight	**Neither Train TBE**
0.4	0.6	Total Probability (checking)	

Note: The gray cells on these rows are set at zero, because in every case, the condition represented by the cell does not exist - either because there are no unequipped passenger trains, or because of the kind of collision

Quarely in cell C18 is for all collisions between a passenger train and an unequipped freight train

Table 2.2: Preventability Data For Unequipped train Guilty, One Train TBE

Segment Type	Not Prevented of Mitigated			Mitigated			Prevented		
	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass
Siding (M)	0.999	0.960	0.970	0.051	0.048	0.000	0.000	0.041	0.080
Siding (U)	1.050	1.050	1.050	0.000	0.000	0.000	0.000	0.000	0.000
CP Adjacent (M)	0.978	1.038	1.039	0.042	0.000	0.000	0.031	0.012	0.011
CP Adjacent (U)	1.041	1.042	1.050	0.009	0.008	0.000	0.000	0.000	0.000
Plain Track	0.308	0.321	0.340	0.028	0.029	0.007	0.026	0.024	0.027
Diamonds	0.558	0.570	0.643	0.098	0.000	0.170	0.394	0.480	0.237

Mauve cells contain data imported from previous worksheet in a group of three worksheets covering one sub-corridor, season and operating

Table 2.3a: Collision Preventability Matrix (Percent Accidents Preventable Relative to CTC Reference Case)

Preventability Equipped Train Guilty	Siding - Monitored							Siding - Unmonitored								CP Adjacent - Monitored Siding								CP Adjacent - Unmonitored Siding								Plain Track							
			Head On			Rear End/Side				Head On			Rear End/Side				Head On			Rear End/Side				Head On			Rear End/Side			Collision Distribution	Rear/Side	Head On			Rear End/Side		
			Equip Guilty	Unequip Guilty		Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty		Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty		Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty		Equip Guilty	Unequip Guilty				Equip Guilty	Unequip Guilty		Equip Guilty	Unequip Guilty	
Both TBE Pass-Pass	90%			90%		90%				90%			90%				90%			90%				90%			90%											
Pass-TBE Freight	90%			90%		90%				90%			90%				90%			90%				90%			90%											
TBE Freight - TBE Freight	90%			90%		90%				90%			90%				90%			90%				90%			90%											
One TBE Pass - NE Freight, Head -On	90%			90%	8%					90%	0%						90%	1%						90%	0%						90%	3%						
Rear/Side, Pass into NE Frt	90%					90%	8%					90%	0%						90%	1%						90%	0%						90%	3%		90%	48.01%	
Rear/Side NE Frt into Pass	90%					90%	0%					90%	0%						90%	0%						90%	0%						90%	0%		90%	48.01%	
TBE Freight - NE Freight	90%			90%	0%	90%	0%			90%	0%	90%	0%			90%	3%	90%	0%					90%	0%	90%	0%					90%	3%	90%	0%		90%	39.39%	
Neither TBE NE Freight - NE Freight					0%		0%				0%		0%				0%		0%						0%		0%					0%		0%			0.00%	
Reference Case (CTC) Collision Accident Likelihood by Segment Type (collisions/million train miles)	0.030							0.040							0.050							0.060							0.006							Collisions/million diamond passes	0.1		

Table 2.3b: Collision Preventability Matrix - Diamonds

Diamond Collisions		Train Pairs in Collision	Train Pair Type
Rear End/Side			
Equip Guilty	Unequip Guilty		
		Pass-Pass	**Both TBE**
		Pass-TBE Freight	
		TBE Freight - TBE Freight	
		Pass - NE Freight, Head -On	**One TBE**
90%	48.01%	Rear/Side, Pass into NE Frt	
90%	48.01%	Rear/Side NE Frt into Pass	
90%	39.39%	TBE Freight - NE Freight	
	0.00%	NE Freight - NE Freight	**Neither TBE**

Table 2.4a: Passenger Trains in Accidents (Collisions per Million Train-Miles Operated in Sub-Corridor)

Passenger Trains in Collisions	Siding - Monitored							Siding - Unmonitored								CP Adjacent - Monitored Siding								CP Adjacent - Unmonitored Siding								Plain Track							
			Head On			Rear End/Side				Head On			Rear End/Side				Head On			Rear End/Side				Head On			Rear End/Side			Collision Distribution	Rear/Side	Head On			Rear End/Side		
			Equip Guilty	Unequip Guilty		Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty		Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty		Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty		Equip Guilty	Unequip Guilty				Equip Guilty	Unequip Guilty		Equip Guilty	Unequip Guilty	
Both TBE Pass-Pass	2			0.0024		0.0024				0.0032			0.0032				0.0064			0.0019				0.0077			0.0019					0.0007			0.0003		
Pass-TBE Freight	1			0.0002		0.0002				0.0003			0.0003				0.0005			0.0002				0.0006			0.0003					0.0000			0.0001		
TBE Freight - TBE Freight	0																																						
One TBE Pass - NE Freight, Head -On	1			0.0000	0.0003					0.0001	0.0005						0.0001	0.0010						0.0001	0.0012						0.0000	0.0001						
Rear/Side, Pass into NE Frt	1					0.0001	0.0000					0.0001	0.0000						0.0000	0.0000						0.0000	0.0000						0.0000	0.0000		0.002500	0.012997	
Rear/Side NE Frt into Pass	1					0.0000	0.0002					0.0000	0.0002						0.0000	0.0001						0.0000	0.0002						0.0000	0.0000		0.000500	0.002599	
TBE Freight - NE Freight	0																																				0.000000	0.000000	
Neither TBE NE Freight - NE Freight	0																																					0.000000	
Checking total				0.0027	0.0003	0.0027	0.0002			0.0036	0.0005	0.0036	0.0002				0.0070	0.0010	0.0019	0.0001				0.0084	0.0012	0.0022	0.0002					0.0007	0.0001	0.0003	0.0000		0.00300	0.01560	

Scenario Totals - Passenger	Tots, P-UF	Totals				Totals			Totals			Totals			Totals			Totals			Totals
Pass Loco Hits Loco	0.0004	0.0030	0.0027	0.0003		0.0006	0.0041	0.0036	0.0005			0.0011	0.0080	0.0070	0.0010			0.0013	0.0096	0.0084	0.0012			0.0001	0.0008	0.0007	0.0001					Pass Loco Hits Loco
Pass Loco Hits Pass Car		0.0012			0.0012		0.0016			0.0016			0.0008			0.0008			0.0010			0.0010			0.0001			0.0001			Pass Loco Hits Pass Car
Pass Loco Hits Freight Car	0.0001	0.0002			0.0002	0.0001	0.0003			0.0003		0.0000	0.0002			0.0002		0.0000	0.0002			0.0002		0.0000	0.0001			0.0001		0.002500	0.012997	0.015497	Pass Loco Hits Freight Car
Pass Car Hit by Loco	0.0002	0.0014			0.0012	0.0002	0.0019			0.0017	0.0002	0.0001	0.0010			0.0009	0.0001	0.0002	0.0012			0.0010	0.0002	0.0000	0.0002			0.0002	0.0000	0.000500	0.002599	0.003099	Pass Car Hit by Loco
Total		0.0058	0.0027	0.0003	0.0027	0.0002	0.0078	0.0036	0.0005	0.0036	0.0002		0.0100	0.0070	0.0010	0.0019	0.0001		0.0120	0.0084	0.0012	0.0022	0.0002		0.0012	0.0007	0.0001	0.0003	0.0000	0.003000	0.015596	0.018596	Total

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Table 2.4b: Passenger Trains in Collisions at Diamonds

Diamond Collisions		Train Pairs in Collision	Train Pair Type
Rear End/Side			
Equip Guilty	Unequip Guilty		
		Pass-Pass	**Both TBE**
		Pass-TBE Freight	
		TBE Freight - TBE Freight	
		Pass - NE Freight, Head -On	**One TBE**
0.002500	0.012997	Rear/Side, Pass into NE Frt	
0.000500	0.002599	Rear/Side NE Frt into Pass	
0.000000	0.000000	TBE Freight - NE Freight	
	0.000000	NE Freight - NE Freight	**Neither TBE**
0.00300	0.01560		

Scenario Totals - Passenger	Totals
Pass Loco Hits Loco	
Pass Loco Hits Pass Car	
Pass Loco Hits Freight Car	0.015497
Pass Car Hit by Loco	0.003099
Total	0.018596

Table 2.5a: Freight trains In Accidents (Collisions per Million Train-Miles Operated in Sub-Corrid

Freight Trains in Collisions	Siding - Monitored							Siding - Unmonitored								CP Adjacent - Monitored Siding								CP Adjacent - Unmonitored Siding								Plain Track							
			Head On			Rear End/Side				Head On			Rear End/Side				Head On			Rear End/Side				Head On			Rear End/Side			Collision Distribution	Rear/Side	Head On			Rear End/Side		
			Equip Guilty	Unequip Guilty		Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty		Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty		Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty		Equip Guilty	Unequip Guilty				Equip Guilty	Unequip Guilty		Equip Guilty	Unequip Guilty	
Both TBE Pass-Pass	0																																						
Pass-TBE Freight	1			0.0002		0.0002				0.0003			0.0003				0.0005			0.0002				0.0006			0.0003					0.0000			0.0001		
TBE Freight - TBE Freight	2			0.0000		0.0000				0.0000			0.0000				0.0000			0.0000				0.0000			0.0000					0.0000			0.0000		
One TBE Pass - NE Freight, Head -On	1			0.0000	0.0003					0.0001	0.0005						0.0001	0.0010						0.0001	0.0012						0.0000	0.0001						
Rear/Side, Pass into NE Frt	1					0.0001	0.0000					0.0001	0.0000						0.0000	0.0000						0.0000	0.0000						0.0000	0.0000		0.002500	0.012997	
Rear/Side NE Frt into Pass	1					0.0000	0.0002					0.0000	0.0002						0.0000	0.0001						0.0000	0.0002						0.0000	0.0000		0.000500	0.002599	
TBE Freight - NE Freight	2			0.0000	0.0000	0.0000	0.0000			0.0000	0.0000	0.0000	0.0000				0.0000	0.0000	0.0000	0.0000				0.0000	0.0000	0.0000	0.0000					0.0000	0.0000	0.0000	0.0000		0.002000	0.012121	
Neither TBE NE Freight - NE Freight	2				0.0000		0.0000				0.0000		0.0000				0.0000		0.0000						0.0000		0.0000					0.0000		0.0000				0.040000	
Checking total				0.0003	0.0003	0.0003	0.0002			0.0004	0.0005	0.0004	0.0002				0.0006	0.0010	0.0003	0.0001				0.0008	0.0012	0.0003	0.0002					0.0000	0.0001	0.0001	0.0000		0.00500	0.06772	

Scenario Totals - Freight	Totals					Totals			Totals			Totals			Totals			Totals			Totals
Freight Loco Hits Loco	0.0004	0.0006	0.0003	0.0003		0.0009	0.0004	0.0005			0.0016	0.0006	0.0010			0.0020			0.0001	0.0001					Freight Loco Hits Loco
Freight Loco Hits Car	0.0002	0.0002			0.00005	0.00015	0.0003				0.0002					0.00006	0.00013		0.0002			0.00007	0.00015		0.0000			0.00001	0.00002	0.003500	0.028660	0.032160	Freight Loco Hits Car
Freight Car Hit By Loco	0.0001	0.0002	b		0.00024	0.00000	0.0003			0.00032	0.00000		0.0002			0.00021	0.00000		0.0002			0.00025	0.00000		0.0001			0.00005	0.00000	0.001500	0.039057	0.040557	Freight Car Hit By Loco
Total		0.0010	0.0003	0.0003	0.0003	0.0002	0.0014	0.0004	0.0005	0.0004	0.0002	0.0000	0.0020	0.0006	0.0010	0.0003	0.0001		0.0024	0.0008	0.0012	0.0003	0.0002		0.0002	0.0000	0.0001	0.0001	0.0000	0.005000	0.067717	0.072717	Total
Freight Plus Passenger Totals (check		0.0069					0.0093					0.0120						0.0144						0.0014									

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Table 2.5b: Freight Trains in Collisions at Diamond

Diamond Collisions		Train Pairs in Collision	Train Pair Type
Rear End/Side			
Equip Guilty	Unequip Guilty		
		Pass-Pass	**Both TBE**
		Pass-TBE Freight	
		TBE Freight - TBE Freight	
		Pass - NE Freight, Head -On	**One TBE**
0.002500	0.012997	Rear/Side, Pass into NE Frt	
0.000500	0.002599	Rear/Side NE Frt into Pass	
0.002000	0.012121	TBE Freight - NE Freight	
	0.040000	NE Freight - NE Freight	**Neither TBE**
0.00500	0.06772		

Scenario Totals - Freight	Totals
Freight Loco Hits Loco	
Freight Loco Hits Car	0.032160
Freight Car Hit By Loco	0.040557
Total	0.072717

In rear-end/side collisions between like trains there is one loco hits car and one car hit by loco in each collision. In rear/side collisions between a passenger and freight trains, the ratio between passenger hits freight and freight loco hits passenger car are a function of the percentages given in Table IN-5b on the Inputs sheet. The values are given in the tables beneath the trains in collisions for each segment type.

Collision Ratios	Like Trains		Unlike Trains	
Collision Type	Loco hits car	car hit by loco	P loco hits F car	F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.8	0.2

Collision Ratios	Like Trains		Unlike Trains	
Collision Type	Loco hits car	car hit by loco	P loco hits F car	F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.80	0.20

Collision Ratios	Like Trains		Unlike Trains	
Collision Type	Loco hits car	car hit by loco	P loco hits F car	F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.75	0.25

Collision Ratios	Like Trains		Unlike Trains	
Collision Type	Loco hits car	car hit by loco	P loco hits F car	F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.75	0.25

Collision Ratios	Like Trains		Unlike Trains	
Collision Type	Loco hits car	car hit by loco	P loco hits F car	F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.83	0.17

Worksheet 3-Sp,T,S: - Risk Calculations - PTC Normal Case, Springfield Subcorridor, Timeout Operating State, Summer

Table 3.1: Consequences Look-up Tables (Data Sources: Previous ICF Passenger Corridor Project (passenger), FRA Accident Data 2001-5 (freight)

Passenger Trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 40 mph			Representative Speed 60 mph			Representative Speed 79 mph			Representative Speed 105 mph		
			Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Pass Loco hits Loco	0.080	0.002	902800	0.139	0.0049	1142000	0.24	0.0085	1976800	0.425	0.016	3495000
		Pass Loco hits Pass Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.008	1747000
		Pass Loco hits Frt Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.008	1747000
		Pass car hit by Loco	0.186	0.005	1505000	0.275	0.0119	2284000	0.476	0.0206	3951000	0.841	0.032	6893000
	Intrusion Collision (rollout)	Pass Loco hits Car	0.013	0.0005	113000	0.031	0.0011	257000	0.054	0.0019	445000	0.096	0.0034	786000
	Intrusion Collision (other))	Pass Loco hits Car	0.026	0.0009	226000	0.063	0.0022	514000	0.108	0.0038	889000	0.191	0.0066	1573000
	Overspeed		0.044	0.0004	667000	0.14	0.00186	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Broken Rail		0.044	0.0004	667000	0.14	0.00186	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Work Zone Violation		0.083	0.0093	0	0.125	0.0125	0	0.164	0.0164	0	0.218	0.0218	0

Freight trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 25 mph			Representative Speed 40 mph			Representative Speed 50 mph		
			Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Frt Loco hits Locos	0.45	0.045	105800	1.1	0.11	270000	1.7	0.17	422000
		Frt Loco hits Car	0.35	0.035	88000	0.9	0.09	225000	1.4	0.14	352000
		Frt car hit by Loco	0	0	44000	0	0	112000	0	0	176000
	Intrusion CollN equip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion CollN equip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion CollN Unequip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion CollN Unequip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Overspeed, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Overspeed, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Work Zone Viol'n, Equip		0.042	0.0042	0	0.065	0.0066	0	0.083	0.0083	0
	Work Zone Viol'n, Unequip		0.042	0.0042	0	0.065	0.0066	0	0.083	0.0083	0

Casualties and damage in Table 3.1 are per accident, except for Work Zone Violationswhich are per million train-miles

Table 3.2: Grade Crossing and Diamonds: Numbers by Speed, Accident Frequency and Consequences

Train Type	Representative Speed (mph)	Type of Grade-crossing	Number Crossings			Accident Frequency Per Million Crossing Passes		Crossing Collision Consequences						Number Diamonds
								Pass. Occup't Casualty Prob/accident)			Freight Trains (per accident)			
			Passenger	HS Passenger	Freight	Passenger	Freight	Injuries	Fatalities	Cost $/Accid't	Injuries	Fatalities	Cost $	
Passenger	40	Public_gates_lights	0	0		0.250		0.0025	0.000047	15000				2
		Public_other	0	0		0.300								
		Private	0	0		0.100								
	60	Public_gates_lights	14	0		0.400		0.0068	0.000112	113000				0
		Public_other	0	0		0.500								
		Private	0	0		0.200								
	79	Public_gates_lights	15	16		0.800		0.0305	0.000156	196000				0
		Public_other	5	5		0.650								
		Private	5	5		0.500								
	105	Public_gates_lights	0	13		1.100		0.0186	0.000276	346000				0
		Public_other	0	4		0.800								
		Private	0	4		0.500								
Freight	25	Public_gates_lights			3		0.150				0.12	0.005	20000	0
		Public_other			0		0.120							
		Private			0		0.050							
	40	Public_gates_lights			0		0.300				0.25	0.013	50000	2
		Public_other			0		0.250							
		Private			0		0.100							
	50	Public_gates_lights			26		0.360				0.39	0.02	78000	0
		Public_other			5		0.300							
		Private			5		0.120							

Table 3.2a: Segment Data (for reference only, not used in calculations)

Segment Number	Start (Milepost)	End (Milepost)	Type	Length (miles)	Representative Speed (mph)		
					Freight	Pass	HS Pass-cons
100	124.85	126.5	CP Adjacent (M)	1.64	25	40	40
33	126.5	126.5	Diamond	0	40	40	40
34	126.5	128.76	CP Adjacent (M)	2.26	25	60	60
35	128.76	130.96	Plain	2.2	50	79	79
36	130.96	133.72	Plain	2.76	50	79	79
37	133.72	136.9	Plain	3.18	50	79	79
38	136.9	138.63	CP Adjacent (M)	1.73	50	79	79
39	138.63	141.3	Siding (M)	2.67	50	79	79
40	141.3	143.35	CP Adjacent (M)	2.05	50	79	79
41	143.35	146.3	Plain	4.95	50	60	79
42	146.3	150.96	Plain	2.66	50	79	79
43	150.96	153.56	CP Adjacent (U)	2.6	50	79	79
44	153.56	155.57	Siding (U)	2.01	50	60	60
45	155.57	155.57	Diamond	0	40	40	40
46	155.57	157.26	CP Adjacent (U)	1.69	50	60	60
47	157.26	160.05	Plain	2.79	50	79	79
48	160.05	162.11	Plain	2.06	50	79	79
49	162.11	164.04	Plain	1.93	50	79	79
50	164.04	166.16	Plain	2.12	50	79	79
51	166.16	168.34	CP Adjacent (U)	2.18	50	79	79
52	168.34	170.4	Siding (U)	2.06	50	79	79
53	170.4	172.34	CP Adjacent (U)	1.94	50	79	79
54	172.34	175.84	Plain	3.5	50	79	79
55	175.84	179.49	Plain	3.65	50	79	79
56	179.49	180.99	CP Adjacent (M)	1.5	50	79	79

Table 3.3b: Aggregate Segment Data: SegmentsTypes, Train Types, Speeds, and Lengths

Aggregate Segment Length by Type and Speed Band (from Seg Def and Preventability)

Segment Type	Train Type	Represent've Speed (mph)	Freight (miles)	Reg Pass (miles)	HS Pass Collision (mi)	HS Pass Other (mi)
Siding (mon)	Freight	25	0.00			
		40	0.00			
		50	2.67			
	Passenger	40		0	0	0
		60		0	0	0
		79		2.67	2.67	0
		105		0	0	2.67
Siding (unmon)	Freight	25	0.00			
		40	0.00			
		50	4.07			
	Passenger	40		0	0	0
		60		2.01	2.01	0
		79		2.06	2.06	2.01
		105		0	0	2.06
CP Adjacent (mon)	Freight	25	3.90			
		40	0.00			
		50	5.28			
	Passenger	40		1.64	1.64	1.64
		60		2.26	2.26	0
		79		5.28	5.28	3.76
		105		0	0	3.78
CP Adjacent (unmon)	Freight	25	0.00			
		40	0.00			
		50	8.41			
	Passenger	40		0	0	0
		60		1.69	1.69	0
		79		6.72	6.72	1.69
		105		0	0	6.72
Plain Track	Freight	25	0.00			
		40	0.00			
		50	31.80			
	Passenger	40		0	0	0
		60		4.95	2.74	0
		79		26.85	29.04	13.59
		105		0	0	18.21
Totals All Types	Freight	25	3.90			
		40	0.00			
		50	52.23			
	Passenger	40		1.64	1.64	1.64
		60		10.91	6.72	0.00
		79		43.58	45.77	21.05
		105		0.00	0.00	33.44
Check Totals			56.13	56.13	56.13	56.13

Table 3.4: Collision Frequencies by Segment Type and Collision Scenario (From Coll Mat'rx)

Scenarios	Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain	Diamond
Pass Loco Hits Loco	0.0030	0.0041	0.0080	0.0096	0.0008	0.000000
Pass Loco Hits Pass Car	0.0012	0.0016	0.0008	0.0010	0.0001	0.000000
Pass Loco Hits Freight Car	0.0002	0.0003	0.0002	0.0002	0.0001	0.015497
Pass Car Hit by Loco	0.0014	0.0019	0.0010	0.0012	0.0002	0.003099
Freight Loco Hits Loco	0.0006	0.0009	0.0016	0.0020	0.0001	0.000000
Freight Loco Hits Car	0.0002	0.0003	0.0002	0.0002	0.0000	0.032160
Freight Car Hit By Loco	0.0002	0.0003	0.0002	0.0002	0.0001	0.040557

Collision Frequencies for Passenger + Unequipped Freight Train

Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain
0.0004	0.0006	0.0011	0.0013	0.0001
0.0001	0.0001	0.0000	0.0000	0.0000
0.0002	0.0002	0.0001	0.0002	0.0000

Mauve cells contain data imported from Worksheet 2 in this group of three worksheets covering this sub-corridor, season and operating state.

All train-to-train collision frequencies are in units of **trains in collisions per million train miles operated in the sub-corridor by all train types.**

Weighted Collision Accident Frequencies by Representative Speed (mph)

Scenarios	Freight			Passenger		
	25	40	50	40	60	79	105
Pass Loco Hits Loco				0.0080	0.0000	0.0015	0.0033
Pass Loco Hits Pass Car				0.0008	0.0000	0.0002	0.0006
Pass Loco Hits Freight Car				0.0002	0.0000	0.0001	0.0001
Pass Car Hit by Loco				0.0010	0.0000	0.0003	0.0006
Freight Loco Hits Loco	0.0016	0.0000	0.0007				
Freight Loco Hits Car	0.0002	0.0000	0.0001				
Freight Car Hit By Loco	0.0002	0.0000	0.0001				

Table 3.4a: Traffic Inputs to Risk Calculation

Train Type	Trips/Day Summer	Trips/Day Rest of Year
Passenger	6.00	6.00
Equipped Freight	0.86	0.86
Unequipped Freight	0.87	2.30
Operating Days	91	274

Percent Train-Miles in	
Timeout (secs)	120
Normal Operating Mode	84.89
Timeout Mode	0.14
Fallback Mode	5

Passenger Train Occupancy	
Seats	320
Occupancy Factor	0.60

Table 3.5a: Risk Calculation - Passenger Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Freq. (per mill trn)	Preventability	Adjusted Frequency	Trips/day	Trips per 10 years	Length of Track (miles)	Train-miles per 10 years	Accidents per 10 years	Number seats per train	Occupancy Factor	Passengers per train	Injuries per 10 years	Fatalities per 10 years	Damage $ per 10 years
40	Train-Train Collision	Pass Loco hits Loco	0.00801	Incl	0.00801	7.73	9.82	1.64	16	0.00000	320	0.6	192	0.00000	0.000000	0
		Pass Loco hits Pass Car	0.00080	Incl	0.00080	7.73	9.82	1.64	16	0.00000	320	0.6	192	0.00000	0.000000	0
		Pass Loco hits Frt Car	0.00021	Incl	0.00021	7.73	9.82	1.64	16	0.00000	320	0.6	192	0.00000	0.000000	0
		Pass car hit by Loco	0.00098	Incl	0.00098	7.73	9.82	1.64	16	0.00000	320	0.6	192	0.00000	0.000000	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.00	0.00860	6.00	7.62	1.64	12	0.00000	320	0.6	192	0.00000	0.000000	0
	Intrusion Collision (other))	Pass Loco hits intruder	0.01440	0.00	0.01440	6.00	7.62	1.64	12	0.00000	320	0.6	192	0.00000	0.000000	0
	Overspeed		0.01100	0.50	0.00550	6.00	7.62	1.64	12	0.00000	320	0.6	192	0.00000	0.000000	0
	Broken Rail		0.01670	0.00	0.01670	6.00	7.62	1.64	12	0.00000	320	0.6	192	0.00000	0.000000	0
	Work Zone Violation			0.25		6.00	7.62	1.64	12					0.00000	0.000000	0
										0.00000				**0.00001**	**0.000000**	**0**
60	Train-Train Collision	Pass Loco hits Loco	0.00000	Incl	0.00000	7.73	9.82	0	0	0.00000	320	0.6	192	0.00000	0.000000	0
		Pass Loco hits Pass Car	0.00000	Incl	0.00000	7.73	9.82	0	0	0.00000	320	0.6	192	0.00000	0.000000	0
		Pass Loco hits Frt Car	0.00000	Incl	0.00000	7.73	9.82	0	0	0.00000	320	0.6	192	0.00000	0.000000	0
		Pass car hit by Loco	0.00000	Incl	0.00000	7.73	9.82	0	0	0.00000	320	0.6	192	0.00000	0.000000	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.00	0.00860	6.00	7.62	0	0	0.00000	320	0.6	192	0.00000	0.000000	0
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.00	0.01440	6.00	7.62	0	0	0.00000	320	0.6	192	0.00000	0.000000	0
	Overspeed		0.01100	0.50	0.00550	6.00	7.62	0	0	0.00000	320	0.6	192	0.00000	0.000000	0
	Broken Rail		0.01670	0.00	0.01670	6.00	7.62	0	0	0.00000	320	0.6	192	0.00000	0.000000	0
	Work Zone Violation			0.25		6.00	7.62	0	0					0.00000	0.000000	0
										0.00000				**0.00000**	**0.000000**	**0**
79	Train-Train Collision	Pass Loco hits Loco	0.00152	Incl	0.00152	7.73	9.82	54.49	535	0.00000	320	0.6	192	0.00004	0.000001	2
		Pass Loco hits Pass Car	0.00018	Incl	0.00018	7.73	9.82	54.49	535	0.00000	320	0.6	192	0.00000	0.000000	0
		Pass Loco hits Frt Car	0.00006	Incl	0.00006	7.73	9.82	54.49	535	0.00000	320	0.6	192	0.00000	0.000000	0
		Pass car hit by Loco	0.00026	Incl	0.00026	7.73	9.82	54.49	535	0.00000	320	0.6	192	0.00001	0.000001	1
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.00	0.00860	6.00	7.62	21.05	160	0.00000	320	0.6	192	0.00001	0.000001	1
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.00	0.01440	6.00	7.62	21.05	160	0.00000	320	0.6	192	0.00005	0.000002	2
	Overspeed		0.01100	0.50	0.00550	6.00	7.62	21.05	160	0.00000	320	0.6	192	0.00004	0.000001	2
	Broken Rail		0.01670	0.00	0.01670	6.00	7.62	21.05	160	0.00000	320	0.6	192	0.00011	0.000002	7
	Work Zone Violation			0.25		6.00	7.62	21.05	160					0.00002	0.000000	0
										0.00001				**0.00028**	**0.000006**	**14**
105	Train-Train Collision	Pass Loco hits Loco	0.00326	Incl	0.00326	7.73	9.82	33.44	328	0.00000	320	0.6	192	0.00009	0.000003	4
		Pass Loco hits Pass Car	0.00056	Incl	0.00056	7.73	9.82	33.44	328	0.00000	320	0.6	192	0.00001	0.000000	0
		Pass Loco hits Frt Car	0.00011	Incl	0.00011	7.73	9.82	33.44	328	0.00000	320	0.6	192	0.00000	0.000000	0
		Pass car hit by Loco	0.00059	Incl	0.00059	7.73	9.82	33.44	328	0.00000	320	0.6	192	0.00003	0.000001	1
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.00	0.00860	6.00	7.62	33.44	255	0.00000	320	0.6	192	0.00004	0.000001	2
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.00	0.01440	6.00	7.62	33.44	255	0.00000	320	0.6	192	0.00013	0.000005	6
	broken Rail		0.01100	0.50	0.00550	6.00	7.62	33.44	255	0.00000	320	0.6	192	0.00008	0.000001	6
	Broken Rail		0.01670	0.00	0.01670	6.00	7.62	33.44	255	0.00000	320	0.6	192	0.00023	0.000004	20
	Work Zone Violation			0.25		6.00	7.62	33.44	255					0.00004	0.000004	0
		Total												**0.00065**	**0.000020**	**39**
										0.00001				**0.00000**	**0.000000**	**0.00**
		Overall Totals								**0.00002**				**0.00093**	**0.00003**	**53**
																0.00000	**0.000004**	**0.000000**	**0**
		Totals All Speeds	**Train-train Collisions**							**0.00000**				**0.00018**	**0.00001**	**8**
			Intrusion Collisions							**0.00001**				**0.00024**	**0.00001**	**10**
			Overspeed							**0.00000**				**0.00011**	**0.00000**	**9**
			Broken Rail							**0.00001**				**0.00034**	**0.00001**	**27**
			Work Zone Violation							**0.00000**				**0.00008**	**0.00000**	**0**

Table 3.5b: Risk Calculation - Collisions at Diamonds - Passenger

Number Diamonds	Freq'y per mill passes	Collisions (millions)	Injuries	Fatalities	Damage
2	0.000000	0.000000	0.000000	0.000000	0.00
2	0.000000	0.000000	0.000000	0.000000	0.00
2	0.015497	0.000000	0.000002	0.000000	0.08
2	0.003099	0.000000	0.000002	0.000000	0.06
		0.000000	**0.000004**	**0.000000**	**0.14**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.015497	0.000000	0.000000	0.000000	0.00
0	0.003099	0.000000	0.000000	0.000000	0.00
		0.000000	**0.000000**	**0.000000**	**0.00

IDOT Risk Model: Cab Signal Case
Preventability 70% (Basic Cab Signal Case)
4/4/2007

Results Summary: Basic Case, Cab Signal and ATS 70% Preventability.

Table R1a: Full Year, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00949	0.70571	0.02705	30764	182477
	Intrusion Collisions	0.00994	0.28484	0.01012	12206	71048
	Diamond Collisions	0.00038	0.00407	0.00012	143	913
	Overspeed	0.00589	0.30214	0.00486	24896	69680
	Broken Rail	0.00841	0.43118	0.00693	35529	99440
	Work Zone Violation	0.00000	0.11143	0.01114	0	44572
	Grade Crossing Collisions	0.59710	1.92530	0.02857	186625	464876
	Total, All Scenarios	0.63121	3.76467	0.08879	290162	933006
Freight	Train-Train Collisions	0.00161	0.00174	0.00017	504	1199
	Intrusion Collisions	0.00218	0.00071	0.00007	90	376
	Diamond Collisions	0.00168	0.00078	0.00008	286	599
	Overspeed	0.00204	0.00064	0.00006	1117	1372
	Broken Rail	0.00667	0.00208	0.00021	3650	4482
	Work Zone Violation	0.00000	0.01020	0.00102	0	4078
	Grade Crossing Collisions	0.04820	0.01713	0.00088	3426	7781
	Total, All Scenarios	0.06239	0.03328	0.00250	9073	19887
Total Passenger + Freight		**0.69360**	**3.79795**	**0.09129**	**299236**	**952893**

Table R1b: Rest of Year, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01061	0.72542	0.02767	31371	186923
	Intrusion Collisions	0.01058	0.28664	0.01018	12216	71416
	Diamond Collisions	0.00033	0.00358	0.00011	125	803
	Overspeed	0.00627	0.30774	0.00493	24916	70493
	Broken Rail	0.00895	0.43917	0.00704	35558	100600
	Work Zone Violation	0.00000	0.11449	0.01145	0	45798
	Grade Crossing Collisions	0.55834	1.55969	0.02319	151171	376715
	Total, All Scenarios	0.59509	3.43673	0.08457	255358	852746
Freight	Train-Train Collisions	0.00335	0.00353	0.00035	1000	2411
	Intrusion Collisions	0.00371	0.00116	0.00012	145	609
	Diamond Collisions	0.00144	0.00066	0.00007	244	509
	Overspeed	0.00347	0.00101	0.00010	1810	2215
	Broken Rail	0.01132	0.00331	0.00033	5911	7235
	Work Zone Violation	0.00000	0.01682	0.00168	0	6729
	Grade Crossing Collisions	0.07555	0.02371	0.00121	4717	10730
	Total, All Scenarios	0.09883	0.05020	0.00386	13827	30438
Total Passenger + Freight		**0.69393**	**3.48694**	**0.08843**	**269185**	**883184**

Table R1c: Rest of Year, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01539	1.04349	0.03975	44878	268485
	Intrusion Collisions	0.01626	0.41145	0.01459	17547	102471
	Diamond Collisions	0.00073	0.00784	0.00023	275	1760
	Overspeed	0.00964	0.45704	0.00733	35795	103495
	Broken Rail	0.01376	0.65224	0.01046	51083	147697
	Work Zone Violation	0.00000	0.16990	0.01699	0	67959
	Grade Crossing Collisions	0.50680	1.47592	0.02191	143142	356461
	Total, All Scenarios	0.56259	4.21788	0.11127	292720	1048327
		0.00000	0.00000	0.00000	0	0
Freight	Train-Train Collisions	0.00460	0.00503	0.00050	1439	3451
	Intrusion Collisions	0.00790	0.00262	0.00026	329	1377
	Diamond Collisions	0.00320	0.00148	0.00015	544	1135
	Overspeed	0.00739	0.00243	0.00024	4105	5079
	Broken Rail	0.02413	0.00795	0.00080	13409	16590
	Work Zone Violation	0.00000	0.03701	0.00370	0	14802
	Grade Crossing Collisions	0.09797	0.03721	0.00190	7427	16859
	Total, All Scenarios	0.14517	0.09373	0.00756	27253	59293
Total Passenger + Freight		0.70776	4.31160	0.11883	319973	1107620

Table R1d: Rest of Year, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.03549	2.47462	0.09447	107014	637884
	Intrusion Collisions	0.03678	0.98293	0.03489	41970	244936
	Diamond Collisions	0.00144	0.01549	0.00046	543	3475
	Overspeed	0.02181	1.06692	0.01712	85607	243668
	Broken Rail	0.03112	1.52259	0.02444	122169	347736
	Work Zone Violation	0.00000	0.39582	0.03958	0	158328
	Grade Crossing Collisions	1.66225	4.96091	0.07367	480938	1198052
	Total, All Scenarios	1.78889	11.41928	0.28464	838240	2834079
Freight	Train-Train Collisions	0.00956	0.01030	0.00103	2943	7061
	Intrusion Collisions	0.01378	0.00449	0.00045	564	2362
	Diamond Collisions	0.00631	0.00292	0.00029	1074	2243
	Overspeed	0.01290	0.00408	0.00041	7032	8666
	Broken Rail	0.04213	0.01334	0.00133	22970	28307
	Work Zone Violation	0.00000	0.06402	0.00640	0	25609
	Grade Crossing Collisions	0.22171	0.07805	0.00400	15570	35370
	Total, All Scenarios	0.30639	0.17720	0.01391	50153	109618
Total Passenger + Freight		**2.09529**	**11.59649**	**0.29855**	**888393**	**2943697**

Table R2a: Summer, Joliet(*Included in Full Year Table)*

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Freight	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Total Passenger + Freight						

There are no seasonal traffic variations on the Joliet Sub-corridor. Therefore only one risk calculation is needed for the full year, and there is no separate summer calculation

Table R2b: Summer, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00356	0.24461	0.00933	10571	63007
	Intrusion Collisions	0.00351	0.09520	0.00338	4057	23718
	Diamond Collisions	0.00010	0.00107	0.00003	37	239
	Overspeed	0.00208	0.10221	0.00164	8275	23412
	Broken Rail	0.00297	0.14586	0.00234	11809	33411
	Work Zone Violation	0.00000	0.03748	0.00380	0	15156
	Grade Crossing Collisions	0.18544	0.51800	0.00770	50207	125113
	Total, All Scenarios	0.19766	1.14442	0.02822	84957	284057
Freight	Train-Train Collisions	0.00060	0.00061	0.00006	177	421
	Intrusion Collisions	0.00077	0.00024	0.00002	30	127
	Diamond Collisions	0.00043	0.00020	0.00002	73	152
	Overspeed	0.00072	0.00021	0.00002	377	461
	Broken Rail	0.00236	0.00069	0.00007	1231	1507
	Work Zone Violation	0.00000	0.00350	0.00035	0	1402
	Grade Crossing Collisions	0.01574	0.00494	0.00025	983	2235
	Total, All Scenarios	0.02062	0.01039	0.00080	2871	6304
Total Passenger + Freight		**0.21828**	**1.15481**	**0.02902**	**87827**	**290361**

Table R2c: Summer, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00504	0.34592	0.01316	14858	88937
	Intrusion Collisions	0.00540	0.13665	0.00485	5828	34032
	Diamond Collisions	0.00020	0.00220	0.00007	77	493
	Overspeed	0.00320	0.15179	0.00244	11888	34372
	Broken Rail	0.00457	0.21662	0.00348	16965	49053
	Work Zone Violation	0.00000	0.05643	0.00564	0	22570
	Grade Crossing Collisions	0.16832	0.49018	0.00728	47540	118387
	Total, All Scenarios	0.18674	1.39978	0.03690	97156	347844
Freight	Train-Train Collisions	0.00056	0.00058	0.00006	172	405
	Intrusion Collisions	0.00144	0.00048	0.00005	60	250
	Diamond Collisions	0.00090	0.00041	0.00004	152	318
	Overspeed	0.00134	0.00044	0.00004	746	923
	Broken Rail	0.00439	0.00145	0.00014	2438	3017
	Work Zone Violation	0.00000	0.00673	0.00067	0	2691
	Grade Crossing Collisions	0.01781	0.00677	0.00035	1350	3065
	Total, All Scenarios	0.02643	0.01686	0.00136	4919	10670
Total Passenger + Freight		**0.21317**	**1.41664**	**0.03826**	**102074**	**358514**

Table R2d: Summer, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00860	0.59053	0.02249	25429	151944
	Intrusion Collisions	0.00891	0.23185	0.00823	9885	57751
	Diamond Collisions	0.00030	0.00326	0.00010	114	732
	Overspeed	0.00529	0.25400	0.00407	20163	57784
	Broken Rail	0.00754	0.36248	0.00581	28775	82463
	Work Zone Violation	0.00000	0.09391	0.00945	0	37726
	Grade Crossing Collisions	0.35375	1.00818	0.01498	97746	243500
	Total, All Scenarios	0.38440	2.54419	0.06512	182112	631901
Freight	Train-Train Collisions	0.00116	0.00119	0.00012	348	826
	Intrusion Collisions	0.00221	0.00072	0.00007	90	377
	Diamond Collisions	0.00132	0.00061	0.00006	225	470
	Overspeed	0.00207	0.00065	0.00007	1123	1385
	Broken Rail	0.00675	0.00214	0.00021	3669	4524
	Work Zone Violation	0.00000	0.01023	0.00102	0	4093
	Grade Crossing Collisions	0.03355	0.01170	0.00060	2333	5300
	Total, All Scenarios	0.04706	0.02725	0.00215	7789	16974
Total Passenger + Freight		**0.43146**	**2.57144**	**0.06728**	**189902**	**648875**

Table R3a: All Year, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00949	0.70571	0.02705	30764	182477
	Intrusion Collisions	0.00994	0.28484	0.01012	12206	71048
	Diamond Collisions	0.00038	0.00407	0.00012	143	913
	Overspeed	0.00589	0.30214	0.00486	24896	69680
	Broken Rail	0.00841	0.43118	0.00693	35529	99440
	Work Zone Violation	0.00000	0.11143	0.01114	0	44572
	Grade Crossing Collisions	0.59710	1.92530	0.02857	186625	464876
	Total, All Scenarios	0.63121	3.76467	0.08879	290162	933006
Freight	Train-Train Collisions	0.00161	0.00174	0.00017	504	1199
	Intrusion Collisions	0.00218	0.00071	0.00007	90	376
	Diamond Collisions	0.00168	0.00078	0.00008	286	599
	Overspeed	0.00204	0.00064	0.00006	1117	1372
	Broken Rail	0.00667	0.00208	0.00021	3650	4482
	Work Zone Violation	0.00000	0.01020	0.00102	0	4078
	Grade Crossing Collisions	0.04820	0.01713	0.00088	3426	7781
	Total, All Scenarios	0.06239	0.03328	0.00250	9073	19887
Total Passenger + Freight		0.69360	3.79795	0.09129	299236	952893

Table R3b: All Year, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01417	0.97002	0.03700	41943	249930
	Intrusion Collisions	0.01409	0.38184	0.01356	16273	95135
	Diamond Collisions	0.00043	0.00464	0.00014	163	1042
	Overspeed	0.00836	0.40995	0.00657	33191	93905
	Broken Rail	0.01192	0.58503	0.00938	47367	134010
	Work Zone Violation	0.00000	0.15197	0.01525	0	60953
	Grade Crossing Collisions	0.74378	2.07769	0.03089	201378	501828
	Total, All Scenarios	0.79275	4.58115	0.11279	340315	1136803
Freight	Train-Train Collisions	0.00396	0.00414	0.00041	1177	2832
	Intrusion Collisions	0.00448	0.00140	0.00014	175	736
	Diamond Collisions	0.00186	0.00086	0.00009	317	660
	Overspeed	0.00419	0.00122	0.00012	2187	2676
	Broken Rail	0.01368	0.00400	0.00040	7143	8742
	Work Zone Violation	0.00000	0.02033	0.00203	0	8130
	Grade Crossing Collisions	0.09129	0.02865	0.00147	5700	12965
	Total, All Scenarios	0.11946	0.06059	0.00466	16698	36742
Total Passenger + Freight		0.91221	4.64174	0.11745	357012	1173545

Table R3c: All Year, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.02043	1.38941	0.05291	59736	357421
	Intrusion Collisions	0.02166	0.54810	0.01944	23375	136503
	Diamond Collisions	0.00093	0.01004	0.00030	352	2253
	Overspeed	0.01285	0.60883	0.00977	47683	137868
	Broken Rail	0.01833	0.86885	0.01394	68048	196750
	Work Zone Violation	0.00000	0.22632	0.02263	0	90529
	Grade Crossing Collisions	0.67512	1.96610	0.02919	190682	474847
	Total, All Scenarios	0.74933	5.61766	0.14818	389876	1396171
Freight	Train-Train Collisions	0.00516	0.00561	0.00056	1610	3856
	Intrusion Collisions	0.00933	0.00310	0.00031	389	1628
	Diamond Collisions	0.00409	0.00189	0.00019	696	1452
	Overspeed	0.00873	0.00288	0.00029	4851	6002
	Broken Rail	0.02852	0.00940	0.00094	15847	19607
	Work Zone Violation	0.00000	0.04373	0.00437	0	17494
	Grade Crossing Collisions	0.11578	0.04397	0.00225	8777	19924
	Total, All Scenarios	0.17161	0.11058	0.00891	32171	69963
Total Passenger + Freight		0.92094	5.72824	0.15709	422047	1466134

Table R3d: All Year, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.04409	3.06515	0.11696	132442	789828
	Intrusion Collisions	0.04569	1.21478	0.04312	51854	302686
	Diamond Collisions	0.00174	0.01876	0.00056	657	4208
	Overspeed	0.02709	1.32091	0.02120	105770	301452
	Broken Rail	0.03867	1.88506	0.03025	150943	430200
	Work Zone Violation	0.00000	0.48973	0.04903	0	196054
	Grade Crossing Collisions	2.01600	5.96909	0.08865	578685	1441552
	Total, All Scenarios	2.17329	13.96348	0.34976	1020352	3465980
Freight	Train-Train Collisions	0.01072	0.01149	0.00115	3292	7887
	Intrusion Collisions	0.01599	0.00521	0.00052	654	2739
	Diamond Collisions	0.00764	0.00353	0.00035	1299	2712
	Overspeed	0.01496	0.00474	0.00047	8155	10051
	Broken Rail	0.04887	0.01548	0.00155	26640	32831
	Work Zone Violation	0.00000	0.07426	0.00743	0	29702
	Grade Crossing Collisions	0.25526	0.08975	0.00460	17903	40670
	Total, All Scenarios	0.35345	0.20445	0.01607	57943	126592
Total Passenger + Freight		**2.52674**	**14.16793**	**0.36583**	**1078295**	**3592572**

	K	L	M	N	O	P	Q	R
133	**Table IN-5b: Collision Distributions Between Head-on and Rear/Side by trains Involved and Segment type**							
134								
135	**Head-on and Rear/Side Train-Train Collision Distributions by Segment Type**							
136	**Segment Type**	**Passenger to Passenger**		**Passenger to Freight**			**Freight to Freight**	
137		**Head-on**	**Rear/Side**	**Head-on**	**R/S P into F**	**R/S F into P**	**Head-on**	**Rear/Side**
138	Siding - Monitored	50%	50%	50%	40%	10%	50%	50%
139	Siding - Unmonitored	50%	50%	50%	40%	10%	50%	50%
140	CP-Adjacent, Monitored	90%	10%	80%	15%	5%	75%	25%
141	CP-Adjacent, Unmonitored	90%	10%	80%	15%	5%	75%	25%
142	Plain Track	80%	20%	70%	25%	5%	50%	50%
143								

Worksheet 1-JN: IDOT Risk Model: Braking Distances and Collision Zone Calculations, Cab Signal/ATC 70% Preventability Case, Joliet Sub-corridor

Table 1.1: Stopping Distance Parameters and Calculations, Including Timeout and ACS Response Delay

Braking Formula Inputs		
Train/System Type	Parameter	Value
Freight	Coefficient F	0.035
	Appl'n Time (secs)	13.0
	Train Weight (lb)	12600000
	Brake Force (lb)	778660
Passenger	Coefficient A	0.650
	Coefficient B	0
	Safety Factor	1.25
Train Control	Latency/T-out (sec)	3
	ACS Response (sec)	0
Guilty Train Speed (mph)		110

Braking Distance Calculations (excluding free running in TO) (ft)						Braking Duration (secs)		Guilty Train Distance (ft)		Total Zone Lengths (ft)		
Train Type	Speeds (mph)	To Stop	Reduction to RedCon²	RedCon² to Stop	Deceleration (ft/sec²)	Reduction to RedCon²	RedCon² to Stop	Reduction to RedCon²	RedCon² to Stop	Reduction to RedCon²	RedCon² to Stop	Full Speed to Stop
Freight	25	1671	1671	0	0.668	58	0	1275	0	2946	0	2946
	40	3686	1819	2068	0.668	14	77	308	1692	1927	3760	5686
	50	5452	3384	2068	0.668	36	77	791	1692	4176	3760	7935
Passenger	40	1452	1452	0	1.293	48	0	1065	0	2517	0	2517
	60	3177	3177	0	1.293	71	0	1565	0	4742	0	4742
	79	5433	3035	2398	1.293	25	68	541	1499	3576	3896	7472
	105	9493	7096	2398	1.293	54	68	1190	1499	8286	3896	12182
Frt Red'd Consp	35	1125	NA	NA	1.293							

Blue cells contain data reproduced from the Inputs worksheet

Sight Distance (ft) 2500

Note: RedCon refers to the speed at which collision consequences will be significantly reduced
60 mph for passenger trains and 35 mph for freight trains
If train speed is lower that this speed, then there are no reduced consequences and Zone A2 has zero length

Table 1.2: Segment Definitions: Sub-Corridor 1: MP 64.7 (Manteno) - MP 86.3 (Bonge)

Segment Number	Start (milepost)	End (milepost)	Type	Variant	Length Miles	Length Feet	Posted Speed (mph) Freight	Passenger	HS Pass	Representative Speed (mph) Freight	Passenger	HS Pass (Consp²)	HS Pass (Other)	Industry Siding Number	Industry Siding Name	Passenger Stops
1.0	64.5	62.6	CP Adjacent (M)		2.2	11616	60	79	110	50	79	79	105	0		
2.0	64.8	66.4	Plain		1.8	9240	60	79	110	50	79	79	105	0		
3.0	66.6	68.2	Plain		1.7	8970.4	60	79	110	50	79	79	105	0		
4.0	68.2	70.2	CP Adjacent (M)		1.9	10243.2	60	79	110	50	79	79	105	0		
5.0	70.2	72.6	Siding (M)	Depot (Sect. 1)	2.6	13886.4	60	79	110	50	79	79	105	0		
6.0	72.6	72.6	Siding (M)		0.0	0	60	79	110	50	79	79	105	0		
7.0	72.6	74.5	CP Adjacent (M)		2.1	11299.2	60	79	110	50	79	79	105	0		
8.0	74.5	77.0	CP Adjacent (M)		2.3	12302.4	60	79	110	50	79	79	105	0		
9.0	77.0	80.1	Plain		2.9	15163.2	60	79	110	50	79	79	105	0		
10.0	80.1	80.5	CP Adjacent (M)		1.9	9820.8	60	79	110	50	79	79	105	0		
11.0	80.5	84.2	CP Adjacent (M)		3.7	19404.8	60	79	110	50	79	79	105	0		
12.0	84.2	86.4	Siding (M)	Joliet (Sect. 1)	1.8	9398.4	60	79	110	50	79	79	105	0		
13.0	86.4	86.4	CP Adjacent (M)		1.9	10137.6	60	79	110	50	79	79	105	0		
			Check Total		25.8											

Table 1.3: Mitigation and Prevention Zones - All Segments - Lengths in Feet

Zone A1: Limited Speed Reduction No Prevention or Mitigation			Zone A2: Reduced Speed to Stop Severity Mitigation			Zone B: Able to Stop Full Prevention			Overlap of Stopping Distance into Zone C			Distance in Timeout in Zone C			Overlap of Zone A1 into Zone C			Overlap of Zone A1 into Zone C within Sight Distance			Overlap of Zone A2 into Zone C within Sight Distance			Zone C within Sight Distance		
Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass
4176	3576	8286	3760	3896	3330	3681	4144	0	0	0	566	0	0	462	0	0	0	0	0	0	0	0	588	0	0	2.2
4176	3576	8286	3896	3896	954	1168	1768	0	0	0	2942	0	0	462	0	0	0	0	0	0	0	0	2500	0	0	1.75
4176	3576	8286	3896	3896	585	799	1399	0	0	0	3311	0	0	462	0	0	0	0	0	0	0	0	2500	0	0	1.68
4176	3576	8286	3896	3896	1958	2172	2772	0	0	0	1939	0	0	462	0	0	0	0	0	0	0	0	1939	0	0	1.84
1927	4742	3576	0	0	0	11960	9145	6415	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.63
1927	4742	3576	0	0	0	8233	6008	3828	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.14
4176	3576	8286	3896	3896	3896	4231	4831	121	0	0	0	0	0	462	0	0	0	0	0	0	0	0	2133	0	0	2.33
4176	3576	8286	3896	3896	3896	5226	7629	2933	0	0	0	0	0	462	0	0	0	0	0	0	0	0	2366	0	0	2.86
4176	3576	8286	3896	3896	3335	1749	2349	0	0	0	2351	0	0	462	0	0	0	0	0	0	0	0	2351	0	0	1.89
4176	3576	8286	3896	3896	3896	9271	9573	1663	0	0	0	0	0	462	0	0	0	0	0	0	0	0	2366	0	0	2.86
4176	3576	8286	3896	3896	1113	1327	1927	0	0	0	2783	0	0	462	0	0	0	0	0	0	0	0	2500	0	0	1.79
4176	3576	8286	3896	3896	1852	2066	2666	0	0	0	2044	0	0	462	0	0	0	0	0	0	0	0	2044	0	0	1.92

Table 1.4: Breakdown of Segments Lengths by Representative Speed (miles)

Segment Number	Freight Speeds (mph) 25	40	50	Conven't Pass Speeds (mph) 40	60	79	HS Pass. Speeds - Coll'n Consep. (mph) 40	60	79	105	HS Pass. Speeds - Other (mph) 40	60	79	105
1.0	0	0	2.2	0	0	2.2	0	0	2.2	0	0	0	0	2.2
2.0	0	0	1.75	0	0	1.75	0	0	1.75	0	0	0	0	1.75
3.0	0	0	1.68	0	0	1.68	0	0	1.68	0	0	0	0	1.68
4.0	0	0	1.94	0	0	1.94	0	0	1.94	0	0	0	0	1.94
5.0	0	2.63	0	0	2.63	0	0	2.63	0	0	0	0	2.63	0
6.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.0	0	2.14	0	0	2.14	0	0	2.14	0	0	0	0	2.14	0
8.0	0	0	2.33	0	0	2.33	0	0	2.33	0	0	0	0	2.33
9.0	0	0	2.86	0	0	2.86	0	0	2.86	0	0	0	0	2.86
10.0	0	0	1.89	0	0	1.89	0	0	1.89	0	0	0	0	1.89
11.0	0	0	3.66	0	0	3.66	0	0	3.66	0	0	0	0	3.66
12.0	0	0	1.79	0	0	1.79	0	0	1.79	0	0	0	0	1.79
13.0	0	0	1.92	0	0	1.92	0	0	1.92	0	0	0	0	1.92

Table 1.5: Aggregate Segment Length by Segment Type and Speed

Segment Type	Train Type	Representative Speed (mph)	Aggregate Length of Segments by Train and Segment Types					
			Freight		Conv passenger		High Speed Passenger	
							Collision Consp²	Other
			Miles	Feet	Miles	Feet	Miles	Feet	Miles	Feet
Siding (mon)	Freight	25	0.0	0						
		40	2.6	13886.4						
		50	2.7	14044.8						
	Passenger	40			0.0	0	0.0	0	0.0	0
		60			2.6	13886.4	2.6	13886.4	0.0	0
		79			2.7	14044.8	2.7	14044.8	2.6	13886.4
		105					0.0	0	2.7	14044.8
Siding (unmon)	Freight	25	0.0	0						
		40	0.0	0						
		50	0.0	0						
	Passenger	40			0.0	0	0.0	0	0.0	0
		60			0.0	0	0.0	0	0.0	0
		79			0.0	0	0.0	0	0.0	0
		105					0.0	0	0.0	0
CP Adjacent (mon)	Freight	25	0.0	0						
		40	2.1	11299.2						
		50	7.8	41078.4						
	Passenger	40			0.0	0	0.0	0	0.0	0
		60			2.1	11299.2	2.1	11299.2	0.0	0
		79			7.8	41078.4	7.8	41078.4	2.1	11299.2
		105					0.0	0	7.8	41078.4
CP Adjacent (unmon)	Freight	25	0.0	0						
		40	0.0	0						
		50	0.0	0						
	Passenger	40			0.0	0	0.0	0	0.0	0
		60			0.0	0	0.0	0	0.0	0
		79			0.0	0	0.0	0	0.0	0
		105					0.0	0	0.0	0
Plain Track	Freight	25	0.0	0						
		40	0.0	0						
		50	10.5	55451.2						
	Passenger	40			0.0	0	0.0	0	0.0	0
		60			0.0	0	0.0	0	0.0	0
		79			10.5	55451.2	10.5	55451.2	0.0	0
		105					0.0	0	10.5	55451.2
Check Total			25.8		25.8		25.8		25.8	

²This speed is used to calculate collision consequences in collisions between an equipped and an unequipped train (VSL Y, reflecting the IDOT PTC speed restriction when an equipped train hears an unequipped train

Yellow cells contain data exported to the next worksheet in the sequence of three sheets that perform the calculations for one sub-corridor, season and operating plan

Table 1.6a: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for Siding (M) Segments

Lengths in Zone C: A1 2500, A2 3896, B 0
Total Length, Siding (M) Segments (ft): 27931.2
Number Siding (M) Segments: 7
Average distance in Zone C (ft): Freight 2500; Passenger 2500; HS Pass 2500

	Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass
Sum Zone Lengths A1, A2, B (ft)	6332	8317	11681	3896	3896	7792	17933	15718	8278
Fraction of total length in zone	0.218	0.298	0.425	0.139	0.139	0.279	0.642	0.563	0.296
Collision Accident Mitigation Probabilities: Combined All Zones	0.208	0.283	0.403	0.133	0.133	0.265	0.718	0.635	0.382

Values transferred to Collision Matrix

Distribution of train location at time of violation in Reference Case accidents: In Block 0.95; Previous Block 0.05
PTC Risk increment in Zone C: 2
Potential danger length in Zone C (ft): 2500

Table 1.6b: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for Siding (U) Segments

Lengths in Zone C: A1 2500, A2 3896, B 0
Total Length, Siding (U) Segments (ft): 1
Number Siding (M) Segments: 0.001
Average distance in Zone C (ft): Freight 2500; Passenger 2500; HS Pass 2500

	Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass
Zone lengths A1, A2, B (ft)	0	0	0	0	0	0	0	0	0
Fraction of total length in zone	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Collision Accident Mitigation Probabilities: Combined All Zones	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100

Values transferred to Collision Matrix

Distribution of train location at time of violation in Reference Case accidents: In Block 0.95; Previous Block 0.05
PTC Risk increment in Zone C: 2
Potential danger length in Zone C (ft): 2500

Table 1.6c: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for CP Adjacent (M) Segments

Lengths in Zone C: A1 2500, A2 3896, B 0
Total Length, CP Adjacent (M) Segments (ft): 52077.4
Number CP Adjacent Segments: 5
Average distance in Zone C (ft): Freight 2500; Passenger 2500; HS Pass 1627

	Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass
Zone lengths A1, A2, B (ft)	18629	19044	36718	15448	15584	11832	18301	17749	3528
Fraction of total length in zone	0.358	0.366	0.705	0.297	0.299	0.227	0.349	0.339	0.073
Collision Accident Mitigation Probabilities: Combined All Zones	0.336	0.345	0.666	0.280	0.283	0.214	0.433	0.422	0.111

Values transferred to Collision Matrix

Distribution of train location at time of violation in Reference Case accidents: In Block 0.95; Previous Block 0.05
PTC Risk increment in Zone C: 2
Potential danger length in Zone C (ft): 2500

Table 1.6d: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for CP Adjacent (U)Segments

Lengths in Zone C: A1 2500, A2 3896, B 0
Total Length, CP Adjacent (U) Segments (ft): 1
Number CP Adjacent Segments: 0.001
Average distance in Zone C (ft): Freight 2500; Passenger 2500; HS Pass 2500

	Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass
Zone lengths A1, A2, B (ft)	0	0	0	0	0	0	0	0	0
Fraction of total length in zone	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Collision Accident Mitigation Probabilities: Combined All Zones	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100

Values transferred to Collision Matrix

Distribution of train location at time of violation in Reference Case accidents: In Block 0.95; Previous Block 0.05
PTC Risk increment in Zone C: 2
Potential danger length in Zone C (ft): 2500

Table 1.6e: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for Plain Track Segments

Lengths in Zone C: A1 2500, A2 3896, B 0
Total Length, Plain Track Segments (ft): 55451.2
Number CP Adjacent Segments: 5
Average distance in Zone C (ft): Freight 2500; Passenger 2500; HS Pass 1409

	Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass
Zone lengths A1, A2, B (ft)	18629	19044	36718	0	0	0	0	0	0
Fraction of total length in zone	0.335	0.343	0.662	0.000	0.000	0.000	0.000	0.000	0.000
Collision Accident Mitigation Probabilities: Combined All Zones	0.316	0.325	0.627	0.000	0.000	0.000	0.100	0.100	0.944

Values transferred to Collision Matrix

Distribution of train location at time of violation in Reference Case accidents: In Block 0.95; Previous Block 0.05
PTC Risk increment in Zone C: 2
Potential danger length in Zone C (ft): 2500

Table 1.6f: Distribution of Equipped Train Locations by Collision Preventability Zones - Values for Diamond Segments

Lengths in Zone C: A1 2500, A2 3896, B 0
Total Length, Diamond Adjacent Segments (ft): 20165.4
Number of Diamond Adjacent Segments: 2
Average distance in Zone C (ft): Freight 2500; Passenger 2500; HS Pass 2500

	Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass
Zone lengths A1, A2, B (ft)	3236	4354	8070	4135	0	4726	17813	16832	14320
Fraction of total length in zone	0.129	0.252	0.241	0.164	0.000	0.190	0.707	0.748	0.569
Collision Accident Mitigation Probabilities: Combined All Zones	0.122	0.240	0.229	0.156	0.000	0.181	0.772	0.815	0.640

Values transferred to Collision Matrix

Distribution of train location at time of violation in Reference Case accidents: In Block 0.95; Previous Block 0.05
PTC Risk increment in Zone C: 2
Potential danger length in Zone C (ft): 2500

Worksheet 2 - J,N,R: Collision Frequencies Calculation - Cab Signal/ATC 70% Preventability Case, Joliet Sub-corridor, Rest of Year

Table 2.1a: Collision Distribution Matrix (Fraction Accidents by Train Pair and Collision Type). Collisions Between Trains Operating on the IDOT Test Corridor Only (not diamonds and intrusions)

Train Pairs in Collision	Collision Scenario Prob (Top Level)	Siding - Monitored: Head On — Collision Distribution	Siding - Monitored: Rear End/Side — Collision Distribution	Siding - Monitored: Head On — Equip Guilty	Siding - Monitored: Head On — Unequip Guilty	Siding - Monitored: Rear End/Side — Equip Guilty	Siding - Monitored: Rear End/Side — Unequip Guilty
Percent Guilty				100%	0%	100%	0%
Pass-Pass	0.71	0.50	0.50	0.355	0	0.355	0
Pass-TBE Freight	0.29	0.50	0.50	0.145	0	0.145	0
TBE Freight - TBE Freight (Note 3)	0.00	0.50	0.50	0	0	0	0
Percent Guilty				50%	50%	50%	50%
Pass - NE Freight, Head -On	0.00	1	0	0	0	0	0
Rear/Side, Pass into NE Frt		0	1	0	0	0	0
Rear/Side NE Frt into Pass		0	1	0	0	0	0
TBE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0
Percent Guilty				0%	100%	0%	100%
NE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0
Total Probability, (checking)	1		1	0.5	0	0.5	0

Train Pairs in Collision	Siding - Unmonitored: Head On — Collision Distribution	Siding - Unmonitored: Rear End/Side — Collision Distribution	Siding - Unmonitored: Head On — Equip Guilty	Siding - Unmonitored: Head On — Unequip Guilty	Siding - Unmonitored: Rear End/Side — Equip Guilty	Siding - Unmonitored: Rear End/Side — Unequip Guilty
Percent Guilty			100%	0%	100%	0%
Pass-Pass	0.5	0.5	0.355	0	0.355	0
Pass-TBE Freight	0.5	0.5	0.145	0	0.145	0
TBE Freight - TBE Freight	0.5	0.5	0	0	0	0
Percent Guilty			50%	50%	50%	50%
Pass - NE Freight, Head -On	1	0	0	0	0	0
Rear/Side, Pass into NE Frt	0	1	0	0	0	0
Rear/Side NE Frt into Pass	0	1	0	0	0	0
TBE Freight - NE Freight	0.5	0.5	0	0	0	0
Percent Guilty			0%	100%	0%	100%
NE Freight - NE Freight	0.5	0.5	0	0	0	0
Total Probability, (checking)		1	0.5	0	0.5	0

Train Pairs in Collision	CP Adjacent - Monitored Siding: Head On — Collision Distribution	CP Adjacent - Monitored Siding: Rear End/Side — Collision Distribution	CP Adjacent - Monitored Siding: Head On — Equip Guilty	CP Adjacent - Monitored Siding: Head On — Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side — Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side — Unequip Guilty
Percent Guilty			100%	0%	100%	0%
Pass-Pass	0.8	0.2	0.568	0	0.142	0
Pass-TBE Freight	0.7	0.3	0.203	0	0.087	0
TBE Freight - TBE Freight	0.7	0.3	0	0	0	0
Percent Guilty			50%	50%	50%	50%
Pass - NE Freight, Head -On	1	0	0	0	0	0
Rear/Side, Pass into NE Frt	0	1	0	0	0	0
Rear/Side NE Frt into Pass	0	1	0	0	0	0
TBE Freight - NE Freight	0.7	0.3	0	0	0	0
Percent Guilty			0%	100%	0%	100%
NE Freight - NE Freight	0.7	0.3	0	0	0	0
Total Probability, (checking)		1	0.771	0	0.229	0

Train Pairs in Collision	CP Adjacent - Unmonitored Siding: Head On — Collision Distribution	CP Adjacent - Unmonitored Siding: Rear End/Side — Collision Distribution	CP Adjacent - Unmonitored Siding: Head On — Equip Guilty	CP Adjacent - Unmonitored Siding: Head On — Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side — Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side — Unequip Guilty
Percent Guilty			100%	0%	100%	0%
Pass-Pass	0.88	0.12	0.568	0	0.142	0
Pass-TBE Freight	0.7	0.3	0.203	0	0.087	0
TBE Freight - TBE Freight	0.7	0.3	0	0	0	0
Percent Guilty			50%	50%	50%	50%
Pass - NE Freight, Head -On	1	0	0	0	0	0
Rear/Side, Pass into NE Frt	0	1	0	0	0	0
Rear/Side NE Frt into Pass	0	1	0	0	0	0
TBE Freight - NE Freight	0.7	0.3	0	0	0	0
Percent Guilty			0%	100%	0%	100%
NE Freight - NE Freight	0.7	0.3	0	0	0	0
Total Probability, (checking)		1	0.771	0	0.229	0

Train Pairs in Collision	Plain Track: Collision Distribution — Head On	Plain Track: Collision Distribution — Rear/Side	Plain Track: Head On — Equip Guilty	Plain Track: Head On — Unequip Guilty	Plain Track: Rear End/Side — Equip Guilty	Plain Track: Rear End/Side — Unequip Guilty
Percent Guilty			100%	0%	100%	0%
Pass-Pass	0.70	0.30	0.497	0	0.213	0
Pass-TBE Freight	0.40	0.60	0.116	0	0.174	0
TBE Freight - TBE Freight	0.50	0.50	0	0	0	0
Percent Guilty			50%	50%	50%	50%
Pass - NE Freight, Head -On	1.00	0.00	0	0	0	0
Rear/Side, Pass into NE Frt	0.00	1.00	0	0	0	0
Rear/Side NE Frt into Pass	0.00	1.00	0	0	0	0
TBE Freight - NE Freight	0.50	0.50	0	0	0	0
Percent Guilty			0%	100%		
NE Freight - NE Freight	0.50	0.50	0	0	0	0
Total Probability, (checking)		1	0.613	0	0.387	0

Table 2.1b: Collision Type Distribution - Diamonds

Train Pairs in Collision	Diamond Collisions: Rear End/Side — Equip Guilty	Diamond Collisions: Rear End/Side — Unequip Guilty
Percent Guilty		
Pass-Pass		
Pass-TBE Freight		
TBE Freight - TBE Freight		
Percent Guilty	50%	50%
Pass - NE Freight, Head -On	0	0
Rear/Side, Pass into NE Frt	0.25	0.25
Rear/Side NE Frt into Pass	0.05	0.05
TBE Freight - NE Freight	0.1	0.1
Percent Guilty		100%
NE Freight - NE Freight	0	0.2
Total Probability, (checking)	0.4	0.6

Note: The gray cells on these rows are set at zero, because in every case, the condition represented by the cell does not exist - either because there are no unequipped passenger trains, or because of the kind of collision defined for the row.

Quantity in cell C18 is for all collisions between a passenger train and an unequipped freight train

Table 2.2: Preventability Data For Unequipped train Guilty, One Train TBE

Segment Type	Not Prevented or Mitigated: Freight	Not Prevented or Mitigated: Pass	Not Prevented or Mitigated: HS Pass	Mitigated: Freight	Mitigated: Pass	Mitigated: HS Pass	Prevented: Freight	Prevented: Pass	Prevented: HS Pass
Siding (M)	0.208	0.283	0.403	0.133	0.133	0.265	0.710	0.635	0.382
Siding (U)	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100
CP Adjacent (M)	0.338	0.345	0.666	0.280	0.283	0.274	0.432	0.422	0.111
CP Adjacent (U)	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100
Plain Track	0.318	0.525	0.677	0.000	0.056	0.056	0.100	0.100	0.044
Diamonds	0.122	0.749	0.229	0.156	0.569	0.181	0.772	0.618	0.648

Mauve cells contain data imported from prev ious worksheet in a group of three worksheets covering one sub-corridor, season and operating state.

Table 2.3a: Collision Preventability Matrix (Percent Accidents Preventable Relative to CTC Reference Case)

Preventability Equipped Train Guilty	Siding - Monitored: Head On — Equip Guilty	Siding - Monitored: Head On — Unequip Guilty	Siding - Monitored: Rear End/Side — Equip Guilty	Siding - Monitored: Rear End/Side — Unequip Guilty	Siding - Unmonitored: Head On — Equip Guilty	Siding - Unmonitored: Head On — Unequip Guilty	Siding - Unmonitored: Rear End/Side — Equip Guilty	Siding - Unmonitored: Rear End/Side — Unequip Guilty
Both TBE								
Pass-Pass	70%		70%		70%		70%	
Pass-TBE Freight	70%		70%		70%		70%	
TBE Freight - TBE Freight	70%		70%		70%		70%	
One TBE								
Pass - NE Freight, Head -On	70%		70%	38%			70%	10%
Rear/Side, Pass into NE Frt	70%				70%	38%		
Rear/Side NE Frt into Pass	70%		70%	0%			70%	0%
TBE Freight - NE Freight	70%		70%	71%	70%	0%	70%	10%
Neither TBE								
NE Freight - NE Freight				0%		0%		0%
Reference Case (CTC) Collision Accident Likelihood by Segment Type (collisions/million train miles)	6.659				0.940			

Preventability Equipped Train Guilty	CP Adjacent - Monitored Siding: Head On — Equip Guilty	CP Adjacent - Monitored Siding: Head On — Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side — Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side — Unequip Guilty	CP Adjacent - Unmonitored Siding: Head On — Equip Guilty	CP Adjacent - Unmonitored Siding: Head On — Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side — Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side — Unequip Guilty
Both TBE								
Pass-Pass	70%		70%		70%		70%	
Pass-TBE Freight	70%		70%		70%		70%	
TBE Freight - TBE Freight	70%		70%		70%		70%	
One TBE								
Pass - NE Freight, Head -On	70%	11%	70%	11%			70%	10%
Rear/Side, Pass into NE Frt					70%	11%		
Rear/Side NE Frt into Pass	70%		70%	0%			70%	0%
TBE Freight - NE Freight	70%	43%	70%	0%	70%	10%	70%	0%
Neither TBE								
NE Freight - NE Freight		0%		0%				
Reference Case (CTC) Collision Accident Likelihood by Segment Type (collisions/million train miles)		1.950			1.063			

Preventability Equipped Train Guilty	Plain Track: Collision Distribution — Head On	Plain Track: Collision Distribution — Rear/Side	Plain Track: Head On — Equip Guilty	Plain Track: Head On — Unequip Guilty	Plain Track: Rear End/Side — Equip Guilty	Plain Track: Rear End/Side — Unequip Guilty
Both TBE						
Pass-Pass			70%		70%	
Pass-TBE Freight			70%		70%	
TBE Freight - TBE Freight			70%		70%	
One TBE						
Pass - NE Freight, Head -On			70%	4%		
Rear/Side, Pass into NE Frt					70%	4%
Rear/Side NE Frt into Pass					70%	0%
TBE Freight - NE Freight			70%	10%	70%	0%
Neither TBE						
NE Freight - NE Freight				0%		
Reference Case (CTC) Collision Accident Likelihood by Segment Type (collisions/million train miles)	5.056					

Table 2.3b: Collision Preventability Matrix - Diamonds

Diamond Collisions: Rear End/Side — Equip Guilty	Diamond Collisions: Rear End/Side — Unequip Guilty
70%	81.03%
70%	81.02%
70%	77.19%
	0.00%
4.1	

Table 2.4a: Passenger Trains in Train-to-Train Collisions (Trains in Collisions per Million Train-Miles)

Passenger Trains in Collisions	Siding - Monitored: Head On — Equip Guilty	Siding - Monitored: Head On — Unequip Guilty	Siding - Monitored: Rear End/Side — Equip Guilty	Siding - Monitored: Rear End/Side — Unequip Guilty	Siding - Unmonitored: Head On — Equip Guilty	Siding - Unmonitored: Head On — Unequip Guilty	Siding - Unmonitored: Rear End/Side — Equip Guilty	Siding - Unmonitored: Rear End/Side — Unequip Guilty
Both TBE								
Pass-Pass	2		0.0064		0.0064		0.0085	
Pass-TBE Freight	1		0.0013		0.0013		0.0017	
TBE Freight - TBE Freight	0							
One TBE								
Pass - NE Freight, Head -On	1		0.0000	0.0000			0.0000	0.0000
Rear/Side, Pass into NE Frt	1				0.0000	0.0000		
Rear/Side NE Frt into Pass	1				0.0000	0.0000		
TBE Freight - NE Freight	0							
Neither TBE								
NE Freight - NE Freight	0							
Checking total			0.0077	0.0000	0.0077	0.0000	0.0103	0.0000
Scenario Totals - Passenger	Tots, P-UP	Totals					Totals	
Pass Loco Hits Loco	0.0000	0.0077	0.0077	0.0000			0.0000	0.0103
Pass Loco Hits Pass Car	0.0000	0.0000			0.0032		0.0043	
Pass Loco Hits Freight Car	0.0000	0.0000			0.0010		0.0000	0.0014
Pass Car Hit by Loco	0.0000	0.0026			0.0035	0.0000	0.0000	0.0046
Total		0.0154	0.0077	0.0000	0.0077	0.0000		0.0035

Passenger Trains in Collisions	CP Adjacent - Monitored Siding: Head On — Equip Guilty	CP Adjacent - Monitored Siding: Head On — Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side — Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side — Unequip Guilty	CP Adjacent - Unmonitored Siding: Head On — Equip Guilty	CP Adjacent - Unmonitored Siding: Head On — Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side — Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side — Unequip Guilty
Both TBE								
Pass-Pass	0.0170		0.0043				0.0024	
Pass-TBE Freight	0.0030		0.0013				0.0037	
TBE Freight - TBE Freight								
One TBE								
Pass - NE Freight, Head -On	0.0000	0.0000					0.0000	0.0000
Rear/Side, Pass into NE Frt			0.0000	0.0000				
Rear/Side NE Frt into Pass			0.0000	0.0000			0.0000	0.0000
TBE Freight - NE Freight	0.0000	0.0000	0.0025	0.0000	0.0000	0.0000	0.0029	0.0000
Neither TBE								
NE Freight - NE Freight								
Checking total	0.0200	0.0000	0.0056	0.0000			0.0241	0.0000
Scenario Totals - Passenger	Totals						Totals	
Pass Loco Hits Loco	0.0000	0.0201	0.0201	0.0000			0.0000	0.0241
Pass Loco Hits Pass Car		0.0021					0.0026	
Pass Loco Hits Freight Car	0.0000	0.0010					0.0012	
Pass Car Hit by Loco	0.0000	0.0025		0.0000			0.0029	0.0000
Total		0.0257	0.0201	0.0000			0.0268	0.0241

Passenger Trains in Collisions	Plain Track: Collision Distribution — Head On	Plain Track: Collision Distribution — Rear/Side	Plain Track: Head On — Equip Guilty	Plain Track: Head On — Unequip Guilty	Plain Track: Rear End/Side — Equip Guilty	Plain Track: Rear End/Side — Unequip Guilty
Both TBE						
Pass-Pass			0.0018		0.0008	
Pass-TBE Freight			0.0002		0.0003	
TBE Freight - TBE Freight						
One TBE						
Pass - NE Freight, Head -On			0.0000	0.0000		
Rear/Side, Pass into NE Frt					0.0000	0.0000
Rear/Side NE Frt into Pass					0.0000	0.0000
TBE Freight - NE Freight			0.0000	0.0000	0.0000	0.0000
Neither TBE						
NE Freight - NE Freight						
Checking total			0.0020	0.0000	0.0011	0.0000
Scenario Totals - Passenger	Totals					
Pass Loco Hits Loco	0.0000	0.0020	0.0020	0.0000		
Pass Loco Hits Pass Car		0.0004			0.0004	0.0000
Pass Loco Hits Freight Car	0.0000	0.0004			0.0003	
Pass Car Hit by Loco	0.0000	0.0004			0.0004	0.0000
Total		0.0033	0.0020	0.0000	0.0011	0.0000

Table 2.4b: Passenger Trains in Collisions at Diamonds

Diamond Collisions: Rear End/Side — Equip Guilty	Diamond Collisions: Rear End/Side — Unequip Guilty
0.007500	0.004742
0.001500	0.000948
0.000000	0.000000
	0.000000
0.009000	0.005690
Totals	
0.0020	0.0000
0.0004	
0.0003	
0.0004	0.0000
0.0031	0.0000
0.007500	0.004742
0.001500	0.000948
0.000000	0.000000
0.009000	0.005690

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Table 2.5a: Freight Trains in Train-to-Train Collisions (Trains in Collisions per Million Train-Miles)

Freight Trains in Collisions	Siding - Monitored: Head On — Equip Guilty	Siding - Monitored: Head On — Unequip Guilty	Siding - Monitored: Rear End/Side — Equip Guilty	Siding - Monitored: Rear End/Side — Unequip Guilty	Siding - Unmonitored: Head On — Equip Guilty	Siding - Unmonitored: Head On — Unequip Guilty	Siding - Unmonitored: Rear End/Side — Equip Guilty	Siding - Unmonitored: Rear End/Side — Unequip Guilty
Both TBE								
Pass-Pass	0							
Pass-TBE Freight	1		0.0013		0.0013		0.0017	
TBE Freight - TBE Freight	2		0.0000		0.0000		0.0000	
One TBE								
Pass - NE Freight, Head -On	1		0.0000	0.0000			0.0000	0.0000
Rear/Side, Pass into NE Frt	1				0.0000	0.0000		
Rear/Side NE Frt into Pass	1				0.0000	0.0000		
TBE Freight - NE Freight	2		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Neither TBE								
NE Freight - NE Freight	2		0.0000		0.0000	0.0000	0.0000	0.0000
Checking total			0.0013	0.0000	0.0013	0.0000	0.0017	0.0000
Scenario Totals - Freight	Totals				Totals			
Freight Loco Hits Loco	0.0000	0.0013	0.0013	0.0000			0.0017	0.0000
Freight Loco Hits Car	0.0000	0.0003			0.00026	0.00000	0.0003	
Freight Car Hit By Loco	0.0000	0.0000			0.00104	0.00000	0.0014	
Total		0.0026	0.0013	0.0000	0.0013	0.0000	0.0035	0.0017

Freight Trains in Collisions	CP Adjacent - Monitored Siding: Head On — Equip Guilty	CP Adjacent - Monitored Siding: Head On — Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side — Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side — Unequip Guilty	CP Adjacent - Unmonitored Siding: Head On — Equip Guilty	CP Adjacent - Unmonitored Siding: Head On — Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side — Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side — Unequip Guilty
Both TBE								
Pass-Pass	0.0030		0.0013				0.0037	
Pass-TBE Freight	0.0000		0.0000				0.0016	
TBE Freight - TBE Freight								
One TBE								
Pass - NE Freight, Head -On	0.0000	0.0000					0.0000	0.0000
Rear/Side, Pass into NE Frt			0.0000	0.0000				
Rear/Side NE Frt into Pass			0.0000	0.0000			0.0000	0.0000
TBE Freight - NE Freight	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Neither TBE								
NE Freight - NE Freight	0.0030	0.0000	0.0013	0.0000			0.0037	0.0000
Checking total								
Scenario Totals - Freight	Totals						Totals	
Freight Loco Hits Loco	0.0030	0.0000			0.00033	0.00000	0.0037	0.0000
Freight Loco Hits Car			0.0013	0.0000	0.00098	0.00000	0.0012	
Freight Car Hit By Loco								
Total								

Freight Trains in Collisions	Plain Track: Collision Distribution — Head On	Plain Track: Collision Distribution — Rear/Side	Plain Track: Head On — Equip Guilty	Plain Track: Head On — Unequip Guilty	Plain Track: Rear End/Side — Equip Guilty	Plain Track: Rear End/Side — Unequip Guilty
Both TBE						
Pass-Pass						
Pass-TBE Freight			0.0002		0.0003	
TBE Freight - TBE Freight						
One TBE						
Pass - NE Freight, Head -On			0.0000	0.0000		
Rear/Side, Pass into NE Frt					0.0000	0.0000
Rear/Side NE Frt into Pass					0.0000	0.0000
TBE Freight - NE Freight			0.0000	0.0000	0.0000	0.0000
Neither TBE						
NE Freight - NE Freight				0.0000	0.0003	0.0000
Checking total			0.0002	0.0000	0.0003	0.0000
Scenario Totals - Freight	Totals					
Freight Loco Hits Loco	0.0000	0.0002	0.0000			
Freight Loco Hits Car					0.00005	0.00000
Freight Car Hit By Loco					0.00005	0.00000
Total						

Table 2.5b: Freight Trains on Collisions at Diamonds

Diamond Collisions: Rear End/Side — Equip Guilty	Diamond Collisions: Rear End/Side — Unequip Guilty
0.007500	0.004742
0.001500	0.000948
0.000000	0.000562
	0.000000
0.010500	0.006624
Totals	
0.0020	0.0000
0.0003	
0.0004	0.0000
0.0027	0.0000
0.010500	0.022239
0.003000	0.001521
0.004500	0.027023
0.015000	0.050252

Freight Trains in Collisions	Collision Ratios: Collision Type	Collision Ratios: Like Trains — Loco hits car	Collision Ratios: Like Trains — car hit by loco	Collision Ratios: Unlike Trains — P loco hits F car	Collision Ratios: Unlike Trains — F loco hits P car
	Freight to Freight	0.50	0.50		
	Passenger to Passenger	0.50	0.50		
	Passenger to Freight			0.4	0.2

Freight Trains in Collisions	Collision Ratios: Collision Type	Collision Ratios: Like Trains — Loco hits car	Collision Ratios: Like Trains — car hit by loco	Collision Ratios: Unlike Trains — P loco hits F car	Collision Ratios: Unlike Trains — F loco hits P car
	Freight to Freight	0.50	0.50		
	Passenger to Passenger	0.50	0.50		
	Passenger to Freight			0.80	0.20

Freight Trains in Collisions	Collision Ratios: Collision Type	Collision Ratios: Like Trains — Loco hits car	Collision Ratios: Like Trains — car hit by loco	Collision Ratios: Unlike Trains — P loco hits F car	Collision Ratios: Unlike Trains — F loco hits P car
	Freight to Freight	0.50	0.50		
	Passenger to Passenger	0.50	0.50		
	Passenger to Freight			0.75	0.25

Freight Trains in Collisions	Collision Ratios: Collision Type	Collision Ratios: Like Trains — Loco hits car	Collision Ratios: Like Trains — car hit by loco	Collision Ratios: Unlike Trains — P loco hits F car	Collision Ratios: Unlike Trains — F loco hits P car
	Freight to Freight	0.50	0.50		
	Passenger to Passenger	0.50	0.50		
	Passenger to Freight			0.83	0.17

In rear-end/side collisions between like trains there is one loco hits car and one car hit by loco in each collision. In rear/side collisions between a passenger and freight trains, the ratio between passenger hits freight and freight loco hits passenger car are a function of the percentages giv en in Table IN-5b on the Inputs sheet. The v alues are given in the tables beneath the trains in collisions f or each segment ty pe.

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Freight Pax Passenger Totals (check)												
	0.0600	0.0180			0.0800	0.0240			0.1000	0.0300		
	0.1200	0.0360							0.0030			

Worksheet 3 - J,N,R: - Risk Calculations - Cab Signal/ATC 70% Preventability Case, Joliet Subcorridor, Rest of Year

Table 3.1: Consequences Look-up Tables (Data Sources: Previous ICF Passenger Corridor Project (passenger), FRA Accident Data 2001-5 (freight)

Passenger Trains	Accident Scenario	Accident Sub-scenarios	Rep. Speed 40 mph: Injuries	Fatalities	Damage $	Rep. Speed 60 mph: Injuries	Fatalities	Damage $	Rep. Speed 79 mph: Injuries	Fatalities	Damage $	Rep. Speed 105 mph: Injuries	Fatalities	Damage $
	Train-Train Collision	Pass Loco hits Loco	0.083	0.002	502000	0.139	0.0049	1142000	0.24	0.0085	1976000	0.425	0.018	3495000
		Pass Loco hits Pass Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.008	1747000
		Pass Loco hits Frt Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.008	1747000
		Pass car hit by Loco	0.166	0.005	1095000	0.275	0.0119	2284000	0.476	0.0205	3951000	0.841	0.032	6989000
	Intrusion Collision (rollout)	Pass Loco hits Car	0.013	0.0005	113000	0.031	0.0011	257000	0.054	0.0019	445000	0.096	0.0034	786000
	Intrusion Collision (other))	Pass Loco hits Car	0.026	0.0009	226000	0.063	0.0022	514000	0.108	0.0038	889000	0.191	0.0068	1573000
	Overspeed		0.044	0.0004	667000	0.14	0.00186	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Broken Rail		0.044	0.0004	667000	0.14	0.00186	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Work Zone Violation		0.063	0.0083	0	0.125	0.0125	0	0.164	0.0164	0	0.218	0.0218	0

Freight trains	Accident Scenario	Accident Sub-scenarios	Rep. Speed 25 mph: Injuries	Fatalities	Damage $	Rep. Speed 40 mph: Injuries	Fatalities	Damage $	Rep. Speed 50 mph: Injuries	Fatalities	Damage $
	Train-Train Collision	Frt Loco hits Loco	0.43	0.043	105000	1.1	0.11	270000	1.7	0.17	422000
		Frt Loco hits Car	0.35	0.035	88000	0.9	0.09	225000	1.4	0.14	352000
		Frt car hit by Loco	0	0	44000	0	0	112000	0	0	176000
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Overspeed, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Overspeed, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Work Zone Viol'n, Equip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0
	Work Zone Viol'n, Unequip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0

Casualties and damage in Table 3.1 are per accident, except for Work Zone Violations which are per million train-miles

Table 3.2: Grade Crossing and Diamonds: Numbers by Representative Speed, and Accident Frequency and Consequences

Train Type	Rep. Speed (mph)	Type of Grade-crossing	Number Crossings: Passenger	HS Passenger	Freight	Accident Frequency per Million Crossing Passes: Passenger	Freight	Crossing Collision Consequences: Pass. Occup't Casualty Prob(accident) Injuries	Casualty Prob(accident) Fatalities	Cost $/Accid't	Freight Trains (per accident): Injuries	Fatalities	Cost $	Number Diamonds
Passenger	40	Public_gates_lights	0	0		0.350		0.0029	0.000047	50000				1
		Public_other	0	0		0.300								
		Private	0	0		0.100								
	60	Public_gates_lights	8	0		0.600		0.0068	0.000112	113000				0
		Public_other	0	0		0.500								
		Private	0	0		0.200								
	79	Public_gates_lights	20	8		0.800		0.0105	0.000158	196000				0
		Public_other	0	0		0.650								
		Private	1	0		0.300								
	105	Public_gates_lights	0	20		1.100		0.0188	0.000276	346000				0
		Public_other	0	0		0.800								
		Private	0	1		0.300								
Freight	25	Public_gates_lights			0		0.150				0.12	0.005	20000	0
		Public_other			0		0.120							
		Private			0		0.050							
	40	Public_gates_lights			8		0.300				0.25	0.013	50000	1
		Public_other			0		0.250							
		Private			0		0.100							
	50	Public_gates_lights			20		0.360				0.39	0.02	78000	0
		Public_other			0		0.300							
		Private			1		0.120							

Table 3.3a: Segment Data (for reference only, not used in calculations)

Segment Number	Start (Milepost)	End (Milepost)	Type	Length (miles)	Rep. Speed (mph): Freight	Pass	HS Pass-Cons	HS Pass
1.0	64.00	64.80	CP Adjacent (M	2.20	50	79	79	105
2.0	64.80	66.55	Plain	1.75	50	79	79	105
3.0	66.55	68.23	Plain	1.68	50	79	79	105
4.0	68.23	70.17	CP Adjacent (M	1.94	50	79	79	105
5.0	70.17	72.80	Siding (M	2.63	40	60	60	79
6.0	72.80	72.80	Diamond	0.00	40	40	40	40
7.0	72.80	74.94	CP Adjacent (M	2.14	40	60	60	79
8.0	74.94	77.27	Plain	2.33	50	79	79	105
9.0	77.27	80.13	Plain	2.86	50	79	79	105
10.0	80.13	81.99	CP Adjacent (M	1.86	50	79	79	105
11.0	81.99	84.65	Siding (M	2.66	50	79	79	105
12.0	84.65	86.43	CP Adjacent (M	1.78	50	79	79	105
13.0	86.43	88.35	Plain	1.92	50	79	79	105
	Length Check	64.8		25.8				

Table 3.3b: Aggregate Segment Data: Segments Types, Train Types, Speeds, and Lengths (miles)

Aggregate Segment Length by Type and Speed Band (from Seg Def and Preventability)

Segment Type	Train Type	Represent've Speed (mph)	Freight (miles)	Reg Pass (miles)	HS Pass Collision (mi)	HS Pass Other (mi)
Siding (mon)	Freight	25	0.00			
		40	2.63			
		50	2.66			
	Passenger	40		0.00	0.00	0.00
		60		2.63	2.63	0.00
		79		2.66	2.66	2.63
		105		0.00	0.00	2.66
Siding (unmon)	Freight	25	0.00			
		40	0.00			
		50	0.00			
	Passenger	40		0.00	0.00	0.00
		60		0.00	0.00	0.00
		79		0.00	0.00	0.00
		105		0.00	0.00	0.00
CP Adjacent (mon)	Freight	25	0.00			
		40	2.14			
		50	7.78			
	Passenger	40		0.00	0.00	0.00
		60		2.14	2.14	0.00
		79		7.78	7.78	2.14
		105		0.00	0.00	7.78
CP Adjacent (unmon)	Freight	25	0.00			
		40	0.00			
		50	0.00			
	Passenger	40		0.00	0.00	0.00
		60		0.00	0.00	0.00
		79		0.00	0.00	0.00
		105		0.00	0.00	0.00
Plain Track	Freight	25	0.00			
		40	0.00			
		50	10.54			
	Passenger	40		0.00	0.00	0.00
		60		0.00	0.00	0.00
		79		10.54	10.54	0.00
		105		0.00	0.00	10.54
Totals All Types	Freight	25	0.00			
		40	4.77			
		50	20.98			
	Passenger	40		0.00	0.00	0.00
		60		4.77	4.77	0.00
		79		20.98	20.98	4.77
		105		0.00	0.00	20.98
		Checking Total	25.75	25.75	25.75	25.75

Table 3.4a: Traffic Inputs to Risk Calculation

Trips/Day

Train Type	Summer	Rest of Year
Passenger	6.00	6.00
Equipped Freight	1.43	1.43
Unequipped Freight	0.00	0.00
Operating Days	91.00	274.00

Percent Train-Miles in

Timeout (secs)	0
Normal Operating Mode	95.00
Timout Mode	0.00
Fallback Mode	5

Passenger Train Occupancy

Seats	320
Occupancy Factor	0.6

Table 3.4: Collision Frequencies by Segment Type and Collision Scenario (From Coll Matrix)

Scenarios	Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain	Diamond
Pass Loco Hits Loco	0.0077	0.0103	0.0201	0.0241	0.0020	0.000000
Pass Loco Hits Pass Car	0.0032	0.0043	0.0021	0.0026	0.0004	0.000000
Pass Loco Hits Freight Car	0.0010	0.0014	0.0010	0.0012	0.0003	0.012242
Pass Car Hit by Loco	0.0035	0.0046	0.0025	0.0029	0.0004	0.002448
Freight Loco Hits Loco	0.0013	0.0017	0.0030	0.0037	0.0002	0.000000
Freight Loco Hits Car	0.0003	0.0003	0.0003	0.0004	0.0001	0.033729
Freight Car Hit By Loco	0.0010	0.0014	0.0010	0.0012	0.0003	0.031523

Collision Frequencies for Passenger + Unequipped Freight Train

Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain
0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000

Mauve cells contain data imported from previous worksheet in a group of three worksheets covering one sub-corridor, season and operating state.

All train-to-train collision frequencies are in units of **trains in collisions per million train-miles operated in the sub-corridor by all train types.**

Weighted Collision Accident Frequencies by Representative Speed (mph)

Scenarios	Freight: 25	40	50	Passenger: 40	60	79	105
Pass Loco Hits Loco				0.0000	0.0000	0.0133	0.0094
Pass Loco Hits Pass Car				0.0000	0.0000	0.0027	0.0014
Pass Loco Hits Freight Car				0.0000	0.0000	0.0010	0.0006
Pass Car Hit by Loco				0.0000	0.0000	0.0030	0.0016
Freight Loco Hits Loco	0.0000	0.0021	0.0014				
Freight Loco Hits Car	0.0000	0.0003	0.0002				
Freight Car Hit By Loco	0.0000	0.0010	0.0006				

Table 3.5a: Risk Calculation - Passenger Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Rep. Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Freq'y (per mill. t-m)	Preventability Factor	Adjusted Frequency	Trips/day	Trips per 10 years	Length of Track (miles)	Train-miles per 10 years	Accidents per 10 years	Number seats per train	Occupancy Factor	Passengers per train	Injuries per 10 years	Fatalities per 10 years	Damage $ per 10 years
40	Train-Train Collision	Pass Loco hits Loco	0.00000	Incl	0.00000	7.43	25764	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Pass Car	0.00000	Incl	0.00000	7.43	25764	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Frt Car	0.00000	Incl	0.00000	7.43	25764	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00000	Incl	0.00000	7.43	25764	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.35	0.00559	6.00	20805	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (other))	Pass Loco hits intruder	0.01440	0.10	0.01296	6.00	20805	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Overspeed		0.01100	0.00	0.01100	6.00	20805	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Broken Rail		0.01670	0.06	0.01570	6.00	20805	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Work Zone Violation			0.00		6.00	20805	0	0					0.0000	0.00000	0
										0.00000				**0.00000**	**0.00000**	**0**
60	Train-Train Collision	Pass Loco hits Loco	0.00000	Incl	0.00000	7.43	25764	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Pass Car	0.00000	Incl	0.00000	7.43	25764	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Frt Car	0.00000	Incl	0.00000	7.43	25764	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00000	Incl	0.00000	7.43	25764	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.35	0.00559	6.00	20805	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.10	0.01296	6.00	20805	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Overspeed		0.01100	0.00	0.01100	6.00	20805	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Broken Rail		0.01670	0.06	0.01570	6.00	20805	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Work Zone Violation			0.00		6.00	20805	0	0					0.0000	0.00000	0
										0.00000				**0.00000**	**0.00000**	**0**
79	Train-Train Collision	Pass Loco hits Loco	0.01325	Incl	0.01325	7.43	25764	4.77	122892	0.00163	320	0.6	192	0.075	0.0027	3218
		Pass Loco hits Pass Car	0.00272	Incl	0.00272	7.43	25764	4.77	122892	0.00033	320	0.6	192	0.006	0.0003	330
		Pass Loco hits Frt Car	0.00101	Incl	0.00101	7.43	25764	4.77	122892	0.00012	320	0.6	192	0.002	0.0001	123
		Pass car hit by Loco	0.00301	Incl	0.00301	7.43	25764	4.77	122892	0.00037	320	0.6	192	0.034	0.0015	1460
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.35	0.00559	6.00	20805	4.77	99240	0.00055	320	0.6	192	0.006	0.0002	247
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.10	0.01296	6.00	20805	4.77	99240	0.00129	320	0.6	192	0.027	0.0009	1143
	Overspeed		0.01100	0.00	0.01100	6.00	20805	4.77	99240	0.00109	320	0.6	192	0.044	0.0007	2838
	Broken Rail		0.01670	0.06	0.01570	6.00	20805	4.77	99240	0.00156	320	0.6	192	0.063	0.0010	4050
	Work Zone Violation			0.00		6.00	20805	4.77	99240					0.016	0.0016	0
										0.00695				**0.27287**	**0.00800**	**13410**
105	Train-Train Collision	Pass Loco hits Loco	0.00943	Incl	0.00943	7.43	25764	20.98	540519	0.00510	320	0.6	192	0.416	0.0157	17809
		Pass Loco hits Pass Car	0.00139	Incl	0.00139	7.43	25764	20.98	540519	0.00075	320	0.6	192	0.025	0.0012	1310
		Pass Loco hits Frt Car	0.00063	Incl	0.00063	7.43	25764	20.98	540519	0.00034	320	0.6	192	0.011	0.0005	592
		Pass car hit by Loco	0.00157	Incl	0.00157	7.43	25764	20.98	540519	0.00085	320	0.6	192	0.137	0.0052	5923
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.35	0.00559	6.00	20805	20.98	436489	0.00244	320	0.6	192	0.045	0.0018	1918
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.10	0.01296	6.00	20805	20.98	436489	0.00566	320	0.6	192	0.207	0.0074	8898
	Overspeed		0.01100	0.00	0.01100	6.00	20805	20.98	436489	0.00480	320	0.6	192	0.258	0.0041	22058
	Broken Rail		0.01670	0.06	0.01570	6.00	20805	20.98	436489	0.00685	320	0.6	192	0.368	0.0059	31478
	Work Zone Violation			0.00		6.00	20805	20.98	436489					0.095	0.0095	0
	Total									**0.02678**				**1.56243**	**0.05109**	**89985**
	Overall Totals									**0.03373**				**1.83530**	**0.06010**	**103395**
	Totals All Speeds	**Train-train Collisions**								**0.00949**				**0.70571**	**0.02705**	**30764**
		Intrusion Collisions								**0.00994**				**0.28484**	**0.01012**	**12206**
		Overspeed								**0.00589**				**0.30214**	**0.00486**	**24896**
		Broken Rail								**0.00841**				**0.43118**	**0.00693**	**35529**
		Work Zone Violation								**0.00000**				**0.11143**	**0.01114**	**0**

Table 3.5b: Risk Calculation - Collisions at Diamonds - Passenger

Number Diamonds	Freq'y per mill passes	Collisions (millions)	Injuries	Fatalities	Damage
1	0.000000	0.000000	0.000000	0.000000	0.00
1	0.000000	0.000000	0.000000	0.000000	0.00
1	0.012242	0.000315	0.002059	0.000061	79.16
1	0.002448	0.000063	0.002010	0.000061	63.39
		0.000378	**0.004069**	**0.000121**	**142.56**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.012242	0.000000	0.000000	0.000000	0.00
0	0.002448	0.000000	0.000000	0.000000	0.00
		0.000000	**0.00000**	**0.00000**	**0.00**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.012242	0.000000	0.000000	0.000000	0.00
0	0.002448	0.000000	0.000000	0.000000	0.00
		0.000000	**0.00000**	**0.00000**	**0.00**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.012242	0.000000	0.000000	0.000000	0.00
0	0.002448	0.000000	0.000000	0.000000	0.00
		0.000000	**0.00000**	**0.00000**	**0.00**

Table 3.6a: Risk Calculation - Freight Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Rep. Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Freq'y (per mill t-m)	Preventability	Adjusted Frequency	Trips/day	Trips per 10 years	Length of Track (miles)	Train-miles	Per 10 years: Accidents	Injuries	Fatalities	Damage $
25	Train-Train Collision	Frt Loco hits Loco	0	Incl	0.00000	7.43	25764	0	0	0.00000	0.00000	0.000000	$0
		Frt Loco hits Car	0	Incl	0.00000	7.43	25764	0	0	0.00000	0.00000	0.000000	$0
		Frt car hit by Loco	0	Incl	0.00000	7.43	25764	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.35	0.00936	1.43	4959	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.10	0.00774	1.43	4959	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.00	0	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.00	0	0	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.00	0.01600	1.43	4959	0	0	0.00000	0.00000	0.000000	$0
	Overspeed, Unequip		0.016	0.00	0.01600	0.00	0	0	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.06	0.05226	1.43	4959	0	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Unequip		0.056	0.00	0.05560	0.00	0	0	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.00		1.43	4959	0	0		0.00000	0.000000	$0
	Work Zone Viol'n, Unequip			0.00		0.00	0	0	0		0.00000	0.000000	$0
		Totals								**0.0000**	**0.0000**	**0.00000**	**$0**
40	Train-Train Collision	Frt Loco hits Loco	0.0021	Incl	0.00209	7.43	25764	4.77	122892	0.00026	0.00028	0.000028	$69
		Frt Loco hits Car	0.0003	Incl	0.00029	7.43	25764	4.77	122892	0.00004	0.00003	0.000003	$8
		Frt car hit by Loco	0.0010	Incl	0.00101	7.43	25764	4.77	122892	0.00012	0.00000	0.000000	$14
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.35	0.00936	1.43	4959	4.77	23652	0.00022	0.00005	0.000005	$6
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.10	0.00774	1.43	4959	4.77	23652	0.00018	0.00004	0.000004	$5
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.00	0	4.77	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.00	0	4.77	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.00	0.01600	1.43	4959	4.77	23652	0.00124	0.00018	0.000018	$464
	Overspeed, Unequip		0.016	0.00	0.01600	0.00	0	4.77	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.06	0.05226	1.43	4959	4.77	23652	0.00124	0.00018	0.000018	$464
	Broken Rail, Unequip		0.056	0.00	0.05560	0.00	0	4.77	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.00		1.43	4959	4.77	23652		0.00156	0.000156	$0
	Work Zone Viol'n, Unequip			0.00		0.00	0	4.77	0		0.00000	0.000000	$0
		Totals								**0.00244**	**0.0022**	**0.00022**	**$708**
50	Train-Train Collision	Frt Loco hits Loco	0.0014	Incl	0.00140	7.43	25764	20.98	540519	0.00076	0.00129	0.000129	$319
		Frt Loco hits Car	0.0002	Incl	0.00018	7.43	25764	20.98	540519	0.00010	0.00014	0.000014	$34
		Frt car hit by Loco	0.0006	Incl	0.00063	7.43	25764	20.98	540519	0.00034	0.00000	0.000000	$60
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.35	0.00936	1.43	4959	20.98	104030	0.00097	0.00034	0.000034	$43
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.10	0.00774	1.43	4959	20.98	104030	0.00081	0.00028	0.000028	$35
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.00	0	20.98	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.00	0	20.98	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.00	0.01600	1.43	4959	20.98	104030	0.00166	0.00058	0.000058	$975
	Overspeed, Unequip		0.016	0.00	0.01600	0.00	0	20.98	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.06	0.05226	1.43	4959	20.98	104030	0.00544	0.00190	0.000190	$3,186
	Broken Rail, Unequip		0.056	0.00	0.05560	0.00	0	20.98	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.00		1.43	4959	20.98	104030		0.00863	0.000863	$0
	Work Zone Viol'n, Unequip			0.00		0.00	0	20.98	0		0.00000	0.000000	$0
		Totals								**0.01007**	**0.0132**	**0.00132**	**$4,653**
	Overall Totals									**0.01251**	**0.0154**	**0.0015**	**$5,361**
Totals All Speeds	**Train-Train Collisions**									**0.00161**	**0.00174**	**0.00017**	**504**
	Intrusion Collisions									**0.00218**	**0.00071**	**0.00007**	**90**
	Diamond Collisions									**0.00168**	**0.00078**	**0.00008**	**286**
	Overspeed									**0.00204**	**0.00064**	**0.00006**	**1117**
	Broken Rail									**0.00667**	**0.00208**	**0.00021**	**3650**
	Work Zone Violation									**0.00000**	**0.01020**	**0.00102**	**0**
	Grade Crossing Collisions												

Table 3.6b: Risk Calculation - Collisions at Diamonds - Freight

Number Diamonds	Freq'y per mill passes	Collisions (millions)	Injuries	Fatalities	Damage
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.033729	0.000000	0.000000	0.000000	0.00
0	0.031523	0.000000	0.000000	0.000000	0.00
1	0.000000	0.000000	0.000000	0.000000	0.00
1	0.033729	0.000869	0.000782	0.000078	195.52
1	0.031523	0.000812	0.000000	0.000000	90.96

Worksheet 1-B,N: IDOT Risk Model: Braking Distances and Collision Zone Calculations, Cab Signal/ATC 70% Preventability Case, Bloomington Sub-corridor

Table 1.1: Stopping Distance Parameters and Calculations, Including Timeout and ACS Response Delay

Braking Formula Inputs		
Train/System Type	Parameter	Value
Freight	Coefficient P	0.035
	Applrn Time (sec)	13.8
	Train Weight (lb)	37000000
	Brake Force (lb)	7736693
Passenger	Coefficient A	0.666
	Coefficient B	0
	Safety Factor	1.25
Train Control	Latency/T-cel (sec)	3
	ACS Response (sec)	0
Guilty Train	Speed (mph)	15

| Braking Distance Calculations (Including free running in TOI) (ft) | | |

Worksheet 2 - B,N,R: Collision Frequencies Calculation - Cab Signal/ATC 70% Preventabilityt Case, Bloomington Sub-corridor, Rest of Year

Table 2.1a: Collision Distribution Matrix (Fraction Accidents by Train Pair and Collision Type). Collisions Between Trains Operating on the IDOT Test Corridor Only (not diamonds and intrusions)

	Train Pairs in In Collision	Collision Scenario Prob (Top Level)	Siding - Monitored: Collision Distribution Head On	Siding - Monitored: Collision Distribution Rear/Side	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty
	Percent Guilty				100%	0%	100%	0%
Both Trains TBE (Note 3)	Pass-Pass	0.60	0.50	0.50	0.3	0	0.3	0
	Pass-TBE Freight	0.32	0.50	0.50	0.16	0	0.16	0
	TBE Freight - TBE Freight	0.08	0.50	0.50	0.04	0	0.04	0
	Percent Guilty				50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	0.00	1	0	0	0	0	0
	Rear/Side, Pass into NE Frt		0	1	0	0	0	0
	Rear/Side NE Frt into Pass		0	1	0	0	0	0
	TBE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0
	Percent Guilty				0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0
	Total Probability (checking)	1		1	0.5	0	0.5	0

	Train Pairs in In Collision	Siding - Unmonitored: Collision Distribution Head On	Siding - Unmonitored: Collision Distribution Rear/Side	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
	Percent Guilty			100%	0%	100%	0%
Both Trains TBE (Note 3)	Pass-Pass	0.5	0.5	0.3	0	0.3	0
	Pass-TBE Freight	0.5	0.5	0.16	0	0.16	0
	TBE Freight - TBE Freight	0.5	0.5	0.04	0	0.04	0
	Percent Guilty			50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	1	0	0	0	0	0
	Rear/Side, Pass into NE Frt	0	1	0	0	0	0
	Rear/Side NE Frt into Pass	0	1	0	0	0	0
	TBE Freight - NE Freight	0.5	0.5	0	0	0	0
	Percent Guilty			0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.5	0.5	0	0	0	0
	Total Probability (checking)		1	0.5	0	0.5	0

	Train Pairs in In Collision	CP Adjacent - Monitored Siding: Collision Distribution Head On	CP Adjacent - Monitored Siding: Collision Distribution Rear/Side	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty
	Percent Guilty			100%	0%	100%	0%
Both Trains TBE (Note 3)	Pass-Pass	0.8	0.2	0.48	0	0.12	0
	Pass-TBE Freight	0.7	0.3	0.224	0	0.096	0
	TBE Freight - TBE Freight	0.7	0.3	0.056	0	0.024	0
	Percent Guilty			50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	1	0	0	0	0	0
	Rear/Side, Pass into NE Frt	0	1	0	0	0	0
	Rear/Side NE Frt into Pass	0	1	0	0	0	0
	TBE Freight - NE Freight	0.7	0.3	0	0	0	0
	Percent Guilty			0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.7	0.3	0	0	0	0
	Total Probability (checking)		1	0.76	0	0.24	0

	Train Pairs in In Collision	CP Adjacent - Unmonitored Siding: Collision Distribution Head On	CP Adjacent - Unmonitored Siding: Collision Distribution Rear/Side	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
	Percent Guilty			100%	0%	100%	0%
Both Trains TBE (Note 3)	Pass-Pass	0.8	0.2	0.48	0	0.12	0
	Pass-TBE Freight	0.8	0.2	0.224	0	0.096	0
	TBE Freight - TBE Freight	0.8	0.2	0.056	0	0.024	0
	Percent Guilty			50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	1	0	0	0	0	0
	Rear/Side, Pass into NE Frt	0	1	0	0	0	0
	Rear/Side NE Frt into Pass	0	1	0	0	0	0
	TBE Freight - NE Freight	0.7	0.3	0	0	0	0
	Percent Guilty			0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.7	0.3	0	0	0	0
	Total Probability (checking)		1	0.76	0	0.24	0

	Train Pairs in In Collision	Plain Track: Collision Distribution Head On	Plain Track: Collision Distribution Rear/Side	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
	Percent Guilty			100%	0%	100%	0%
Both Trains TBE (Note 3)	Pass-Pass	0.70	0.30	0.42	0	0.18	0
	Pass-TBE Freight	0.40	0.60	0.128	0	0.192	0
	TBE Freight - TBE Freight	0.50	0.50	0.04	0	0.04	0
	Percent Guilty			50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	1.00	0.00	0	0	0	0
	Rear/Side, Pass into NE Frt	0.00	1.00	0	0	0	0
	Rear/Side NE Frt into Pass	0.00	1.00	0	0	0	0
	TBE Freight - NE Freight	0.50	0.50	0	0	0	0
	Percent Guilty			0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.50	0.50	0	0	0	0
	Total Probability (checking)		1	0.588	0	0.412	0

Table 2.1b: Collision Type Distribution - Diamonds

	Train Pairs in In Collision	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty
	Percent Guilty	50%	50%
One Train TBE	Pass - NE Freight, Head -On	0	0
	Rear/Side, Pass into NE Frt	0.25	0.25
	Rear/Side NE Frt into Pass	0.05	0.05
	TBE Freight - NE Freight	0.1	0.1
	Percent Guilty		100%
Neither Train TBE	NE Freight - NE Freight	0	0.2
	Total Probability (checking)	0.4	0.6

Note: The gray cells on these rows are set at zero, because in every case, the condition represented by the cell does not exist - either because there are no unequipped passenger trains, or because of the kind of collision defined for the row.

Quantity in cell C18 is for all collisions between a passenger train and an unequipped freight train

Table 2.2: Preventability Data For Unequipped train Guilty, One Train TBE

Segment Type	Not Prevented of Mitigated: Freight	Not Prevented of Mitigated: Pass	Not Prevented of Mitigated: HS Pass	Mitigated: Freight	Mitigated: Pass	Mitigated: HS Pass	Prevented: Freight	Prevented: Pass	Prevented: HS Pass
Siding (M)	0.342	0.364	0.542	0.249	0.168	0.252	0.459	0.518	0.257
Siding (U)	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100
CP Adjacent (M)	0.269	0.342	0.526	0.230	0.187	0.296	0.550	0.521	0.229
CP Adjacent (U)	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100
Plain Track	0.308	0.391	0.601	0.000	0.000	0.020	0.100	0.100	0.080
Diamonds	0.135	0.265	0.253	0.172	0.000	0.200	0.743	0.785	0.597

Mauve cells contain data imported from previous worksheet in a group of three worksheets covering one sub-corridor, season and operating state.

Table 2.3a: Collision Preventability Matrix (Percent Accidents Preventable Relative to CTC Reference Case)

	Train Pairs in In Collision	Preventability Equipped Train Guilty	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	70%	70%		70%	
	Pass-TBE Freight	70%	70%		70%	
	TBE Freight - TBE Freight	70%	70%		70%	
One TBE	Pass - NE Freight, Head -On	70%	70%	26%		
	Rear/Side, Pass into NE Frt	70%			70%	26%
	Rear/Side NE Frt into Pass	70%			70%	0%
	TBE Freight - NE Freight	70%	70%	46%	70%	0%
Neither TBE	NE Freight - NE Freight			0%		0%
Reference Case (CTC) Collision Accident Likelihood by Segment Type (collisions/million train miles)		0.030				

	Train Pairs in In Collision	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	70%		70%	
	Pass-TBE Freight	70%		70%	
	TBE Freight - TBE Freight	70%		70%	
One TBE	Pass - NE Freight, Head -On	70%	10%		
	Rear/Side, Pass into NE Frt			70%	10%
	Rear/Side NE Frt into Pass			70%	0%
	TBE Freight - NE Freight	70%	10%	70%	0%
Neither TBE	NE Freight - NE Freight		0%		0%
		0.040			

	Train Pairs in In Collision	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	70%		70%	
	Pass-TBE Freight	70%		70%	
	TBE Freight - TBE Freight	70%		70%	
One TBE	Pass - NE Freight, Head -On	70%	23%		
	Rear/Side, Pass into NE Frt			70%	23%
	Rear/Side NE Frt into Pass			70%	0%
	TBE Freight - NE Freight	70%	55%	70%	0%
Neither TBE	NE Freight - NE Freight		0%		0%
		0.050			

	Train Pairs in In Collision	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	70%		70%	
	Pass-TBE Freight	70%		70%	
	TBE Freight - TBE Freight	70%		70%	
One TBE	Pass - NE Freight, Head -On	70%	10%		
	Rear/Side, Pass into NE Frt			70%	10%
	Rear/Side NE Frt into Pass			70%	0%
	TBE Freight - NE Freight	70%	10%	70%	0%
Neither TBE	NE Freight - NE Freight		0%		0%
		0.060			

	Train Pairs in In Collision	Plain Track: Collision Distribution Head On	Plain Track: Collision Distribution Rear/Side	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass			70%		70%	
	Pass-TBE Freight			70%		70%	
	TBE Freight - TBE Freight			70%		70%	
One TBE	Pass - NE Freight, Head -On			70%	8%		
	Rear/Side, Pass into NE Frt					70%	8%
	Rear/Side NE Frt into Pass					70%	0%
	TBE Freight - NE Freight			70%	10%	70%	0%
Neither TBE	NE Freight - NE Freight				0%		0%
		0.006				Collisions/million diamond passes	

Table 2.3b: Collision Preventability Matrix - Diamonds

	Train Pairs in In Collision	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty
Both TBE	Pass-Pass		
	Pass-TBE Freight		
	TBE Freight - TBE Freight		
One TBE	Pass - NE Freight, Head -On		
	Rear/Side, Pass into NE Frt	70%	78.54%
	Rear/Side NE Frt into Pass	70%	78.54%
	TBE Freight - NE Freight	70%	74.29%
Neither TBE	NE Freight - NE Freight		0.00%
		0.1	

Table 2.4a: Passenger Trains in Train-to-Train Collisions (Trains in Collisions per Million Train-Miles)

	Passenger Trains in Collisions	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	0.0054		0.0054	
	Pass-TBE Freight	0.0014		0.0014	
	TBE Freight - TBE Freight				
One TBE	Pass - NE Freight, Head -On	0.0000	0.0000		
	Rear/Side, Pass into NE Frt			0.0000	0.0000
	Rear/Side NE Frt into Pass			0.0000	0.0000
	TBE Freight - NE Freight				
Neither TBE	NE Freight - NE Freight				
	Checking total	0.0068	0.0000	0.0068	0.0000

	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
Both TBE	0.0072	0	0.0072	0
	0.0019	0	0.0019	0
One TBE	0.0000	0.0000		
			0.0000	0.0000
			0.0000	0.0000
Neither TBE				
	0.0091	0.0000	0.0091	0.0000

	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty
Both TBE	0.0144	0.0036	0.0173	0.0043
	0.0034		0.0014	
One TBE	0.0000	0.0000		
			0.0000	0.0000
			0.0000	0.0000
Neither TBE				
	0.0178	0.0000	0.0050	0.0000

	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
Both TBE	0.0173	0.0036	0.0043	
	0.0040		0.0017	
One TBE	0.0000	0.0000		
			0.0000	0.0000
			0.0000	0.0000
Neither TBE				
	0.0213	0.0000	0.0060	0.0000

	Plain Track: Collision Distribution Head On	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
Both TBE		0.0015		0.0006	
		0.0002		0.0003	
One TBE		0.0000	0.0000		
				0.0000	0.0000
				0.0000	0.0000
Neither TBE					
	Totals	0.0017	0.0000	0.0010	0.0000

Table 2.4b: Passenger Trains in Collisions at Diamonds

	Train Pairs in In Collision	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty
Both TBE	Pass-Pass		
	Pass-TBE Freight		
	TBE Freight - TBE Freight		
One TBE	Pass - NE Freight, Head -On		
	Rear/Side, Pass into NE Frt	0.007500	0.005366
	Rear/Side NE Frt into Pass	0.001500	0.001073
	TBE Freight - NE Freight	0.000000	0.000000
Neither TBE	NE Freight - NE Freight		0.000000
		0.00900	0.00644

Scenario Totals - Passenger	Tots, P-UF	Totals
Pass Loco Hits Loco	0.0000	0.0068
Pass Loco Hits Pass Car		0.0027
Pass Loco Hits Freight Car	0.0000	0.0012
Pass Car Hit by Loco	0.0000	0.0030
Total		0.0137

	Totals
	0.0000
	0.0036
	0.0015
	0.0040
	0.0182

	Totals
	0.0000
	0.0018
	0.0011
	0.0022
	0.0228

	Totals
	0.0000
	0.0022
	0.0013
	0.0026
	0.0274

	Totals
	0.0000
	0.0003
	0.0003
	0.0004
	0.0027

Scenario Totals - Passenger	Totals
Pass Loco Hits Loco	
Pass Loco Hits Pass Car	
Pass Loco Hits Freight Car	0.012866
Pass Car Hit by Loco	0.002573
Total	0.015439

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Table 2.5a: Freight trains in Train-to-Train Collisions (Trains in Collisions per Million Train-Miles)

	Freight Trains in Collisions	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass				
	Pass-TBE Freight	0.0014		0.0014	
	TBE Freight - TBE Freight	0.0007		0.0007	
One TBE	Pass - NE Freight, Head -On	0.0000	0.0000		
	Rear/Side, Pass into NE Frt			0.0000	0.0000
	Rear/Side NE Frt into Pass			0.0000	0.0000
	TBE Freight - NE Freight	0.0000	0.0000	0.0000	0.0000
Neither TBE	NE Freight - NE Freight			0.0000	
	Checking total	0.0022	0.0000	0.0022	0.0000

	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
Both TBE				
	0.0019		0.0019	
	0.0010		0.0010	
One TBE	0.0000	0.0000		
			0.0000	0.0000
			0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000
Neither TBE		0.0000		0.0000
	0.0029	0.0000	0.0029	0.0000

	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty
Both TBE				
	0.0034		0.0014	
	0.0017		0.0007	
One TBE	0.0000	0.0000		
			0.0000	0.0000
			0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000
Neither TBE		0.0000		0.0000
	0.0050	0.0000	0.0022	0.0000

	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
Both TBE				
	0.0040		0.0017	
	0.0020		0.0009	
One TBE	0.0000	0.0000		
			0.0000	0.0000
			0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000
Neither TBE		0.0000		0.0000
	0.0060	0.0000	0.0026	0.0000

	Plain Track: Collision Distribution Head On	Plain Track: Collision Distribution Rear/Side	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
Both TBE						
			0.0002		0.0003	
			0.0001		0.0001	
One TBE			0.0000	0.0000		
					0.0000	0.0000
					0.0000	0.0000
Neither TBE				0.0000		0.0000
			0.0004	0.0000	0.0005	0.0000

	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty
Both TBE		
One TBE		
	0.007500	0.005366
	0.001500	0.001073
	0.006000	0.005141
Neither TBE		0.040000
	0.01500	0.05158

Scenario Totals - Freight	Totals
Freight Loco Hits Loco	
Freight Loco Hits Car	0.034144
Freight Car Hit By Loco	0.032437
Total	0.066581

	Totals
	0.0000
	0.0009
	0.0020
	0.0058

	Totals
	0.0000
	0.0007
	0.0014
	0.0050
	0.0072

	Totals
	0.0000
	0.0009
	0.0017
	0.0060
	0.0086

	Totals
	0.0004
	0.0001
	0.0004
	0.0009

	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty
	0.010500	0.023644
	0.004500	0.027937
	0.015000	0.051581

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Freight Plus Passenger Totals (check)		0.0600	0.0180					0.0800	0.0240					0.1000	0.0300					0.1200	0.0360						0.0036				

In rear-end/side collisions between like trains there is one loco hits car and one car hit by loco in each collision. In rear/side collisions between a passenger and freight trains, the ratio between passenger hits freight and freight loco hits passenger car are a function of the percentages given in Table IN-5b on the Inputs sheet. The values are given in the tables beneath the trains in collisions for each segment type.

Collision Ratios: Collision Type	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.8	0.2

Collision Ratios: Collision Type	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.80	0.20

Collision Ratios: Collision Type	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.75	0.25

Collision Ratios: Collision Type	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.75	0.25

Collision Ratios: Collision Type	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.83	0.17

Worksheet 3 - B,N,R: - Risk Calculations - Cab Signal/ATC 70% Preventability Case, Bloomington Sub-corridor, Rest of Year

Table 3.1: Consequences Look-up Tables (Data Sources: Previous ICF Passenger Corridor Project (passenger), FRA Accident Data 2001-5 (freight)

Passenger Trains	Accident Scenario	Accident Sub-scenarios	Rep. Speed 40 mph: Injuries	Fatalities	Damage $	Rep. Speed 60 mph: Injuries	Fatalities	Damage $	Rep. Speed 79 mph: Injuries	Fatalities	Damage $	Rep. Speed 105 mph: Injuries	Fatalities	Damage $
	Train-Train Collision	Pass Loco hits Loco	0.083	0.002	503000	0.139	0.0049	1142000	0.24	0.0085	1976000	0.425	0.016	3495000
		Pass Loco hits Pass Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.008	1747000
		Pass Loco hits Frt Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.008	1747000
		Pass car hit by Loco	0.166	0.005	1005000	0.275	0.0119	2284000	0.476	0.0206	3951000	0.841	0.032	6989000
	Intrusion Collision (rollout)	Pass Loco hits Car	0.013	0.0005	113000	0.031	0.0011	257000	0.054	0.0019	445000	0.096	0.0034	786000
	Intrusion Collision (other))	Pass Loco hits Car	0.026	0.0009	226000	0.063	0.0022	514000	0.108	0.0038	889000	0.191	0.0068	1573000
	Overspeed		0.044	0.0004	667000	0.14	0.00186	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Broken Rail		0.044	0.0004	667000	0.14	0.00186	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Work Zone Violation		0.083	0.0083	0	0.125	0.0125	0	0.164	0.0164	0	0.218	0.0218	0

Freight trains	Accident Scenario	Accident Sub-scenarios	Rep. Speed 25 mph: Injuries	Fatalities	Damage $	Rep. Speed 40 mph: Injuries	Fatalities	Damage $	Rep. Speed 50 mph: Injuries	Fatalities	Damage $
	Train-Train Collision	Frt Loco hits Loco	0.43	0.043	105000	1.1	0.11	270000	1.7	0.17	422000
		Frt Loco hits Car	0.35	0.035	88000	0.9	0.09	225000	1.4	0.14	352000
		Frt car hit by Loco	0	0	44000	0	0	112000	0	0	176000
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Overspeed, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Overspeed, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Work Zone Viol'n, Equip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0
	Work Zone Viol'n, Unequip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0

Casualties and damage in Table 3.1 are per accident, except for Work Zone Violations which are per million train-miles

Table 3.2: Grade Crossing and Diamonds: Numbers by Representative Speed, and Accident Frequency and Consequences

Train Type	Rep. Speed (mph)	Type of Grade-crossing	Number Crossings: Passenger	HS Passenger	Freight	Accident Frequency Per Million Crossing Passes: Passenger	Freight	Crossing Collision Consequences: Pass. Occup't Casualty Prob/accident): Injuries	Fatalities	Cost $/Accid't	Freight Trains (per accident): Injuries	Fatalities	Cost $	Number Diamonds
Passenger	40	Public gates lights	7	7		0.350		0.0028	0.000047	50000				1
		Public other	0	0		0.300								
		Private	0	0		0.100								
	60	Public gates lights	16	0		0.600		0.0068	0.000112	113000				0
		Public other	0	0		0.500								
		Private	1	0		0.200								
	79	Public gates lights	16	16		0.800		0.0105	0.000156	196000				0
		Public other	1	0		0.650								
		Private	6	1		0.300								
	105	Public gates lights	0	16		1.100		0.0186	0.000276	346000				0
		Public other	0	1		0.800								
		Private	0	6		0.300								
Freight	25	Public gates lights			7		0.150				0.12	0.005	20000	0
		Public other			0		0.120							
		Private			0		0.050							
	40	Public gates lights			16		0.300				0.25	0.013	50000	1
		Public other			0		0.250							
		Private			1		0.100							
	50	Public gates lights			16		0.360				0.39	0.02	78000	0
		Public other			1		0.300							0.0003
		Private			6		0.120							

Table 3.3a: Segment Data (for reference only, not used in calculations)

Segment Number	Start (Milepost)	End (Milepost)	Type	Length (miles)	Posted Speed (mph): Freight	Pass	HS Pass (conseq)	HS Pass
14.0	88.35	90.55	Plain	2.20	50	79	79	105
15.0	90.55	92.47	CP Adjacent (M)	1.92	40	60	60	79
16.0	92.47	94.97	Siding (M)	2.50	50	79	79	105
17.0	94.97	96.81	CP Adjacent (M)	1.84	50	79	79	105
18.0	96.81	100.28	Plain	3.47	50	79	79	105
19.0	100.28	102.25	CP Adjacent (M)	1.97	40	60	60	79
20.0	102.25	102.25	Diamond	0.00	40	40	40	40
21.0	102.25	104.60	CP Adjacent (M)	2.35	40	60	60	79
22.0	104.60	106.43	CP Adjacent (M)	1.83	50	79	79	105
23.0	106.43	108.83	Siding (M)	2.40	50	79	79	105
24.0	108.83	111.36	CP Adjacent (M)	2.53	50	79	79	105
25.0	111.36	113.30	Plain	1.94	50	79	79	105
26.0	113.30	116.39	Plain	3.06	50	79	79	105
27.0	116.39	118.86	Plain	2.47	50	79	79	105
28.0	118.83	121.40	CP Adjacent (M)	2.57	50	79	79	105
29.0	121.40	123.57	Siding (M)	2.17	40	60	79	79
30.0	123.57	124.38	Siding (M)	0.81	25	40	40	40
31.0	124.38	124.86	Siding (M)	0.48	25	40	40	40
	Length Check	36.5		36.5				

Table 3.3b: Aggregate Segment Data: Segments, Train Types, Speeds, and Lengths

Aggregate Segment Length by Type and Speed Band (from Seg Def and Preventability)

Segment Type	Train Type	Represent've Speed (mph)	Freight (miles)	Reg Pass (miles)	HS Pass Collision (mi)	HS Pass Other (mi)
Siding (mon)	Freight	25	1.29			
		40	2.17			
		50	4.9			
	Passenger	40		1.29	1.29	1.29
		60		2.17	0	0
		79		4.9	7.07	2.17
		105		0	0	4.9
Siding (unmon)	Freight	25	0			
		40	0			
		50	0			
	Passenger	40		0	0	0
		60		0	0	0
		79		0	0	0
		105		0	0	0
CP Adjacent (mon)	Freight	25	0			
		40	6.24			
		50	8.77			
	Passenger	40		0	0	0
		60		6.24	6.24	0
		79		8.77	8.77	6.24
		105		0	0	8.77
CP Adjacent (unmon)	Freight	25	0			
		40	0			
		50	0			
	Passenger	40		0	0	0
		60		0	0	0
		79		0	0	0
		105		0	0	0
Plain Track	Freight	25	0			
		40	0			
		50	13.14			
	Passenger	40		0	0	0
		60		0	0	0
		79		13.14	13.14	0
		105		0	0	13.14
Totals All Types	Freight	25	1.29			
		40	8.41			
		50	26.81			
	Passenger	40		1.29	1.29	1.29
		60		8.41	6.24	0
		79		26.81	28.98	8.41
		105		0	0	26.81
	Checking Totals			36.51	36.51	36.51

Table 3.4: Collision Frequencies by Segment Type and Collision Scenario (From Coll Matrix)

Scenarios	Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain	Diamond
Pass Loco Hits Loco	0.0068	0.0091	0.0178	0.0213	0.0017	0.000000
Pass Loco Hits Pass Car	0.0027	0.0036	0.0018	0.0022	0.0003	0.000000
Pass Loco Hits Freight Car	0.0012	0.0015	0.0011	0.0013	0.0003	0.012866
Pass Car Hit by Loco	0.0030	0.0040	0.0022	0.0026	0.0004	0.002573
Freight Loco Hits Loco	0.0022	0.0029	0.0050	0.0060	0.0004	0.000000
Freight Loco Hits Car	0.0006	0.0009	0.0007	0.0009	0.0001	0.034144
Freight Car Hit By Loco	0.0015	0.0020	0.0014	0.0017	0.0004	0.032437

Weighted Collision Accident Frequencies by Representative Speed (mph)

Scenarios	Freight: 25	40	50	Passenger: 40	60	79	105
Pass Loco Hits Loco				0.0068	0.0000	0.0149	0.0079
Pass Loco Hits Pass Car				0.0027	0.0000	0.0020	0.0012
Pass Loco Hits Freight Car				0.0012	0.0000	0.0011	0.0007
Pass Car Hit by Loco				0.0030	0.0000	0.0024	0.0014
Freight Loco Hits Loco	0.0022	0.0043	0.0022				
Freight Loco Hits Car	0.0006	0.0007	0.0004				
Freight Car Hit By Loco	0.0015	0.0015	0.0009				

Collision Frequencies for Passenger + Unequipped Freight Train

Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain
0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000

Mauve cells contain data imported from previous worksheet in a group of three worksheets covering one sub-corridor, season and operating state.

All train-to-train collision frequencies are in units of **trains in collisions per million train-miles operated in the sub-corridor by all train types.**

Table 3.4a: Traffic Inputs to Risk Calculation

Trips/Day: Train Type	Summer	Rest of Year
Passenger	6.00	6.00
Equipped Freight	1.43	2.28
Unequipped Freight	0.00	0.00
Operating Days	91.00	274.00

Percent Train-Miles in	
Timeout (secs)	0.00
Normal Operating Mode	95.00
Timeout Mode	0.00
Fallback Mode	5.00

Passenger Train Occupancy	
Seats	320.00
Occupancy Factor	0.60

Table 3.5a: Risk Calculation - Passenger Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Rep. Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Freq'y (per million trn)	Preventability	Adjusted Frequency	Trips/day	Trips per 10 years	Length of Track (miles)	Train-miles per 10 years	Accidents per 10 years	Number seats per train	Occupancy Factor	Passengers per train	Injuries per 10 years	Fatalities per 10 years	Damage $ per 10 years
40	Train-Train Collision	Pass Loco hits Loco	0.00683	Incl	0.00683	8.28	21553	1.29	27803	0.00019	320	0.6	192	0.0030	0.00007	0
		Pass Loco hits Pass Car	0.00270	Incl	0.00270	8.28	21553	1.29	27803	0.00008	320	0.6	192	0.0005	0.00001	0
		Pass Loco hits Frt Car	0.00115	Incl	0.00115	8.28	21553	1.29	27803	0.00003	320	0.6	192	0.0002	0.00001	0
		Pass car hit by Loco	0.00299	Incl	0.00299	8.28	21553	1.29	27803	0.00008	320	0.6	192	0.0026	0.00008	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.35	0.00559	6.00	15618	1.29	20147	0.00011	320	0.6	192	0.0003	0.00001	0
	Intrusion Collision (other))	Pass Loco hits intruder	0.01440	0.10	0.01296	6.00	15618	1.29	20147	0.00026	320	0.6	192	0.0013	0.00005	0
	Overspeed		0.01100	0.00	0.01100	6.00	15618	1.29	20147	0.00022	320	0.6	192	0.0019	0.00002	0
	Broken Rail		0.01670	0.06	0.01570	6.00	15618	1.29	20147	0.00032	320	0.6	192	0.0027	0.00002	0
	Work Zone Violation			0.00		6.00	15618	1.29	20147					0.0017	0.00017	0
										0.00129				**0.01417**	**0.00044**	**1**
60	Train-Train Collision	Pass Loco hits Loco	0.00000	Incl	0.00000	8.28	21553	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Pass Car	0.00000	Incl	0.00000	8.28	21553	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Frt Car	0.00000	Incl	0.00000	8.28	21553	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00000	Incl	0.00000	8.28	21553	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.35	0.00559	6.00	15618	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.10	0.01296	6.00	15618	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Overspeed		0.01100	0.00	0.01100	6.00	15618	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Broken Rail		0.01670	0.06	0.01570	6.00	15618	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Work Zone Violation			0.00		6.00	15618	0	0					0.0000	0.00000	0
										0.00000				**0.00000**	**0.00000**	**0**
79	Train-Train Collision	Pass Loco hits Loco	0.01494	Incl	0.01494	8.28	21553	8.41	181259	0.00271	320	0.6	192	0.125	0.0044	5351
		Pass Loco hits Pass Car	0.00203	Incl	0.00203	8.28	21553	8.41	181259	0.00037	320	0.6	192	0.007	0.0003	364
		Pass Loco hits Frt Car	0.00110	Incl	0.00110	8.28	21553	8.41	181259	0.00020	320	0.6	192	0.004	0.0002	197
		Pass car hit by Loco	0.00237	Incl	0.00237	8.28	21553	8.41	181259	0.00043	320	0.6	192	0.039	0.0017	1700
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.35	0.00559	6.00	15618	8.41	131347	0.00073	320	0.6	192	0.008	0.0003	327
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.10	0.01296	6.00	15618	8.41	131347	0.00170	320	0.6	192	0.035	0.0012	1513
	Overspeed		0.01100	0.00	0.01100	6.00	15618	8.41	131347	0.00144	320	0.6	192	0.058	0.0009	3757
	Broken Rail		0.01670	0.06	0.01570	6.00	15618	8.41	131347	0.00206	320	0.6	192	0.083	0.0013	5361
	Work Zone Violation			0.00		6.00	15618	8.41	131347					0.022	0.0022	0
										0.00965				**0.38052**	**0.01255**	**18569**
105	Train-Train Collision	Pass Loco hits Loco	0.00791	Incl	0.00791	8.28	21553	26.81	577832	0.00457	320	0.6	192	0.373	0.0140	15981
		Pass Loco hits Pass Car	0.00124	Incl	0.00124	8.28	21553	26.81	577832	0.00072	320	0.6	192	0.024	0.0011	1253
		Pass Loco hits Frt Car	0.00070	Incl	0.00070	8.28	21553	26.81	577832	0.00041	320	0.6	192	0.013	0.0006	712
		Pass car hit by Loco	0.00144	Incl	0.00144	8.28	21553	26.81	577832	0.00083	320	0.6	192	0.134	0.0051	5814
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.35	0.00559	6.00	15618	26.81	418719	0.00234	320	0.6	192	0.043	0.0015	1840
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.10	0.01296	6.00	15618	26.81	418719	0.00543	320	0.6	192	0.199	0.0071	8536
	Overspeed		0.01100	0.00	0.01100	6.00	15618	26.81	418719	0.00461	320	0.6	192	0.248	0.0040	21160
	Broken Rail		0.01670	0.06	0.01570	6.00	15618	26.81	418719	0.00657	320	0.6	192	0.353	0.0057	30197
	Work Zone Violation			0.00		6.00	15618	26.81	418719					0.091	0.0091	0
	Total									**0.02548**				**1.47878**	**0.04828**	**85492**
	Overall Totals									**0.03642**				**1.87347**	**0.06127**	**104061**
	Totals All Speeds	**Train-train Collisions**								**0.01061**				**0.72542**	**0.02767**	**31371**
		Intrusion Collisions								**0.01058**				**0.28664**	**0.01018**	**12216**
		Overspeed								**0.00627**				**0.30774**	**0.00493**	**24916**
		Broken Rail								**0.00895**				**0.43917**	**0.00704**	**35558**
		Work Zone Violation								**0.00000**				**0.11449**	**0.01145**	**0**

Table 3.5b: Risk Calculation - Collisions at Diamonds - Passenger

Number Diamonds	Freq'y per mill passes	Collisions (millions)	Injuries	Fatalities	Damage
1	0.000000	0.000000	0.000000	0.000000	0.00
1	0.000000	0.000000	0.000000	0.000000	0.00
1	0.012866	0.000277	0.001810	0.000053	69.60
1	0.002573	0.000055	0.001768	0.000053	55.74
		0.000333	**0.003578**	**0.000106**	**125.34**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.012866	0.000000	0.000000	0.000000	0.00
0	0.002573	0.000000	0.000000	0.000000	0.00
		0.000000	**0.00000**	**0.00000**	**0.00

Worksheet 2 - B,N,R: Collision Frequencies Calculation - Cab Signal/ATC 70% Preventabilityt Case, Bloomington Sub-corridor, Summer

Table 2.1a: Collision Distribution Matrix (Fraction Accidents by Train Pair and Collision Type). Collisions Between Trains Operating on the IDOT Test Corridor Only (not diamonds and intrusions)

	Train Pairs in In Collision	Collision Scenario Prob (Top Level)	Siding - Monitored						Siding - Unmonitored						CP Adjacent - Monitored Siding						CP Adjacent - Unmonitored Siding						Plain Track					
			Collision Distribution		Head On		Rear End/Side		Collision Distribution		Head On		Rear End/Side		Collision Distribution		Head On		Rear End/Side		Collision Distribution		Head On		Rear End/Side		Collision Distribution		Head On		Rear End/Side	
			Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty
	Percent Guilty				100%	0%	100%	0%	100%	0%	100%	0%	100%	0%			100%	0%	100%	0%			100%	0%	100%	0%			100%	0%	100%	0%
Both Trains TBE (Note 3)	Pass-Pass	0.71	0.50	0.50	0.355	0	0.355	0	0.5	0.5	0.355	0	0.355	0	0.8	0.2	0.568	0	0.142	0	0.8	0.2	0.568	0	0.142	0	0.70	0.30	0.497	0	0.213	0
	Pass-TBE Freight	0.29	0.50	0.50	0.145	0	0.145	0	0.5	0.5	0.145	0	0.145	0	0.7	0.3	0.203	0	0.087	0	0.7	0.3	0.203	0	0.087	0	0.40	0.60	0.116	0	0.174	0
	TBE Freight - TBE Freight	0.00	0.50	0.50	0	0	0	0	0.5	0.5	0	0	0	0	0.7	0.3	0	0	0	0	0.7	0.3	0	0	0	0	0.50	0.50	0	0	0	0
	Percent Guilty				50%	50%	50%	50%			50%	50%	50%	50%			50%	50%	50%	50%			50%	50%	50%	50%			50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	0.00	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1.00	0.00	0	0	0	0
	Rear/Side, Pass into NE Frt		0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0.00	1.00	0	0	0	0
	Rear/Side NE Frt into Pass		0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0.00	1.00	0	0	0	0
	TBE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0	0.5	0.5	0	0	0	0	0.7	0.3	0	0	0	0	0.7	0.3	0	0	0	0	0.50	0.50	0	0	0	0
	Percent Guilty				0%	100%	0%	100%			0%	100%	0%	100%			0%	100%	0%	100%			0%	100%	0%	100%			0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0	0.5	0.5	0	0	0	0	0.7	0.3	0	0	0	0	0.7	0.3	0	0	0	0	0.50	0.50	0	0	0	0
	Total Probability (checking)	1		1	0.5	0	0.5	0		1	0.5	0	0.5	0		1	0.771	0	0.229	0		1	0.771	0	0.229	0		1	0.613	0	0.387	0

Quantity in cell C18 is for all collisions between a passenger train and an unequipped freight train

Table 2.2: Preventability Data For Unequipped train Guilty, One Train TBE

Segment Type	Not Prevented of Mitigated			Mitigated			Prevented		
	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass
Siding (M)	0.342	0.364	0.542	0.249	0.188	0.252	0.459	0.518	0.257
Siding (U)	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100
CP Adjacent (M)	0.269	0.342	0.526	0.230	0.187	0.296	0.550	0.521	0.229
CP Adjacent (U)	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100
Plain Track	0.308	0.391	0.601	0.000	0.000	0.020	0.100	0.100	0.080
Diamonds	0.135	0.265	0.253	0.172	0.000	0.200	0.743	0.785	0.597

Mauve cells contain data imported from previous worksheet in a group of three worksheets covering one sub-corridor, season and operating state.

Table 2.3a: Collision Preventability Matrix (Percent Accidents Preventable Relative to CTC Reference Case)

	Train Pairs in In Collision	Preventability Equipped Train Guilty	Siding - Monitored						Siding - Unmonitored						CP Adjacent - Monitored Siding						CP Adjacent - Unmonitored Siding						Plain Track					
					Head On		Rear End/Side				Head On		Rear End/Side				Head On		Rear End/Side				Head On		Rear End/Side		Collision Distribution		Head On		Rear End/Side	
					Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty
Both TBE	Pass-Pass	70%			70%		70%				70%		70%				70%		70%				70%		70%				70%		70%	
	Pass-TBE Freight	70%			70%		70%				70%		70%				70%		70%				70%		70%				70%		70%	
	TBE Freight - TBE Freight	70%			70%		70%				70%		70%				70%		70%				70%		70%				70%		70%	
One TBE	Pass - NE Freight, Head -On	70%			70%	26%					70%	10%					70%	23%					70%	10%					70%	8%		
	Rear/Side, Pass into NE Frt	70%					70%	26%					70%	10%					70%	23%					70%	10%					70%	8%
	Rear/Side NE Frt into Pass	70%					70%	0%					70%	0%					70%	0%					70%	0%					70%	0%
	TBE Freight - NE Freight	70%			70%	46%	70%	0%			70%	10%	70%	0%			70%	55%	70%	0%			70%	10%	70%	0%			70%	10%	70%	0%
Neither TBE	NE Freight - NE Freight					0%		0%				0%		0%				0%		0%				0%		0%				0%		0%
Reference Case (CTC) Collision Accident Likelihood by Segment Type (collisions/million train miles)			0.030						0.040						0.050						0.060						0.006					

Table 2.4a: Passenger Trains in Train-to-Train Collisions (Trains in Collisions per Million Train-Miles)

	Train Pairs in In Collision	Passenger Trains in Collisions	Siding - Monitored						Siding - Unmonitored						CP Adjacent - Monitored Siding						CP Adjacent - Unmonitored Siding						Plain Track					
					Head On		Rear End/Side				Head On		Rear End/Side				Head On		Rear End/Side				Head On		Rear End/Side		Collision Distribution		Head On		Rear End/Side	
					Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty
Both TBE	Pass-Pass	2			0.0064		0.0064				0.0085		0.0085				0.0170		0.0043				0.0204		0.0051				0.0018		0.0008	
	Pass-TBE Freight	1			0.0013		0.0013				0.0017		0.0017				0.0030		0.0013				0.0037		0.0016				0.0002		0.0003	
	TBE Freight - TBE Freight	0																														
One TBE	Pass - NE Freight, Head -On	1			0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000		
	Rear/Side, Pass into NE Frt	1					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000
	Rear/Side NE Frt into Pass	1					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000
	TBE Freight - NE Freight	0																														
Neither TBE	NE Freight - NE Freight	0																														
	Checking total				0.0077	0.0000	0.0077	0.0000			0.0103	0.0000	0.0103	0.0000			0.0201	0.0000	0.0056	0.0000			0.0241	0.0000	0.0067	0.0000			0.0020	0.0000	0.0011	0.0000

Scenario Totals - Passenger	Tots, P-UF	Totals			Totals				Totals				Totals				Totals				Totals				Totals				Totals			
Pass Loco Hits Loco	0.0000	0.0077	0.0077	0.0000	0.0000	0.0103	0.0103	0.0000			0.0000	0.0201	0.0201	0.0000			0.0000	0.0241	0.0241	0.0000			0.0000	0.0020	0.0020	0.0000						
Pass Loco Hits Pass Car		0.0032				0.0043			0.0043			0.0021			0.0021			0.0026				0.0004			0.0004						
Pass Loco Hits Freight Car	0.0000	0.0010			0.0000	0.0014			0.0014		0.0000	0.0010			0.0010		0.0000	0.0012			0.0000	0.0003			0.0003		0.007500	0.005366	0.012866	Pass Loco Hits Freight Car
Pass Car Hit by Loco	0.0000	0.0035		0.0035	0.0000	0.0046		0.0046	0.0000	0.0000	0.0025			0.0025	0.0000	0.0000	0.0029	0.0000	0.0000	0.0004			0.0004	0.0000	0.001500	0.001073	0.002573	Pass Car Hit by Loco
Total		0.0154	0.0077	0.0000	0.0205	0.0103	0.0000	0.0103	0.0000		0.0257	0.0201	0.0000	0.0056	0.0000		0.0308	0.0241	0.0000	0.0067	0.0000		0.0031	0.0020	0.0000	0.0011	0.0000	0.009000	0.006439	0.015439	Total

Table 2.5a: Freight trains in Train-to-Train Collisions (Trains in Collisions per Million Train-Miles)

	Train Pairs in In Collision	Freight Trains in Collisions	Siding - Monitored						Siding - Unmonitored						CP Adjacent - Monitored Siding						CP Adjacent - Unmonitored Siding						Plain Track					
					Head On		Rear End/Side				Head On		Rear End/Side				Head On		Rear End/Side				Head On		Rear End/Side		Collision Distribution		Head On		Rear End/Side	
					Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty
Both TBE	Pass-Pass	0																														
	Pass-TBE Freight	1			0.0013		0.0013				0.0017		0.0017				0.0030		0.0013				0.0037		0.0016				0.0002		0.0003	
	TBE Freight - TBE Freight	2			0.0000		0.0000				0.0000		0.0000				0.0000		0.0000				0.0000		0.0000				0.0000		0.0000	
One TBE	Pass - NE Freight, Head -On	1			0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000		
	Rear/Side, Pass into NE Frt	1					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000
	Rear/Side NE Frt into Pass	1					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000
	TBE Freight - NE Freight	2			0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000		
Neither TBE	NE Freight - NE Freight	2				0.0000		0.0000				0.0000		0.0000				0.0000		0.0000				0.0000		0.0000				0.0000		0.0000
	Checking total				0.0013	0.0000	0.0013	0.0000			0.0017	0.0000	0.0017	0.0000			0.0030	0.0000	0.0013	0.0000			0.0037	0.0000	0.0016	0.0000			0.0002	0.0000	0.0003	0.0000

Scenario Totals - Freight		Totals			Totals				Totals				Totals				Totals				Totals				Totals				Totals			
Freight Loco Hits Loco	0.0000	0.0013	0.0013	0.0000	0.0017	0.0017	0.0000				0.0030	0.0030	0.0000				0.0037	0.0037	0.0000				0.0002	0.0002	0.0000							
Freight Loco Hits Car	0.0000	0.0003		0.00026	0.00000	0.0003			0.00035	0.00000	0.0003			0.00033	0.00000		0.0004			0.00039	0.00000		0.0001			0.00005	0.00000	0.010500	0.023644	0.034144	Freight Loco Hits Car
Freight Car Hit By Loco	0.0000	0.0010		0.00104	0.00000	0.0014			0.00139	0.00000	0.0010			0.00098	0.00000		0.0012			0.00117	0.00000		0.0003			0.00026	0.00000	0.004500	0.027937	0.032437	Freight Car Hit By Loco
Total		0.0026	0.0013	0.0000	0.0035	0.0017	0.0000	0.0017	0.0000	0.0000	0.0044	0.0030	0.0000	0.0013	0.0000		0.0052	0.0037	0.0000	0.0016	0.0000		0.0005	0.0002	0.0000	0.0003	0.0000	0.015000	0.051581	0.066581	Total
Freight Plus Passenger Totals (check)	0.0600	0.0180			0.0800	0.0240			0.1000	0.0300				0.1200	0.0360					0.0036											

In rear-end/side collisions between like trains there is one loco hits car and one car hit by loco in each collision. In rear/side collisions between a passenger and freight trains, the ratio between passenger hits freight and freight loco hits passenger car are a function of the percentages given in Table IN-5b on the Inputs sheet. The values are given in the tables beneath the trains in collisions for each segment type.

Collision Type	Collision Ratios: Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.8	0.2

Collision Type	Collision Ratios: Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.80	0.20

Collision Type	Collision Ratios: Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.75	0.25

Collision Type	Collision Ratios: Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.75	0.25

Collision Type	Collision Ratios: Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.83	0.17

Table 2.1b: Collision Type Distribution - Diamonds

Train Pairs in In Collision	Train Pair Type	Diamond Collisions Rear End/Side: Equip Guilty	Unequip Guilty
Percent Guilty			
Pass-Pass	Both Trains TBE		
Pass-TBE Freight			
TBE Freight - TBE Freight			
Percent Guilty	One Train TBE	50%	50%
Pass - NE Freight, Head -On		0	0
Rear/Side, Pass into NE Frt		0.25	0.25
Rear/Side NE Frt into Pass		0.05	0.05
TBE Freight - NE Freight		0.1	0.1
Percent Guilty			100%
NE Freight - NE Freight	Neither Train TBE	0	0.2
Total Probability (checking)		0.4	0.6

Note: The gray cells on these rows are set at zero, because in every case, the condition represented by the cell does not exist - either because there are no unequipped passenger trains, or because of the kind of collision defined for the row.

Table 2.3b: Collision Preventability Matrix - Diamonds

Train Pairs in In Collision	Train Pair Type	Diamond Collisions Rear End/Side: Equip Guilty	Unequip Guilty
Pass-Pass	Both TBE		
Pass-TBE Freight			
TBE Freight - TBE Freight			
Pass - NE Freight, Head -On	One TBE		
Rear/Side, Pass into NE Frt		70%	78.54%
Rear/Side NE Frt into Pass		70%	78.54%
TBE Freight - NE Freight		70%	74.29%
NE Freight - NE Freight	Neither TBE		0.00%
Collisions/million diamond passes			0.1

Table 2.4b: Passenger Trains in Collisions at Diamonds

Train Pairs in In Collision	Train Pair Type	Diamond Collisions Rear End/Side: Equip Guilty	Unequip Guilty
Pass-Pass	Both TBE		
Pass-TBE Freight			
TBE Freight - TBE Freight			
Pass - NE Freight, Head -On	One TBE		
Rear/Side, Pass into NE Frt		0.007500	0.005366
Rear/Side NE Frt into Pass		0.001500	0.001073
TBE Freight - NE Freight		0.000000	0.000000
NE Freight - NE Freight	Neither TBE		0.000000
Scenario Totals - Passenger		0.00900	0.00644
Pass Loco Hits Loco			
Pass Loco Hits Pass Car			
Pass Loco Hits Freight Car		0.007500	0.005366
Pass Car Hit by Loco		0.001500	0.001073
Total		0.009000	0.006439

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Table 2.5b: Freight Trains in Collisions at Diamonds

Train Pairs in In Collision	Train Pair Type	Diamond Collisions Rear End/Side: Equip Guilty	Unequip Guilty
Pass-Pass	Both TBE		
Pass-TBE Freight			
TBE Freight - TBE Freight			
Pass - NE Freight, Head -On	One TBE		
Rear/Side, Pass into NE Frt		0.007500	0.005366
Rear/Side NE Frt into Pass		0.001500	0.001073
TBE Freight - NE Freight		0.006000	0.005141
NE Freight - NE Freight	Neither TBE		0.040000
Scenario Totals - Freight		0.01500	0.05158
Freight Loco Hits Loco			
Freight Loco Hits Car		0.010500	0.023644
Freight Car Hit By Loco		0.004500	0.027937
Total		0.015000	0.051581

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Worksheet 2 - B,N,R: Collision Frequencies Calculation - Cab Signal/ATC 70% Preventabilityt Case, Bloomington Sub-corridor, Summer

Table 2.1a: Collision Distribution Matrix (Fraction Accidents by Train Pair and Collision Type). Collisions Between Trains Operating on the IDOT Test Corridor Only (not diamonds and intrusions)

	Train Pairs in In Collision	Collision Scenario Prob (Top Level)	Siding - Monitored						Siding - Unmonitored						CP Adjacent - Monitored Siding						CP Adjacent - Unmonitored Siding						Plain Track					
			Collision Distribution		Head On		Rear End/Side		Collision Distribution		Head On		Rear End/Side		Collision Distribution		Head On		Rear End/Side		Collision Distribution		Head On		Rear End/Side		Collision Distribution		Head On		Rear End/Side	
			Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty
	Percent Guilty				100%	0%	100%	0%	100%	0%	100%	0%	100%	0%			100%	0%	100%	0%			100%	0%	100%	0%			100%	0%	100%	0%
Both Trains TBE (Note 3)	Pass-Pass	0.71	0.50	0.50	0.355	0	0.355	0	0.5	0.5	0.355	0	0.355	0	0.8	0.2	0.568	0	0.142	0	0.8	0.2	0.568	0	0.142	0	0.70	0.30	0.497	0	0.213	0
	Pass-TBE Freight	0.29	0.50	0.50	0.145	0	0.145	0	0.5	0.5	0.145	0	0.145	0	0.7	0.3	0.203	0	0.087	0	0.7	0.3	0.203	0	0.087	0	0.40	0.60	0.116	0	0.174	0
	TBE Freight - TBE Freight	0.00	0.50	0.50	0	0	0	0	0.5	0.5	0	0	0	0	0.7	0.3	0	0	0	0	0.7	0.3	0	0	0	0	0.50	0.50	0	0	0	0
	Percent Guilty				50%	50%	50%	50%			50%	50%	50%	50%			50%	50%	50%	50%			50%	50%	50%	50%			50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	0.00	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1.00	0.00	0	0	0	0
	Rear/Side, Pass into NE Frt		0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0.00	1.00	0	0	0	0
	Rear/Side NE Frt into Pass		0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0.00	1.00	0	0	0	0
	TBE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0	0.5	0.5	0	0	0	0	0.7	0.3	0	0	0	0	0.7	0.3	0	0	0	0	0.50	0.50	0	0	0	0
	Percent Guilty				0%	100%	0%	100%			0%	100%	0%	100%			0%	100%	0%	100%			0%	100%	0%	100%			0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0	0.5	0.5	0	0	0	0	0.7	0.3	0	0	0	0	0.7	0.3	0	0	0	0	0.50	0.50	0	0	0	0
	Total Probability (checking)	1		1	0.5	0	0.5	0		1	0.5	0	0.5	0		1	0.771	0	0.229	0		1	0.771	0	0.229	0		1	0.613	0	0.387	0

Quantity in cell C18 is for all collisions between a passenger train and an unequipped freight train

Table 2.2: Preventability Data For Unequipped train Guilty, One Train TBE

Segment Type	Not Prevented of Mitigated			Mitigated			Prevented		
	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass
Siding (M)	0.342	0.364	0.542	0.249	0.188	0.252	0.459	0.518	0.257
Siding (U)	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100
CP Adjacent (M)	0.269	0.342	0.526	0.230	0.187	0.296	0.550	0.521	0.229
CP Adjacent (U)	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100
Plain Track	0.308	0.391	0.601	0.000	0.000	0.020	0.100	0.100	0.080
Diamonds	0.135	0.265	0.253	0.172	0.000	0.200	0.743	0.785	0.597

Mauve cells contain data imported from previous worksheet in a group of three worksheets covering one sub-corridor, season and operating state.

Table 2.3a: Collision Preventability Matrix (Percent Accidents Preventable Relative to CTC Reference Case)

	Train Pairs in In Collision	Preventability Equipped Train Guilty	Siding - Monitored						Siding - Unmonitored						CP Adjacent - Monitored Siding						CP Adjacent - Unmonitored Siding						Plain Track					
					Head On		Rear End/Side				Head On		Rear End/Side				Head On		Rear End/Side				Head On		Rear End/Side		Collision Distribution		Head On		Rear End/Side	
					Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty
Both TBE	Pass-Pass	70%			70%		70%				70%		70%				70%		70%				70%		70%				70%		70%	
	Pass-TBE Freight	70%			70%		70%				70%		70%				70%		70%				70%		70%				70%		70%	
	TBE Freight - TBE Freight	70%			70%		70%				70%		70%				70%		70%				70%		70%				70%		70%	
One TBE	Pass - NE Freight, Head -On	70%			70%	26%					70%	10%					70%	23%					70%	10%					70%	8%		
	Rear/Side, Pass into NE Frt	70%					70%	26%					70%	10%					70%	23%					70%	10%					70%	8%
	Rear/Side NE Frt into Pass	70%					70%	0%					70%	0%					70%	0%					70%	0%					70%	0%
	TBE Freight - NE Freight	70%			70%	46%	70%	0%			70%	10%	70%	0%			70%	55%	70%	0%			70%	10%	70%	0%			70%	10%	70%	0%
Neither TBE	NE Freight - NE Freight					0%		0%				0%		0%				0%		0%				0%		0%				0%		0%
Reference Case (CTC) Collision Accident Likelihood by Segment Type (collisions/million train miles)			0.030						0.040						0.050						0.060						0.006					

Table 2.4a: Passenger Trains in Train-to-Train Collisions (Trains in Collisions per Million Train-Miles)

	Train Pairs in In Collision	Passenger Trains in Collisions	Siding - Monitored						Siding - Unmonitored						CP Adjacent - Monitored Siding						CP Adjacent - Unmonitored Siding						Plain Track					
					Head On		Rear End/Side				Head On		Rear End/Side				Head On		Rear End/Side				Head On		Rear End/Side		Collision Distribution		Head On		Rear End/Side	
					Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty
Both TBE	Pass-Pass	2			0.0064		0.0064				0.0085		0.0085				0.0170		0.0043				0.0204		0.0051				0.0018		0.0008	
	Pass-TBE Freight	1			0.0013		0.0013				0.0017		0.0017				0.0030		0.0013				0.0037		0.0016				0.0002		0.0003	
	TBE Freight - TBE Freight	0																														
One TBE	Pass - NE Freight, Head -On	1			0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000		
	Rear/Side, Pass into NE Frt	1					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000
	Rear/Side NE Frt into Pass	1					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000
	TBE Freight - NE Freight	0																														
Neither TBE	NE Freight - NE Freight	0																														
	Checking total				0.0077	0.0000	0.0077	0.0000			0.0103	0.0000	0.0103	0.0000			0.0201	0.0000	0.0056	0.0000			0.0241	0.0000	0.0067	0.0000			0.0020	0.0000	0.0011	0.0000

Scenario Totals - Passenger	Tots, P-UF	Totals			Totals				Totals				Totals				Totals				Totals				Totals				Totals			
Pass Loco Hits Loco	0.0000	0.0077	0.0077	0.0000	0.0000	0.0103	0.0103	0.0000			0.0000	0.0201	0.0201	0.0000			0.0000	0.0241	0.0241	0.0000			0.0000	0.0020	0.0020	0.0000						
Pass Loco Hits Pass Car		0.0032				0.0043			0.0043			0.0021			0.0021			0.0026				0.0004			0.0004						
Pass Loco Hits Freight Car	0.0000	0.0010			0.0000	0.0014			0.0014		0.0000	0.0010			0.0010		0.0000	0.0012			0.0000	0.0003			0.0003		0.007500	0.005366	0.012866	Pass Loco Hits Freight Car
Pass Car Hit by Loco	0.0000	0.0035		0.0035	0.0000	0.0046		0.0046	0.0000	0.0000	0.0025			0.0025	0.0000	0.0000	0.0029	0.0000	0.0000	0.0004			0.0004	0.0000	0.001500	0.001073	0.002573	Pass Car Hit by Loco
Total		0.0154	0.0077	0.0000	0.0205	0.0103	0.0000	0.0103	0.0000		0.0257	0.0201	0.0000	0.0056	0.0000		0.0308	0.0241	0.0000	0.0067	0.0000		0.0031	0.0020	0.0000	0.0011	0.0000	0.009000	0.006439	0.015439	Total

Table 2.5a: Freight trains in Train-to-Train Collisions (Trains in Collisions per Million Train-Miles)

	Train Pairs in In Collision	Freight Trains in Collisions	Siding - Monitored						Siding - Unmonitored						CP Adjacent - Monitored Siding						CP Adjacent - Unmonitored Siding						Plain Track					
					Head On		Rear End/Side				Head On		Rear End/Side				Head On		Rear End/Side				Head On		Rear End/Side		Collision Distribution		Head On		Rear End/Side	
					Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty
Both TBE	Pass-Pass	0																														
	Pass-TBE Freight	1			0.0013		0.0013				0.0017		0.0017				0.0030		0.0013				0.0037		0.0016				0.0002		0.0003	
	TBE Freight - TBE Freight	2			0.0000		0.0000				0.0000		0.0000				0.0000		0.0000				0.0000		0.0000				0.0000		0.0000	
One TBE	Pass - NE Freight, Head -On	1			0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000		
	Rear/Side, Pass into NE Frt	1					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000
	Rear/Side NE Frt into Pass	1					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000
	TBE Freight - NE Freight	2			0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000		
Neither TBE	NE Freight - NE Freight	2				0.0000		0.0000				0.0000		0.0000				0.0000		0.0000				0.0000		0.0000				0.0000		0.0000
	Checking total				0.0013	0.0000	0.0013	0.0000			0.0017	0.0000	0.0017	0.0000			0.0030	0.0000	0.0013	0.0000			0.0037	0.0000	0.0016	0.0000			0.0002	0.0000	0.0003	0.0000

Scenario Totals - Freight		Totals			Totals				Totals				Totals				Totals				Totals				Totals				Totals			
Freight Loco Hits Loco	0.0000	0.0013	0.0013	0.0000	0.0017	0.0017	0.0000				0.0030	0.0030	0.0000				0.0037	0.0037	0.0000				0.0002	0.0002	0.0000							
Freight Loco Hits Car	0.0000	0.0003		0.00026	0.00000	0.0003			0.00035	0.00000	0.0003			0.00033	0.00000		0.0004			0.00039	0.00000		0.0001			0.00005	0.00000	0.010500	0.023644	0.034144	Freight Loco Hits Car
Freight Car Hit By Loco	0.0000	0.0010		0.00104	0.00000	0.0014			0.00139	0.00000	0.0010			0.00098	0.00000		0.0012			0.00117	0.00000		0.0003			0.00026	0.00000	0.004500	0.027937	0.032437	Freight Car Hit By Loco
Total		0.0026	0.0013	0.0000	0.0035	0.0017	0.0000	0.0017	0.0000	0.0000	0.0044	0.0030	0.0000	0.0013	0.0000		0.0052	0.0037	0.0000	0.0016	0.0000		0.0005	0.0002	0.0000	0.0003	0.0000	0.015000	0.051581	0.066581	Total
Freight Plus Passenger Totals (check)	0.0600	0.0180			0.0800	0.0240			0.1000	0.0300				0.1200	0.0360					0.0036											

In rear-end/side collisions between like trains there is one loco hits car and one car hit by loco in each collision. In rear/side collisions between a passenger and freight trains, the ratio between passenger hits freight and freight loco hits passenger car are a function of the percentages given in Table IN-5b on the Inputs sheet. The values are given in the tables beneath the trains in collisions for each segment type.

Collision Type	Collision Ratios: Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.8	0.2

Collision Type	Collision Ratios: Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.80	0.20

Collision Type	Collision Ratios: Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.75	0.25

Collision Type	Collision Ratios: Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.75	0.25

Collision Type	Collision Ratios: Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.83	0.17

Table 2.1b: Collision Type Distribution - Diamonds

Train Pairs in In Collision	Train Pair Type	Diamond Collisions Rear End/Side: Equip Guilty	Unequip Guilty
Percent Guilty			
Pass-Pass	Both Trains TBE		
Pass-TBE Freight			
TBE Freight - TBE Freight			
Percent Guilty	One Train TBE	50%	50%
Pass - NE Freight, Head -On		0	0
Rear/Side, Pass into NE Frt		0.25	0.25
Rear/Side NE Frt into Pass		0.05	0.05
TBE Freight - NE Freight		0.1	0.1
Percent Guilty			100%
NE Freight - NE Freight	Neither Train TBE	0	0.2
Total Probability (checking)		0.4	0.6

Note: The gray cells on these rows are set at zero, because in every case, the condition represented by the cell does not exist - either because there are no unequipped passenger trains, or because of the kind of collision defined for the row.

Table 2.3b: Collision Preventability Matrix - Diamonds

Train Pairs in In Collision	Train Pair Type	Diamond Collisions Rear End/Side: Equip Guilty	Unequip Guilty
Pass-Pass	Both TBE		
Pass-TBE Freight			
TBE Freight - TBE Freight			
Pass - NE Freight, Head -On	One TBE		
Rear/Side, Pass into NE Frt		70%	78.54%
Rear/Side NE Frt into Pass		70%	78.54%
TBE Freight - NE Freight		70%	74.29%
NE Freight - NE Freight	Neither TBE		0.00%
Collisions/million diamond passes			0.1

Table 2.4b: Passenger Trains in Collisions at Diamonds

Train Pairs in In Collision	Train Pair Type	Diamond Collisions Rear End/Side: Equip Guilty	Unequip Guilty
Pass-Pass	Both TBE		
Pass-TBE Freight			
TBE Freight - TBE Freight			
Pass - NE Freight, Head -On	One TBE		
Rear/Side, Pass into NE Frt		0.007500	0.005366
Rear/Side NE Frt into Pass		0.001500	0.001073
TBE Freight - NE Freight		0.000000	0.000000
NE Freight - NE Freight	Neither TBE		0.000000
Scenario Totals - Passenger		0.00900	0.00644
Pass Loco Hits Loco			
Pass Loco Hits Pass Car			
Pass Loco Hits Freight Car		0.007500	0.005366
Pass Car Hit by Loco		0.001500	0.001073
Total		0.009000	0.006439

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Table 2.5b: Freight Trains in Collisions at Diamonds

Train Pairs in In Collision	Train Pair Type	Diamond Collisions Rear End/Side: Equip Guilty	Unequip Guilty
Pass-Pass	Both TBE		
Pass-TBE Freight			
TBE Freight - TBE Freight			
Pass - NE Freight, Head -On	One TBE		
Rear/Side, Pass into NE Frt		0.007500	0.005366
Rear/Side NE Frt into Pass		0.001500	0.001073
TBE Freight - NE Freight		0.006000	0.005141
NE Freight - NE Freight	Neither TBE		0.040000
Scenario Totals - Freight		0.01500	0.05158
Freight Loco Hits Loco			
Freight Loco Hits Car		0.010500	0.023644
Freight Car Hit By Loco		0.004500	0.027937
Total		0.015000	0.051581

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Worksheet 3 - B,N,S: - Risk Calculations - Cab Signal/ATC 70% Preventability Case, Bloomington Sub-corridor, Summer

Table 3.1: Consequences Look-up Tables (Data Sources: Previous ICF Passenger Corridor Project (passenger), FRA Accident Data 2001-5 (freight)

Passenger Trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 40 mph Injuries	Fatalities	Damage $	Representative Speed 60 mph Injuries	Fatalities	Damage $	Representative Speed 79 mph Injuries	Fatalities	Damage $	Representative Speed 105 mph Injuries	Fatalities	Damage $
	Train-Train Collision	Pass Loco hits Loco	0.083	0.002	502000	0.139	0.0049	1142000	0.24	0.0085	1976000	0.429	0.018	3495000
		Pass Loco hits Pass Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.008	1747000
		Pass Loco hits Frt Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.008	1747000
		Pass car hit by Loco	0.166	0.005	1005000	0.275	0.0119	2284000	0.476	0.0206	3951000	0.841	0.032	6989000
	Intrusion Collision (rollout)	Pass Loco hits Car	0.013	0.0005	113000	0.031	0.0011	257000	0.054	0.0019	445000	0.096	0.0034	788000
	Intrusion Collision (other!)	Pass Loco hits Car	0.026	0.0009	226000	0.063	0.0022	514000	0.108	0.0038	889000	0.191	0.0068	1573000
	Overspeed		0.044	0.0004	667000	0.14	0.00186	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Broken Rail		0.044	0.0004	667000	0.14	0.00186	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Work Zone Violation		0.083	0.0083	0	0.125	0.0125	0	0.164	0.0164	0	0.218	0.0218	0

Freight trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 25 mph Injuries	Fatalities	Damage $	Representative Speed 40 mph Injuries	Fatalities	Damage $	Representative Speed 50 mph Injuries	Fatalities	Damage $
	Train-Train Collision	Frt Loco hits Loco	0.43	0.043	109000	1.1	0.11	270000	1.7	0.17	422000
		Frt Loco hits Car	0.35	0.035	88000	0.9	0.09	225000	1.4	0.14	352000
		Frt car hit by Loco	0	0	44000	0	0	112000	0	0	176000
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Overspeed, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Overspeed, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Work Zone Viol'n, Equip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0
	Work Zone Viol'n, Unequip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0

Casualties and damage in Table 3.1 are per accident, except for Work Zone Violations which are per million train-miles

Table 3.2: Grade Crossing and Diamonds: Numbers by Representative Speed, and Accident Frequency and Consequences

Train Type	Representative Speed (mph)	Type of Grade-crossing	Number Crossings Passenger	HS Passenger	Freight	Accident Frequency Per Million Crossing Passes Passenger	Freight	Crossing Collision Consequences Pass. Occup't Casualty Prob/accident) Injuries	Fatalities	Cost $/Accid't	Freight Trains (per accident) Injuries	Fatalities	Cost $	Number Diamonds
Passenger	40	Public_gates_lights	7	7		0.350		0.0028	0.000047	91000				1
		Public_other	0	0		0.300								
		Private	0	0		0.100								
	60	Public_gates_lights	16	0		0.600		0.0068	0.000112	113000				0
		Public_other	0	0		0.500								
		Private	1	0		0.200								
	79	Public_gates_lights	16	16		0.800		0.0105	0.000156	196000				0
		Public_other	1	0		0.650								
		Private	6	1		0.300								
	105	Public_gates_lights	0	16		1.100		0.0186	0.000276	346000				0
		Public_other	0	1		0.800								
		Private	0	6		0.300								
Freight	25	Public_gates_lights			7		0.150				0.12	0.005	20000	0
		Public_other			0		0.120							
		Private			0		0.050							
	40	Public_gates_lights			16		0.300				0.25	0.013	50000	1
		Public_other			1		0.250							
		Private			1		0.100							
	50	Public_gates_lights			16		0.360				0.39	0.02	78000	0
		Public_other			1		0.300							
		Private			6		0.120							

Table 3.3a: Segment Data (for reference only, not used in calculations)

Segment Number	Start (Milepost)	End (Milepost)	Type	Length (miles)	Representative Speed (mph) Freight	Pass	HS Pass (conseq)	HS Pass
	14.0	88.35	90.55	Rain	2.20	50	79	79	105
	15.0	90.55	92.47	CP Adjacent (M)	1.92	40	60	60	79
	16.0	92.47	94.97	Siding (M)	2.50	50	79	79	105
	17.0	94.97	96.81	CP Adjacent (M)	1.84	50	79	79	105
	18.0	96.81	100.28	Rain	3.47	50	79	79	105
	19.0	100.28	102.25	CP Adjacent (M)	1.97	40	60	60	79
	20.0	102.25	102.25	Diamond	0.00	40	40	40	40
	21.0	102.25	104.60	CP Adjacent (M)	2.35	40	60	60	79
	22.0	104.60	106.43	CP Adjacent (M)	1.83	50	79	79	105
	23.0	106.43	108.83	Siding (M)	2.40	50	79	79	105
	24.0	108.83	111.36	CP Adjacent (M)	2.53	50	79	79	105
	25.0	111.36	113.30	Rain	1.94	50	79	79	105
	26.0	113.30	116.36	Rain	3.06	50	79	79	105
	27.0	116.36	118.83	Rain,	2.47	50	79	79	105
	28.0	118.83	121.40	CP Adjacent (M)	2.57	50	79	79	105
	29.0	121.40	123.57	Siding (M)	2.17	40	60	79	79
	30.0	123.57	124.38	Siding (M)	0.81	25	40	40	40
	31.0	124.38	124.86	Siding (M)	0.48	25	40	40	40
				Length Check	36.5		36.5							

Table 3.3b: Aggregate Segment Data: Segments Types, Train Types, Speeds, and Lengths

Aggregate Segment Length by Type and Speed Band (from Seg Def and Preventability)

Segment Type	Train Type	Representative Speed (mph)	Freight (miles)	Reg Pass (miles)	HS Pass Collision (mi)	HS Pass Other (mi)
Siding (mon)	Freight	25	1.29			
		40	2.17			
		50	4.9			
	Passenger	40		1.29	1.29	1.29
		60		2.17	0	0
		79		4.9	7.07	2.17
		105		0	0	4.9
Siding (unmon)	Freight	25	0			
		40	0			
		50	0			
	Passenger	40		0	0	0
		60		0	0	0
		79		0	0	0
		105		0	0	0
CP Adjacent (mon)	Freight	25	0			
		40	6.24			
		50	8.77			
	Passenger	40		0	0	0
		60		6.24	6.24	0
		79		8.77	8.77	6.24
		105		0	0	8.77
CP Adjacent (unmon)	Freight	25	0			
		40	0			
		50	0			
	Passenger	40		0	0	0
		60		0	0	0
		79		0	0	0
		105		0	0	0
Plain Track	Freight	25	0			
		40	0			
		50	13.14			
	Passenger	40		0	0	0
		60		0	0	0
		79		13.14	13.14	0
		105		0	0	13.14
Totals All Types	Freight	25	1.29			
		40	8.41			
		50	26.81			
	Passenger	40		1.29	1.29	1.29
		60		8.41	6.24	0
		79		26.81	28.98	8.41
		105		0	0	26.81
		Checking Totals		36.51	36.51	36.51

Table 3.4a: Traffic Inputs to Risk Calculation

Train Type	Trips/Day Summer	Rest of Year
Passenger	6.00	5.00
Equipped Freight	1.43	2.28
Unequipped Freight	0.00	0.00
Operating Days	91.00	274.00

Percent Train-Miles in	
Timeout (secs)	0.00
Normal Operating Mode	95.00
Timeout Mode	0.00
Fallback Mode	5.00

Passenger Train Occupancy	
Seats	320.00
Occupancy Factor	0.60

Table 3.4: Collision Frequencies by Segment Type and Collision Scenario (From Coll Matrix)

Scenarios	Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain	Diamond
Pass Loco Hits Loco	0.0077	0.0103	0.0201	0.0241	0.0020	0.000000
Pass Loco Hits Pass Car	0.0032	0.0043	0.0021	0.0026	0.0004	0.000000
Pass Loco Hits Freight Car	0.0010	0.0014	0.0010	0.0012	0.0003	0.012866
Pass Car Hit by Loco	0.0035	0.0046	0.0025	0.0029	0.0004	0.002573
Freight Loco Hits Loco	0.0013	0.0017	0.0030	0.0037	0.0002	0.000000
Freight Loco Hits Car	0.0003	0.0003	0.0003	0.0004	0.0001	0.034144
Freight Car Hit By Loco	0.0010	0.0014	0.0010	0.0012	0.0003	0.032437

Collision Frequencies for Passenger + Unequipped Freight Train

Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain
0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000

Mauve cells contain data imported from previous worksheet in a group of three worksheets covering one sub-corridor, season and operating state.

All train-to-train collision frequencies are in units of **trains in collisions per million train-miles operated in the sub-corridor by all train types.**

Weighted Collision Accident Frequencies by Representative Speed (mph)

Scenarios	25	40	50	Passenger 40	60	79	105
Pass Loco Hits Loco				0.0077	0.0000	0.0169	0.0090
Pass Loco Hits Pass Car				0.0032	0.0000	0.0024	0.0015
Pass Loco Hits Freight Car				0.0010	0.0000	0.0010	0.0006
Pass Car Hit by Loco				0.0035	0.0000	0.0027	0.0016
Freight Loco Hits Loco	0.0013	0.0026	0.0013				
Freight Loco Hits Car	0.0003	0.0003	0.0002				
Freight Car Hit By Loco	0.0010	0.0010	0.0006				

Table 3.5a: Risk Calculation - Passenger Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Freq'y (per million tm)	Preventability	Adjusted Frequency	Trips/day	Trips per 10 years	Length of Track (miles)	Train-miles per 10 years	Accidents per 10 years	Number seats per train	Occupancy Factor	Passengers per train	Injuries per 10 years	Fatalities per 10 years	Damage $ per 10 years
40	Train-Train Collision	Pass Loco hits Loco	0.00769	Incl	0.00769	7.43	6423	1.29	8286	0.00006	320	0.6	192	0.0010	0.00002	0
		Pass Loco hits Pass Car	0.00319	Incl	0.00319	7.43	6423	1.29	8286	0.00003	320	0.6	192	0.0002	0.00001	0
		Pass Loco hits Frt Car	0.00104	Incl	0.00104	7.43	6423	1.29	8286	0.00001	320	0.6	192	0.0001	0.00000	0
		Pass car hit by Loco	0.00345	Incl	0.00345	7.43	6423	1.29	8286	0.00003	320	0.6	192	0.0009	0.00003	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.35	0.00559	6.00	5187	1.29	6691	0.00004	320	0.6	192	0.0001	0.00000	0
	Intrusion Collision (other!)	Pass Loco hits intruder	0.01440	0.10	0.01296	6.00	5187	1.29	6691	0.00009	320	0.6	192	0.0004	0.00001	0
	Overspeed		0.01100	0.00	0.01100	6.00	5187	1.29	6691	0.00007	320	0.6	192	0.0006	0.00001	0
	Broken Rail		0.01670	0.06	0.01570	6.00	5187	1.29	6691	0.00011	320	0.6	192	0.0009	0.00001	0
	Work Zone Violation			0.00		6.00	5187	1.29	6691					0.0000	0.00006	0
										0.00043				**0.00420**	**0.00015**	**0**
60	Train-Train Collision	Pass Loco hits Loco	0.00000	Incl	0.00000	7.43	6423	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Pass Car	0.00000	Incl	0.00000	7.43	6423	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Frt Car	0.00000	Incl	0.00000	7.43	6423	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00000	Incl	0.00000	7.43	6423	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.35	0.00559	6.00	5187	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (other!)	Pass Loco hits car	0.01440	0.10	0.01296	6.00	5187	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Overspeed		0.01100	0.00	0.01100	6.00	5187	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Broken Rail		0.01670	0.06	0.01570	6.00	5187	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Work Zone Violation			0.00		6.00	5187	0	0					0.0000	0.00000	0
										0.00000				**0.00000**	**0.00000**	**0**
79	Train-Train Collision	Pass Loco hits Loco	0.01689	Incl	0.01689	7.43	6423	8.41	54019	0.00091	320	0.6	192	0.042	0.0015	1802
		Pass Loco hits Pass Car	0.00240	Incl	0.00240	7.43	6423	8.41	54019	0.00013	320	0.6	192	0.002	0.0001	128
		Pass Loco hits Frt Car	0.00100	Incl	0.00100	7.43	6423	8.41	54019	0.00005	320	0.6	192	0.001	0.0000	53
		Pass car hit by Loco	0.00271	Incl	0.00271	7.43	6423	8.41	54019	0.00015	320	0.6	192	0.013	0.0006	579
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.35	0.00559	6.00	5187	8.41	43623	0.00024	320	0.6	192	0.003	0.0001	109
	Intrusion Collision (other!)	Pass Loco hits car	0.01440	0.10	0.01296	6.00	5187	8.41	43623	0.00057	320	0.6	192	0.012	0.0004	503
	Overspeed		0.01100	0.00	0.01100	6.00	5187	8.41	43623	0.00048	320	0.6	192	0.019	0.0003	1248
	Broken Rail		0.01670	0.06	0.01570	6.00	5187	8.41	43623	0.00068	320	0.6	192	0.028	0.0004	1780
	Work Zone Violation			0.00		6.00	5187	8.41	43623					0.007	0.0007	0
										0.00322				**0.12722**	**0.00420**	**6202**
105	Train-Train Collision	Pass Loco hits Loco	0.00896	Incl	0.00896	7.43	6423	26.81	172207	0.00154	320	0.6	192	0.126	0.0047	5390
		Pass Loco hits Pass Car	0.00147	Incl	0.00147	7.43	6423	26.81	172207	0.00025	320	0.6	192	0.008	0.0004	442
		Pass Loco hits Frt Car	0.00064	Incl	0.00064	7.43	6423	26.81	172207	0.00011	320	0.6	192	0.004	0.0002	192
		Pass car hit by Loco	0.00165	Incl	0.00165	7.43	6423	26.81	172207	0.00028	320	0.6	192	0.046	0.0017	1984
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.35	0.00559	6.00	5187	26.81	139063	0.00078	320	0.6	192	0.014	0.0005	611
	Intrusion Collision (other!)	Pass Loco hits car	0.01440	0.10	0.01296	6.00	5187	26.81	139063	0.00180	320	0.6	192	0.066	0.0024	2835
	Overspeed		0.01100	0.00	0.01100	6.00	5187	26.81	139063	0.00153	320	0.6	192	0.082	0.0013	7027
	Broken Rail		0.01670	0.06	0.01570	6.00	5187	26.81	139063	0.00218	320	0.6	192	0.117	0.0019	10029
	Work Zone Violation			0.00		6.00	5187	26.81	139063					0.030	0.0030	0
	Total									**0.00848**				**0.49393**	**0.01614**	**28510**
	Overall Totals									**0.01213**				**0.62535**	**0.02049**	**34713**
	Totals All Speeds	**Train-train Collisions**								**0.00356**				**0.24461**	**0.00933**	**10571**
		Intrusion Collisions								**0.00351**				**0.09520**	**0.00338**	**4057**
		Overspeed								**0.00208**				**0.10221**	**0.00164**	**8275**
		Broken Rail								**0.00297**				**0.14586**	**0.00234**	**11809**
		Work Zone Violation								**0.00000**				**0.03748**	**0.00380**	**0**

Table 3.5b: Risk Calculation - Collisions at Diamonds - Passenger

Number Diamonds	Freq'y per mill passes	Collisions (millions)	Injuries	Fatalities	Damage
1	0.000000	0.000000	0.000000	0.000000	0.00
1	0.000000	0.000000	0.000000	0.000000	0.00
1	0.012866	0.000083	0.000539	0.000016	20.74
1	0.002573	0.000017	0.000527	0.000016	16.61
		0.000099	**0.001066**	**0.000032**	**37.35**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.012866	0.000000	0.000000	0.000000	0.00
0	0.002573	0.000000	0.000000	0.000000	0.00
		0.000000	**0.000000**	**0.000000**	**0.00**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.012866	0.000000	0.000000	0.000000	0.00
0	0.002573	0.000000	0.000000	0.000000	0.00
		0.000000	**0.000000**	**0.000000**	**0.00**
1	0.000000	0.000000	0.000000	0.000000	0.00
1	0.034144	0.000219	0.000197	0.000020	49.35
1	0.032437	0.000208	0.000000	0.000000	23.34
		0.000428	**0.000197**	**0.000020**	**72.68**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.034144	0.000000	0.000000	0.000000	0.00
0	0.032437	0.000000	0.000000	0.000000	0.00
		0.000000	**0.000000**	**0.000000**	**0.00**
		0.000428	**0.000197**	**0.000020**	**573**

Table 3.6a: Risk Calculation - Freight Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Freq'y (per million tm)	Preventability	Adjusted Frequency	Trips/day	Trips per 10 years	Length of Track (miles)	Per 10 years Train-miles	Accidents	Injuries	Fatalities	Damage $
25	Train-Train Collision	Frt Loco hits Loco	0.001303989	Incl	0.00130	7.43	6423	1.29	8286	0.00001	0.00000	0.000000	$1
		Frt Loco hits Car	0.000260798	Incl	0.00026	7.43	6423	1.29	8286	0.00000	0.00000	0.000000	$0
		Frt car hit by Loco	0.001043191	Incl	0.00104	7.43	6423	1.29	8286	0.00001	0.00000	0.000000	$0
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.35	0.00936	1.43	1236	1.29	1595	0.00001	0.00000	0.000000	$0
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.10	0.00774	1.43	1236	1.29	1595	0.00001	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.00	0	1.29	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.00	0	1.29	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.00	0.01600	1.43	1236	1.29	1595	0.00003	0.00000	0.000000	$4
	Overspeed, Unequip		0.016	0.00	0.01600	0.00	0	1.29	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.06	0.05226	1.43	1236	1.29	1595	0.00008	0.00000	0.000000	$13
	Broken Rail, Unequip		0.056	0.00	0.05560	0.00	0	1.29	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.00		1.43	1236	1.29	1595		0.00007	0.000007	$0
	Work Zone Viol'n, Unequip			0.00		0.00	0	1.29	0		0.00000	0.000000	$0
	Totals									**0.0002**	**0.0001**	**0.00001**	**$18**
40	Train-Train Collision	Frt Loco hits Loco	0.0026	Incl	0.00260	7.43	6423	8.41	54019	0.00014	0.00015	0.000015	$38
		Frt Loco hits Car	0.0003	Incl	0.00031	7.43	6423	8.41	54019	0.00002	0.00002	0.000002	$4
		Frt car hit by Loco	0.0010	Incl	0.00100	7.43	6423	8.41	54019	0.00005	0.00000	0.000000	$6
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.35	0.00936	1.43	1236	8.41	10397	0.00010	0.00002	0.000002	$3
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.10	0.00774	1.43	1236	8.41	10397	0.00008	0.00002	0.000002	$2
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.00	0	8.41	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.00	0	8.41	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.00	0.01600	1.43	1236	8.41	10397	0.00017	0.00002	0.000002	$62
	Overspeed, Unequip		0.016	0.00	0.01600	0.00	0	8.41	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.06	0.05226	1.43	1236	8.41	10397	0.00054	0.00008	0.000008	$204
	Broken Rail, Unequip		0.056	0.00	0.05560	0.00	0	8.41	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.00		1.43	1236	8.41	10397		0.00069	0.000069	$0
	Work Zone Viol'n, Unequip			0.00		0.00	0	8.41	0		0.00000	0.000000	$0
	Totals									**0.00110**	**0.0010**	**0.00010**	**$319**
50	Train-Train Collision	Frt Loco hits Loco	0.0013	Incl	0.00134	7.43	6423	26.81	172207	0.00023	0.00039	0.000039	$97
		Frt Loco hits Car	0.0002	Incl	0.00018	7.43	6423	26.81	172207	0.00003	0.00004	0.000004	$11
		Frt car hit by Loco	0.0006	Incl	0.00064	7.43	6423	26.81	172207	0.00011	0.00000	0.000000	$19
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.35	0.00936	1.43	1236	26.81	33143	0.00031	0.00011	0.000011	$14
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.10	0.00774	1.43	1236	26.81	33143	0.00026	0.00009	0.000009	$11
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.00	0	26.81	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.00	0	26.81	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.00	0.01600	1.43	1236	26.81	33143	0.00053	0.00019	0.000019	$311
	Overspeed, Unequip		0.016	0.00	0.01600	0.00	0	26.81	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.06	0.05226	1.43	1236	26.81	33143	0.00173	0.00061	0.000061	$1,015
	Broken Rail, Unequip		0.056	0.00	0.05560	0.00	0	26.81	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.00		1.43	1236	26.81	33143		0.00275	0.000275	$0
	Work Zone Viol'n, Unequip			0.00		0.00	0	26.81	0		0.00000	0.000000	$0
	Totals									**0.00320**	**0.0042**	**0.00042**	**$1,478**
	Overall Totals									**0.00446**	**0.0053**	**0.0005**	**$1,815**
Totals All Speeds	**Train-Train Collisions**									**0.00060**	**0.00061**	**0.00006**	**177**
	Intrusion Collisions									**0.00077**	**0.00024**	**0.00002**	**30**
	Diamond Collisions									**0.00043**	**0.00020**	**0.00002**	**73**
	Overspeed									**0.00072**	**0.00021**	**0.00002**	**377**
	Broken Rail

Worksheet 1-Sp,N: IDOT Risk Model: Braking Distances and Collision Zone Calculations, Cab Signal/ATC 70% Preventability Case, Springfield Sub-corridor

Table 1.1: Stopping Distance Parameters and Calculations, including Timeout and ACS Response Delay

Train/System Type	Parameter	Value
Freight	Coefficient P	0.035
	Appl'n Time (sec)	13.8
	Train Weight (lb)	2500000
	Brake Force (lb)	275600
Passenger	Coefficient A	1.065
	Coefficient B	0
	Safety Factor	1.29
Train Control	Latency/T-out (sec)	3
	ACS Response (sec)	0
Guideway	Train Speed (mph)	79

Braking Distance Calculations (including free running in TOS (ft)):

Train Type	Speeds (mph)	To Stop	Reduction to RedCon*	RedCon* to Stop
Freight	25	1671	1671	0
	40	3686	1619	2068
	50	5462	3394	2068
Passenger	40	1452	1452	0
	60	3177	3177	0
	79	5433	3035	2398
	105	9403	7096	2398
Pin Redhd Consist	35	1125	NA	NA

Decel-eration (ft/sec²):

0.668
0.668
0.668
1.293
1.293
1.293
1.293
1.293

Braking Duration (secs) / Refig Train Distance (ft):

Reduction to RedCon*	RedCon* to Stop	Reduction to RedCon*	RedCon* to Stop	Total Zone Lengths (ft): Reduction to RedCon*	Full Speed to Stop
58	0	1275	0	2946	0
14	77	308	1692	1927	3760
36	77	791	1692	4176	3760
48	0	1065	0	2517	0
71	0	1565	0	4742	0
25	68	541	1499	3576	3896
54	68	1190	1499	8286	3896
					12182

Blue cells contain data imported from the Inputs worksheet

*Note: RedCon refers to the speed at which collision consequences will be significantly reduced

50 mph for pas-senger trains and 35 mph for freight trains

If train speed is lower that this speed, then there are no reduced consequences and Zone A2 has zero length

Sight Distance (ft): 2500

Table 1.2: Segment Definitions: Springfield Sub-Corridor - MP 124.9 (Bloomington) - MP 181.0 (Ridgely)

Segment Number	Start (milepost	End (milepost)	Type	Variant	Length Miles	Length Feet	Posted Speed (mph) Freight	Pass	HS Pass	Representative Speed (mph) Freight	Pass	HS Pass (Consist*)	HS Pass (Other)	Industry Siding Number	Industry Siding Name	Passenger Stops
26	32.0	124.9	126.5	CP Adjacent (Mi	1.6	8459.2	25.0	40.0	40.0	25.0	40.0	40.0	40.0		Illiopm Yard	
27	33.0	126.5	126.5	Diamond	0.0	0.0	25.0	40.0	40.0	25.0	40.0	40.0	40.0			
28	34.0	126.5	128.8	CP Adjacent (Mi	2.3	11932.8	30.0	40.0	50.0	30.0	40.0	50.0	79.0			
29	35.0	128.8	131.0	Plain	2.2	11616.0	60.0	79.0	90.0	50.0	79.0	79.0	79.0			
30	36.0	131.0	133.7	Plain	2.8	14572.8	60.0	79.0	110.0	50.0	79.0	79.0	105.0			
31	37.0	133.7	136.9	Plain	3.2	16795.4	60.0	79.0	110.0	50.0	79.0	79.0	105.0			
32	38.0	136.9	139.6	CP Adjacent (Mi	2.7	14194.4	60.0	79.0	110.0	50.0	79.0	79.0	105.0			
33	39.0	139.6	141.3	Siding (Mi	McLean (Ogle)	2.7	14097.6	60.0	79.0	110.0	50.0	79.0	79.0	105.0	1.0	McLean
34	40.0	141.3	143.4	CP Adjacent (Mi	2.0	10924.0	60.0	79.0	110.0	50.0	79.0	79.0	105.0			
35	41.0	143.4	148.9	Plain	5.0	26136.0	60.0	79.0	110.0	50.0	79.0	79.0	105.0	2.0	Pember, Atlanta	
36	42.0	148.9	151.0	Plain	2.1	11404.8	60.0	79.0	110.0	50.0	79.0	79.0	105.0	1.0	Lincoln Grain	
37	43.0	151.0	153.6	CP Adjacent (Mi	2.6	13728.0	60.0	79.0	110.0	50.0	79.0	79.0	105.0	1.0	Kingan	
38	44.0	153.6	155.6	Siding (Mi	Elkhart (Logan)	2.0	10562.8	60.0	79.0	110.0	50.0	79.0	79.0	105.0		
39	45.0	155.6	155.6	Diamond	0.0	0.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0			
40	46.0	155.6	157.3	CP Adjacent (Mi	1.7	8972.2	50.0	50.0	70.0	70.0	50.0	60.0	79.0	1.0	Illinois Mill	Lincoln
41	47.0	157.3	160.1	Plain	2.8	14791.2	60.0	79.0	90.0	50.0	79.0	79.0	105.0			
42	48.0	160.1	162.1	Plain	2.1	10876.8	60.0	79.0	110.0	50.0	79.0	79.0	105.0			
43	49.0	162.1	164.0	Plain	2.1	10108.8	60.0	79.0	110.0	50.0	79.0	79.0	105.0			
44	50.0	164.0	166.2	Plain	2.1	11193.6	60.0	79.0	110.0	50.0	79.0	79.0	105.0			
45	51.0	166.2	168.3	CP Adjacent (Mi	2.1	11510.4	60.0	79.0	110.0	50.0	79.0	79.0	105.0	1.0	Elkhart Grain	
46	52.0	168.3	170.4	Siding (Mi	Elkhart (Arlington)	2.1	10876.8	60.0	79.0	110.0	50.0	79.0	79.0	105.0		
47	53.0	170.4	172.3	CP Adjacent (Mi	1.9	10240.8	60.0	79.0	110.0	50.0	79.0	79.0	105.0			
48	54.0	172.3	174.8	Plain	2.5	13440.0	60.0	79.0	110.0	50.0	79.0	79.0	105.0			
49	55.0	174.8	177.1	Plain	2.3	12178.0	60.0	79.0	110.0	50.0	79.0	79.0	105.0			
50	56.0	177.1	181.0	CP Adjacent (Mi	3.9	20592.0	60.0	79.0	110.0	50.0	79.0	79.0	79.0			
51																
52																
53																
54																
55																
56																
57																
58			Check Total		56.1											

Table 1.3: Mitigation and Prevention Zones - All Segments - Lengths in Feet

Segment Number	Zone A1: Limited Speed Reduction No Prevention or Mitigation Freight	Pass	HS Pass	Zone A2: Reduced Speed to Stop Severity Mitigation Freight	Pass	HS Pass	Zone B: Able to Stop Full Prevention Freight	Pass	HS Pass	Overlap of Stopping Distance into Zone C Freight	Pass	HS Pass	Distance in Timeout in Zone C Freight	Pass	HS Pass	Overlap of Zone A1 into Zone C Freight	Pass	HS Pass	Overlap of Zone A1 into Zone C within Sight Distance Freight	Pass	HS Pass	Overlap of Zone A2 into Zone C within Sight Distance Freight	Pass	HS Pass
26	2946	2517	2517	0	0	0	5713	6142	6142	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27																								
28	2946	4742	3576	0	0	3896	8987	7191	4461	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	4176	3576	3576	3896	3896	3896	3544	4144	4144	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	4176	3576	8286	3896	3896	3896	6901	7101	2391	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	4176	3576	8286	3760	3896	3896	8855	9319	4609	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	4176	3576	8286	3896	3896	3896	849	1063	0	0	0	0	462	0	0	0	0	0	0	0	0	0	0	0
33	4176	3576	8286	3896	3896	3896	6026	6626	1916	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	4176	3576	8286	3896	3896	3896	2538	2752	3352	0	0	0	462	0	0	0	0	0	0	0	0	0	0	0
35	4176	4742	3576	0	0	3896	21960	21394	18664	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	4176	3576	8286	3896	3896	3896	5973	6572	1863	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	4176	3576	8286	3896	3896	3896	5656	6256	1546	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	4176	4742	3576	0	0	3896	6437	5871	3141	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39																								
40	4176	4742	3576	3760	0	3896	868	4182	1452	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41	4176	3576	3576	3760	3896	3896	6796	7292	7292	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
42	4176	3576	8286	3760	3896	2591	2942	3405	0	0	0	0	1305	0	0	0	0	0	1305	0	0	0	0	0
43	4176	3576	8286	3896	3896	1905	2255	2719	0	0	0	0	1961	0	0	0	0	0	1961	0	0	0	0	0
44	4176	3576	8286	3760	3896	2908	3258	3722	0	0	0	0	988	0	0	0	0	0	988	0	0	0	0	0
45	4176	3576	8286	3760	3896	3225	3575	4039	0	0	0	0	671	0	0	0	0	0	671	0	0	0	0	0
46	4176	3576	8286	3760	3896	2591	2942	3405	0	0	0	0	1305	0	0	0	0	0	1305	0	0	0	0	0
47	4176	3576	8286	3760	3896	1958	2308	2772	0	0	0	0	1009	0	0	0	0	0	1009	0	0	0	0	0
48	4176	3576	8286	3760	3896	3896	10545	11008	6298	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49	4176	3576	3576	3760	3896	3896	11337	11800	11800	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50	4176	3576	3576	3744	3896	3896	0	448	448	15	0	0	15	0	0	0	0	0	15	0	0	0	0	0

Table 1.4: Breakdown of Segments Lengths by Representative Speed (miles)

Segment Number	Freight Speeds (mph) 25	40	50	Convent'l Pass Speeds (mph) 40	60	79	HS Pass. Speeds - Cab'n Consist (mph) 40	60	79	105	HS Pass. Speeds - Other (mph) 40	60	79	105
26	32.0	1.64	0	0	1.64	0	0	1.64	0	0	0	1.64	0	0	0
27															
28	34.0	2.26	0	0	2.26	0	0	2.26	0	0	0	2.26	0	0	0
29	35.0	0	2.2	0	0	2.2	0	0	2.2	0	0	0	2.2	0	0
30	36.0	0	2.76	0	0	2.76	0	0	2.76	0	0	0	2.76	0	0
31	37.0	0	3.18	0	0	3.18	0	0	3.18	0	0	0	3.18	0	0
32	38.0	0	1.73	0	0	1.73	0	0	1.73	0	0	0	1.73	0	0
33	39.0	0	2.67	0	0	2.67	0	0	2.67	0	0	0	2.67	0	0
34	40.0	0	2.05	0	0	2.05	0	0	2.05	0	0	0	2.05	0	0
35	41.0	0	4.95	0	0	4.95	0	0	4.95	0	0	0	4.95	0	0
36	42.0	0	2.66	0	0	2.66	0	0	2.66	0	0	0	2.66	0	0
37	43.0	0	2.6	0	0	2.6	0	0	2.6	0	0	0	2.6	0	0
38	44.0	0	2.01	0	0	2.01	0	0	2.01	0	0	0	2.01	0	0
39															
40	46.0	0	1.69	0	1.69	0	0	1.69	0	0	0	1.69	0	0	0
41	47.0	0	2.79	0	0	2.79	0	0	2.79	0	0	0	2.79	0	0
42	48.0	0	2.06	0	0	2.06	0	0	2.06	0	0	0	2.06	0	0
43	49.0	0	1.93	0	0	1.93	0	0	1.93	0	0	0	1.93	0	0
44	50.0	0	2.12	0	0	2.12	0	0	2.12	0	0	0	2.12	0	0
45	51.0	0	2.18	0	0	2.18	0	0	2.18	0	0	0	2.18	0	0
46	52.0	0	2.06	0	0	2.06	0	0	2.06	0	0	0	2.06	0	0
47	53.0	0	1.94	0	0	1.94	0	0	1.94	0	0	0	1.94	0	0
48	54.0	0	3.5	0	0	3.5	0	0	3.5	0	0	0	3.5	0	0
49	55.0	0	3.65	0	0	3.65	0	0	3.65	0	0	0	3.65	0	0
50	56.0	0	1.5	0	0	1.5	0	0	1.5	0	0	0	1.5	0	0
51															
52															
53															
54															
55															
56															
57															
58															

Table 1.5: Aggregate Segment Length by Segment Type and Speed

Segment Type	Train Type	Representative Speed (mph)	Aggregate Length of Segments by Train and Segment Types: Freight Miles	Freight Feet	Pass-senger Miles	Pass-senger Feet	High Speed Passenger Collision Consist* Miles	Collision Consist* Feet	Other Miles	Other Feet
Siding (mini)	Freight	25	0.0	0						
		40	0.0	0						
		50	2.7	14097.6						
	Passenger	40			0.0	0	0.0	0	0.0	0
		60			0.0	0	0.0	0	0.0	0
		79			2.7	14097.6	2.7	14097.6	0.0	0
		105					0.0	0	2.7	14097.6
Siding (unmini)	Freight	25	0.0	0						
		40	0.0	0						
		50	4.1	21469.6						
	Passenger	40			0.0	0	0.0	0	0.0	0
		60			2.0	10612.8	2.0	10612.8	0.0	0
		79			2.1	10876.8	2.1	10876.8	2.0	10612.8
		105					0.0	0	2.1	10876.8
CP Adjacent (mini)	Freight	25	3.9	20592						
		40	0.0	0						
		50	5.3	27878.4						
	Passenger	40			1.6	8659.2	1.6	8659.2	1.6	8659.2
		60			2.3	11932.8	2.3	11932.8	0.0	0
		79			5.3	27878.4	5.3	27878.4	3.8	19852.8
		105					0.0	0	3.8	19958.4
CP Adjacent (unmini)	Freight	25	0.0	0						
		40	0.0	0						
		50	8.4	44404.8						
	Passenger	40			0.0	0	0.0	0	0.0	0
		60			1.7	8923.2	1.7	8923.2	0.0	0
		79			6.7	35481.6	6.7	35481.6	1.7	8923.2
		105					0.0	0	6.7	35481.6
Plain Track	Freight	25	0.0	0						
		40	0.0	0						
		50	31.8	167904						
	Passenger	40			0.0	0	0.0	0	0.0	0
		60			5.0	26136	2.8	14572.8	0.0	0
		79			26.9	141768	29.0	153331.2	13.6	71755.2
		105					0.0	0	18.2	96144.8
Check Total			56.1		56.1		56.1		56.1	

*This speed is used to calculate collision consequences in collisions between an equipped and an unequipped train ONLY reflecting the IDOT PTC speed restriction when an equipped train nears an unequipped train

Yellow cells contain data exported to the next worksheet in the sequence of three sheets that perform the calculations for one sub-corridor, cases and operating state

Table 1.6a: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for Siding (M) Segments

Lengths in Zone C: A1 | A2 | B

Total Length, Siding (M) Segments (ft): 140097.6
Number Siding (M) Segments: 1
Average distance in Zone C (ft): Freight 0 | 0 | 2500; Passenger 0 | 0 | 2500; HS Pass 0 | 0 | 2500

Sum Zone Lengths A1, A2, B (ft): 2500
Fraction of total length in zone: 0.056 | 0.234 | 0.548

Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass
4176	3576	8286	3896	3896	3896	6026	6626	1916
0.276	0.276	0.276	0.276	0.276	0.276	0.427	0.470	0.136

Collision Accident Mitigation Probabilities: Combined All Zones:

0.281	0.241	0.558	0.263	0.263	0.263	0.506	0.547	0.229

Values transferred to Collision Matrix

Distribution of train location at time of violation in Reference Case accidents: In Block 0.95; Previous Block 0.05
PTC Risk Increment in Zone C: 2
Potential danger length in Zone C (ft): 2500

Table 1.6b: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for Siding (U) Segments

Lengths in Zone C: A1 | A2 | B

Total Length, Siding (U) Segments (ft): 21469.6
Number Siding (M) Segments: 2
Average distance in Zone C (ft): Freight 0 | 0 | 2500; Passenger 0 | 0 | 2500; HS Pass 0 | 662 | 1848

Zone lengths A1, A2, B (ft): 8351 | 8317 | 11801
Fraction of total length in zone: 0.389 | 0.387 | 0.552

Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass
8351	8317	11801	3760	3896	6487	9379	9276	3141
0.389	0.387	0.552	0.175	0.181	0.302	0.436	0.432	0.146

Collision Accident Mitigation Probabilities: Combined All Zones:

0.369	0.368	0.524	0.166	0.172	0.313	0.515	0.510	0.213

Values transferred to Collision Matrix

Distribution of train location at time of violation in Reference Case accidents: In Block 0.95; Previous Block 0.05
PTC Risk Increment in Zone C: 2
Potential danger length in Zone C (ft): 2500

Table 1.6c: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for CP Adjacent (M) Segments

Lengths in Zone C: A1 | A2 | B

Total Length, CP Adjacent (M) Segments (ft): 46470.4
Number CP Adjacent Segments: 5
Average distance in Zone C (ft): Freight 0 | 3 | 2497; Passenger 0 | 0 | 2500; HS Pass 0 | 772 | 1728

Zone lengths A1, A2, B (ft): 18418 | 17985 | 26239
Fraction of total length in zone: 0.380 | 0.371 | 0.541

Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass
18418	17985	26239	11537	11688	11179	18516	18797	11052
0.380	0.371	0.541	0.238	0.241	0.231	0.382	0.388	0.228

Collision Accident Mitigation Probabilities: Combined All Zones:

0.361	0.353	0.514	0.226	0.229	0.250	0.463	0.468	0.286

Values transferred to Collision Matrix

Distribution of train location at time of violation in Reference Case accidents: In Block 0.95; Previous Block 0.05
PTC Risk Increment in Zone C: 2
Potential danger length in Zone C (ft): 2500

Table 1.6d: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for CP Adjacent (U)Segments

Lengths in Zone C: A1 | A2 | B

Total Length, CP Adjacent (U) Segments (ft): 44404.8
Number CP Adjacent Segments: 4
Average distance in Zone C (ft): Freight 0 | 0 | 2500; Passenger 0 | 0 | 2500; HS Pass 0 | 662 | 1848

Zone lengths A1, A2, B (ft): 16702 | 15498 | 28432
Fraction of total length in zone: 0.376 | 0.348 | 0.640

Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass
16702	15498	28432	15175	11688	12976	12527	17248	2998
0.376	0.348	0.640	0.342	0.263	0.292	0.282	0.388	0.068

Collision Accident Mitigation Probabilities: Combined All Zones:

0.357	0.331	0.608	0.325	0.250	0.304	0.368	0.469	0.198

Values transferred to Collision Matrix

Distribution of train location at time of violation in Reference Case accidents: In Block 0.95; Previous Block 0.05
PTC Risk Increment in Zone C: 2
Potential danger length in Zone C (ft): 2500

Table 1.6e: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for Plain Track Segments

Lengths in Zone C: A1 | A2 | B

Total Length, Plain Track Segments (ft): 167904
Number CP Adjacent Segments: 11
Average distance in Zone C (ft): Freight 0 | 0 | 2500; Passenger 0 | 0 | 2500; HS Pass 0 | 389 | 2111

Zone lengths A1, A2, B (ft): 18418 | 17985 | 26239
Fraction of total length in zone: 0.110 | 0.107 | 0.156

Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass
18418	17985	26239	0	0	0	0	0	0
0.110	0.107	0.156	0.000	0.000	0.000	0.000	0.000	0.000

Collision Accident Mitigation Probabilities: Combined All Zones:

0.104	0.102	0.148	0.000	0.000	0.016	0.100	0.100	0.094

Values transferred to Collision Matrix

Distribution of train location at time of violation in Reference Case accidents: In Block 0.95; Previous Block 0.05
PTC Risk Increment in Zone C: 2
Potential danger length in Zone C (ft): 2500

Table 1.6f: Distribution of Equipped Train Locations by Collision Preventability Zones - Values for Diamond Segments

Lengths in Zone C: A1 | A2 | B

Total Length, Diamond Adjacent Segments (ft): 40128.0
Number of Diamond Adjacent Segments: 4
Average distance in Zone C (ft): Freight 0 | 0 | 2500; Passenger 0 | 0 | 2500; HS Pass 0 | 0 | 2500

Zone lengths A1, A2, B (ft): 10111 | 10983 | 10517
Fraction of total length in zone: 0.252 | 0.274 | 0.263

Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass
10111	10983	10517	4135	0	7191	25882	29145	22378
0.252	0.274	0.263	0.103	0.000	0.179	0.645	0.726	0.558

Collision Accident Mitigation Probabilities: Combined All Zones:

0.239	0.260	0.250	0.098	0.000	0.170	0.713	0.750	0.630

Values transferred to Collision Matrix

Distribution of train location at time of violation in Reference Case accidents: In Block 0.95; Previous Block 0.05
PTC Risk Increment in Zone C: 2
Potential danger length in Zone C (ft): 2500

Worksheet 2 - Sp,N,R: Collision Frequencies Calculation - Cab Signal/ATC 70% Preventability Case, Springfield Sub-corridor, Rest of Year

Table 2.1a: Collision Distribution Matrix (Fraction Accidents by Train Pair and Collision Type). Collisions Between Trains Operating on the IDOT Test Corridor Only (not diamonds and intrusions)

	Train Pairs in In Collision	Collision Scenario Prob (Top Level)	Siding - Monitored						Siding - Unmonitored						CP Adjacent - Monitored Siding						CP Adjacent - Unmonitored Siding						Plain Track					
			Collision Distribution		Head On		Rear End/Side		Collision Distribution		Head On		Rear End/Side		Collision Distribution		Head On		Rear End/Side		Collision Distribution		Head On		Rear End/Side		Collision Distribution		Head On		Rear End/Side	
			Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty
Percent Guilty					100%	0%	100%	0%	100%	0%	100%	0%	100%	0%			100%	0%	100%	0%			100%	0%	100%	0%			100%	0%	100%	0%
Both Trains TBE (Note 3)	Pass-Pass	0.62	0.50	0.50	0.31	0	0.31	0	0.5	0.5	0.31	0	0.31	0	0.8	0.2	0.496	0	0.124	0	0.8	0.2	0.496	0	0.124	0	0.70	0.30	0.434	0	0.186	0
	Pass-TBE Freight	0.30	0.50	0.50	0.15	0	0.15	0	0.5	0.5	0.15	0	0.15	0	0.7	0.3	0.21	0	0.09	0	0.7	0.3	0.21	0	0.09	0	0.40	0.60	0.12	0	0.18	0
	TBE Freight - TBE Freight	0.08	0.50	0.50	0.04	0	0.04	0	0.5	0.5	0.04	0	0.04	0	0.7	0.3	0.056	0	0.024	0	0.7	0.3	0.056	0	0.024	0	0.50	0.50	0.04	0	0.04	0
Percent Guilty					50%	50%	50%	50%			50%	50%	50%	50%			50%	50%	50%	50%			50%	50%	50%	50%			50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	0.00	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1.00	0.00	0	0	0	0
	Rear/Side, Pass into NE Frt		0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0.00	1.00	0	0	0	0
	Rear/Side NE Frt into Pass		0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0.00	1.00	0	0	0	0
	TBE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0	0.5	0.5	0	0	0	0	0.7	0.3	0	0	0	0	0.7	0.3	0	0	0	0	0.50	0.50	0	0	0	0
Percent Guilty					0%	100%	0%	100%			0%	100%	0%	100%			0%	100%	0%	100%			0%	100%	0%	100%			0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0	0.5	0.5	0	0	0	0	0.7	0.3	0	0	0	0	0.7	0.3	0	0	0	0	0.50	0.50	0	0	0	0
	Total Probability (checking)	1		1	0.5	0	0.5	0		1	0.5	0	0.5	0		1	0.762	0	0.238	0		1	0.762	0	0.238	0		1	0.594	0	0.406	0

Quantity in cell C18 is for all collisions between a passenger train and an unequipped freight train

Table 2.1b: Collision Type Distribution - Diamonds

Diamond Collisions Rear End/Side		Train Pairs in In Collision	Train Pair Type
Equip Guilty	Unequip Guilty		
		Percent Guilty	
		Pass-Pass	Both Trains TBE
		Pass-TBE Freight	
		TBE Freight - TBE Freight	
50%	50%	Percent Guilty	One Train TBE
0	0	Pass - NE Freight, Head -On	
0.25	0.25	Rear/Side, Pass into NE Frt	
0.05	0.05	Rear/Side NE Frt into Pass	
0.1	0.1	TBE Freight - NE Freight	
		Percent Guilty	
0	0.2	NE Freight - NE Freight	Neither Train TBE
0.4	0.6	Total Probability (checking)	

Note: The gray cells on these rows are set at zero, because in every case, the condition represented by the cell does not exist - either because there are no unequipped passenger trains, or because of the kind of collision defined for the row.

Table 2.2: Preventability Data For Unequipped train Guilty, One Train TBE

Segment Type	Not Prevented of Mitigated			Mitigated			Prevented		
	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass
Siding (M)	0.281	0.241	0.558	0.263	0.263	0.263	0.506	0.547	0.229
Siding (U)	0.369	0.368	0.524	0.166	0.172	0.313	0.515	0.510	0.213
CP Adjacent (M)	0.361	0.353	0.514	0.226	0.229	0.250	0.463	0.468	0.286
CP Adjacent (U)	0.357	0.331	0.608	0.325	0.250	0.304	0.368	0.469	0.138
Plain Track	0.104	0.102	0.148	0.000	0.000	0.016	0.100	0.100	0.084
Diamonds	0.239	0.260	0.250	0.098	0.000	0.170	0.713	0.790	0.630

Mauve cells contain data imported from previous worksheet in a group of three worksheets covering one sub-corridor, season and operating state.

Table 2.3a: Collision Preventability Matrix (Percent Accidents Preventable Relative to CTC Reference Case)

	Train Pairs in Collision	Preventability Equipped Train Guilty	Siding - Monitored						Siding - Unmonitored						CP Adjacent - Monitored Siding						CP Adjacent - Unmonitored Siding						Plain Track					
					Head On		Rear End/Side				Head On		Rear End/Side				Head On		Rear End/Side				Head On		Rear End/Side		Collision Distribution		Head On		Rear End/Side	
					Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty
Both TBE	Pass-Pass	70%			70%		70%				70%		70%				70%		70%				70%		70%				70%		70%	
	Pass-TBE Freight	70%			70%		70%				70%		70%				70%		70%				70%		70%				70%		70%	
	TBE Freight - TBE Freight	70%			70%		70%				70%		70%				70%		70%				70%		70%				70%		70%	
One TBE	Pass - NE Freight, Head -On	70%			70%	23%					70%	21%					70%	29%					70%	14%					70%	8%		
	Rear/Side, Pass into NE Frt	70%					70%	23%					70%	21%					70%	29%					70%	14%					70%	8%
	Rear/Side NE Frt into Pass	70%					70%	0%					70%	0%					70%	0%					70%	0%					70%	0%
	TBE Freight - NE Freight	70%			70%	51%	70%	0%			70%	51%	70%	0%			70%	46%	70%	0%			70%	37%	70%	0%			70%	10%	70%	0%
Neither TBE	NE Freight - NE Freight					0%		0%				0%		0%				0%		0%				0%		0%				0.00%		
Reference Case (CTC) Collision Accident Likelihood by Segment Type (collisions/million train miles)			0.030						0.040						0.050						0.060						0.006					

Collisions/million diamond passes: 0.1

Table 2.3b: Collision Preventability Matrix - Diamonds

Diamond Collisions Rear End/Side		Train Pairs in In Collision	Train Pair Type
Equip Guilty	Unequip Guilty		
		Pass-Pass	Both TBE
		Pass-TBE Freight	
		TBE Freight - TBE Freight	
		Pass - NE Freight, Head -On	One TBE
70%	79.00%	Rear/Side, Pass into NE Frt	
70%	79.00%	Rear/Side NE Frt into Pass	
70%	71.27%	TBE Freight - NE Freight	
	0.00%	NE Freight - NE Freight	Neither TBE

Table 2.4a: Passenger Trains in Train-to-Train Collisions (Trains in Collisions per Million Train-Miles)

	Train Pairs in In Collision	Passenger Trains in Collisions	Siding - Monitored						Siding - Unmonitored						CP Adjacent - Monitored Siding						CP Adjacent - Unmonitored Siding						Plain Track					
					Head On		Rear End/Side				Head On		Rear End/Side				Head On		Rear End/Side				Head On		Rear End/Side		Collision Distribution		Head On		Rear End/Side	
					Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty
Both TBE	Pass-Pass	2			0.0056		0.0056				0.0074		0.0074				0.0149		0.0037				0.0179		0.0045				0.0016		0.0007	
	Pass-TBE Freight	1			0.0014		0.0014				0.0018		0.0018				0.0032		0.0014				0.0038		0.0016				0.0002		0.0003	
	TBE Freight - TBE Freight	0																														
One TBE	Pass - NE Freight, Head -On	1			0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000		
	Rear/Side, Pass into NE Frt	1					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000
	Rear/Side NE Frt into Pass	1					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000
	TBE Freight - NE Freight	0																														
Neither TBE	NE Freight - NE Freight	0																														
	Checking total				0.0069	0.0000	0.0069	0.0000			0.0092	0.0000	0.0092	0.0000			0.0180	0.0000	0.0051	0.0000			0.0216	0.0000	0.0061	0.0000			0.0018	0.0000	0.0010	0.0000

Scenario Totals - Passenger	Tots, P-UF	Totals				Totals				Totals				Totals				Totals				Totals			
Pass Loco Hits Loco	0.0000	0.0069	0.0069	0.0000		0.0000	0.0092	0.0092	0.0000		0.0000	0.0180	0.0180	0.0000		0.0000	0.0216	0.0216	0.0000		0.0000	0.0018	0.0018	0.0000	
Pass Loco Hits Pass Car		0.0028			0.0028		0.0037			0.0037				0.0019				0.0022				0.0022			0.0003
Pass Loco Hits Freight Car	0.0000	0.0011			0.0011	0.0000	0.0014			0.0014	0.0000	0.0010			0.0010	0.0000	0.0012			0.0012	0.0000	0.0003			0.0003
Pass Car Hit by Loco	0.0000	0.0031			0.0031	0.0000	0.0041			0.0041	0.0000	0.0022			0.0022	0.0000	0.0026			0.0026	0.0000	0.0004			0.0004	0.0000
Total		0.0139	0.0069	0.0000	0.0069	0.0000	0.0185	0.0092	0.0000	0.0092	0.0000	0.0231	0.0180	0.0000	0.0051	0.0000	0.0277	0.0216	0.0000	0.0061	0.0000	0.0028	0.0018	0.0000	0.0010	0.0000

Table 2.4b: Passenger Trains in Collisions at Diamonds

Diamond Collisions Rear End/Side		Train Pairs in In Collision	Train Pair Type
Equip Guilty	Unequip Guilty		
		Pass-Pass	Both TBE
		Pass-TBE Freight	
		TBE Freight - TBE Freight	
		Pass - NE Freight, Head -On	One TBE
0.007500	0.005250	Rear/Side, Pass into NE Frt	
0.001500	0.001050	Rear/Side NE Frt into Pass	
0.000000	0.000000	TBE Freight - NE Freight	
	0.000000	NE Freight - NE Freight	Neither TBE
0.00900	0.00630		

Scenario Totals - Passenger	Totals			
Pass Loco Hits Loco				
Pass Loco Hits Pass Car				
Pass Loco Hits Freight Car	0.007500	0.005250	0.012750	Pass Loco Hits Freight Car
Pass Car Hit by Loco	0.001500	0.001050	0.002550	Pass Car Hit by Loco
Total	0.009000	0.006300	0.015300	Total

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Table 2.5a: Freight trains in Train-to-Train Collisions (Trains in Collisions per Million Train-Miles)

	Train Pairs in In Collision	Freight Trains in Collisions	Siding - Monitored						Siding - Unmonitored						CP Adjacent - Monitored Siding						CP Adjacent - Unmonitored Siding						Plain Track					
					Head On		Rear End/Side				Head On		Rear End/Side				Head On		Rear End/Side				Head On		Rear End/Side		Collision Distribution		Head On		Rear End/Side	
					Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty			Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty	Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty
Both TBE	Pass-Pass	0																														
	Pass-TBE Freight	1			0.0014		0.0014				0.0018		0.0018				0.0032		0.0014				0.0038		0.0016				0.0002		0.0003	
	TBE Freight - TBE Freight	2			0.0007		0.0007				0.0010		0.0010				0.0017		0.0007				0.0020		0.0009				0.0001		0.0001	
One TBE	Pass - NE Freight, Head -On	1			0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000		
	Rear/Side, Pass into NE Frt	1					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000
	Rear/Side NE Frt into Pass	1					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000					0.0000	0.0000
	TBE Freight - NE Freight	2			0.0000	0.0000	0.0000	0.0000			0.0000	0.0000	0.0000	0.0000			0.0000	0.0000	0.0000	0.0000			0.0000	0.0000	0.0000	0.0000			0.0000	0.0000	0.0000	0.0000
Neither TBE	NE Freight - NE Freight	2				0.0000		0.0000				0.0000		0.0000				0.0000		0.0000				0.0000		0.0000				0.0000		0.0000
	Checking total				0.0021	0.0000	0.0021	0.0000			0.0028	0.0000	0.0028	0.0000			0.0048	0.0000	0.0021	0.0000			0.0058	0.0000	0.0025	0.0000			0.0004	0.0000	0.0005	0.0000

Scenario Totals - Freight	Totals					Totals				Totals				Totals				Totals				Totals			
Freight Loco Hits Loco	0.0000	0.0021	0.0021	0.0000		0.0028	0.0028	0.0000			0.0048	0.0048	0.0000			0.0058	0.0058	0.0000			0.0004	0.0004	0.0000		
Freight Loco Hits Car	0.0000	0.0006			0.00063	0.00000	0.0008			0.00084	0.00000	0.0007			0.00070	0.00000	0.0008			0.00084	0.00000	0.0001			0.00013	0.00000
Freight Car Hit By Loco	0.0000	0.0014	b		0.00144	0.00000	0.0019			0.00192	0.00000	0.0014			0.00137	0.00000	0.0016			0.00165	0.00000	0.0003			0.00034	0.00000
Total		0.0041	0.0021	0.0000	0.0021	0.0000	0.0055	0.0028	0.0000	0.0028	0.0000	0.0000	0.0069	0.0048	0.0000	0.0021	0.0000		0.0083	0.0058	0.0000	0.0025	0.0000		0.0008	0.0004	0.0000	0.0005	0.0000

Diamond Collisions Rear End/Side		Train Pairs in In Collision	Train Pair Type
Equip Guilty	Unequip Guilty		
		Pass-Pass	Both TBE
		Pass-TBE Freight	
		TBE Freight - TBE Freight	
		Pass - NE Freight, Head -On	One TBE
0.007500	0.005250	Rear/Side, Pass into NE Frt	
0.001500	0.001050	Rear/Side NE Frt into Pass	
0.006000	0.005745	TBE Freight - NE Freight	
	0.040000	NE Freight - NE Freight	Neither TBE
0.01500	0.05205		

Scenario Totals - Freight	Totals			
Freight Loco Hits Loco				
Freight Loco Hits Car	0.010500	0.023923	0.034423	Freight Loco Hits Car
Freight Car Hit By Loco	0.004500	0.028123	0.032623	Freight Car Hit By Loco
Total	0.015000	0.052046	0.067046	Total

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Freight Plus Passenger Totals (check)	0.0600	0.0180					0.0800	0.0240					0.1000	0.0300					0.1200	0.0360					0.0036							

In rear-end/side collisions between like trains there is one loco hits car and one car hit by loco in each collision. In rear/side collisions between a passenger and freight trains, the ratio between passenger hits freight and freight loco hits passenger car are a function of the percentages given in Table IN-5b on the Inputs sheet. The values are given in the tables beneath the trains in collisions for each segment type.

Collision Ratios					Collision Ratios					Collision Ratios					Collision Ratios					Collision Ratios				
Collision Type	Like Trains		Unlike Trains		Collision Type	Like Trains		Unlike Trains		Collision Type	Like Trains		Unlike Trains		Collision Type	Like Trains		Unlike Trains		Collision Type	Like Trains		Unlike Trains	
	Loco hits car	car hit by loco	P loco hits F car	F loco hits P car		Loco hits car	car hit by loco	P loco hits F car	F loco hits P car		Loco hits car	car hit by loco	P loco hits F car	F loco hits P car		Loco hits car	car hit by loco	P loco hits F car	F loco hits P car		Loco hits car	car hit by loco	P loco hits F car	F loco hits P car
Freight to Freight	0.50	0.50			Freight to Freight	0.50	0.50			Freight to Freight	0.50	0.50			Freight to Freight	0.50	0.50			Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50			Passenger to Passenger	0.50	0.50			Passenger to Passenger	0.50	0.50			Passenger to Passenger	0.50	0.50			Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.8	0.2	Passenger to Freight			0.80	0.20	Passenger to Freight			0.75	0.25	Passenger to Freight			0.75	0.25	Passenger to Freight			0.83	0.17

Worksheet 3 - Sp,N,R: - Risk Calculations - Cab Signal/ATC 70% Preventability, Springfield Subcorridor, Rest of Year

Table 3.1: Consequences Look-up Tables (Data Sources: Previous ICF Passenger Corridor Project (passenger), FRA Accident Data 2001-5 (freight)

Passenger Trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 40 mph Injuries	Fatalities	Damage $	Representative Speed 60 mph Injuries	Fatalities	Damage $	Representative Speed 79 mph Injuries	Fatalities	Damage $	Representative Speed 105 mph Injuries	Fatalities	Damage $
	Train-Train Collision	Pass Loco hits Loco	0.083	0.002	502000	0.139	0.0049	1142000	0.24	0.0085	1976000	0.425	0.018	3495000
		Pass Loco hits Pass Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.008	1747000
		Pass Loco hits Frt Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.008	1747000
		Pass car hit by Loco	0.166	0.005	1005000	0.275	0.0119	2284000	0.476	0.0206	3951000	0.841	0.032	6989000
	Intrusion Collision (rollout)	Pass Loco hits Car	0.013	0.0005	113000	0.031	0.0011	257000	0.054	0.0019	445000	0.096	0.0034	788000
	Intrusion Collision (other!)	Pass Loco hits Car	0.026	0.0009	226000	0.063	0.0022	514000	0.108	0.0038	889000	0.191	0.0068	1573000
	Overspeed		0.044	0.0004	667000	0.14	0.00186	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Broken Rail		0.044	0.0004	667000	0.14	0.00186	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Work Zone Violation		0.083	0.0083	0	0.125	0.0125	0	0.164	0.0164	0	0.218	0.0218	0

Freight trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 25 mph Injuries	Fatalities	Damage $	Representative Speed 40 mph Injuries	Fatalities	Damage $	Representative Speed 50 mph Injuries	Fatalities	Damage $
	Train-Train Collision	Frt Loco hits Loco	0.43	0.043	105000	1.1	0.11	270000	1.7	0.17	422000
		Frt Loco hits Car	0.35	0.035	88000	0.9	0.09	225000	1.4	0.14	352000
		Frt car hit by Loco	0	0	44000	0	0	112000	0	0	176000
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Overspeed, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Overspeed, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Work Zone Viol'n, Equip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0
	Work Zone Viol'n, Unequip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0

Casualties and damage in Table 3.1 are per accident, except for Work Zone Violations which are per million train-miles

Table 3.2: Grade Crossing and Diamonds: Numbers by Representative Speed, and Accident Frequency and Consequences

Train Type	Representative Speed (mph)	Type of Grade-crossing	Number Crossings Passenger	HS Passenger	Freight	Accident Frequency (Per Million Crossing Passes) Passenger	Freight	Crossing Collision Consequences Pass. Occup't Casualty Prob/accident) Injuries	Fatalities	Cost $/Accident	Freight Trains (per accident) Injuries	Fatalities	Cost $	Number Diamonds
Passenger	40	Public_gates_lights	0	0		0.300		0.0028	0.000047	91000				2
		Public_other	0	0		0.300								
		Private	0	0		0.100								
	60	Public_gates_lights	14	0		0.600		0.0068	0.000112	113000				0
		Public_other	0	0		0.500								
		Private	0	0		0.200								
	79	Public_gates_lights	15	16		0.800		0.0105	0.000156	196000				0
		Public_other	5	1		0.650								
		Private	5	1		0.300								
	105	Public_gates_lights	0	12		1.100		0.0186	0.000276	346000				0
		Public_other	0	4		0.800								
		Private	0	4		0.300								
Freight	25	Public_gates_lights			3		0.150				0.12	0.005	20000	0
		Public_other			0		0.120							
		Private			0		0.050							
	40	Public_gates_lights			0		0.300				0.25	0.013	50000	2
		Public_other			0		0.250							
		Private			0		0.100							
	50	Public_gates_lights			26		0.360				0.39	0.02	78000	0
		Public_other			5		0.300							
		Private			5		0.120							

Table 3.3a: Segment Data (for reference only, not used in calculations)

Segment Number	Start (Milepost)	End (Milepost)	Type	Length (miles)	Representative Speed (mph) Freight	Pass	HS Pass	HS Pass
32	$124.86	$126.50	CP Adjacent (M)	1.64	25	40	40	40
33	$126.50	$126.50	Diamond	0.00	25	40	40	40
34	$126.50	$128.76	CP Adjacent (M)	2.26	25	60	60	79
35	$128.76	$130.96	Plain	2.20	50	79	79	79
36	$130.96	$133.72	Plain	2.76	50	79	60	105
37	$133.72	$136.90	Plain	3.18	50	79	79	105
38	$136.90	$138.63	CP Adjacent (M)	1.73	50	79	79	105
39	$138.63	$141.30	Siding (M)	2.67	50	79	79	105
40	$141.30	$143.35	CP Adjacent (M)	2.05	50	79	79	105
41	$143.35	$148.30	Plain	4.95	50	60	79	79
42	$148.30	$150.96	Plain	2.66	50	79	79	105
43	$150.96	$153.56	CP Adjacent (U)	2.60	50	79	79	105
44	$153.56	$155.57	Siding (U)	2.01	50	60	60	79
45	$155.57	$155.57	Diamond	0.00	40	40	40	40
46	$155.57	$157.26	CP Adjacent (U)	1.69	50	60	60	79
47	$157.26	$160.05	Plain	2.79	50	79	79	79
48	$160.05	$162.11	Plain	2.06	50	79	79	105
49	$162.11	$164.04	Plain	1.93	50	79	79	105
50	$164.04	$166.16	Plain	2.12	50	79	79	105
51	$166.16	$168.34	CP Adjacent (U)	2.18	50	79	79	105
52	$168.34	$170.40	Siding (U)	2.06	50	79	79	105
53	$170.40	$172.34	CP Adjacent (U)	1.94	50	79	79	105
54	$172.34	$175.81	Plain	3.50	50	79	79	105
55	$175.84	$179.49	Plain	3.65	50	79	79	79
56	$179.49	$180.99	CP Adjacent (M)	1.50	50	79	79	79

Table 3.3b: Aggregate Segment Data: SegmentsTypes, Train Types, Speeds, and Lengths

Aggregate Segment Length by Type and Speed Band (from Seg Def and Preventability)

Segment Type	Train Type	Represent've Speed (mph)	Freight (miles)	Reg Pass (miles)	HS Pass Collision (mi)	HS Pass Other (mi)
Siding (mon)	Freight	25	0			
		40	0			
		50	2.67			
	Passenger	40		0	0	0
		60		0	0	0
		79		2.67	2.67	0
		105		0	0	2.67
Siding (unmon)	Freight	25	0			
		40	0			
		50	4.07			
	Passenger	40		0	0	0
		60		2.01	2.01	0
		79		2.06	2.06	2.01
		105		0	0	2.06
CP Adjacent (mon)	Freight	25	3.9			
		40	0			
		50	5.28			
	Passenger	40		1.64	1.64	1.64
		60		2.26	2.26	0
		79		5.28	5.28	3.76
		105		0	0	3.78
CP Adjacent (unmon)	Freight	25	0			
		40	0			
		50	8.41			
	Passenger	40		0	0	0
		60		1.69	1.69	0
		79		6.72	6.72	1.69
		105		0	0	6.72
Plain Track	Freight	25	0			
		40	0			
		50	31.8			
	Passenger	40		0	0	0
		60		4.95	2.76	0
		79		26.85	29.04	13.59
		105		0	0	18.21
Totals All Types	Freight	25	3.9			
		40	0			
		50	52.23			
	Passenger	40		1.64	1.64	1.64
		60		10.91	8.72	0
		79		43.58	45.77	21.05
		105		0	0	33.44
Check Totals			56.13	56.13	56.13	56.13

Table 3.4a: Traffic Inputs to Risk Calculation

Train Type	Trips/Day Summer	Rest of Year
Passenger	6.00	6.00
Equipped Freight	1.73	3.16
Unequipped Freight	0.00	0.00
Operating Days	91	274

Percent Train-Miles in	
Timout (secs)	0
Normal Operating Mode	95.00
Timout Mode	0.00
Fallback Mode	5

Passenger Train Occupancy	
Seats	320
Occupancy Factor	0.60

Table 3.4: Collision Frequencies by Segment Type and Collision Scenario (From Coll Matrix)

Scenarios	Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain	Diamond
Pass Loco Hits Loco	0.0069	0.0092	0.0180	0.0216	0.0018	0.000000
Pass Loco Hits Pass Car	0.0028	0.0037	0.0019	0.0022	0.0003	0.000000
Pass Loco Hits Freight Car	0.0011	0.0014	0.0010	0.0012	0.0003	0.012750
Pass Car Hit by Loco	0.0031	0.0041	0.0022	0.0026	0.0004	0.002550
Freight Loco Hits Loco	0.0021	0.0028	0.0048	0.0058	0.0004	0.000000
Freight Loco Hits Car	0.0006	0.0008	0.0007	0.0008	0.0001	0.034423
Freight Car Hit By Loco	0.0014	0.0019	0.0014	0.0016	0.0003	0.032623

Collision Frequencies for Passenger + Unequipped Freight Train

Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain
0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000

Mauve cells contain data imported from previous worksheet in a group of three worksheets covering one sub-corridor, season and operating state.

Weighted Collision Accident Frequencies by Representative Speed (mph)

Scenarios	25	40	50	Passenger 40	60	79	105
Pass Loco Hits Loco				0.0180	0.0000	0.0070	0.0085
Pass Loco Hits Pass Car				0.0019	0.0000	0.0011	0.0013
Pass Loco Hits Freight Car				0.0010	0.0000	0.0006	0.0007
Pass Car Hit by Loco				0.0022	0.0000	0.0012	0.0015
Freight Loco Hits Loco	0.0048	0.0000	0.0020				
Freight Loco Hits Car	0.0007	0.0000	0.0004				
Freight Car Hit By Loco	0.0014	0.0000	0.0008				

All train-to-train collision frequencies are in units of **trains in collisions per million train-miles operated in the sub-corridor by all train types.**

Table 3.5a: Risk Calculation - Passenger Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Freq'y (per million tm)	Preventability	Adjusted Frequency	Trips/day	Trips per 10 years	Length of Track (miles)	Train-miles per 10 years	Accidents per 10 years	Number seats per train	Occupancy Factor	Passengers per train	Injuries per 10 years	Fatalities per 10 years	Damage $ per 10 years
40	Train-Train Collision	Pass Loco hits Loco	0.01802	Incl	0.01802	9.16	23843	1.64	39103	0.00070	320	0.6	192	0.0112	0.00027	0
		Pass Loco hits Pass Car	0.00186	Incl	0.00186	9.16	23843	1.64	39103	0.00007	320	0.6	192	0.0005	0.00001	0
		Pass Loco hits Frt Car	0.00101	Incl	0.00101	9.16	23843	1.64	39103	0.00004	320	0.6	192	0.0003	0.00001	0
		Pass car hit by Loco	0.00220	Incl	0.00220	9.16	23843	1.64	39103	0.00009	320	0.6	192	0.0027	0.00008	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.35	0.00559	6.00	15618	1.64	25614	0.00014	320	0.6	192	0.0004	0.00001	0
	Intrusion Collision (other!)	Pass Loco hits intruder	0.01440	0.10	0.01296	6.00	15618	1.64	25614	0.00033	320	0.6	192	0.0017	0.00006	0
	Overspeed		0.01100	0.00	0.01100	6.00	15618	1.64	25614	0.00028	320	0.6	192	0.0024	0.00002	0
	Broken Rail		0.01670	0.06	0.01570	6.00	15618	1.64	25614	0.00040	320	0.6	192	0.0034	0.00003	0
	Work Zone Violation			0.00		6.00	15618	1.64	25614					0.0021	0.00021	0
										0.00206				**0.02462**	**0.00071**	**1**
60	Train-Train Collision	Pass Loco hits Loco	0.00000	Incl	0.00000	9.16	23843	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Pass Car	0.00000	Incl	0.00000	9.16	23843	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Frt Car	0.00000	Incl	0.00000	9.16	23843	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00000	Incl	0.00000	9.16	23843	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.35	0.00559	6.00	15618	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (other!)	Pass Loco hits car	0.01440	0.10	0.01296	6.00	15618	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Overspeed		0.01100	0.00	0.01100	6.00	15618	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Broken Rail		0.01670	0.06	0.01570	6.00	15618	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Work Zone Violation			0.00		6.00	15618	0	0					0.0000	0.00000	0
										0.00000				**0.00000**	**0.00000**	**0**
79	Train-Train Collision	Pass Loco hits Loco	0.00699	Incl	0.00699	9.16	23843	21.05	501905	0.00351	320	0.6	192	0.162	0.0057	6930
		Pass Loco hits Pass Car	0.00108	Incl	0.00108	9.16	23843	21.05	501905	0.00054	320	0.6	192	0.010	0.0005	537
		Pass Loco hits Frt Car	0.00059	Incl	0.00059	9.16	23843	21.05	501905	0.00030	320	0.6	192	0.006	0.0003	293
		Pass car hit by Loco	0.00124	Incl	0.00124	9.16	23843	21.05	501905	0.00062	320	0.6	192	0.057	0.0025	2468
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.35	0.00559	6.00	15618	21.05	328759	0.00184	320	0.6	192	0.019	0.0007	818
	Intrusion Collision (other!)	Pass Loco hits car	0.01440	0.10	0.01296	6.00	15618	21.05	328759	0.00426	320	0.6	192	0.088	0.0031	3788
	Overspeed		0.01100	0.00	0.01100	6.00	15618	21.05	328759	0.00362	320	0.6	192	0.146	0.0023	9403
	Broken Rail		0.01670	0.06	0.01570	6.00	15618	21.05	328759	0.00516	320	0.6	192	0.208	0.0033	13418
	Work Zone Violation			0.00		6.00	15618	21.05	328759					0.054	0.0054	0
										0.01985				**0.74956**	**0.02379**	**37654**
105	Train-Train Collision	Pass Loco hits Loco	0.00848	Incl	0.00848	9.16	23843	33.44	797326	0.00676	320	0.6	192	0.552	0.0208	23622
		Pass Loco hits Pass Car	0.00129	Incl	0.00129	9.16	23843	33.44	797326	0.00103	320	0.6	192	0.034	0.0016	1801
		Pass Loco hits Frt Car	0.00068	Incl	0.00068	9.16	23843	33.44	797326	0.00054	320	0.6	192	0.018	0.0008	948
		Pass car hit by Loco	0.00149	Incl	0.00149	9.16	23843	33.44	797326	0.00118	320	0.6	192	0.191	0.0073	8279
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.35	0.00559	6.00	15618	33.44	522266	0.00292	320	0.6	192	0.054	0.0019	2295
	Intrusion Collision (other!)	Pass Loco hits car	0.01440	0.10	0.01296	6.00	15618	33.44	522266	0.00677	320	0.6	192	0.248	0.0088	10647
	Overspeed		0.01100	0.00	0.01100	6.00	15618	33.44	522266	0.00574	320	0.6	192	0.309	0.0050	26392
	Broken Rail		0.01670	0.06	0.01570	6.00	15618	33.44	522266	0.00820	320	0.6	192	0.441	0.0071	37664
	Work Zone Violation			0.00		6.00	15618	33.44	522266					0.114	0.0114	0
	Total									**0.03315**				**1.95993**	**0.06463**	**111647**
	Overall Totals									**0.05506**				**2.73411**	**0.08913**	**149303**
	Totals All Speeds	**Train-train Collisions**								**0.01539**				**1.04349**	**0.03975**	**44878**
		Intrusion Collisions								**0.01626**				**0.41145**	**0.01459**	**17547**
		Overspeed								**0.00964**				**0.45704**	**0.00733**	**35795**
		Broken Rail								**0.01376**				**0.65224**	**0.01046**	**51083**
		Work Zone Violation								**0.00000**				**0.16990**	**0.01699**	**0**

Table 3.5b: Risk Calculation - Collisions at Diamonds - Passenger

Number Diamonds	Freq'y per mill passes	Collisions (millions)	Injuries	Fatalities	Damage
2	0.000000	0.000000	0.000000	0.000000	0.00
2	0.000000	0.000000	0.000000	0.000000	0.00
2	0.012750	0.000608	0.003969	0.000117	152.61
2	0.002550	0.000122	0.003876	0.000117	122.21
		0.000730	**0.007845**	**0.000233**	**274.83**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.012750	0.000000	0.000000	0.000000	0.00
0	0.002550	0.000000	0.000000	0.000000	0.00
		0.000000	**0.00000**	**0.00000**	**0.00

Worksheet 2 - Sp,N,S: Collision Frequencies Calculation - Cab Signal/ATC 70% Preventability Case, Springfield Sub-corridor, Summer

Table 2.1a: Collision Distribution Matrix (Fraction Accidents by Train Pair and Collision Type). Collisions Between Trains Operating on the IDOT Test Corridor Only (not diamonds and intrusions)

	Train Pairs in In Collision	Collision Scenario Prob (Top Level)	Siding - Monitored: Collision Distribution Head On	Siding - Monitored: Collision Distribution Rear End/Side	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty
	Percent Guilty				100%	0%	100%	0%
Both Trains TBE (Note 3)	Pass-Pass	0.80	0.50	0.50	0.4	0	0.4	0
	Pass-TBE Freight	0.20	0.50	0.50	0.1	0	0.1	0
	TBE Freight - TBE Freight	0.00	0.50	0.50	0	0	0	0
	Percent Guilty				50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	0.00	1	0	0	0	0	0
	Rear/Side, Pass into NE Frt		0	1	0	0	0	0
	Rear/Side NE Frt into Pass		0	1	0	0	0	0
	TBE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0
	Percent Guilty				0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0
	Total Probability (checking)	1		1	0.5	0	0.5	0

	Train Pairs in In Collision	Siding - Unmonitored: Collision Distribution Head On	Siding - Unmonitored: Collision Distribution Rear End/Side	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
	Percent Guilty			100%	0%	100%	0%
Both Trains TBE (Note 3)	Pass-Pass	0.5	0.5	0.4	0	0.4	0
	Pass-TBE Freight	0.5	0.5	0.1	0	0.1	0
	TBE Freight - TBE Freight	0.5	0.5	0	0	0	0
	Percent Guilty			50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	1	0	0	0	0	0
	Rear/Side, Pass into NE Frt	0	1	0	0	0	0
	Rear/Side NE Frt into Pass	0	1	0	0	0	0
	TBE Freight - NE Freight	0.5	0.5	0	0	0	0
	Percent Guilty			0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.5	0.5	0	0	0	0
	Total Probability (checking)		1	0.5	0	0.5	0

	Train Pairs in In Collision	CP Adjacent - Monitored Siding: Collision Distribution Head On	CP Adjacent - Monitored Siding: Collision Distribution Rear End/Side	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty
	Percent Guilty			100%	0%	100%	0%
Both Trains TBE (Note 3)	Pass-Pass	0.8	0.2	0.64	0	0.16	0
	Pass-TBE Freight	0.7	0.3	0.14	0	0.06	0
	TBE Freight - TBE Freight	0.7	0.3	0	0	0	0
	Percent Guilty			50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	1	0	0	0	0	0
	Rear/Side, Pass into NE Frt	0	1	0	0	0	0
	Rear/Side NE Frt into Pass	0	1	0	0	0	0
	TBE Freight - NE Freight	0.7	0.3	0	0	0	0
	Percent Guilty			0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.7	0.3	0	0	0	0
	Total Probability (checking)		1	0.78	0	0.22	0

	Train Pairs in In Collision	CP Adjacent - Unmonitored Siding: Collision Distribution Head On	CP Adjacent - Unmonitored Siding: Collision Distribution Rear End/Side	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
	Percent Guilty			100%	0%	100%	0%
Both Trains TBE (Note 3)	Pass-Pass	0.8	0.2	0.64	0	0.16	0
	Pass-TBE Freight	0.7	0.3	0.14	0	0.06	0
	TBE Freight - TBE Freight	0.7	0.3	0	0	0	0
	Percent Guilty			50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	1	0	0	0	0	0
	Rear/Side, Pass into NE Frt	0	1	0	0	0	0
	Rear/Side NE Frt into Pass	0	1	0	0	0	0
	TBE Freight - NE Freight	0.7	0.3	0	0	0	0
	Percent Guilty			0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.7	0.3	0	0	0	0
	Total Probability (checking)		1	0.78	0	0.22	0

	Train Pairs in In Collision	Plain Track: Collision Distribution Head On	Plain Track: Collision Distribution Rear/Side	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
	Percent Guilty			100%	0%	100%	0%
Both Trains TBE (Note 3)	Pass-Pass	0.7	0.3	0.56	0	0.24	0
	Pass-TBE Freight	0.4	0.6	0.08	0	0.12	0
	TBE Freight - TBE Freight	0.5	0.5	0	0	0	0
	Percent Guilty			50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	1.00	0.00	0	0	0	0
	Rear/Side, Pass into NE Frt	0.00	1.00	0	0	0	0
	Rear/Side NE Frt into Pass	0.00	1.00	0	0	0	0
	TBE Freight - NE Freight	0.50	0.50	0	0	0	0
	Percent Guilty			0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.50	0.50	0	0	0	0
	Total Probability (checking)		1	0.64	0	0.36	0

Table 2.1b: Collision Type Distribution - Diamonds

	Train Pairs in In Collision	Train Pair Type	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty
	Percent Guilty			
Both Trains TBE	Pass-Pass			
	Pass-TBE Freight			
	TBE Freight - TBE Freight			
One Train TBE	Percent Guilty		50%	50%
	Pass - NE Freight, Head -On		0	0
	Rear/Side, Pass into NE Frt		0.25	0.25
	Rear/Side NE Frt into Pass		0.05	0.05
	TBE Freight - NE Freight		0.1	0.1
	Percent Guilty			100%
Neither Train TBE	NE Freight - NE Freight		0	0.2
	Total Probability (checking)		0.4	0.6

Note: The gray cells on these rows are set at zero, because in every case, the condition represented by the cell does not exist - either because there are no unequipped passenger trains, or because of the kind of collision defined for the row.

Quantity in cell C18 is for all collisions between a passenger train and an unequipped freight train

Table 2.2: Preventability Data For Unequipped train Guilty, One Train TBE

Segment Type	Not Prevented of Mitigated Freight	Not Prevented of Mitigated Pass	Not Prevented of Mitigated HS Pass	Mitigated Freight	Mitigated Pass	Mitigated HS Pass	Prevented Freight	Prevented Pass	Prevented HS Pass
Siding (M)	0.281	0.241	0.558	0.263	0.263	0.263	0.506	0.547	0.229
Siding (U)	0.369	0.368	0.524	0.166	0.172	0.313	0.515	0.510	0.213
CP Adjacent (M)	0.361	0.353	0.514	0.226	0.229	0.250	0.463	0.468	0.286
CP Adjacent (U)	0.357	0.331	0.608	0.325	0.250	0.304	0.368	0.469	0.138
Plain Track	0.104	0.102	0.148	0.000	0.000	0.016	0.100	0.100	0.084
Diamonds	0.239	0.260	0.250	0.098	0.000	0.170	0.713	0.790	0.630

Mauve cells contain data imported from Worksheet 1 in this group of three worksheets covering this sub-corridor, season and operating state.

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Worksheet 3 - Sp,N,R: - Risk Calculations - Cab Signal/ATC 70% Preventability, Springfield Subcorridor, Summer

Table 3.1: Consequences Look-up Tables (Data Sources: Previous ICF Passenger Corridor Project (passenger), FRA Accident Data 2001-5 (freight)

Passenger Trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 40 mph Injuries	Fatalities	Damage $	Representative Speed 60 mph Injuries	Fatalities	Damage $	Representative Speed 79 mph Injuries	Fatalities	Damage $	Representative Speed 105 mph Injuries	Fatalities	Damage $
	Train-Train Collision	Pass Loco hits Loco	0.083	0.002	502000	0.139	0.0049	1142000	0.24	0.0085	1976000	0.425	0.016	3495000
		Pass Loco hits Pass Car	0.034	0.001	251000	0.056	0.0020	571000	0.097	0.0045	988000	0.171	0.008	1747000
		Pass Loco hits Frt Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.008	1747000
		Pass car hit by Loco	0.166	0.005	1095000	0.275	0.0119	2284000	0.476	0.0206	3951000	0.841	0.032	6989000
	Intrusion Collision (rollout)	Pass Loco hits Car	0.013	0.0005	113000	0.031	0.0011	257000	0.054	0.0019	445000	0.096	0.0034	786000
	Intrusion Collision (other))	Pass Loco hits Car	0.026	0.0009	226000	0.063	0.0022	514000	0.108	0.0038	889000	0.191	0.0068	1573000
	Overspeed		0.044	0.0004	667000	0.14	0.00186	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Broken Rail		0.044	0.0004	667000	0.14	0.00186	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Work Zone Violation		0.083	0.0083	0	0.125	0.0125	0	0.164	0.0164	0	0.218	0.0218	0

Freight trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 25 mph Injuries	Fatalities	Damage $	Representative Speed 40 mph Injuries	Fatalities	Damage $	Representative Speed 50 mph Injuries	Fatalities	Damage $
	Train-Train Collision	Frt Loco hits Loco	0.43	0.043	105000	1.1	0.11	270000	1.7	0.17	422000
		Frt Loco hits Car	0.35	0.035	88000	0.9	0.09	225000	1.4	0.14	352000
		Frt car hit by Loco	0	0	44000	0	0	112000	0	0	176000
	Intrusion Colln equip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Colln equip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Colln Unequip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Colln Unequip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Overspeed, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Overspeed, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Work Zone Viol'n, Equip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0
	Work Zone Viol'n, Unequip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0

Casualties and damage in Table 3.1 are per accident, except for Work Zone Violations which are per million train-miles

Table 3.2: Grade Crossing and Diamonds: Numbers by Representative Speed, and Accident Frequency and Consequences

Train Type	Representative Speed (mph)	Type of Grade-crossing	Number Crossings Passenger	HS Passenger	Freight	Accident Frequency Per Million Crossing Passes Passenger	Freight	HS Pass	Crossing Collision Consequences Pass. Occup't Casualty Prob(accident) Injuries	Fatalities	Cost $/Accid't	Freight Trains (per accident) Injuries	Fatalities	Cost $	Number Diamonds
Passenger	40	Public_gates_lights	0	0		0.250			0.0028	0.000047	50000				2
		Public_other	0	0		0.300									
		Private	0	0		0.100									
	60	Public_gates_lights	14	0		0.600			0.0068	0.000112	113000				0
		Public_other	0	0		0.500									
		Private	0	0		0.200									
	79	Public_gates_lights	15	16		0.800			0.0105	0.000156	196000				0
		Public_other	5	1		0.650									
		Private	5	1		0.300									
	105	Public_gates_lights	0	13		1.100			0.0186	0.000276	346000				0
		Public_other	0	4		0.800									
		Private	0	4		0.300									
Freight	25	Public_gates_lights			3		0.150					0.12	0.005	20000	0
		Public_other			0		0.120								
		Private			0		0.050								
	40	Public_gates_lights			0		0.300					0.25	0.013	50000	2
		Public_other			0		0.200								
		Private			0		0.100								
	50	Public_gates_lights			26		0.360					0.39	0.02	78000	0
		Public_other			5		0.300								
		Private			5		0.120								
		Check Totals	39	39	39										

Table 3.3a: Segment Data (for reference only, not used in calculations)

Segment Number	Start (Milepost)	End (Milepost)	Type	Length (miles)	Representative Speed (mph) Freight	Pass	HS Pass	HS Pass
32	$124.86	$126.50	CP Adjacent (M	1.64	25	40	40	40
33	$126.50	$126.50	Diamond	0.00	25	40	40	40
34	$126.50	$128.76	CP Adjacent (M	2.26	25	60	60	79
35	$128.76	$130.96	Plain	2.20	50	79	79	79
36	$130.96	$133.72	Plain	2.76	50	79	60	105
37	$133.72	$136.90	Plain	3.18	50	79	79	105
38	$136.90	$136.63	CP Adjacent (M	1.73	50	79	79	105
39	$138.63	$141.30	Siding (M)	2.67	50	79	79	105
40	$141.30	$143.35	CP Adjacent (M	2.05	50	79	79	105
41	$143.35	$148.30	Plain	4.95	50	60	79	79
42	$148.30	$150.96	Plain	2.66	50	79	79	105
43	$150.96	$153.56	CP Adjacent (U	2.60	50	79	79	105
44	$153.56	$155.57	Siding (U)	2.01	50	60	60	79
45	$155.57	$155.57	Diamond	0.00	40	40	40	40
46	$155.57	$157.26	CP Adjacent (U	1.69	50	60	60	79
47	$157.26	$160.05	Plain	2.79	50	79	79	79
48	$160.05	$162.11	Plain	2.06	50	79	79	105
49	$162.11	$164.04	Plain	1.93	50	79	79	105
50	$164.04	$166.16	Plain	2.12	50	79	79	105
51	$166.16	$168.34	CP Adjacent (U	2.18	50	79	79	105
52	$168.34	$170.40	Siding (U)	2.06	50	79	79	105
53	$170.40	$172.34	CP Adjacent (U	1.94	50	79	79	105
54	$172.34	$175.84	Plain	3.50	50	79	79	105
55	$175.84	$179.49	Plain	3.65	50	79	79	79
56	$179.46	$180.99	CP Adjacent (M	1.50	50	79	79	79

Table 3.3b: Aggregate Segment Data: SegmentsTypes, Train Types, Speeds, and Lengths

Aggregate Segment Length by Type and Speed Band (from Seg Def and Preventability)

Segment Type	Train Type	Representative Speed (mph)	Freight (miles)	Reg Pass (miles)	HS Pass Collision (mi)	HS Pass Other (mi)
Siding (mon)	Freight	25	0			
		40	0			
		50	2.67			
	Passenger	40		0	0	0
		60		0	0	0
		79		2.67	2.67	0
		105		0	0	2.67
Siding (unmon)	Freight	25	0			
		40	0			
		50	4.07			
	Passenger	40		0	0	0
		60		0	0	0
		79		0	0	0
		105		0	0	0
CP Adjacent (mon)	Freight	25	3.9			
		40	0			
		50	5.28			
	Passenger	40		1.64	1.64	1.64
		60		2.26	2.26	0
		79		5.28	5.28	3.76
		105		0	0	3.78
CP Adjacent (unmon)	Freight	25	0			
		40	0			
		50	8.41			
	Passenger	40		0	0	0
		60		1.69	1.69	0
		79		6.72	6.72	1.69
		105		0	0	6.72
Plain Track	Freight	25	0			
		40	0			
		50	31.8			
	Passenger	40		0	0	0
		60		4.95	2.76	0
		79		26.85	29.04	13.59
		105		0	0	18.21
Totals All Types	Freight	25	3.9			
		40	0			
		50	52.23			
	Passenger	40		1.64	1.64	1.64
		60		10.91	8.72	0
		79		43.58	45.77	21.05
		105		0	0	33.44
		Check Totals		56.13	56.13	56.13

Table 3.4a: Traffic Inputs to Risk Calculation

Train Type	Trips/Day Summer	Rest of Year
Passenger	6.00	6.00
Equipped Freight	1.73	3.16
Unequipped Freight	0.00	0.00
Operating Days	91	274

Percent Train-Miles in	
Timeout (secs)	0
Normal Operating Mode	95.00
Timeout Mode	0.00
Fallback Mode	5

Passenger Train Occupancy	
Seats	320
Occupancy Factor	0.60

Table 3.4: Collision Frequencies by Segment Type and Collision Scenario (From Coll Matrix)

Scenarios	Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain	Diamond
Pass Loco Hits Loco	0.0081	0.0108	0.0213	0.0256	0.0022	0.000000
Pass Loco Hits Pass Car	0.0036	0.0048	0.0024	0.0029	0.0004	0.000000
Pass Loco Hits Freight Car	0.0007	0.0010	0.0007	0.0008	0.0002	0.012750
Pass Car Hit by Loco	0.0038	0.0050	0.0026	0.0032	0.0005	0.002550
Freight Loco Hits Loco	0.0009	0.0012	0.0021	0.0025	0.0001	0.000000
Freight Loco Hits Car	0.0002	0.0002	0.0002	0.0003	0.0000	0.034423
Freight Car Hit By Loco	0.0007	0.0010	0.0007	0.0008	0.0002	0.032623

Collision Frequencies for Passenger + Unequipped Freight Train

Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain
0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000

Mauve cells contain data imported from Worksheet 2 in this group of three worksheets covering this sub-corridor, season and operating state.

Weighted Collision Accident Frequencies by Representative Speed (mph)

Scenarios	Freight 25	Freight 40	Freight 50	Passenger 40	Passenger 60	Passenger 79	Passenger 105
Pass Loco Hits Loco				0.0213	0.0000	0.0083	0.0100
Pass Loco Hits Pass Car				0.0024	0.0000	0.0014	0.0017
Pass Loco Hits Freight Car				0.0007	0.0000	0.0004	0.0005
Pass Car Hit by Loco				0.0026	0.0000	0.0015	0.0018
Freight Loco Hits Loco	0.0021	0.0000	0.0008				
Freight Loco Hits Car	0.0002	0.0000	0.0001				
Freight Car Hit By Loco	0.0007	0.0000	0.0004				

All train-to-train collision frequencies are in units of **trains in collisions per million train-miles operated in the sub-corridor by all train types.**

Table 3.5a: Risk Calculation - Passenger Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Freq'y per million tm	Preventability Factor	Adjusted Frequency	Trips/day	Trips per 10 years	Length of Track (miles)	Train-miles per 10 years	Accidents per 10 years	Number seats per train	Occupancy Factor	Passengers per train	Injuries per 10 years	Fatalities per 10 years	Damage $ per 10 years
40	Train-Train Collision	Pass Loco hits Loco	0.02129	Incl	0.02129	7.73	6683	1.64	10959	0.00023	320	0.6	192	0.0037	0.00009	0
		Pass Loco hits Pass Car	0.00240	Incl	0.00240	7.73	6683	1.64	10959	0.00003	320	0.6	192	0.0002	0.00001	0
		Pass Loco hits Frt Car	0.00067	Incl	0.00067	7.73	6683	1.64	10959	0.00001	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00262	Incl	0.00262	7.73	6683	1.64	10959	0.00003	320	0.6	192	0.0009	0.00003	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.35	0.00559	6.00	5187	1.64	8507	0.00005	320	0.6	192	0.0001	0.00000	0
	Intrusion Collision (other))	Pass Loco hits intruder	0.01440	0.10	0.01296	6.00	5187	1.64	8507	0.00011	320	0.6	192	0.0006	0.00002	0
	Overspeed		0.01100	0.00	0.01100	6.00	5187	1.64	8507	0.00009	320	0.6	192	0.0008	0.00001	0
	Broken Rail		0.01670	0.06	0.01570	6.00	5187	1.64	8507	0.00013	320	0.6	192	0.0011	0.00001	0
	Work Zone Violation			0.00		6.00	5187	1.64	8507					0.0007	0.00007	0
										0.00068				**0.00815**	**0.00024**	**0**
60	Train-Train Collision	Pass Loco hits Loco	0.00000	Incl	0.00000	7.73	6683	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Pass Car	0.00000	Incl	0.00000	7.73	6683	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Frt Car	0.00000	Incl	0.00000	7.73	6683	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00000	Incl	0.00000	7.73	6683	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.35	0.00559	6.00	5187	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.10	0.01296	6.00	5187	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Overspeed		0.01100	0.00	0.01100	6.00	5187	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Broken Rail		0.01670	0.06	0.01570	6.00	5187	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Work Zone Violation			0.00		6.00	5187	0	0					0.0000	0.00000	0
										0.00000				**0.00000**	**0.00000**	**0.00**
79	Train-Train Collision	Pass Loco hits Loco	0.00828	Incl	0.00828	7.73	6683	21.05	140668	0.00117	320	0.6	192	0.054	0.0019	2302
		Pass Loco hits Pass Car	0.00140	Incl	0.00140	7.73	6683	21.05	140668	0.00020	320	0.6	192	0.004	0.0002	194
		Pass Loco hits Frt Car	0.00039	Incl	0.00039	7.73	6683	21.05	140668	0.00006	320	0.6	192	0.001	0.0000	55
		Pass car hit by Loco	0.00151	Incl	0.00151	7.73	6683	21.05	140668	0.00021	320	0.6	192	0.019	0.0008	837
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.35	0.00559	6.00	5187	21.05	109186	0.00061	320	0.6	192	0.006	0.0002	272
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.10	0.01296	6.00	5187	21.05	109186	0.00142	320	0.6	192	0.029	0.0010	1258
	Overspeed		0.01100	0.00	0.01100	6.00	5187	21.05	109186	0.00120	320	0.6	192	0.048	0.0008	3123
	Broken Rail		0.01670	0.06	0.01570	6.00	5187	21.05	109186	0.00171	320	0.6	192	0.069	0.0011	4456
	Work Zone Violation			0.00		6.00	5187	21.05	109186					0.018	0.0018	0
										0.00657				**0.24804**	**0.00789**	**12496**
105	Train-Train Collision	Pass Loco hits Loco	0.01003	Incl	0.01003	7.73	6683	33.44	223466	0.00224	320	0.6	192	0.183	0.0069	7835
		Pass Loco hits Pass Car	0.00167	Incl	0.00167	7.73	6683	33.44	223466	0.00037	320	0.6	192	0.012	0.0006	651
		Pass Loco hits Frt Car	0.00045	Incl	0.00045	7.73	6683	33.44	223466	0.00010	320	0.6	192	0.003	0.0002	177
		Pass car hit by Loco	0.00180	Incl	0.00180	7.73	6683	33.44	223466	0.00040	320	0.6	192	0.065	0.0025	2806
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.35	0.00559	6.00	5187	33.44	173453	0.00097	320	0.6	192	0.018	0.0006	762
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.10	0.01296	6.00	5187	33.44	173453	0.00225	320	0.6	192	0.082	0.0029	3536
	Overspeed		0.01100	0.00	0.01100	6.00	5187	33.44	173453	0.00191	320	0.6	192	0.103	0.0016	8765
	Broken Rail		0.01670	0.06	0.01570	6.00	5187	33.44	173453	0.00272	320	0.6	192	0.146	0.0024	12509
	Work Zone Violation			0.00		6.00	5187	33.44	173453					0.038	0.0038	0
	Total									**0.01097**				**0.65042**	**0.02143**	**37042**
	Overall Totals									**0.01822**				**0.90740**	**0.02956**	**49539**
	Totals All Speeds	**Train-train Collisions**								**0.00504**				**0.34592**	**0.01316**	**14858**
		Intrusion Collisions								**0.00540**				**0.13665**	**0.00485**	**5828**
		Overspeed								**0.00320**				**0.15179**	**0.00244**	**11888**
		Broken Rail								**0.00457**				**0.21662**	**0.00348**	**16965**
		Work Zone Violation								**0.00000**				**0.05643**	**0.00564**	**0**

Table 3.5b: Risk Calculation - Collisions at Diamonds - Passenger

Number Diamonds	Freq'y per mill passes	Collisions (millions)	Injuries	Fatalities	Damage
2	0.000000	0.000000	0.000000	0.000000	0.00
2	0.000000	0.000000	0.000000	0.000000	0.00
2	0.012750	0.000170	0.001112	0.0000033	42.77
2	0.002550	0.000034	0.001086	0.0000033	34.25
		0.000204	**0.002199**	**0.000065**	**77.03**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.012750	0.000000	0.000000	0.000000	0.00
0	0.002550	0.000000	0.000000	0.000000	0.00
		0.000000	**0.00000**	**0.00000**	**0.00

Model Inputs: Base Case II: Northeast Corridor ATC: 85% Preventability

Table IN-1a: Braking Formula Inputs

Train/System Type	Parameter	Value
Freight	Coefficient A	0.033
	Appl'n Time (secs)	13.8
	Train Weight (lb)	37500000
	Brake Force (lb)	774663
Passenger	Coefficient A	0.666
	Coefficient B	0
	Safety Factor	1.25
Train Control	Timeout (secs)	3
	PTC latency (secs)	3
	ACS Response (secs)	6
Guilty Train Speed (mph)		15

Table IN-1b: Miscellaneous Inputs

Parameter		Value	Units
Sight Distance		2500	ft
Distribution of train location at time of violation in Reference Case accidents	At Block	0.95	Probability
	Previous Block	0.05	Probability
PTC Risk Increment in Zone C	(PTC Models ONLY)	2	Ratio
Potential danger length in Zone C	(PTC Models ONLY)	2500	ft
Unit Cost Per Casualty	Injury	1000000	Dollars
	Fatality	30000000	Dollars

PTC, Timeout, and Latency values in Table IN-1a used only for PTC calculations.

Table IN-1c:Traffic and Related Data

Train Type	Average One-Way Trips/Day					
	Joliet Sub-Corridor		Bloomington Sub-Corridor		Springfield Sub-Corridor	
	Summer	Rest of Year	Summer	Rest of Year	Summer	Rest of Year
Passenger	6.00	6.00	6.00	6.00	6.00	6.00
Equipped Freight	1.43	1.43	1.43	2.29	1.73	3.16
Unequipped Freight	0.00	0.00	0.00	0.00	0.00	0.00
Operating Days	91.0	274.0	91.0	274.0	91.0	274.0

Percent Train Miles in						
Timeout (secs)	0		0		0	
Normal Operating Mode	95.00		95.00		95.00	
Timeout Mode	0.00		0.00		0.00	
Fallback Mode	5.00		5.00		5.00	
Passenger Train Occupancy						
Seats	320		320		320	
Occupancy Factor	0.6		0.6		0.6	

Table IN-2a: Segment Definitions: Joliet Sub-Corridor: MP 62.7 (Mazonia) - MP 88.3 (Bunge)

Segment Number	Start (milepost)	End (milepost)	Type	Variant	Length		Passed Speed (mph)			Representative Speed (mph)				Industry Siding		Passenger Stops
					Miles	Feet	Freight	Pass	HS Pass	Freight	Pass	HS Pass (Correct*)	HS Pass (Other)	Number	Name	
1.0	62.60	64.00	CP Adjacent (NB)		2.20	11616	60.0	79.0	110	50	79	79	105	0		
2.0	64.80	66.55	Plain		1.75	9240	60.0	79.0	110	50	79	79	105	0		
3.0	66.55	69.10	Plain		1.94	10219.4	60.0	79.0	110	50	79	79	105	0		
4.0	69.10	70.17	CP Adjacent (NB		1.07	5654.4	60.0	79.0	110	50	79	79	105	0		
5.0	70.17	72.80	Siding (NB)	Dw light (sig'd)	2.63	13886.4	60.0	79.0	110	40	60	60	79	0		
6.0	72.80	72.80	Diamond		0.00	0	40.0	40.0	40	40	40	40	40	0		
7.0	72.80	74.94	CP Adjacent (NB)		2.14	11299.2	60.0	79.0	110	40	60	60	79	0		
8.0	74.94	77.27	Plain		2.33	12303.4	60.0	79.0	110	50	79	79	105	0		
9.0	77.27	80.13	Plain		2.86	15100.8	60.0	79.0	110	50	79	79	105	0		
10.0	80.13	81.59	CP Adjacent (NB		1.46	7708.8	60.0	79.0	110	50	79	79	105	0		
11.0	81.59	84.65	Siding (NB	Odell (Sig'd)	2.66	14044.8	60.0	79.0	110	50	79	79	105	0		
12.0	84.65	86.43	CP Adjacent (NB)		1.78	9398.4	60.0	79.0	110	50	79	79	105	0		
13.0	86.43	88.35	Plain		1.92	10137.6	60.0	79.0	110	50	79	79	105	0		

Check Total 25.8

Table IN-2b: Segment Definitions: Bloomington Sub-Corridor: MP 88.3 (Bunge) - MP 124.9 (Bloomington)

Segment Number	Start (MP)	End (MP)	Type	Variant	Length		Passed Speed (mph)			Representative Speed (mph)				Industry Siding		Passenger Stops
					Miles	Feet	Freight	Pass	HS Pass	Freight	Pass	HS Pass (Correct*)	HS Pass (Other)	Number	Name	
14.0	88.35	90.55	Plain		2.20	11616	60.0	79.0	110	50	79	79	105	1	Bunge	
15.0	90.55	92.47	CP Adjacent (NB		1.92	10137.6	49.0	50.0	50	40	60	60	79	1	Donnley	
16.0	92.47	94.51	Siding (NB	Pontiac (Sig'd)	2.04	10771.2	60.0	79.0	110	50	79	79	105	0		Pontiac
17.0	94.51	96.81	CP Adjacent (NB		2.30	12144	60.0	79.0	110	50	79	79	105	0	Occya	
18.0	96.81	100.28	Plain		3.47	18321.6	60.0	79.0	110	50	79	79	105	0		
19.0	100.28	102.25	CP Adjacent (NB		1.97	10401.6	60.0	79.0	110	40	60	60	79	0		
20.0	102.25	102.25	Diamond		0.00	0	40.0	40.0	40	40	40	40	40	0		
21.0	102.25	104.93	CP Adjacent (NB		2.26	12408	60.0	79.0	110	40	60	60	79	0		
22.0	104.93	106.43	CP Adjacent (NB		1.83	9662.4	60.0	79.0	110	50	79	79	105	0		
23.0	106.43	108.83	Siding (NB	Ballard (Sig'd)	2.40	12652.8	60.0	79.0	110	50	79	79	105	0		
24.0	108.83	111.35	CP Adjacent (NB		2.53	13356.4	60.0	79.0	110	50	79	79	105	0		
25.0	111.35	113.30	Plain		1.94	10243.2	60.0	79.0	110	50	79	79	105	0		
26.0	113.30	116.36	Plain		3.06	16156.8	60.0	79.0	110	50	79	79	105	0		
27.0	116.36	118.83	Plain		2.47	13041.6	60.0	79.0	110	50	79	79	105	1	Tee-anda	
28.0	118.83	121.45	CP Adjacent (NB		2.62	13804.8	60.0	79.0	110	50	79	79	105	0		
29.0	121.40	123.57	Siding (NB	Bloomington Yard	2.17	11452.8	49.0	79.0	110	40	60	60	79	1	Bloomington	
30.0	123.57	124.50	Siding (NB	Bloomington Yard	0.91	4804.8	49.0	79.0	110	40	60	60	79	1	Bloomington	Bloomington
31.0	124.38	124.86	Siding (NB	Bloomington Yard	0.48	2534.4	25.0	40.0	40	25	40	40	40	1	Bloomington	

Check Total 36.5

Table IN-2c: Segment Definitions: Springfield Sub-Corridor: MP 124.9 (Bloomington) - MP 181.0 (Ridgely)

Segment Number	Start	End	Type	Variant	Length		Passed Speed (mph)			Representative Speed (mph)				Industry Siding		Passenger Stops
					Miles	Feet	Freight	Pass	HS Pass	Freight	Pass	HS Pass (Correct*)	HS Pass (Other)	Number	Name	
32.0	124.86	126.50	CP Adjacent (NB		1.6	8608.2	25.0	40.0	40	25	40	40	40	0		(Bloom Y ard)
33.0	126.50	126.50	Diamond		0.0	0	25.0	40.0	40	25	40	40	40	0		
34.0	126.50	128.70	CP Adjacent (NB		2.2	11616	60.0	79.0	110	50	79	79	105	0		
35.0	128.70	130.98	Plain		2.3	12134	60.0	79.0	110	50	79	79	105	0		
36.0	130.98	133.72	Plain		2.8	14572.8	60.0	79.0	110	50	79	79	105	0		
37.0	133.72	136.90	Plain		3.2	16790.4	60.0	79.0	110	50	79	79	105	0		
38.0	136.90	138.63	CP Adjacent (NB		1.7	9134.4	60.0	79.0	110	50	79	79	105	0		
39.0	138.63	141.30	Siding (NB	McLean (sig'd)	2.7	14097.6	60.0	79.0	110	50	79	79	105	1		McLean
40.0	141.30	143.35	CP Adjacent (NB		2.0	10824	60.0	79.0	110	50	79	79	105	0		
41.0	143.35	145.91	Plain		2.6	13728	60.0	79.0	110	50	79	79	105	0		FTS Fertilizer, Atlanta
42.0	145.91	150.96	Plain		2.7	14544.8	60.0	79.0	110	50	79	79	105	1		E Lincoln Grain
43.0	150.96	153.56	CP Adjacent (LS		2.6	13728	60.0	79.0	110	50	79	79	105	1		Kruger
44.0	153.56	155.57	Siding (LS	Elkhart (Uns sig'd)	2.0	10612.8	60.0	79.0	110	50	79	79	105	0		
45.0	155.57	155.57	Diamond		0.0	0	40.0	40.0	40	40	40	40	40	0		
46.0	155.57	157.26	CP Adjacent (LS		1.7	8985.6	60.0	79.0	110	50	79	79	105	0		Havana Rd. Lincoln
47.0	157.26	160.01	Plain		2.8	14731.2	60.0	79.0	110	50	79	79	105	0		
48.0	160.01	162.11	Plain		2.6	13756.8	60.0	79.0	110	50	79	79	105	0		
49.0	162.11	164.04	Plain		1.9	10180.4	60.0	79.0	110	50	79	79	105	0		
50.0	164.04	166.18	Plain		2.1	11193.6	60.0	79.0	110	50	79	79	105	0		
51.0	166.18	168.34	CP Adjacent (LS		2.2	11510.4	60.0	79.0	110	50	79	79	105	1		(Elmart Grain
52.0	168.34	170.40	Siding (LS	Elkhart (Uns sig'd)	2.1	10876.8	60.0	79.0	110	50	79	79	105	0		
53.0	170.40	172.24	CP Adjacent (LS		1.8	9504.0	60.0	79.0	110	50	79	79	105	0		
54.0	172.24	175.84	Plain		3.5	18480	60.0	79.0	110	50	79	79	105	0		
55.0	175.84	179.49	Plain		3.7	19272	60.0	79.0	110	50	79	79	79	0		
56.0	179.49	180.99	CP Adjacent (NB		1.5	7920	60.0	79.0	110	50	79	79	79	0		

Check Total 56.1

Table IN-3a: Crossing and Diamond Data, Joliet Sub-Corridor

Train Type	Representative Speed (mph)	Type of Grade-crossing	Number Crossings			Number Diamonds
			Passenger	HS Passenger	Freight	
Passenger	40	Public_gates_lights	0	0		
		Public_other	0	0		
		Private	0	0		
	60	Public_gates_lights	0	0		
		Public_other	0	0		
		Private	0	0		
	79	Public_gates_lights	20	8		
		Public_other	0	0		
		Private	1	0		
	105	Public_gates_lights	0	20		
		Public_other	0	1		
		Private	0	1		
Freight	25	Public_gates_lights			0	
		Public_other			0	
		Private			6	
	40	Public_gates_lights			0	
		Public_other			0	
		Private			0	
	50	Public_gates_lights			20	
		Public_other			0	
		Private			1	

Check Totals 29 29 29

Table IN-3b: Crossing Data, Bloomington Sub-Corridor

Train Type	Representative Speed (mph)	Type of Grade-crossing	Number Crossings			Number Diamonds
			Passenger	HS Passenger	Freight	
Passenger	40	Public_gates_lights	7	7		
		Public_other				
		Private				
	60	Public_gates_lights	16			
		Public_other				
		Private	1			
	79	Public_gates_lights	16	16		
		Public_other	1			
		Private	6	1		
	105	Public_gates_lights		16		
		Public_other		1		
		Private		4		
Freight	25	Public_gates_lights			7	
		Public_other			0	
		Private			4	
	40	Public_gates_lights			16	
		Public_other			1	
		Private			1	
	50	Public_gates_lights			19	
		Public_other			1	
		Private			4	

Check Totals 47 47 47

Table IN-3c: Crossing Data, Springfield Sub-Corridor

Train Type	Representative Speed (mph)	Type of Grade-crossing	Number Crossings			Number Diamonds
			Passenger	HS Passenger	Freight	
Passenger	40	Public_gates_lights				
		Public_other				
		Private				
	60	Public_gates_lights	14			
		Public_other				
		Private				
	79	Public_gates_lights	15	16		
		Public_other	5	1		
		Private	5	1		
	105	Public_gates_lights		13		
		Public_other		1		
		Private		4		
Freight	25	Public_gates_lights			8	
		Public_other				
		Private				
	40	Public_gates_lights				
		Public_other				
		Private				
	50	Public_gates_lights			29	
		Public_other			5	
		Private			1	

Check Totals 39 39 39

Table IN-3d: Grade Crossings: Collision Frequency and Consequences

Train Type	Representative Speed (mph)	Type of Grade-crossing	Accident Frequency Per Million Crossing Passes		Crossing Collision Consequences: Pass, Occupt Casualty Prob/accident			Freight Trains (per accident)		
			Passenger	Freight	Cost $/Accident	Injuries	Fatalities	Cost $		
Passenger	40	Public_gates_lights	0.350		0.0028	0.000047	50,000			
		Public_other	0.500							
		Private	0.530							
	60	Public_gates_lights	0.500		0.0068	0.000112	113,000			
		Public_other	0.500							
		Private	0.200							
	79	Public_gates_lights	0.650		0.0105	0.000156	196,000			
		Public_other	0.650							
		Private	0.300							
	105	Public_gates_lights	1.100		0.0186	0.000276	346,000			
		Public_other	1.100							
		Private	0.300							
Freight	25	Public_gates_lights	0.150					0.13	0.005	20000
		Public_other	0.110							
		Private	0.050							
	40	Public_gates_lights	0.500					0.25	0.013	50000
		Public_other	0.200							
		Private	0.150							
	50	Public_gates_lights	0.900					0.39	0.02	78000
		Public_other	0.300							
		Private	0.120							

Table IN-4: Consequences Look-up Tables (Data Sources: Previous ICF Passenger Corridor Project (passenger), FRA Accident Data 2001-5 (freight)

Passenger Trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 40 mph			Representative Speed 60 mph			Representative Speed 79 mph			Representative Speed 105 mph		
			Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Pass Loco hits Loco	0.083	0.002	502000	0.139	0.0049	1142000	0.240	0.0085	1976000	0.425	0.0160	3495000
		Pass Loco hits Pass Car	0.034	0.001	251000	0.056	0.0026	572000	0.097	0.0045	988000	0.171	0.0080	1747000
		Pass Loco hits Frt Car	0.034	0.001	253000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.0080	1747000
		Pass car hit by Loco	0.166	0.005	1005000	0.275	0.0119	2284000	0.476	0.0206	3951000	0.841	0.0320	6989000
	Intrusion Collision (rollout)	Pass Locos hits Car	0.013	0.001	113000	0.031	0.0011	257000	0.054	0.0019	445000	0.096	0.0034	786000
	Intrusion Collision (other)	Pass Loco hits Car	0.026	0.001	226000	0.063	0.0022	514000	0.108	0.0038	889000	0.191	0.0068	1573000
	Overspeed		0.044	0.000	667000	0.140	0.0019	1500000	0.210	0.0034	2600000	0.280	0.0045	4594000
	Broken Rail		0.044	0.000	667000	0.140	0.0019	1500000	0.210	0.0034	2600000	0.280	0.0045	4594000
	Work Zone Violation		0.083	0.008	0	0.125	0.013	0	0.164	0.0164	0	0.218	0.0218	0

Freight trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 25 mph			Representative Speed 40 mph			Representative Speed 50 mph		
			Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Frt Loco hits Locs	0.43	0.043	105000	1.1	0.11	270000	1.7	0.17	422000
		Frt Loco hits Car	0.35	0.035	88000	0.9	0.09	220000	1.4	0.14	352000
		Frt car hit by Locs	0	0	44000	0	0	112000	0	0	176000
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Overspeed, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Overspeed, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Work Zone Viol'n, Equip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0
	Work Zone Viol'n, Unequip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0

Casualties and damage in Table IN-4 are per accident, except for Work Zone Violations which are per million train-miles

Table IN-5a: Reference Case Collision Accident Frequencies by Sub-Corridor and Season

Train-Train Collision Frequency by Segment Type, Sub Corridor and Season (Collision Frequency in Collisions per Million Train Miles)

Segment Type	Joliet Sub-Corridor		Bloomington Sub-Corridor		Springfield Sub-Corridor	
	Summer	Rest of Year	Summer	Rest of Year	Summer	Rest of Year
Siding - Monitored	0.030	0.030	0.030	0.030	0.030	0.030
Siding - Unmonitored	0.040	0.040	0.040	0.040	0.040	0.040
CP-Adjacent, Monitored	0.050	0.050	0.050	0.050	0.050	0.050
CP-Adjacent, Unmonitored	0.060	0.060	0.060	0.060	0.060	0.060
Plain Track	0.006	0.006	0.006	0.008	0.006	0.006

Table IN-5b: Collision Distributions Between Head-on and Rear/Side by trains involved and Segment type

Segment Type	Head-on and Rear/Side Train-Train Collision Distributions by Segment Type							
	Pass vs Pass		Pass vs Freight				Freight to Freight	
	Head-on	Rear/Side	HS P into P	HS F into P	HS F into F	Rear/Side P	Head-on	Rear/Side
Siding - Monitored	50%	50%	50%	40%	10%	50%	50%	50%
Siding - Unmonitored	50%	50%	50%	40%	10%	50%	50%	50%
CP-Adjacent, Monitored	90%	10%	80%	15%	5%	75%	25%	
CP-Adjacent, Unmonitored	90%	10%	80%	15%	5%	75%	25%	
Plain Track	80%	20%	70%	25%	5%	50%	50%	

Table IN-5c: Reference Case Frequencies for Other Accident Types

All Other Accident Frequencies			
Accident Type	Units	Frequencies	
		Passenger	Freight
Intrusion Collision (rollout)	Per million train-miles	0.0113	0.0160
Intrusion Collision (other)	Per million train-miles	0.0144	0.0268
Overspeed	Per million train-miles	0.0110	0.0160
Broken Rail	Per million train-miles	0.0167	0.0056
Work Zone Violation	Per million train-miles	See Consequence Table	
Derrends	Per million derrend passes	0.1000	0.1000

Table IN-5d: Reference Case Collision Distributions by Sub-Corridor and Train Type

Train-Train Collision Distributions by Train Types							
Collision Types	Joliet Sub-Corridor		Bloomington Sub-Corridor		Springfield Sub-Corridor		
	Summer	Rest of Year	Summer	Rest of Year	Summer	Rest of Year	
Passenger-Passenger	0.29	0.29	0.29	0.29	0.29	0.29	
Passenger - Equip Freight	0.29	0.29	0.29	0.29	0.29	0.29	
Passenger - Unequip Freight	0.00	0.00	0.00	0.00	0.00	0.00	
Equip Freight - Equip Freight	0.00	0.00	0.00	0.08	0.00	0.00	
Equip Freight - Unequip Freight	0.00	0.00	0.00	0.00	0.00	0.00	
Unequip. Freight - Unequip Freight	0.00	0.00	0.00	0.00	0.00	0.00	
	Checking	1.00	1.00	1.00	1.00	1.00	1.00

Note: Send all trains are equipped in Cab Signal and ATC cases, there are no Unequipped trains, subsequent trains.

Table IN-6a: Preventability for Other Accident Types

Accident Type	Preventability factors - ATC		Prev'ty Factors - PTC Timeout	
	Passenger	Freight	Passenger	Freight
Intrusion Collision (rollout)	0.43	0.43	0.00	0.00
Intrusion Collision (other)	0.12	0.00	0.00	0.00
Overspeed	0.00	0.00	0.90	0.90
Broken Rail	0.00	0.00	0.90	0.90
Work Zone Violation	0.00	0.00	0.00	0.00
Grade Crossings	0.00	0.00	0.00	0.00

Prev'ty Factors - PTC Timeout only used in PTC models

Equipped Train Preventability Values

Collision Type		Preventability
Both TIBE	Pass-Pass	0.35
	Pass-TBE Freight	0.85
	TBE Freight - TBE Freight	0.85
One TIBE	Pass - NE Freight, Head -On	0.85
	Rear/Side, Pass into NE Frt	0.85
	Rear/Side NE Frt into Pass	0.85
	TBE Freight - NE Freight	0.85

Tables IN-7: Base Consequences Look-up Table (Data Sources: Previous ICF Passenger Corridor Project (passenger), FRA Accident Data 2001-5 (freight)

Passenger Trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 40 mph			Representative Speed 60 mph			Representative Speed 79 mph			Representative Speed 105 mph		
			Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Pass Loco hits Loco	0.083	0.0020	503000	0.139	0.0049	1142000	0.240	0.0085	1976000	0.425	0.0160	3495000
		Pass Loco hits Pass Car	0.034	0.0010	251000	0.056	0.0026	572000	0.097	0.0045	988000	0.171	0.0080	1747000
		Pass Loco hits Frt Car	0.034	0.0010	253000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.0080	1747000
		Pass car hit by Loco	0.166	0.0050	1005000	0.275	0.0119	2284000	0.476	0.0206	3951000	0.841	0.0320	6989000
	Intrusion Collision (rollout)	Pass Locos hits Car	0.013	0.001	113000	0.031	0.0011	257000	0.054	0.0019	445000	0.096	0.0034	786000
	Intrusion Collision (other)	Pass Loco hits Car	0.026	0.0009	226000	0.063	0.0022	514000	0.108	0.0038	889000	0.191	0.0068	1573000
	Overspeed		0.044	0.0004	667000	0.140	0.0019	1500000	0.210	0.0034	2600000	0.280	0.0045	4594000
	Broken Rail		0.044	0.0004	667000	0.140	0.0019	1500000	0.210	0.0034	2600000	0.280	0.0045	4594000
	Work Zone Violation		0.083	0.0083	0	0.125	0.0125	0	0.164	0.0164	0	0.218	0.0218	0

Consequence Adjustment Factors by Representative Speed

40 mph	60 mph	79 mph	105 mph
1.00	1.00	1.00	1.00
1.00	1.00	1.00	1.00
1.00	1.00	1.00	1.00
1.00	1.00	1.00	1.00
1.00	1.00	1.00	1.00
1.00	1.00	1.00	1.00
1.00	1.00	1.00	1.00

Freight trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 25 mph			Representative Speed 40 mph			Representative Speed 50 mph		
			Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Frt Loco hits Locs	0.43	0.043	105000	1.1	0.11	270000	1.7	0.17	422000
		Frt Loco hits Car	0.35	0.035	88000	0.9	0.09	220000	1.4	0.14	352000
		Frt car hit by Locs	0	0	44000	0	0	112000	0	0	176000
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Overspeed, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Overspeed, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Work Zone Viol'n, Equip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0
	Work Zone Viol'n, Unequip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0

Casualties and damage in Table IN-7 are per accident, except for Work Zone Violations which are per million train-miles

Consequence Adjustment Factors by Representative Speed

25 mph	40 mph	50 mph
1.00	1.00	1.00
1.00	1.00	1.00
1.00	1.00	1.00
1.00	1.00	1.00
1.00	1.00	1.00
1.00	1.00	1.00
1.00	1.00	1.00

Tables IN-8: Adjusted Consequences Look-up Table (Data Sources: Previous ICF Passenger Corridor Project (passenger), FRA Accident Data 2001-5 (freight)

Results Summary: Base Case II: Northeast Corridor ATC, 85% Preventability.

Table R1a: Full Year, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00474	0.35286	0.01352	15382	91238
	Intrusion Collisions	0.00941	0.27340	0.00971	11717	68197
	Diamond Collisions	0.00026	0.00282	0.00008	99	633
	Overspeed	0.00589	0.30214	0.00486	24896	69680
	Broken Rail	0.00823	0.42200	0.00678	34773	97324
	Work Zone Violation	0.00000	0.11143	0.01114	0	44572
	Grade Crossing Collisions	0.59710	1.92530	0.02857	186625	464876
	Total, All Scenarios	0.62565	3.38995	0.07468	273491	836520
Freight	Train-Train Collisions	0.00080	0.00087	0.00009	252	599
	Intrusion Collisions	0.00201	0.00066	0.00007	83	347
	Diamond Collisions	0.00149	0.00066	0.00007	250	514
	Overspeed	0.00204	0.00064	0.00006	1117	1372
	Broken Rail	0.00653	0.00204	0.00020	3572	4387
	Work Zone Violation	0.00000	0.01020	0.00102	0	4078
	Grade Crossing Collisions	0.04820	0.01713	0.00088	3426	7781
	Total, All Scenarios	0.06108	0.03219	0.00239	8700	19078
Total Passenger + Freight		**0.68673**	**3.42213**	**0.07706**	**282191**	**855598**

Table R1b: Rest of Year, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00531	0.36271	0.01383	15686	93461
	Intrusion Collisions	0.01002	0.27512	0.00977	11726	68549
	Diamond Collisions	0.00024	0.00253	0.00008	89	569
	Overspeed	0.00627	0.30774	0.00493	24916	70493
	Broken Rail	0.00876	0.42983	0.00689	34801	98459
	Work Zone Violation	0.00000	0.11449	0.01145	0	45798
	Grade Crossing Collisions	0.55834	1.55969	0.02319	151171	376715
	Total, All Scenarios	0.58894	3.05212	0.07015	238389	754043
Freight	Train-Train Collisions	0.00168	0.00176	0.00018	500	1206
	Intrusion Collisions	0.00342	0.00107	0.00011	134	562
	Diamond Collisions	0.00127	0.00056	0.00006	213	437
	Overspeed	0.00347	0.00101	0.00010	1810	2215
	Broken Rail	0.01108	0.00324	0.00032	5786	7081
	Work Zone Violation	0.00000	0.01682	0.00168	0	6729
	Grade Crossing Collisions	0.07555	0.02371	0.00121	4717	10730
	Total, All Scenarios	0.09647	0.04818	0.00366	13159	28959
Total Passenger + Freight		**0.68541**	**3.10030**	**0.07381**	**251548**	**783003**

Table R1c: Rest of Year, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00770	0.52175	0.01988	22439	134242
	Intrusion Collisions	0.01541	0.39492	0.01401	16843	98358
	Diamond Collisions	0.00052	0.00554	0.00016	194	1242
	Overspeed	0.00964	0.45704	0.00733	35795	103495
	Broken Rail	0.01347	0.63836	0.01024	49996	144554
	Work Zone Violation	0.00000	0.16990	0.01699	0	67959
	Grade Crossing Collisions	0.50680	1.47592	0.02191	143142	356461
	Total, All Scenarios	0.55353	3.66342	0.09052	268409	906311
Freight		0.00000	0.00000	0.00000	0	0
	Train-Train Collisions	0.00232	0.00253	0.00025	725	1738
	Intrusion Collisions	0.00728	0.00242	0.00024	304	1271
	Diamond Collisions	0.00284	0.00125	0.00013	475	976
	Overspeed	0.00739	0.00243	0.00024	4105	5079
	Broken Rail	0.02362	0.00778	0.00078	13124	16237
	Work Zone Violation	0.00000	0.03701	0.00370	0	14802
	Grade Crossing Collisions	0.09797	0.03721	0.00190	7427	16859
	Total, All Scenarios	0.14141	0.09063	0.00725	26160	56962
Total Passenger + Freight		0.69495	3.75405	0.09777	294569	963273

Table R1d: Rest of Year, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01775	1.23731	0.04723	53507	318942
	Intrusion Collisions	0.03484	0.94344	0.03349	40286	235104
	Diamond Collisions	0.00101	0.01090	0.00032	382	2444
	Overspeed	0.02181	1.06692	0.01712	85607	243668
	Broken Rail	0.03046	1.49019	0.02392	119569	340337
	Work Zone Violation	0.00000	0.39582	0.03958	0	158328
	Grade Crossing Collisions	1.66225	4.96091	0.07367	480938	1198052
	Total, All Scenarios	1.76812	10.10549	0.23535	780289	2496875
Freight	Train-Train Collisions	0.00480	0.00516	0.00052	1478	3543
	Intrusion Collisions	0.01272	0.00414	0.00041	520	2179
	Diamond Collisions	0.00560	0.00247	0.00025	938	1927
	Overspeed	0.01290	0.00408	0.00041	7032	8666
	Broken Rail	0.04123	0.01306	0.00131	22482	27705
	Work Zone Violation	0.00000	0.06402	0.00640	0	25609
	Grade Crossing Collisions	0.22171	0.07805	0.00400	15570	35370
	Total, All Scenarios	0.29896	0.17099	0.01329	48019	104999
Total Passenger + Freight		**2.06708**	**10.27648**	**0.24864**	**828309**	**2601874**

Table R2a: Summer, Joliet *(Included in Full Year Table)*

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Freight	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Total Passenger + Freight						

There are no seasonal traffic variations on the Joliet Sub-corridor. Therefore only one risk calculation is needed for the full year, and there is no separate summer calculation

Table R2b: Summer, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00178	0.12230	0.00466	5286	31504
	Intrusion Collisions	0.00333	0.09137	0.00324	3894	22766
	Diamond Collisions	0.00007	0.00076	0.00002	26	169
	Overspeed	0.00208	0.10221	0.00164	8275	23412
	Broken Rail	0.00291	0.14275	0.00229	11558	32700
	Work Zone Violation	0.00000	0.03748	0.00380	0	15156
	Grade Crossing Collisions	0.18544	0.51800	0.00770	50207	125113
	Total, All Scenarios	0.19561	1.01487	0.02336	79246	250820
Freight	Train-Train Collisions	0.00030	0.00030	0.00003	88	210
	Intrusion Collisions	0.00071	0.00022	0.00002	28	117
	Diamond Collisions	0.00038	0.00017	0.00002	63	130
	Overspeed	0.00072	0.00021	0.00002	377	461
	Broken Rail	0.00231	0.00067	0.00007	1205	1475
	Work Zone Violation	0.00000	0.00350	0.00035	0	1402
	Grade Crossing Collisions	0.01574	0.00494	0.00025	983	2235
	Total, All Scenarios	0.02016	0.01002	0.00076	2744	6031
Total Passenger + Freight		**0.21577**	**1.02490**	**0.02412**	**81991**	**256851**

Table R2c: Summer, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00252	0.17296	0.00658	7429	44468
	Intrusion Collisions	0.00512	0.13116	0.00465	5594	32666
	Diamond Collisions	0.00014	0.00155	0.00005	54	348
	Overspeed	0.00320	0.15179	0.00244	11888	34372
	Broken Rail	0.00447	0.21201	0.00340	16604	48009
	Work Zone Violation	0.00000	0.05643	0.00564	0	22570
	Grade Crossing Collisions	0.16832	0.49018	0.00728	47540	118387
	Total, All Scenarios	0.18378	1.21607	0.03003	89110	300821
Freight	Train-Train Collisions	0.00028	0.00029	0.00003	86	203
	Intrusion Collisions	0.00132	0.00044	0.00004	55	231
	Diamond Collisions	0.00080	0.00035	0.00004	133	274
	Overspeed	0.00134	0.00044	0.00004	746	923
	Broken Rail	0.00429	0.00142	0.00014	2386	2952
	Work Zone Violation	0.00000	0.00673	0.00067	0	2691
	Grade Crossing Collisions	0.01781	0.00677	0.00035	1350	3065
	Total, All Scenarios	0.02585	0.01643	0.00131	4757	10340
Total Passenger + Freight		**0.20963**	**1.23251**	**0.03135**	**93867**	**311161**

Table R2d: Summer, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00430	0.29526	0.01124	12714	75972
	Intrusion Collisions	0.00844	0.22253	0.00790	9488	55433
	Diamond Collisions	0.00021	0.00231	0.00007	81	518
	Overspeed	0.00529	0.25400	0.00407	20163	57784
	Broken Rail	0.00738	0.35476	0.00569	28162	80709
	Work Zone Violation	0.00000	0.09391	0.00945	0	37726
	Grade Crossing Collisions	0.35375	1.00818	0.01498	97746	243500
	Total, All Scenarios	0.37938	2.23095	0.05340	168356	551641
Freight	Train-Train Collisions	0.00058	0.00060	0.00006	174	413
	Intrusion Collisions	0.00204	0.00066	0.00007	83	348
	Diamond Collisions	0.00118	0.00052	0.00005	197	404
	Overspeed	0.00207	0.00065	0.00007	1123	1385
	Broken Rail	0.00660	0.00209	0.00021	3591	4427
	Work Zone Violation	0.00000	0.01023	0.00102	0	4093
	Grade Crossing Collisions	0.03355	0.01170	0.00060	2333	5300
	Total, All Scenarios	0.04601	0.02646	0.00207	7502	16370
Total Passenger + Freight		**0.42539**	**2.25740**	**0.05547**	**175857**	**568011**

Table R3a: All Year, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00474	0.35286	0.01352	15382	91238
	Intrusion Collisions	0.00941	0.27340	0.00971	11717	68197
	Diamond Collisions	0.00026	0.00282	0.00008	99	633
	Overspeed	0.00589	0.30214	0.00486	24896	69680
	Broken Rail	0.00823	0.42200	0.00678	34773	97324
	Work Zone Violation	0.00000	0.11143	0.01114	0	44572
	Grade Crossing Collisions	0.59710	1.92530	0.02857	186625	464876
	Total, All Scenarios	0.62565	3.38995	0.07468	273491	836520
Freight	Train-Train Collisions	0.00080	0.00087	0.00009	252	599
	Intrusion Collisions	0.00201	0.00066	0.00007	83	347
	Diamond Collisions	0.00149	0.00066	0.00007	250	514
	Overspeed	0.00204	0.00064	0.00006	1117	1372
	Broken Rail	0.00653	0.00204	0.00020	3572	4387
	Work Zone Violation	0.00000	0.01020	0.00102	0	4078
	Grade Crossing Collisions	0.04820	0.01713	0.00088	3426	7781
	Total, All Scenarios	0.06108	0.03219	0.00239	8700	19078
Total Passenger + Freight		0.68673	3.42213	0.07706	282191	855598

Table R3b: All Year, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00709	0.48501	0.01850	20971	124965
	Intrusion Collisions	0.01335	0.36650	0.01302	15620	91316
	Diamond Collisions	0.00031	0.00329	0.00010	115	738
	Overspeed	0.00836	0.40995	0.00657	33191	93905
	Broken Rail	0.01167	0.57258	0.00918	46359	131159
	Work Zone Violation	0.00000	0.15197	0.01525	0	60953
	Grade Crossing Collisions	0.74378	2.07769	0.03089	201378	501828
	Total, All Scenarios	0.78455	4.06700	0.09351	317635	1004864
Freight	Train-Train Collisions	0.00198	0.00207	0.00021	588	1416
	Intrusion Collisions	0.00413	0.00129	0.00013	162	679
	Diamond Collisions	0.00165	0.00073	0.00007	276	567
	Overspeed	0.00419	0.00122	0.00012	2187	2676
	Broken Rail	0.01339	0.00391	0.00039	6991	8556
	Work Zone Violation	0.00000	0.02033	0.00203	0	8130
	Grade Crossing Collisions	0.09129	0.02865	0.00147	5700	12965
	Total, All Scenarios	0.11663	0.05820	0.00442	15904	34990
Total Passenger + Freight		0.90118	4.12519	0.09793	333539	1039854

Table R3c: All Year, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01022	0.69471	0.02646	29868	178711
	Intrusion Collisions	0.02052	0.52608	0.01866	22437	131024
	Diamond Collisions	0.00066	0.00709	0.00021	248	1590
	Overspeed	0.01285	0.60883	0.00977	47683	137868
	Broken Rail	0.01794	0.85037	0.01364	66600	192563
	Work Zone Violation	0.00000	0.22632	0.02263	0	90529
	Grade Crossing Collisions	0.67512	1.96610	0.02919	190682	474847
	Total, All Scenarios	0.73731	4.87949	0.12055	357519	1207132
Freight	Train-Train Collisions	0.00260	0.00282	0.00028	811	1941
	Intrusion Collisions	0.00861	0.00286	0.00029	359	1502
	Diamond Collisions	0.00364	0.00160	0.00016	608	1250
	Overspeed	0.00873	0.00288	0.00029	4851	6002
	Broken Rail	0.02791	0.00920	0.00092	15510	19190
	Work Zone Violation	0.00000	0.04373	0.00437	0	17494
	Grade Crossing Collisions	0.11578	0.04397	0.00225	8777	19924
	Total, All Scenarios	0.16726	0.10706	0.00856	30917	67302
Total Passenger + Freight		0.90457	4.98656	0.12911	388436	1274434

Table R3d: All Year, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.02205	1.53257	0.05848	66221	394914
	Intrusion Collisions	0.04329	1.16598	0.04139	49775	290536
	Diamond Collisions	0.00123	0.01320	0.00039	463	2962
	Overspeed	0.02709	1.32091	0.02120	105770	301452
	Broken Rail	0.03784	1.84495	0.02961	147732	421046
	Work Zone Violation	0.00000	0.48973	0.04903	0	196054
	Grade Crossing Collisions	2.01600	5.96909	0.08865	578685	1441552
	Total, All Scenarios	2.14750	12.33644	0.28874	948645	3048516
Freight	Train-Train Collisions	0.00538	0.00576	0.00058	1652	3956
	Intrusion Collisions	0.01475	0.00480	0.00048	603	2527
	Diamond Collisions	0.00678	0.00299	0.00030	1134	2331
	Overspeed	0.01496	0.00474	0.00047	8155	10051
	Broken Rail	0.04783	0.01515	0.00151	26073	32132
	Work Zone Violation	0.00000	0.07426	0.00743	0	29702
	Grade Crossing Collisions	0.25526	0.08975	0.00460	17903	40670
	Total, All Scenarios	0.34497	0.19745	0.01537	55521	121369
Total Passenger + Freight		**2.49248**	**12.53388**	**0.30411**	**1004166**	**3169886**

Model Inputs: Base Case II: Northeast Corridor ATC: 85% Preventability

Table IN-1a: Braking Formula Inputs

Train/System Type	Parameter	Value
Freight	Coefficient P	0.035
	Appln Time (secs)	13.8
	Train Weight (lb)	37600000
	Brake Force (lb)	779583
Passenger	Coefficient A	0.666
	Coefficient B	0
	Safety Factor	1.25
Train Control	PTC Timeout (secs)	3
	PTC Latency (secs)	3
	ACS Response (secs)	8
Gutty Train Speed (mph)		35

Table IN-1b: Miscellaneous Inputs

Parameter			Value	Units
Sight Distance			2500	ft
Distribution of train location at time of collision in Reference Case accidents		In Block	0.95	Probability
		Previous Block	0.05	Probability
PTC Risk Increment in Zone C	(PTC Models ONLY)		2	Ratio
Potential danger length in Zone C	(PTC Models ONLY)		2500	ft
Unit Cost Per Casualty		Injury	1000000	Dollars
		Fatality	3000000	Dollars

PTC Timeout and Latency values in Table IN-1a used only for PTC calculations.

Table IN-1c:Traffic and Related Data

Train Type	Average One-Way Trips/Day					
	Joliet Sub-Corridor		Bloomington Sub-Corridor		Springfield Sub-Corridor	
	Summer	Rest of Year	Summer	Rest of Year	Summer	Rest of Year
Passenger	6.00	6.00	6.00	6.00	6.00	6.00
Equipped Freight	1.43	1.43	1.43	2.28	1.73	3.16
Unequipped Freight	0.00	0.00	0.00	0.00	0.00	0.00
Operating Days	91.0	274.0	91.0	274.0	91.0	274.0
Percent Train-Miles in						
Timeout (secs)	0		0		0	
Normal Operating Mode	95.00		95.00		95.00	
Timeout Mode	0.00		0.00		0.00	
Fallback Mode	5.00		5.00		5.00	
Passenger Train Occupancy						
Seats	320		320		320	
Occupancy Factor	0.6		0.6		0.6	

Table IN-2a: Segment Definitions: Joliet Sub-Corridor: MP 62.7 (Mazonia) - MP 88.3 (Bunge)

Segment Number	Start (milepost)	End (milepost)	Type	Variant	Length		Posted Speed (mph)			Representative Speed (mph)				Industry Siding		Passenger Stops
					Miles	Feet	Freight	Pass	HS Pass	Freight	Pass	HS Pass (Consv)*	HS Pass (Other)	Number	Name	
1.0	62.60	64.80	CP-Adjacent (M)		2.20	11616	60.0	79.0	110	50	79	79	105	0		
2.0	64.80	66.55	Plain		1.75	9240	60.0	79.0	110	50	79	79	105	0		
3.0	66.55	68.23	Plain		1.68	8870.4	60.0	79.0	110	50	79	79	105	0		
4.0	68.23	70.17	CP-Adjacent (M)		1.94	10243.2	60.0	79.0	110	50	79	79	105	0		
5.0	70.17	72.80	Siding (M)	De-light (Sdg'd)	2.63	13886.4	60.0	79.0	110	40	60	79	0			
6.0	72.80	72.80	Diamond		0.00	0	40.0	40.0	40	40	40	40	40	0		
7.0	72.80	74.94	CP-Adjacent (M)		2.14	11299.2	60.0	79.0	110	40	60	60	79	0		
8.0	74.94	77.27	Plain		2.33	12302.4	60.0	79.0	110	50	79	79	105	0		
9.0	77.27	80.13	Plain		2.86	15100.8	60.0	79.0	110	50	79	79	105	0		
10.0	80.13	81.99	CP-Adjacent (M)		1.86	9820.8	60.0	79.0	110	50	79	79	105	0		
11.0	81.99	84.65	Siding (M)	Odell (Sdg'd)	2.66	14044.8	60.0	79.0	110	50	79	79	105	0		
12.0	84.65	86.43	CP-Adjacent (M)		1.78	9398.4	60.0	79.0	110	50	79	79	105	0		
13.0	86.43	88.35	Plain		1.92	10137.6	60.0	79.0	110	50	79	79	105	0		
Check Total					25.8											

Table IN-2b: Segment Definitions: Bloomington Sub-Corridor: MP 88.3 (Bunge) - MP 124.9 (Bloomington)

Segment Number	Start (MP)	End (MP)	Type	Variant	Length		Posted Speed (mph)			Representative Speed (mph)				Industry Siding		Passenger Stops
					Miles	Feet	Freight	Pass	HS Pass	Freight	Pass	HS Pass (Consv)*	HS Pass (Other)	Number	Name	
14.0	88.35	90.55	Plain		2.20	11616	60.0	79.0	110	50	79	79	105	1	Bunge	
15.0	90.55	92.47	CP Adjacent (M)		1.92	10137.6	49.0	50.0	50	40	60	60	79	1	Donnley	
16.0	92.47	94.97	Siding (M)	Pontiac (Sdg'd)	2.50	13200	60.0	79.0	110	50	79	79	105	0	Pontiac	
17.0	94.97	96.81	CP Adjacent (M)		1.84	9715.2	60.0	79.0	110	50	79	79	105	0	Occiya	
18.0	96.81	100.28	Plain		3.47	18321.6	60.0	79.0	110	50	79	79	105	0		
19.0	100.28	102.25	CP Adjacent (M)		1.97	10401.6	60.0	79.0	110	40	60	60	79	0		
20.0	102.25	102.25	Diamond		0.00	0	40.0	40.0	40	40	40	40	40	0		
21.0	102.25	104.60	CP Adjacent (M)		2.35	12408	60.0	79.0	110	40	60	60	79	0		
22.0	104.60	106.43	CP Adjacent (M)		1.83	9662.4	60.0	79.0	110	50	79	79	105	0		
23.0	106.43	108.83	Siding (M)	Ballard (Sdg'd)	2.40	12672	60.0	79.0	110	50	79	79	105	0		
24.0	108.83	111.36	CP Adjacent (M)		2.53	13358.4	60.0	79.0	110	50	79	79	105	0		
25.0	111.36	113.30	Plain		1.94	10243.2	60.0	79.0	110	50	79	79	105	0		
26.0	113.30	116.36	Plain		3.06	16156.8	60.0	79.0	110	50	79	79	105	0		
27.0	116.36	118.83	Plain		2.47	13041.6	60.0	79.0	110	50	79	79	105	1	Tow anda	
28.0	118.83	121.40	CP Adjacent (M)		2.57	13569.6	60.0	79.0	110	50	79	79	105	0		
29.0	121.40	123.57	Siding (M)	Bloomington Yard	2.17	11457.6	60.0	79.0	110	40	60	79	79	1	Bloomington	
30.0	123.57	124.38	Siding (M)	Bloomington Yard	0.81	4276.8	25.0	40.0	40	25	40	40	40	1	Bloomington	Bloomington
31.0	124.38	124.86	Siding (M)	Bloomington Yard	0.48	2534.4	25.0	40.0	40	25	40	40	40	1	Bloomington	
Check Total					36.5											

Table IN-2c: Segment Definitions: Springfield Sub-Corridor: MP 124.9 (Bloomington) - MP 181.0 (Ridgely)

Segment Number	Start	End	Type	Variant	Length		Posted Speed (mph)			Representative Speed (mph)				Industry Siding		Passenger Stops
					Miles	Feet	Freight	Pass	HS Pass	Freight	Pass	HS Pass (Consv)*	HS Pass (Other)	Number	Name	
32.0	124.86	126.50	CP-Adjacent (M)		1.6	8659.2	25.0	40.0	40	25	40	40	40	0	Bloom Yard	
33.0	126.50	126.50	Diamond		0.0	0	25.0	40.0	40	25	40	40	40	0		
34.0	126.50	128.76	CP-Adjacent (M)		2.3	11932.8	30.0	50.0	50	25	60	60	79	0		
35.0	128.76	130.96	Plain		2.2	11616	60.0	79.0	90	50	79	79	79	0		
36.0	130.96	133.72	Plain		2.8	14572.8	60.0	79.0	110	50	79	79	105	0		
37.0	133.72	136.90	Plain		3.2	16790.4	60.0	79.0	110	50	79	79	105	0		
38.0	136.90	138.63	CP-Adjacent (M)		1.7	9134.4	60.0	79.0	110	50	79	79	105	0		
39.0	138.63	141.30	Siding (M)	McLean (sig'd)	2.7	14097.6	60.0	79.0	110	50	79	79	105	1	McLean	
40.0	141.30	143.35	CP-Adjacent (M)		2.0	10824	60.0	79.0	110	50	79	79	105	0		
41.0	143.35	148.30	Plain		5.0	26136	60.0	79.0	110	50	79	79	105	2	FTS Fertilizer, Atlanta	
42.0	148.30	150.96	Plain		2.7	14044.8	60.0	79.0	110	50	79	79	105	1	E Lincoln Grain	
43.0	150.96	153.56	CP-Adjacent (U)		2.6	13728	60.0	79.0	110	50	79	79	105	1	Kruger	
44.0	153.56	155.57	Siding (U)	Elkhart (Unsig'd)	2.0	10612.8	60.0	79.0	110	50	60	60	79	0		
45.0	155.57	155.57	Diamond		0.0	0	40.0	40.0	40	40	40	40	40	0		
46.0	155.57	157.26	CP-Adjacent (U)		1.7	8923.2	50.0	70.0	70	50	60	60	79	1	Havana Ind.	Lincoln
47.0	157.26	160.05	Plain		2.8	14713.2	60.0	79.0	90	50	79	79	79	0		
48.0	160.05	162.11	Plain		2.1	10876.8	60.0	79.0	110	50	79	79	105	0		
49.0	162.11	164.04	Plain		1.9	10190.4	60.0	79.0	110	50	79	79	105	0		
50.0	164.04	166.16	Plain		2.1	11193.6	60.0	79.0	110	50	79	79	105	0		
51.0	166.16	168.34	CP-Adjacent (U)		2.2	11510.4	60.0	79.0	110	50	79	79	105	1	Elkhart Grain	
52.0	168.34	170.40	Siding (U)	Elkhart (Unsig'd)	2.1	10876.8	60.0	79.0	110	50	79	79	105	0		
53.0	170.40	172.34	CP-Adjacent (U)		1.9	10243.2	60.0	79.0	110	50	79	79	105	0		
54.0	172.34	175.84	Plain		3.5	18480	60.0	79.0	110	50	79	79	105	0		
55.0	175.84	179.49	Plain		3.7	19272	60.0	79.0	110	50	79	79	79	0		
56.0	179.49	180.99	CP-Adjacent (M)		1.5	7920	60.0	79.0	110	50	79	79	79	0		
Check Total					56.1											

Table IN-3a: Crossing and Diamond Data, Joliet Sub-Corridor

Train Type	Representative Speed (mph)	Type of Grade-crossing	Number Crossings			Number Diamonds
			Passenger	HS Passenger	Freight	
Passenger	40	Public_gates_lights	0	0		1
		Public_other	0	0		
		Private	0	0		
	60	Public_gates_lights	8	0		0
		Public_other	0	0		
		Private	0	0		
	79	Public_gates_lights	20	8		0
		Public_other	0	0		
		Private	1	0		
	105	Public_gates_lights	0	20		0
		Public_other	0	0		
		Private	0	1		
Freight	25	Public_gates_lights			0	0
		Public_other			0	
		Private			0	
	40	Public_gates_lights			8	1
		Public_other			0	
		Private			0	
	50	Public_gates_lights			20	0
		Public_other			0	
		Private			1	
Check Totals			29	29	29	

Table IN-3b: Crossing Data, Bloomington Sub-Corridor

Train Type	Representative Speed (mph)	Type of Grade-crossing	Number Crossings			Number Diamonds
			Passenger	HS Passenger	Freight	
Passenger	40	Public_gates_lights	7	7		
		Public_other				
		Private				
	60	Public_gates_lights	16			
		Public_other				
		Private	1			
	79	Public_gates_lights	16	16		
		Public_other	1			
		Private	6	1		
	105	Public_gates_lights		16		
		Public_other		1		
		Private		6		
Freight	25	Public_gates_lights			7	
		Public_other				
		Private				
	40	Public_gates_lights			16	
		Public_other			1	
		Private				
	50	Public_gates_lights			16	
		Public_other			1	
		Private			6	
Check Totals			47	47	47	

Table IN-3c: Crossing Data, Springfield Sub-Corridor

Train Type	Representative Speed (mph)	Type of Grade-crossing	Number Crossings			Number Diamonds
			Passenger	HS Passenger	Freight	
Passenger	40	Public_gates_lights				
		Public_other				
		Private				
	60	Public_gates_lights	14			
		Public_other				
		Private				
	79	Public_gates_lights	15	16		
		Public_other	5	1		
		Private	5	1		
	105	Public_gates_lights		13		
		Public_other		4		
		Private		4		
Freight	25	Public_gates_lights			3	
		Public_other				
		Private				
	40	Public_gates_lights				
		Public_other				
		Private				
	50	Public_gates_lights			26	
		Public_other			5	
		Private			4	
Check Totals			39	39	39	

Table IN-3d: Grade Crossings Collision Frequency and Consequences

Train Type	Representative Speed (mph)	Type of Grade-crossing	Accident Frequency Per Million Crossing Passes			Crossing Collision Consequences					
						Pass, Occup't Casualty Probs(accident)			Freight Trains (per accident)		
			Passenger	Freight		Injuries	Fatalities	Cost $/Accid't	Injuries	Fatalities	Cost $
Passenger	40	Public_gates_lights	0.350			0.0028	0.000047	50,000			
		Public_other	0.300								
		Private	0.100								
	60	Public_gates_lights	0.600			0.0068	0.000112	113,000			
		Public_other	0.500								
		Private	0.200								
	79	Public_gates_lights	0.800			0.0105	0.000156	196,000			
		Public_other	0.650								
		Private	0.300								
	105	Public_gates_lights	1.100			0.0186	0.000276	346,000			
		Public_other	0.800								
		Private	0.300								
Freight	25	Public_gates_lights		0.150					0.12	0.005	20000
		Public_other		0.120							
		Private		0.050							
	40	Public_gates_lights		0.300					0.25	0.013	50000
		Public_other		0.250							
		Private		0.100							
	50	Public_gates_lights		0.360					0.39	0.02	78000
		Public_other		0.300							
		Private		0.120							

Table IN-4: Consequences Look-up Tables (Data Sources: Previous ICF Passenger Corridor Project (passenger), FRA Accident Data 2001-5 (freight)

Passenger Trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 40 mph			Representative Speed 60 mph			Representative Speed 79 mph			Representative Speed 105 mph		
			Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Pass Loco hits Loco	0.083	0.002	502000	0.139	0.0049	1142000	0.240	0.0085	1976000	0.425	0.0160	3495000
		Pass Loco hits Pass Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.0080	1747000
		Pass Loco hits Frt Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.0080	1747000
		Pass car hit by Loco	0.166	0.005	1005000	0.275	0.0119	2284000	0.476	0.0206	3951000	0.841	0.0320	6989000
	Intrusion Collision (rollout)	Pass Loco hits Car	0.013	0.001	113000	0.031	0.0011	257000	0.054	0.0019	445000	0.096	0.0034	786000
	Intrusion Collision (other))	Pass Loco hits Car	0.026	0.001	226000	0.063	0.0022	514000	0.108	0.0038	889000	0.191	0.0068	1573000
	Overspeed		0.044	0.000	667000	0.140	0.0019	1500000	0.210	0.0034	2600000	0.280	0.0045	4594000
	Broken Rail		0.044	0.000	667000	0.140	0.0019	1500000	0.210	0.0034	2600000	0.280	0.0045	4594000
	Work Zone Violation		0.083	0.008	0	0.125	0.013	0	0.164	0.0164	0	0.218	0.0218	0

Freight trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 25 mph			Representative Speed 40 mph			Representative Speed 50 mph		
			Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Frt Loco hits Loco	0.43	0.043	105000	1.1	0.11	270000	1.7	0.17	422000
		Frt Loco hits Car	0.35	0.035	88000	0.9	0.09	225000	1.4	0.14	352000
		Frt Car hit by Loco	0	0	44000	0	0	112000	0	0	176000
	Intrusion Colln equip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Colln equip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Colln Unequip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Colln Unequip (other	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Overspeed, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Overspeed, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Work Zone Violtn, Equip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0
	Work Zone Violtn, Unequip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0

Casualties and damage in Table IN-4 are per accident, except for Work Zone Violations w hich are per million train-miles

Table IN-5a: Reference Case Collision Accident Frequencies by Sub-Corridor and Season

Train-Train Collision Frequency by Segment Type, Sub Corridor and Season - (Collision Frequency in Collisions per Million Train Miles)

Segment Type	Joliet Sub-Corridor		Bloomington Sub-Corridor		Springfield Sub-Corridor	
	Summer	Rest of Year	Summer	Rest of Year	Summer	Rest of Year
Siding - Monitored	0.030	0.030	0.030	0.030	0.030	0.030
Siding - Unmonitored	0.040	0.040	0.040	0.040	0.040	0.040
CP-Adjacent, Monitored	0.050	0.050	0.050	0.050	0.050	0.050
CP-Adjacent, Unmonitored	0.060	0.060	0.060	0.060	0.060	0.060
Plain Track	0.006	0.006	0.006	0.006	0.006	0.006

Table IN-5b: Collision Distributions Between Head-on and Rear/Side by trains Involved and Segment type

Segment Type	Head-on and Rear/Side Train-Train Collision Distributions by Segment Type						
	Passenger to Passenger		Passenger to Freight			Freight to Freight	
	Head-on	Rear/Side	Head-on	RS F into F	RS F into P	Head-on	Rear/Side
Siding - Monitored	50%	50%	50%	40%	10%	50%	50%
Siding - Unmonitored	50%	50%	50%	40%	10%	50%	50%
CP-Adjacent, Monitored	90%	10%	80%	15%	5%	75%	25%
CP-Adjacent, Unmonitored	90%	10%	80%	15%	5%	75%	25%
Plain Track	80%	20%	70%	25%	5%	50%	50%

Table IN-5c: Reference Case Frequencies for Other Accident Types

Accident Type	All Other Accident Frequencies		
	Units	Frequencies	
		Passenger	Freight
Intrusion Collision (rollout)	Per million train-miles	0.0099	0.0144
Intrusion Collision (other))	Per million train-miles	0.0144	0.0086
Overspeed	Per million train-miles	0.0110	0.0160
Broken Rail	Per million train-miles	0.0167	0.0556
Work Zone Violation	Per million train-miles	See Consequence Table	
Diamonds	Per million diamond passes	0.1000	0.1000

Table IN-5d: Reference Case Collision Distributions by Sub-Corridor and Train Type

Collision Types	Train-Train Collision Distributions by Train Types					
	Joliet Sub-Corridor		Bloomington Sub-Corridor		Springfield Sub-Corridor	
	Summer	Rest of Year	Summer	Rest of Year	Summer	Rest of Year
Passenger-Passenger	0.71	0.71	0.71	0.60	0.80	0.62
Passenger - Equip Freight	0.29	0.29	0.29	0.32	0.20	0.30
Passenger - Unequip Freight	0.00	0.00	0.00	0.00	0.00	0.00
Equip Freight - Equip Freight	0.00	0.00	0.00	0.08	0.00	0.08
Equip Freight - Unequip Freight	0.00	0.00	0.00	0.00	0.00	0.00
Unequip Freight - Unequip Freight	0.00	0.00	0.00	0.00	0.00	0.00
Checking	1.00	1.00	1.00	1.00	1.00	1.00

Note: Since all trains are equipped in Cab Signal and ATC cases, there are no collisions involving unequipped trains.

Table IN-6a: Preventability for Other Accident Types

Accident Type	Preventability Factors - ATC		Prev'ty Factors - PTC Timeout	
	Passenger	Freight	Passenger	Freight
Intrusion Collision (rollout)	0.43	0.43	0.00	0.00
Intrusion Collision (other))	0.12	0.12	0.00	0.00
Overspeed	0.00	0.00	0.90	0.90
Broken Rail	0.08	0.08	0.00	0.00
Work Zone Violation	0.00	0.00	0.90	0.90
Grade Crossings	0.00	0.00	0.00	0.00

Prev'ty factors - PTC Timeout only used w ith PTC cases.

Equipped Train Preventability Values

Collision Type	Preventability
Both TBE	
Pass-Pass	0.85
Pass -TBE Freight	0.85
TBE Freight - TBE Freight	0.85
One TBE	
Pass - NE Freight, Head -On	0.85
Rear/Side, Pass into NE Frt	0.85
Rear/Side NE Frt into Pass	0.85
TBE Freight - NE Freight	0.85

Tables IN-7: Base Consequences Look-up Table (Data Sources: Previous ICF Passenger Corridor Project (passenger), FRA Accident Data 2001-5 (freight)

Passenger Trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 40 mph			Representative Speed 60 mph			Representative Speed 79 mph			Representative Speed 105 mph		
			Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Pass Loco hits Loco	0.083	0.0020	502000	0.139	0.0049	1142000	0.240	0.0085	1976000	0.425	0.0160	3495000
		Pass Loco hits Pass Car	0.034	0.0010	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.0080	1747000
		Pass Loco hits Frt Car	0.034	0.0010	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.0080	1747000
		Pass car hit by Loco	0.166	0.0050	1005000	0.275	0.0119	2284000	0.476	0.0206	3951000	0.841	0.0320	6989000
	Intrusion Collision (rollout)	Pass Loco hits Car	0.013	0.0005	113000	0.031	0.0011	257000	0.054	0.0019	445000	0.096	0.0034	786000
	Intrusion Collision (other))	Pass Loco hits Car	0.026	0.0009	226000	0.063	0.0022	514000	0.108	0.0038	889000	0.191	0.0068	1573000
	Overspeed		0.044	0.0004	667000	0.140	0.0019	1500000	0.210	0.0034	2600000	0.280	0.0045	4594000

Consequence Adjustment Factors by Representative Speed				
40 mph	60 mph	79 mph	105 mph	
1.00	1.00	1.00	1.00	
1.00	1.00	1.00	1.00	
1.00	1.00	1.00	1.00	
1.00	1.00	1.00	1.00	
1.00	1.00	1.00	1.00	
1.00	1.00	1.00	1.00	
1.00	1.00	1.00	1.00	

	Broken Rail		0.044	0.0004	667000	0.140	0.0019	1500000	0.210	0.0034	2600000	0.280	0.0045	4594000	1.00	1.00	1.00	1.00
	Work Zone Violation		0.083	0.0083	0	0.125	0.0125	0	0.164	0.0164	0	0.218	0.0218	0	1.00	1.00	1.00	1.00

Freight trains	Accident Scenario	Accident	Representative Speed 25 mph			Representative Speed 40 mph			Representative Speed 50 mph		
		Sub-scenarios	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Frt Loco hits Loco	0.43	0.043	105000	1.1	0.11	270000	1.7	0.17	422000
		Frt Loco hits Car	0.35	0.035	88000	0.9	0.09	225000	1.4	0.14	352000
		Frt Car hit by Loco	0	0	44000	0	0	112000	0	0	176000
	Intrusion Colln equip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Colln equip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Colln Unequip (rollou	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Colln Unequip (other	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Overspeed, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Overspeed, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Work Zone Violn, Equip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0
	Work Zone Violn, Unequip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0

Casualties and damage in Table IN-7 are per accident, except for Work Zone Violations w hich are per million train-miles.

Consequence Adjustment Factors by Representative Speed			
25 m ph	40 m ph	50 m ph	
1.00	1.00	1.00	1.00
1.00	1.00	1.00	1.00
1.00	1.00	1.00	1.00
1.00	1.00	1.00	1.00
1.00	1.00	1.00	1.00
1.00	1.00	1.00	1.00
1.00	1.00	1.00	1.00
1.00	1.00	1.00	1.00
1.00	1.00	1.00	1.00
1.00	1.00	1.00	1.00
1.00	1.00	1.00	1.00

Tables IN-8: Adjusted Consequences Look-up Table (Data Sources: Previous ICF Passenger Corridor Project (passenger), FRA Accident Data 2001-5 (freight)

Passenger Trains	Accident Scenario	Accident	Representative Speed 40 mph			Representative Speed 60 mph			Representative Speed 79 mph			Representative Speed 105 mph		
		Sub-scenarios	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Pass Loco hits Loco	0.083	0.0020	502000	0.139	0.0049	1142000	0.240	0.0085	1976000	0.425	0.0160	3495000
		Pass Loco hits Pass Car	0.034	0.0010	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.0080	1747000
		Pass Loco hits Frt Car	0.034	0.0010	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.0080	1747000
		Pass car hit by Loco	0.166	0.0050	1005000	0.275	0.0119	2284000	0.476	0.0206	3951000	0.841	0.0320	6989000
	Intrusion Collision (rollout)	Pass Loco hits Car	0.013	0.0005	113000	0.031	0.0011	257000	0.054	0.0019	445000	0.096	0.0034	786000
	Intrusion Collision (other))	Pass Loco hits Car	0.026	0.0009	236000	0.063	0.0022	514000	0.108	0.0038	889000	0.191	0.0068	1573000
	Overspeed		0.044	0.0004	667000	0.140	0.0019	1500000	0.210	0.0034	2600000	0.280	0.0045	4594000
	Broken Rail		0.044	0.0004	667000	0.140	0.0019	1500000	0.210	0.0034	2600000	0.280	0.0045	4594000
	Work Zone Violation		0.083	0.0083	0	0.125	0.0125	0	0.164	0.0164	0	0.218	0.0218	0

Freight trains	Accident Scenario	Accident	Representative Speed 25 mph			Representative Speed 40 mph			Representative Speed 50 mph		
		Sub-scenarios	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Frt Loco hits Loco	0.43	0.043	105000	1.1	0.11	270000	1.7	0.17	422000
		Frt Loco hits Car	0.35	0.035	88000	0.9	0.09	225000	1.4	0.14	352000
		Frt Car hit by Loco	0	0	44000	0	0	112000	0	0	176000
	Intrusion Colln equip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Colln equip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Colln Unequip (rollou	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Colln Unequip (other	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Overspeed, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Overspeed, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Work Zone Violn, Equip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0
	Work Zone Violn, Unequip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0

Casualties and damage in Table IN-8 are per accident, except for Work Zone Violations w hich are per million train-miles

Inputs

Worksheet 1-JN: IDOT Risk Model: Braking Distances and Collision Zone Calculations, Base Case II: Northeast Corridor ATC, 85% Preventability, Joliet Sub-corridor

Table 1.1: Stopping Distance Parameters and Calculations, Including Timeout and ACS Response Delay

Braking Formula Inputs				Braking Distance Calculations (including free running in TO) (ft)					Braking Duration (secs)		Guilty Train Distance (ft)		Total Zone Lengths (ft)		
Train/System Type	Parameter	Value		Train Type	Speeds (mph)	To Stop	Reduction to RedCon*	RedCon* to Stop	Deceleration (ft/sec²)	Reduction to RedCon*	RedCon* to Stop	Reduction to RedCon*	RedCon* to Stop	Reduction to RedCon*	RedCon* to Stop	Full Speed to Stop
Freight	Coefficient P	0.035		Freight	25	1671	1671	0	0.668	58	0	1275	0	2946	0	2946
	Appl'n Time (secs)	13.8			40	3686	1619	2068	0.668	14	77	308	1692	1927	3760	5686
	Train Weight (lb)	37600000			50	5452	3384	2068	0.668	36	77	791	1692	4176	3760	7935
	Brake Force (lb)	779683		Passenger	40	1452	1452	0	1.293	48	0	1065	0	2517	0	2517
Passenger	Coefficient A	0.666			60	3177	3177	0	1.293	71	0	1565	0	4742	0	4742
	Coefficient B	0			79	5433	3035	2398	1.293	25	68	541	1499	3576	3896	7472
	Safety Factor	1.25			105	9493	7096	2398	1.293	54	68	1190	1499	8286	3896	12182
Train Control	Latency/T-out (sec)	3		Frt Red'd Consq	35	1125	NA	NA	1.293							
	ACS Response (sec	0														
Guilty Train Speed (mph)		15														

Blue cells contain data imported from the Inputs worksheet

Sight Distance (ft): 2500

*Note: RedCon refers to the speed at which collision consequences will be significantly reduced
60 mph for passenger trains and 35 mph for freight trains
If train speed is lower that this speed, then there are no reduced consequences and Zone A2 has zero length

Table 1.2: Segment Definitions: Sub-Corridor 1: MP 62.7 (Manzonia) - MP 88.3 (Bunge)

Segment Number	Start (milepost)	End (milepost)	Type	Variant	Length Miles	Length Feet	Posted Speed (mph) Freight	Posted Speed (mph) Pass	Posted Speed (mph) HS Pass	Representative Speed (mph) Freight	Representative Speed (mph) Pass	Representative Speed (mph) HS Pass (Consq*)	Representative Speed (mph) HS Pass (Other)	Industry Siding Number	Industry Siding Name	Passenger Stops
1.0	62.6	64.8	CP Adjacent (M)		2.2	11616	60	79	110	50	79	79	105	0		
2.0	64.8	66.6	Plain		1.8	9240	60	79	110	50	79	79	105	0		
3.0	66.6	68.2	Plain		1.7	8970.4	60	79	110	50	79	79	105	0		
4.0	68.2	70.2	CP Adjacent (M)		1.9	10243.2	60	79	110	50	79	79	105	0		
5.0	70.2	72.8	Siding (M)	Dwight (sg/g)	2.6	13886.4	60	79	110	40	60	60	79	0		
6.0	72.8	72.8	Diamond		0.0	0	40	40	40	40	40	40	40	0		
7.0	72.8	74.9	CP Adjacent (M)		2.1	11299.2	60	79	110	40	60	60	79	0		
8.0	74.9	77.3	Plain		2.3	12302.4	60	79	110	50	79	79	105	0		
9.0	77.3	80.1	Plain		2.9	15100.8	60	79	110	50	79	79	105	0		
10.0	80.1	82.0	CP Adjacent (M)		1.9	9820.8	60	79	110	50	79	79	105	0		
11.0	82.0	84.7	Siding (M)	Odell (Sq/dt)	2.7	14044.8	60	79	110	50	79	79	105	0		
12.0	84.7	86.4	CP Adjacent (M)		1.8	9398.4	60	79	110	50	79	79	105	0		
13.0	86.4	88.4	Plain		1.9	10137.6	60	79	110	50	79	79	105	0		

Check Total: 25.8

Table 1.3: Mitigation and Prevention Zones - All Segments - Lengths in Feet)

Zone A1: Limited Speed Reduction No Prevention or Mitigation			Zone A2: Reduced Speed to Stop Severity Mitigation			Zone B: Able to Stop Full Prevention			Overlap of Stopping Distance into Zone C			Distance in Timeout in Zone C			Overlap of Zone A1 into Zone C			Overlap of Zone A1 Into Zone C within Sight Distance			Overlap of Zone A2 into Zone C within Sight Distance		
Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass
4176	3576	8286	3760	3896	3330	3681	4144	0	0	0	566	0	0	462	0	0	0	0	0	0	0	0	566
4176	3576	8286	3896	3896	954	1168	1768	0	0	0	462	0	0	0	0	0	0	0	0	0	0	0	2500
4176	3576	8286	3896	3896	585	799	1399	0	0	0	3311	0	0	462	0	0	0	0	0	0	0	0	2500
4176	3576	8286	3896	3896	1958	2172	2772	0	0	0	1939	0	0	462	0	0	0	0	0	0	0	0	1939
1927	4742	3576	0	0	3896	11960	9145	6415	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1927	4742	3576	0	0	3896	9373	6558	3828	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	8286	3896	3896	3896	4231	4831	121	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	8286	3896	3896	3896	7029	7629	2919	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	8286	3896	3896	1535	1749	2349	0	0	0	2361	0	0	462	0	0	0	0	0	0	0	0	2361
4176	3576	8286	3896	3896	3896	5973	6573	1863	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	8286	3896	3896	1113	1327	1927	0	0	0	2783	0	0	462	0	0	0	0	0	0	0	0	2500
4176	3576	8286	3896	3896	1852	2066	2666	0	0	0	2044	0	0	462	0	0	0	0	0	0	0	0	2044

Table 1.4: Breakdown of Segments Lengths by Representative Speed (miles)

Segment Number	Freight Speeds (mph) 25	40	50	Convent'l Pass Speeds (mph) 40	60	79	HS Pass. Speeds - Coll'n Conseq. (mph) 40	60	79	105	HS Pass. Speeds - Other (mph) 40	60	79	105
1.0	0	0	2.2	0	0	2.2	0	0	2.2	0	0	0	0	2.2
2.0	0	0	1.75	0	0	1.75	0	0	1.75	0	0	0	0	1.75
3.0	0	0	1.68	0	0	1.68	0	0	1.68	0	0	0	0	1.68
4.0	0	0	1.94	0	0	1.94	0	0	1.94	0	0	0	0	1.94
5.0	0	2.63	0	0	2.63	0	0	2.63	0	0	0	0	2.63	0
6.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.0	0	2.14	0	0	2.14	0	0	2.14	0	0	0	0	2.14	0
8.0	0	0	2.33	0	0	2.33	0	0	2.33	0	0	0	0	2.33
9.0	0	0	2.86	0	0	2.86	0	0	2.86	0	0	0	0	2.86
10.0	0	0	1.86	0	0	1.86	0	0	1.86	0	0	0	0	1.86
11.0	0	0	2.66	0	0	2.66	0	0	2.66	0	0	0	0	2.66
12.0	0	0	1.78	0	0	1.78	0	0	1.78	0	0	0	0	1.78
13.0	0	0	1.92	0	0	1.92	0	0	1.92	0	0	0	0	1.92

Table 1.5: Aggregate Segment Length by Segment Type and Speed

Segment Type	Train Type	Representative Speed (mph)	Aggregate Length of Segments by Train and Segment Types: Freight Miles	Freight Feet	Conv passenger Miles	Conv passenger Feet	High Speed Passenger Collision Consq* Miles	High Speed Passenger Collision Consq* Feet	High Speed Passenger Other Miles	High Speed Passenger Other Feet
Siding (mon)	Freight	25	0.0	0						
		40	2.6	13886.4						
		50	2.7	14044.8						
	Passenger	40			0.0	0	0.0	0	0.0	0
		60			2.6	13886.4	2.6	13886.4	0.0	0
		79			2.7	14044.8	2.7	14044.8	2.6	13886.4
		105					0.0	0	2.7	14044.8
Siding (unmon)	Freight	25	0.0	0						
		40	0.0	0						
		50	0.0	0						
	Passenger	40			0.0	0	0.0	0	0.0	0
		60			0.0	0	0.0	0	0.0	0
		79			0.0	0	0.0	0	0.0	0
		105					0.0	0	0.0	0
CP Adjacent (mon)	Freight	25	0.0	0						
		40	2.1	11299.2						
		50	7.8	41078.4						
	Passenger	40			0.0	0	0.0	0	0.0	0
		60			2.1	11299.2	2.1	11299.2	0.0	0
		79			7.8	41078.4	7.8	41078.4	2.1	11299.2
		105					0.0	0	7.8	41078.4
CP Adjacent (unmon)	Freight	25	0.0	0						
		40	0.0	0						
		50	0.0	0						
	Passenger	40			0.0	0	0.0	0	0.0	0
		60			0.0	0	0.0	0	0.0	0
		79			0.0	0	0.0	0	0.0	0
		105					0.0	0	0.0	0
Plain Track	Freight	25	0.0	0						
		40	0.0	0						
		50	10.5	55651.2						
	Passenger	40			0.0	0	0.0	0	0.0	0
		60			0.0	0	0.0	0	0.0	0
		79			10.5	55651.2	10.5	55651.2	0.0	0
		105					0.0	0	10.5	55651.2
Check Total			25.8		25.8		25.8		25.8	

*This speed is used to calculate collision consequences in collisions between an equipped and an unequipped train ONLY, reflecting the IDOT PTC speed restriction when an equipped train nears an unequipped train

Yellow cells contain data exported to the next sec/sheet in the sequence of three sheets that perform the calculations for one sub-corridor, season and operating state

Table 1.6a: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for Siding (M) Segments

Lengths in Zone C	A1	A2	B
Total Length, Siding (M) Segments (ft)	27931.2		
Number Siding (M) Segments	2		
Average distance in Zone C (ft) Freight	0	0	2500
Passenger	0	0	2500
HS Pass	0	0	2500

	Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass
Sum Zone Lengths A1, A2, B (ft)	6102	8317	11861	3896	3896	7792	17933	15718	8278
Fraction of total length in zone	0.218	0.298	0.425	0.139	0.139	0.279	0.642	0.563	0.296
Collision Accident Mitigation Probabilities: Combined All Zones.	0.208	0.283	0.403	0.133	0.133	0.265	0.710	0.635	0.382

Values transferred to Collision Matrix

Distribution of train location at time of	In Block	0.95
violation in Reference Case accidents	Previous Block	0.05
PTC Risk Increment in Zone C		2
Potential danger length in Zone C (ft)		2500

Table 1.6b: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for Siding (U) Segments

Lengths in Zone C	A1	A2	B
Total Length, Siding (U) Segments (ft)	1		
Number Siding (M) Segments	0.001		
Average distance in Zone C (ft) Freight	0	0	2500
Passenger	0	0	2500
HS Pass	0	0	2500

	Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass
Zone lengths A1, A2, B (ft)	0	0	0	0	0	0	0	0	0
Fraction of total length in zone	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Collision Accident Mitigation Probabilities: Combined All Zones.	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100

Values transferred to Collision Matrix

Distribution of train location at time of	In Block	0.95
violation in Reference Case accidents	Previous Block	0.05
PTC Risk Increment in Zone C		2
Potential danger length in Zone C (ft)		2500

Table 1.6c: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for CP Adjacent (M) Segments

Lengths in Zone C	A1	A2	B
Total Length, CP Adjacent (M) Segments (ft)	52377.6		
Number CP Adjacent Segments	5		
Average distance in Zone C (ft) Freight	0	0	2500
Passenger	0	0	2500
HS Pass	0	1473	1027

	Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass
Zone lengths A1, A2, B (ft)	18629	19044	36718	15448	15584	11832	18301	17749	3828
Fraction of total length in zone	0.356	0.364	0.701	0.295	0.298	0.226	0.349	0.339	0.073
Collision Accident Mitigation Probabilities: Combined All Zones.	0.338	0.345	0.666	0.280	0.283	0.274	0.432	0.422	0.111

Values transferred to Collision Matrix

Distribution of train location at time of	In Block	0.95
violation in Reference Case accidents	Previous Block	0.05
PTC Risk Increment in Zone C		2
Potential danger length in Zone C (ft)		2500

Table 1.6d: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for CP Adjacent (U)Segments

Lengths in Zone C	A1	A2	B
Total Length, CP Adjacent (U) Segments (ft)	1		
Number CP Adjacent Segments	0.001		
Average distance in Zone C (ft) Freight	0	0	2500
Passenger	0	0	2500
HS Pass	0	0	2500

	Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass
Zone lengths A1, A2, B (ft)	0	0	0	0	0	0	0	0	0
Fraction of total length in zone	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Collision Accident Mitigation Probabilities: Combined All Zones.	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100

Values transferred to Collision Matrix

Distribution of train location at time of	In Block	0.95
violation in Reference Case accidents	Previous Block	0.05
PTC Risk Increment in Zone C		2
Potential danger length in Zone C (ft)		2500

Table 1.6e: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for Plain Track Segments

Lengths in Zone C	A1	A2	B
Total Length, Plain Track Segments (ft)	55651.2		
Number CP Adjacent Segments	5		

	Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass

| | | |

Worksheet 3 - J,N,R: - Risk Calculations - Base Case II: Northeast Corridor ATC, 85% Preventability, Joliet Subcorridor, Rest of Year

Table 3.1: Consequences Look-up Tables (Data Sources: Previous ICF Passenger Corridor Project (passenger), FRA Accident Data 2001-5 (freight)

Passenger Trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 40 mph			Representative Speed 60 mph			Representative Speed 79 mph			Representative Speed 105 mph		
			Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Pass Loco hits Loco	0.083	0.002	502000	0.139	0.0049	1142000	0.24	0.0085	1976000	0.425	0.016	3495000
		Pass Loco hits Pass Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.008	1747000
		Pass Loco hits Frt Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.008	1747000
		Pass car hit by Loco	0.166	0.005	1005000	0.275	0.0119	2284000	0.476	0.0206	3951000	0.841	0.032	6989000
	Intrusion Collision (rollout)	Pass Loco hits Car	0.013	0.0005	113000	0.031	0.0011	257000	0.054	0.0019	445000	0.096	0.0034	786000
	Intrusion Collision (other))	Pass Loco hits Car	0.026	0.0009	226000	0.063	0.0022	514000	0.108	0.0038	889000	0.191	0.0068	1573000
	Overspeed		0.044	0.0004	667000	0.14	0.00186	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Broken Rail		0.044	0.0004	667000	0.14	0.00186	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Work Zone Violation		0.083	0.0083	0	0.125	0.0125	0	0.164	0.0164	0	0.218	0.0218	0

Freight trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 25 mph			Representative Speed 40 mph			Representative Speed 50 mph		
			Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Frt Loco hits Loco	0.43	0.043	105000	1.1	0.11	270000	1.7	0.17	422000
		Frt Loco hits Car	0.35	0.035	88000	0.9	0.09	225000	1.4	0.14	352000
		Frt car hit by Loco	0	0	44000	0	0	112000	0	0	176000
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Overspeed, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Overspeed, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Work Zone Viol'n, Equip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0
	Work Zone Viol'n, Unequip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0

Casualties and damage in Table 3.1 are per accident, except for Work Zone Violations which are per million train-miles

Table 3.2: Grade Crossing and Diamonds: Numbers by Representative Speed, and Accident Frequency and Consequences

Train Type	Representative Speed (mph)	Type of Grade-crossing	Number Crossings			Accident Frequency Per Million Crossing Passes		Crossing Collision Consequences						Number Diamonds
								Pass. Occup't Casualty Prob/accident)			Freight Trains (per accident)			
			Passenger	HS Passenger	Freight	Passenger	Freight	Injuries	Fatalities	Cost $/Accid't	Injuries	Fatalities	Cost $	
Passenger	40	Public_gates_lights	0	0		0.350		0.0028	0.000047	50000				1
		Public_other	0	0		0.300								
		Private	0	0		0.100								
	60	Public_gates_lights	8	0		0.600		0.0068	0.000112	113000				0
		Public_other	0	0		0.500								
		Private	0	0		0.200								
	79	Public_gates_lights	20	8		0.800		0.0105	0.000156	196000				0
		Public_other	0	0		0.650								
		Private	1	0		0.300								
	105	Public_gates_lights	0	20		1.100		0.0186	0.000276	346000				0
		Public_other	0	0		0.800								
		Private	0	1		0.300								
Freight	25	Public_gates_lights			0		0.150				0.12	0.005	20000	0
		Public_other			0		0.120							
		Private			0		0.050							
	40	Public_gates_lights			8		0.300				0.25	0.013	50000	1
		Public_other			0		0.250							
		Private			0		0.100							
	50	Public_gates_lights			20		0.360				0.39	0.02	78000	0
		Public_other			0		0.300							
		Private			1		0.120							

Table 3.4: Collision Frequencies by Segment Type and Collision Scenario (From Coll Matrix)

Scenarios	Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain	Diamond
Pass Loco Hits Loco	0.0038	0.0051	0.0100	0.0121	0.0010	0.000000
Pass Loco Hits Pass Car	0.0016	0.0021	0.0011	0.0013	0.0002	0.000000
Pass Loco Hits Freight Car	0.0005	0.0007	0.0005	0.0006	0.0001	0.008492
Pass Car Hit by Loco	0.0017	0.0023	0.0012	0.0015	0.0002	0.001698
Freight Loco Hits Loco	0.0007	0.0009	0.0015	0.0018	0.0001	0.000000
Freight Loco Hits Car	0.0001	0.0002	0.0002	0.0002	0.0000	0.028479
Freight Car Hit By Loco	0.0005	0.0007	0.0005	0.0006	0.0001	0.029273

Collision Frequencies for Passenger + Unequipped Freight Train

Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain
0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000

Mauve cells contain data imported from previous worksheet in a group of three worksheets covering one sub-corridor, season and operating state.

All train-to-train collision frequencies are in units of **trains in collisions per million train-miles operated in the sub-corridor by all train types.**

Table 3.3a: Segment Data (for reference only, not used in calculations)

Segment Number	Start (Milepost)	End (Milepost)	Type	Length (miles)	Representative Speed (mph)			
					Freight	Pass	HS Pass-Cons	HS Pass
1.0	62.60	64.80	CP Adjacent (M	2.20	50	79	79	105
2.0	64.80	66.55	Plain	1.75	50	79	79	105
3.0	66.55	68.23	Plain	1.68	50	79	79	105
4.0	68.23	70.17	CP Adjacent (M	1.94	50	79	79	105
5.0	70.17	72.80	Siding (M)	2.63	40	60	60	79
6.0	72.80	72.80	Diamond	0.00	40	40	40	40
7.0	72.80	74.94	CP Adjacent (M	2.14	40	60	60	79
8.0	74.94	77.27	Plain	2.33	50	79	79	105
9.0	77.27	80.13	Plain	2.86	50	79	79	105
10.0	80.13	81.99	CP Adjacent (M	1.86	50	79	79	105
11.0	81.99	84.65	Siding (M)	2.66	50	79	79	105
12.0	84.65	86.43	CP Adjacent (M	1.78	50	79	79	105
13.0	86.43	88.35	Plain	1.92	50	79	79	105
	Length Check	-64.8		25.8				

Table 3.3b: Aggregate Segment Data: SegmentsTypes, Train Types, Speeds, and Lengths (miles)

Segment Type	Train Type	Represent've Speed (mph)	Freight (miles)	Reg Pass (miles)	HS Pass Collision (mi)	HS Pass Other (mi)
Siding (mon)	Freight	25	0.00			
		40	2.63			
		50	2.66			
	Passenger	40		0.00	0.00	0.00
		60		2.63	2.63	0.00
		79		2.66	2.66	2.63
		105		0.00	0.00	2.66
Siding (unmon)	Freight	25	0.00			
		40	0.00			
		50	0.00			
	Passenger	40		0.00	0.00	0.00
		60		0.00	0.00	0.00
		79		0.00	0.00	0.00
		105		0.00	0.00	0.00
CP Adjacent (mon)	Freight	25	0.00			
		40	2.14			
		50	7.78			
	Passenger	40		0.00	0.00	0.00
		60		2.14	2.14	0.00
		79		7.78	7.78	2.14
		105		0.00	0.00	7.78
CP Adjacent (unmon)	Freight	25	0.00			
		40	0.00			
		50	0.00			
	Passenger	40		0.00	0.00	0.00
		60		0.00	0.00	0.00
		79		0.00	0.00	0.00
		105		0.00	0.00	0.00
Plain Track	Freight	25	0.00			
		40	0.00			
		50	10.54			
	Passenger	40		0.00	0.00	0.00
		60		0.00	0.00	0.00
		79		10.54	10.54	0.00
		105		0.00	0.00	10.54
Totals All Types	Freight	25	0.00			
		40	4.77			
		50	20.98			
	Passenger	40		0.00	0.00	0.00
		60		4.77	4.77	0.00
		79		20.98	20.98	4.77
		105		0.00	0.00	20.98
	Checking Total		25.75	25.75	25.75	25.75

Weighted Collision Accident Frequencies by Representative Speed (mph)

Scenarios	Freight			Passenger			
	25	40	50	40	60	79	105
Pass Loco Hits Loco				0.0000	0.0000	0.0066	0.0047
Pass Loco Hits Pass Car				0.0000	0.0000	0.0014	0.0007
Pass Loco Hits Freight Car				0.0000	0.0000	0.0005	0.0003
Pass Car Hit by Loco				0.0000	0.0000	0.0015	0.0008
Freight Loco Hits Loco	0.0000	0.0010	0.0007				
Freight Loco Hits Car	0.0000	0.0001	0.0001				
Freight Car Hit By Loco	0.0000	0.0005	0.0003				

Table 3.4a: Traffic Inputs to Risk Calculation

Trips/Day		
Train Type	Summer	Rest of Year
Passenger	6.00	6.00
Equipped Freight	1.43	1.43
Unequipped Freight	0.00	0.00
Operating Days	91.00	274.00

Percent Train-Miles in	
Timeout (secs)	0
Normal Operating Mode	95.00
Timeout Mode	0.00
Fallback Mode	5

Passenger Train Occupancy	
Seats	320
Occupancy Factor	0.6

Table 3.5a: Risk Calculation - Passenger Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Table 3.5b: Risk Calculation - Collisions at Diamonds - Passenger

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Freq'y (per mill. t-m)	Preventability	Adjusted Frequency	Trips/day	Trips per 10 years	Length of Track (miles)	Train-miles per 10 years	Accidents per 10 years	Number seats per train	Occupancy Factor	Passengers per train	Injuries per 10 years	Fatalities per 10 years	Damage $ per 10 years
40	Train-Train Collision	Pass Loco hits Loco	0.00000	Incl	0.00000	7.43	25764	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Pass Car	0.00000	Incl	0.00000	7.43	25764	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Frt Car	0.00000	Incl	0.00000	7.43	25764	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00000	Incl	0.00000	7.43	25764	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	20805	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (other))	Pass Loco hits intruder	0.01440	0.12	0.01267	6.00	20805	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Overspeed		0.01100	0.00	0.01100	6.00	20805	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Broken Rail		0.01670	0.08	0.01536	6.00	20805	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Work Zone Violation			0.00		6.00	20805	0	0					0.0000	0.00000	0
										0.00000				**0.00000**	**0.00000**	**0**
60	Train-Train Collision	Pass Loco hits Loco	0.00000	Incl	0.00000	7.43	25764	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Pass Car	0.00000	Incl	0.00000	7.43	25764	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Frt Car	0.00000	Incl	0.00000	7.43	25764	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00000	Incl	0.00000	7.43	25764	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	20805	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.12	0.01267	6.00	20805	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Overspeed		0.01100	0.00	0.01100	6.00	20805	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Broken Rail		0.01670	0.08	0.01536	6.00	20805	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Work Zone Violation			0.00		6.00	20805	0	0					0.0000	0.00000	0
										0.00000				**0.00000**	**0.00000**	**0**
79	Train-Train Collision	Pass Loco hits Loco	0.00663	Incl	0.00663	7.43	25764	4.77	122892	0.00081	320	0.6	192	0.038	0.0013	1609
		Pass Loco hits Pass Car	0.00136	Incl	0.00136	7.43	25764	4.77	122892	0.00017	320	0.6	192	0.003	0.0001	165
		Pass Loco hits Frt Car	0.00051	Incl	0.00051	7.43	25764	4.77	122892	0.00006	320	0.6	192	0.001	0.0001	62
		Pass car hit by Loco	0.00150	Incl	0.00150	7.43	25764	4.77	122892	0.00018	320	0.6	192	0.017	0.0007	730
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	20805	4.77	99240	0.00049	320	0.6	192	0.005	0.0002	216
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.12	0.01267	6.00	20805	4.77	99240	0.00126	320	0.6	192	0.026	0.0009	1118
	Overspeed		0.01100	0.00	0.01100	6.00	20805	4.77	99240	0.00109	320	0.6	192	0.044	0.0007	2838
	Broken Rail		0.01670	0.08	0.01536	6.00	20805	4.77	99240	0.00152	320	0.6	192	0.061	0.0010	3964
	Work Zone Violation			0.00		6.00	20805	4.77	99240					0.016	0.0016	0
										0.00559				**0.21156**	**0.00668**	**10702**
105	Train-Train Collision	Pass Loco hits Loco	0.00471	Incl	0.00471	7.43	25764	20.98	540519	0.00255	320	0.6	192	0.208	0.0078	8904
		Pass Loco hits Pass Car	0.00069	Incl	0.00069	7.43	25764	20.98	540519	0.00037	320	0.6	192	0.012	0.0006	655
		Pass Loco hits Frt Car	0.00031	Incl	0.00031	7.43	25764	20.98	540519	0.00017	320	0.6	192	0.006	0.0003	296
		Pass car hit by Loco	0.00078	Incl	0.00078	7.43	25764	20.98	540519	0.00042	320	0.6	192	0.068	0.0026	2961
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	20805	20.98	436489	0.00214	320	0.6	192	0.039	0.0014	1682
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.12	0.01267	6.00	20805	20.98	436489	0.00553	320	0.6	192	0.203	0.0072	8701
	Overspeed		0.01100	0.00	0.01100	6.00	20805	20.98	436489	0.00480	320	0.6	192	0.258	0.0041	22058
	Broken Rail		0.01670	0.08	0.01536	6.00	20805	20.98	436489	0.00671	320	0.6	192	0.361	0.0058	30808
	Work Zone Violation			0.00		6.00	20805	20.98	436489					0.095	0.0095	0
	Total									**0.02269**				**1.25026**	**0.03934**	**76065**
	Overall Totals									**0.02828**				**1.46183**	**0.04602**	**86767**
	Totals All Speeds	**Train-train Collisions**								**0.00474**				**0.35286**	**0.01352**	**15382**
		Intrusion Collisions								**0.00941**				**0.27340**	**0.00971**	**11717**
		Overspeed								**0.00589**				**0.30214**	**0.00486**	**24896**
		Broken Rail								**0.00823**				**0.42200**	**0.00678**	**34773**
		Work Zone Violation								**0.00000**				**0.11143**	**0.01114**	**0**

Number Diamonds	Freq'y per mill passes	Collisions (millions)	Injuries	Fatalities	Damage
1	0.000000	0.000000	0.000000	0.000000	0.00
1	0.000000	0.000000	0.000000	0.000000	0.00
1	0.008492	0.000219	0.001428	0.000042	54.91
1	0.001698	0.000044	0.001395	0.000042	43.97
		0.000263	**0.002823**	**0.000084**	**98.89**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.008492	0.000000	0.000000	0.000000	0.00
0	0.001698	0.000000	0.000000	0.000000	0.00
		0.000000	**0.00000**	**0.00000**	**0.00

Table 3.7: Risk Calculations: Passenger and Freight Trains; Grade Crossings

Train Type	Representative Speed	Type of Grade-crossing	Base Collision Frequency	Preventability Factor	Adjusted Collision Frequency	Trips per Day	Crossing Passes per Trip	Crossing Passes per 10 Years	Collisions per 10 Years	Seats per Train (Passenger)	Occupancy Factor	Passengers per Train	Passenger/ Crew Injuries per 10 Years	Passenger/ Crew Fatalities per 10 Years	Damage per 10 Years ($)
Passenger	40	Public_gates_lights	0.35	0%	0.350	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Public_other	0.30	0%	0.300	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Private	0.10	0%	0.100	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
	60	Public_gates_lights	0.60	0%	0.600	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Public_other	0.50	0%	0.500	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Private	0.20	0%	0.200	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
	79	Public_gates_lights	0.80	0%	0.800	6.00	8	166440	0.133	320	0.60	192	0.2684	0.0040	26098
		Public_other	0.65	0%	0.650	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Private	0.30	0%	0.300	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
	105	Public_gates_lights	1.10	0%	1.100	6.00	20	416100	0.458	320	0.60	192	1.6346	0.0243	158368
		Public_other	0.80	0%	0.800	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Private	0.30	0%	0.300	6.00	1	20805	0.006	320	0.60	192	0.0223	0.0003	2160
Freight	25	Public_gates_lights	0.15	0%	0.150	1.43	0	0	0.000				0.00000	0.00000	0
Equipped		Public_other	0.12	0%	0.120	1.43	0	0	0.000				0.00000	0.00000	0
		Private	0.05	0%	0.050	1.43	0	0	0.000				0.00000	0.00000	0
	40	Public_gates_lights	0.30	0%	0.300	1.43	8	39668.2	0.012				0.00298	0.00015	595
		Public_other	0.25	0%	0.250	1.43	0	0	0.000				0.00000	0.00000	0
		Private	0.10	0%	0.100	1.43	0	0	0.000				0.00000	0.00000	0
	50	Public_gates_lights	0.36	0%	0.360	1.43	20	99170.5	0.036				0.01392	0.00071	2785
		Public_other	0.30	0%	0.300	1.43	0	0	0.000				0.00000	0.00000	0
		Private	0.12	0%	0.120	1.43	1	4958.525	0.001				0.00023	0.00001	46
Freight	25	Public_gates_lights	0.15	0%	0.150	0.00	0	0	0.000				0.00000	0.00000	0
Unequipped		Public_other	0.12	0%	0.120	0.00	0	0	0.000				0.00000	0.00000	0
		Private	0.05	0%	0.050	0.00	0	0	0.000				0.00000	0.00000	0
	40	Public_gates_lights	0.30	0%	0.300	0.00	8	0	0.000				0.00000	0.00000	0
		Public_other	0.25	0%	0.250	0.00	0	0	0.000				0.00000	0.00000	0
		Private	0.10	0%	0.100	0.00	0	0	0.000				0.00000	0.00000	0
	50	Public_gates_lights	0.36	0%	0.360	0.00	20	0	0.000				0.00000	0.00000	0
		Public_other	0.30	0%	0.300	0.00	0	0	0.000				0.00000	0.00000	0
		Private	0.12	0%	0.120	0.00	1	0	0.000				0.00000	0.00000	0
								Total - Passenger	**0.597**				**1.925**	**0.029**	**186625**
Risk Calculations: Passenger and Freight Trains; Diamonds								**Total - Freight**	**0.048**				**0.017**	**0.001**	**3426**
Train Type								**Totals - All Speeds**	**0.645**				**1.94**	**0.03**	**190051**

Table 3.8: Summary - All Risks

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00474	0.35286	0.01352	15382	91238
	Intrusion Collisions	0.00941	0.27340	0.00971	11717	68197
	Diamond Collisions	0.000263	0.00282	0.00008	99	633
	Overspeed	0.00589	0.30214	0.00486	24896	69680
	Broken Rail	0.00823	0.42200	0.00678	34773	97324
	Work Zone Violation	0.00000	0.11143	0.01114	0	44572
	Grade Crossing Collisions	0.59710	1.92530	0.02857	186625	464876
	Total, All Scenarios	0.62565	3.38995	0.07468	273491	836520
Freight	Train-Train Collisions	0.00080	0.00087	0.00009	252	599
	Intrusion Collisions	0.00201	0.00066	0.00007	83	347
	Diamond Collisions	0.00149	0.00066	0.00007	250	514
	Overspeed	0.00204	0.00064	0.00006	1117	1372
	Broken Rail	0.00653	0.00204	0.00020	3572	4387
	Work Zone Violation	0.00000	0.01020	0.00102	0	4078
	Grade Crossing Collisions	0.04820	0.01713	0.00088	3426	7781
	Total, All Scenarios	0.06108	0.03219	0.00239	8700	19078
	Total Passenger + Freight	**0.68673**	**3.42213**	**0.07706**	**282191**	**855598**
	Unit Costs ($/Casualty)		100000	3000000		

Data exported to the Results Summary worksheet

Worksheet 1-B,N: IDOT Risk Model: Braking Distances and Collision Zone Calculations, Base Case II; Northeast Corridor ATC, 85% Preventability, Bloomington Sub-corridor

Table 1.1: Stopping Distance Parameters and Calculations, Including Timeout and ACS Response Delay

Braking Formula Inputs			Braking Distance Calculations (including free running in TO) (ft)					Braking Duration (secs)		Guilty Train Distance (ft)		Total Zone Lengths (ft)		
Train/System Type	Parameter	Value	Train Type	Speeds (mph)	To Stop	Reduction to RedCon*	RedCon* to Stop	Deceleration (ft/sec²)	Reduction to RedCon*	RedCon* to Stop	Reduction to RedCon*	RedCon* to Stop	Reduction to RedCon*	RedCon* to Stop	Full Speed to Stop
Freight	Coefficient P	0.035	Freight	25	1671	1671	0	0.668	58	0	1275	0	2946	0	2946
	Appl'n Time (sec)	13.8		40	3686	1619	2068	0.668	14	77	308	1692	1927	3760	5686
	Train Weight (lb)	37600000		50	5452	3384	2068	0.668	36	77	791	1692	4176	3760	7935
	Brake Force (lb)	779683	Passenger	40	1452	1452	0	1.293	48	0	1065	0	2517	0	2517
Passenger	Coefficient A	0.666		60	3177	3177	0	1.293	71	0	1565	0	4742	0	4742
	Coefficient B	0		79	5433	3035	2398	1.293	25	68	541	1499	3576	3896	7472
	Safety Factor	1.25		105	9493	7096	2398	1.293	54	68	1190	1499	8286	3896	12182
Train Control	Latency/T-out (sec)	3	Frt Red'd Consc	35	1125	NA	NA	1.293							
	ACS Response (sec	0													
Guilty Train Speed (mph)		15													

Blue cells contain data imported from the Inputs worksheet

Sight Distance (ft): 2500

Note: RedCon refers to the speed at which collision consequences will be significantly reduced
60 mph for passenger trains and 35 mph for freight trains
If train speed is lower that this speed, then there are no reduced consequences and Zone A2 has zero length

Table 1.2: Segment Definitions: Bloomington Sub-Corridor: MP 88.4 (Bunge) - MP 124.9 (Bloomington)

Segment Number	Start (milepost	End (milepost)	Type	Variant	Length		Posted Speed (mph)			Representative Speed (mph)			Industry Siding		Passenger Stops
					Miles	Feet	Freight	Pass	HS Pass	Freight	Pass	HS Pass (Consq*)	HS Pass (Other)	Number	Name	
14.0	88.4	90.6	Plain		2.2	11616	60.0	79.0	110.0	50.0	79.0	79.0	105.0	1.0	Bunge	
15.0	90.6	92.5	CP Adjacent (M)		1.9	10137.6	49.0	50.0	50.0	40.0	60.0	60.0	79.0	1.0	Donnley	
16.0	92.5	95.0	Siding (M)	Pontiac (Sag'd)	2.5	13200	60.0	79.0	110.0	50.0	79.0	79.0	105.0	0.0		Pontiac
17.0	95.0	96.8	CP Adjacent (M)		1.8	9715.2	60.0	79.0	110.0	50.0	79.0	79.0	105.0	0.0	Ooiya	
18.0	96.8	100.3	Plain		3.5	18321.6	60.0	79.0	110.0	50.0	79.0	79.0	105.0	0.0		
19.0	100.3	102.3	CP Adjacent (M)		2.0	10401.6	60.0	79.0	110.0	40.0	60.0	60.0	79.0	0.0		
20.0	102.3	102.3	Diamond		0.0	0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	0.0		
21.0	102.3	104.6	CP Adjacent (M)		2.3	12408	60.0	79.0	110.0	40.0	60.0	60.0	79.0	0.0		
22.0	104.6	106.4	CP Adjacent (M)		1.8	9662.4	60.0	79.0	110.0	50.0	79.0	79.0	105.0	0.0		
23.0	106.4	108.8	Siding (M)	Ballard (Sag'd)	2.4	12672	60.0	79.0	110.0	50.0	79.0	79.0	105.0	0.0		
24.0	108.8	111.4	CP Adjacent (M)		2.5	13358.4	60.0	79.0	110.0	50.0	79.0	79.0	105.0	0.0		
25.0	111.4	113.3	Plain		1.9	10243.2	60.0	79.0	110.0	50.0	79.0	79.0	105.0	0.0		
26.0	113.3	116.4	Plain		3.1	16156.8	60.0	79.0	110.0	50.0	79.0	79.0	105.0	0.0		
27.0	116.4	118.8	Plain		2.5	13041.6	60.0	79.0	110.0	50.0	79.0	79.0	105.0	1.0	Towanda	
28.0	118.8	121.4	CP Adjacent (M)		2.6	13569.6	60.0	79.0	110.0	50.0	79.0	79.0	105.0	0.0		
29.0	121.4	123.6	Siding (M)	Bloomington Yard	2.2	11457.6	60.0	79.0	110.0	40.0	60.0	79.0	79.0	1.0	Bloomington	
30.0	123.6	124.4	Siding (M)	Bloomington Yard	0.8	4276.8	25.0	40.0	40.0	25.0	40.0	40.0	40.0	1.0	Bloomington	Bloomington
31.0	124.4	124.9	Siding (M)	Bloomington Yard	0.5	2534.4	25.0	40.0	40.0	25.0	40.0	40.0	40.0	1.0	Bloomington	

Table 1.3: Mitigation and Prevention Zones - All Segments - Lengths in Feet

Zone A1: Limited Speed Reduction No Prevention or Mitigation			Zone A2: Reduced Speed to Stop Severity Mitigation			Zone B: Able to Stop Full Prevention			Overlap of Stopping Distance into Zone C			Distance in Timeout in Zone C			Overlap of Zone A1 into Zone C			Overlap of Zone A1 into Zone C within Sight Distance			Overlap of Zone A2 into Zone C within Sight Distance		
Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass
4176	3576	8286	3760	3896	3330	3681	4144	0	0	0	566	0	0	462	0	0	0	0	0	0	0	0	566
1927	4742	3576	0	0	3896	8211	5396	2666	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	8286	3896	3896	3896	5128	6012	5728	1018	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	8286	3896	3896	1430	1644	2244	0	0	0	2467	0	0	462	0	0	0	0	0	0	0	0	2467
4176	3576	8286	3896	3896	3896	10250	10850	6140	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1927	4742	3576	3760	0	3896	4715	5660	2930	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1927	4742	3576	0	0	3896	10481	7666	4936	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	8286	3896	3896	1377	1591	2191	0	0	0	2519	0	0	462	0	0	0	0	0	0	0	0	2500
4176	3576	8286	3896	3896	3896	4600	5200	490	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	8286	3896	3896	3896	5287	5887	1177	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	8286	3896	3896	1958	2172	2772	0	0	0	1939	0	0	462	0	0	0	0	0	0	0	0	1939
4176	3576	8286	3896	3896	3896	8085	8685	3975	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	8286	3760	3896	3896	5106	5570	860	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	8286	3760	3896	3896	5634	6098	1388	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1927	4742	3576	3760	0	3896	5771	6716	3986	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2946	2517	2517	0	0	0	1331	1760	1760	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2534	2517	2517	0	0	0	0	17	17	411	0	0	110	0	0	411	0	0	411	0	0	0	0	0

Table 1.4: Breakdown of Segments Lengths by Representative Speed (miles)

Segment Number	Freight Speeds (mph)			Convent'l Pass Speeds (mph)			HS Pass. Speeds - Coll'n Conseq. (mph)			HS Pass. Speeds - Other (mph)			
	25	40	50	40	60	79	40	60	79	105	40	60	79
14.0	0	0	2.2	0	0	2.2	0	0	2.2	0	0	0	2.2
15.0	0	1.92	0	0	1.92	0	0	1.92	0	0	0	0	1.92
16.0	0	0	2.5	0	0	2.5	0	0	2.5	0	0	0	2.5
17.0	0	0	1.84	0	0	1.84	0	0	1.84	0	0	0	1.84
18.0	0	0	3.47	0	0	3.47	0	0	3.47	0	0	0	3.47
19.0	0	1.97	0	0	1.97	0	0	1.97	0	0	0	0	1.97
20.0	0	0	0	0	0	0	0	0	0	0	0	0	0
21.0	0	2.35	0	0	2.35	0	0	2.35	0	0	0	0	2.35
22.0	0	0	1.83	0	0	1.83	0	0	1.83	0	0	0	1.83
23.0	0	0	2.4	0	0	2.4	0	0	2.4	0	0	0	2.4
24.0	0	0	2.53	0	0	2.53	0	0	2.53	0	0	0	2.53
25.0	0	0	1.94	0	0	1.94	0	0	1.94	0	0	0	1.94
26.0	0	0	3.06	0	0	3.06	0	0	3.06	0	0	0	3.06
27.0	0	0	2.47	0	0	2.47	0	0	2.47	0	0	0	2.47
28.0	0	0	2.57	0	0	2.57	0	0	2.57	0	0	0	2.57
29.0	0	2.17	0	0	2.17	0	0	2.17	0	0	0	0	2.17
30.0	0.81	0	0	0.81	0	0	0.81	0	0	0	0.81	0	0
31.0	0.48	0	0	0.48	0	0	0.48	0	0	0	0.48	0	0

Table 1.5: Aggregate Segment Length by Segment Type and Speed

Segment Type	Train Type	Representative Speed	Aggregate Length of Segments by Train and Segment Types							
			Freight		Conv passenger		High Speed Passenger			
							Collision Conseq*		Other	
			Miles	Feet	Miles	Feet	Miles	Feet	Miles	Feet
Siding (mon)	Freight	25	1.29	6811						
		40	2.17	11458						
		50	4.90	25872						
	Passenger	40			1.29	6811	1.29	6811	1.29	6811
		60			2.17	11458	0.00	0	0.00	0
		79			4.90	25872	7.07	37330	2.17	11458
		105					0.00	0	4.90	25872
Siding (unmon)	Freight	25	0.00	0						
		40	0.00	0						
		50	0.00	0						
	Passenger	40			0.00	0	0.00	0	0.00	0
		60			0.00	0	0.00	0	0.00	0
		79			0.00	0	0.00	0	0.00	0
		105					0.00	0	0.00	0
CP Adjacent (mon)	Freight	25	0.00	0						
		40	6.24	32947						
		50	8.77	46306						
	Passenger	40			0.00	0	0.00	0	0.00	0
		60			6.24	32947	6.24	32947	0.00	0
		79			8.77	46306	8.77	46306	6.24	32947
		105					0.00	0	8.77	46306
CP Adjacent (unmon)	Freight	25	0.00	0						
		40	0.00	0						
		50	0.00	0						
	Passenger	40			0.00	0	0.00	0	0.00	0
		60			0.00	0	0.00	0	0.00	0
		79			0.00	0	0.00	0	0.00	0
		105					0.00	0	0.00	0
Plain Track	Freight	25	0.00	0						
		40	0.00	0						
		50	13.14	69379						
	Passenger	40			0.00	0	0.00	0	0.00	0
		60			0.00	0	0.00	0	0.00	0
		79			13.14	69379	13.14	69379	0.00	0
		105					0.00	0	13.14	69379
Check Total			36.51		36.51		36.51		36.51	

*This speed is used to calculate collision consequences in collisions between an equipped and an unequipped train ONLY, reflecting the IDOT PTC speed restriction when an equipped train nears an unequipped train

Yellow cells contain data exported to the next sec/sheet in the sequence of three sheets that perform the calculations for one sub-corridor, season and operating state

Table 1.6a: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for Siding (M) Segments

Lengths in Zone C	A1	A2	B
Total Length, Siding (M) Segments (ft)	44140.8		
Number Siding (M) Segments	5		
Average distance in Zone C (ft)	Freight	82	0	2418
	Passenger	0	0	2500
	HS Pass	0	0	2500

	Zone A1 Totals			Zone A2 Totals			Zone B Totals		
	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass
Sum Zone Lengths A1, A2, B (ft)	15758	16927	25181	11552	7792	11688	16831	19422	7272
Fraction of total length in zone	0.357	0.383	0.570	0.262	0.177	0.265	0.381	0.440	0.165
Collision Accident Mitigation Probabilities: Combined All Zones.	0.342	0.364	0.542	0.249	0.168	0.252	0.459	0.518	0.257

Values transferred to Collision Matrix

Distribution of train location at time of	In Block	0.95
violation in Reference Case accidents	Previous Block	0.05
PTC Risk Increment in Zone C		2
Potential danger length in Zone C (ft)		2500

Table 1.6b: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for Siding (U) Segments

Lengths in Zone C	A1	A2	B
Total Length, Siding (U) Segments (ft)	1		
Number Siding (M) Segments	0.001		
Average distance in Zone C (ft)	Freight	0	0	2500
	Passenger	0	0	2500
	HS Pass	0	0	2500

	Zone A1 Totals			Zone A2 Totals			Zone B Totals		
	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass
Zone lengths A1, A2, B (ft)	0	0	0	0	0	0	0	0	0
Fraction of total length in zone	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Collision Accident Mitigation Probabilities: Combined All Zones.	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100

Values transferred to Collision Matrix

Distribution of train location at time of	In Block	0.95
violation in Reference Case accidents	Previous Block	0.05
PTC Risk Increment in Zone C		2
Potential danger length in Zone C (ft)		2500

Table 1.6c: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for CP Adjacent (M) Segments

Lengths in Zone C	A1	A2	B
Total Length, CP Adjacent (M) Segments (ft)	76252.8		
Number CP Adjacent Segments	7		
Average distance in Zone C (ft)	Freight	0	0	2500
	Passenger	0	0	2500
	HS Pass	0	710	1790

	Zone A1 Totals			Zone A2 Totals			Zone B Totals		
	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass
Zone lengths A1, A2, B (ft)	22482	28527	43869	19208	15584	22287	37563	35142	13097
Fraction of total length in zone	0.284	0.360	0.554	0.242	0.197	0.281	0.474	0.443	0.165
Collision Accident Mitigation Probabilities: Combined All Zones.	0.269	0.342	0.526	0.230	0.187	0.296	0.550	0.521	0.229

Values transferred to Collision Matrix

Distribution of train location at time of	In Block	0.95
violation in Reference Case accidents	Previous Block	0.05
PTC Risk Increment in Zone C		2
Potential danger length in Zone C (ft)		2500

Table 1.6d: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for CP Adjacent (U)Segments

Lengths in Zone C	A1	A2	B
Total Length, CP Adjacent (U) Segments (ft)	1		
Number CP Adjacent Segments	0.001		
Average distance in Zone C (ft)	Freight	0	0	2500
	Passenger	0	0	2500
	HS Pass	0	0	2500

	Zone A1 Totals			Zone A2 Totals			Zone B Totals		
	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass
Zone lengths A1, A2, B (ft)	0	0	0	0	0	0	0	0	0
Fraction of total length in zone	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Collision Accident Mitigation Probabilities: Combined All Zones.	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100

Values transferred to Collision Matrix

Distribution of train location at time of	In Block	0.95
violation in Reference Case accidents	Previous Block	0.05
PTC Risk Increment in Zone C		2
Potential danger length in Zone C (ft)		2500

Table 1.6e: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for Plain Track Segments

Lengths in Zone C	A1	A2	B
Total Length, Plain Track Segments (ft)	69379.2		
Number CP Adjacent Segments	5		

	Zone A1 Totals			Zone A2 Totals			Zone B Totals		
	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass

| | | |

Worksheet 2 - B,N,R: Collision Frequencies Calculation - Base Case II: Northeast Corridor ATC, 85% Preventability, Bloomington Sub-corridor, Rest of Year

Table 2.1a: Collision Distribution Matrix (Fraction Accidents by Train Pair and Collision Type). Collisions Between Trains Operating on the IDOT Test Corridor Only (not diamonds and intrusions)

	Train Pairs in In Collision	Collision Scenario Prob (Top Level)	Siding - Monitored: Collision Distribution Head On	Siding - Monitored: Collision Distribution Rear/Side	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty
	Percent Guilty				100%	0%	100%	0%
Both Trains TBE	Pass-Pass	0.60	0.50	0.50	0.3	0	0.3	0
	Pass-TBE Freight	0.32	0.50	0.50	0.16	0	0.16	0
(Note 3)	TBE Freight - TBE Freight	0.08	0.50	0.50	0.04	0	0.04	0
One Train TBE	**Percent Guilty**				50%	50%	50%	50%
	Pass - NE Freight, Head -On	0.00	1	0	0	0	0	0
	Rear/Side, Pass into NE Frt		0	1	0	0	0	0
	Rear/Side NE Frt into Pass		0	1	0	0	0	0
	TBE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0
	Percent Guilty				0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0
	Total Probability (checking)	1		1	0.5	0	0.5	0

	Siding - Unmonitored: Collision Distribution Head On	Siding - Unmonitored: Collision Distribution Rear/Side	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
			100%	0%	100%	0%
Both Trains TBE	0.8	0.2	0.3	0	0.3	0
(Note 3)	0.7	0.3	0.16	0	0.16	0
	0.7	0.3	0.04	0	0.04	0
One Train TBE			50%	50%	50%	50%
	1	0	0	0	0	0
	0	1	0	0	0	0
	0	1	0	0	0	0
	0.7	0.3	0	0	0	0
			0%	100%	0%	100%
Neither Train TBE	0.7	0.3	0	0	0	0
		1	0.5	0	0.5	0

	CP Adjacent - Monitored Siding: Collision Distribution Head On	CP Adjacent - Monitored Siding: Collision Distribution Rear/Side	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty
			100%	0%	100%	0%
Both Trains TBE	0.8	0.2	0.48	0	0.12	0
(Note 3)	0.7	0.3	0.224	0	0.096	0
	0.7	0.3	0.056	0	0.024	0
One Train TBE			50%	50%	50%	50%
	1	0	0	0	0	0
	0	1	0	0	0	0
	0	1	0	0	0	0
	0.7	0.3	0	0	0	0
			0%	100%	0%	100%
Neither Train TBE	0.7	0.3	0	0	0	0
		1	0.76	0	0.24	0

	CP Adjacent - Unmonitored Siding: Collision Distribution Head On	CP Adjacent - Unmonitored Siding: Collision Distribution Rear/Side	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
			100%	0%	100%	0%
Both Trains TBE	0.8	0.2	0.48	0	0.12	0
(Note 3)	0.7	0.3	0.224	0	0.096	0
	0.7	0.3	0.056	0	0.024	0
One Train TBE			50%	50%	50%	50%
	1	0	0	0	0	0
	0	1	0	0	0	0
	0	1	0	0	0	0
	0.7	0.3	0	0	0	0
			0%	100%	0%	100%
Neither Train TBE	0.7	0.3	0	0	0	0
		1	0.76	0	0.24	0

	Plain Track: Collision Distribution Head On	Plain Track: Collision Distribution Rear/Side	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
			100%	0%	100%	0%
Both Trains TBE	0.70	0.30	0.42	0	0.18	0
(Note 3)	0.40	0.60	0.128	0	0.192	0
	0.50	0.50	0.04	0	0.04	0
One Train TBE			50%	50%	50%	50%
	1.00	0.00	0	0	0	0
	0.00	1.00	0	0	0	0
	0.00	1.00	0	0	0	0
	0.50	0.50	0	0	0	0
			0%	100%	0%	100%
Neither Train TBE	0.50	0.50	0	0	0	0
		1	0.588	0	0.412	0

Table 2.1b: Collision Type Distribution - Diamonds

	Diamond Collisions: Rear End/Side Equip Guilty	Diamond Collisions: Rear End/Side Unequip Guilty	Train Pairs in In Collision	Train Pair Type
			Percent Guilty	
Both Trains TBE			Pass-Pass	**Both Trains TBE**
			Pass-TBE Freight	
			TBE Freight - TBE Freight	
One Train TBE	50%	50%	**Percent Guilty**	**One Train TBE**
	0	0	Pass - NE Freight, Head -On	
	0.25	0.25	Rear/Side, Pass into NE Frt	
	0.05	0.05	Rear/Side NE Frt into Pass	
	0.1	0.1	TBE Freight - NE Freight	
		100%	**Percent Guilty**	
Neither Train TBE	0	0.2	NE Freight - NE Freight	**Neither Train TBE**
	0.4	0.6	Total Probability (checking)	

Note: The gray cells on these rows are set at zero, because in every case, the condition represented by the cell does not exist - either because there are no unequipped passenger trains, or because of the kind of collision defined for the row.

Quantity in cell C18 is for all collisions between a passenger train and an unequipped freight train

Table 2.2: Preventability Data For Unequipped train Guilty, One Train TBE

Segment Type	Not Prevented of Mitigated: Freight	Not Prevented of Mitigated: Pass	Not Prevented of Mitigated: HS Pass	Mitigated: Freight	Mitigated: Pass	Mitigated: HS Pass	Prevented: Freight	Prevented: Pass	Prevented: HS Pass
Siding (M)	0.342	0.364	0.542	0.249	0.168	0.252	0.459	0.518	0.257
Siding (U)	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100
CP Adjacent (M)	0.269	0.342	0.526	0.230	0.187	0.296	0.550	0.521	0.229
CP Adjacent (U)	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100
Plain Track	0.308	0.391	0.601	0.000	0.000	0.020	0.100	0.100	0.080
Diamonds	0.135	0.265	0.253	0.172	0.000	0.200	0.743	0.785	0.597

Mauve cells contain data imported from previous worksheet in a group of three worksheets covering one sub-corridor, season and operating state.

Table 2.3a: Collision Preventability Matrix (Percent Accidents Preventable Relative to CTC Reference Case)

	Preventability Equipped Train Guilty	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty
Both TBE	85%	85%		85%	
	85%	85%		85%	
	85%	85%		85%	
One TBE	85%	85%	26%		
	85%			85%	26%
	85%			85%	0%
	85%	85%	46%	85%	0%
Neither TBE			0%		0%

	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
Both TBE	85%		85%	
	85%		85%	
	85%		85%	
One TBE	85%	10%		
			85%	10%
			85%	0%
	85%	10%	85%	0%
Neither TBE		0%		0%

	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty
Both TBE	85%		85%	
	85%		85%	
	85%		85%	
One TBE	85%	23%		
			85%	23%
			85%	0%
	85%	55%	85%	0%
Neither TBE		0%		0%

	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
Both TBE	85%		85%	
	85%		85%	
	85%		85%	
One TBE	85%	10%		
			85%	10%
			85%	0%
	85%	10%	85%	0%
Neither TBE		0%		0%

	Plain Track: Collision Distribution Head On	Plain Track: Collision Distribution Rear/Side	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
Both TBE			85%		85%	
			85%		85%	
			85%		85%	
One TBE			85%	8%		
					85%	8%
					85%	0%
			85%	10%	85%	0%
Neither TBE				0%		0%

Collisions/million diamond passes: 0.1

Table 2.3b: Collision Preventability Matrix - Diamonds

	Diamond Collisions: Rear End/Side Equip Guilty	Diamond Collisions: Rear End/Side Unequip Guilty	Train Pairs in In Collision	Train Pair Type
Both TBE			Pass-Pass	**Both TBE**
			Pass-TBE Freight	
			TBE Freight - TBE Freight	
One TBE			Pass - NE Freight, Head -On	**One TBE**
	85%	78.54%	Rear/Side, Pass into NE Frt	
	85%	78.54%	Rear/Side NE Frt into Pass	
	85%	74.29%	TBE Freight - NE Freight	
Neither TBE		0.00%	NE Freight - NE Freight	**Neither TBE**

	Reference Case (CTC) Collision Accident Likelihood by Segment Type (collisions/million train miles)	Siding - Monitored	Siding - Unmonitored	CP Adjacent - Monitored Siding	CP Adjacent - Unmonitored Siding	Plain Track
		0.030	0.040	0.050	0.060	0.006

Table 2.4a: Passenger Trains in Train-to-Train Collisions (Trains in Collisions per Million Train-Miles)

	Passenger Trains in Collisions	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty
Both TBE	2	0.0027		0.0027	
	1	0.0007		0.0007	
	0				
One TBE	1	0.0000	0.0000		
	1			0.0000	0.0000
	1			0.0000	0.0000
	0				
Neither TBE	0				
Checking tota		0.0034	0.0000	0.0034	0.0000

	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
Both TBE	0.0036		0.0036	
	0.0010		0.0010	
One TBE	0.0000	0.0000		
			0.0000	0.0000
			0.0000	0.0000
Neither TBE				
Checking tota	0.0046	0.0000	0.0046	0.0000

	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty
Both TBE	0.0072		0.0018	
	0.0017		0.0007	
One TBE	0.0000	0.0000		
			0.0000	0.0000
			0.0000	0.0000
Neither TBE				
Checking tota	0.0089	0.0000	0.0025	0.0000

	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
Both TBE	0.0086		0.0022	
	0.0020		0.0009	
One TBE	0.0000	0.0000		
			0.0000	0.0000
			0.0000	0.0000
Neither TBE				
Checking tota	0.0107	0.0000	0.0030	0.0000

	Plain Track: Collision Distribution Head On	Plain Track: Collision Distribution Rear/Side	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
Both TBE			0.0008		0.0003	
			0.0001		0.0002	
One TBE			0.0000	0.0000		
					0.0000	0.0000
					0.0000	0.0000
Neither TBE						
Checking tota	0.0000	0.0000	0.0009	0.0000	0.0005	0.0000

Table 2.4b: Passenger Trains in Collisions at Diamonds

	Diamond Collisions: Rear End/Side Equip Guilty	Diamond Collisions: Rear End/Side Unequip Guilty	Train Pairs in In Collision	Train Pair Type
Both TBE			Pass-Pass	**Both TBE**
			Pass-TBE Freight	
			TBE Freight - TBE Freight	
One TBE			Pass - NE Freight, Head -On	**One TBE**
	0.003750	0.005366	Rear/Side, Pass into NE Frt	
	0.000750	0.001073	Rear/Side NE Frt into Pass	
	0.000000	0.000000	TBE Freight - NE Freight	
Neither TBE		0.000000	NE Freight - NE Freight	**Neither TBE**
Checking tota	0.00450	0.00644		
Scenario Totals - Passenger			**Scenario Totals - Passenger**	
Pass Loco Hits Loco			Pass Loco Hits Loco	
Pass Loco Hits Pass Ca			Pass Loco Hits Pass Ca	
Pass Loco Hits Freight Ca	0.003750	0.005366	Pass Loco Hits Freight Ca	
Pass Car Hit by Loco	0.000750	0.001073	Pass Car Hit by Loco	
Total	0.004500	0.006439	Total	

	Tots, P-UF	Totals
Pass Loco Hits Loco	0.0000	0.0034
Pass Loco Hits Pass Ca		0.0014
Pass Loco Hits Freight Ca	0.0000	0.0006
Pass Car Hit by Loco	0.0000	0.0015
Total		0.0068

	Totals
Pass Loco Hits Loco	0.0046
Pass Loco Hits Pass Ca	0.0018
Pass Loco Hits Freight Ca	0.0008
Pass Car Hit by Loco	0.0020
Total	0.0091

	Totals
Pass Loco Hits Loco	0.0089
Pass Loco Hits Pass Ca	0.0009
Pass Loco Hits Freight Ca	0.0005
Pass Car Hit by Loco	0.0011
Total	0.0114

	Totals
Pass Loco Hits Loco	0.0089
Pass Loco Hits Pass Ca	0.0009
Pass Loco Hits Freight Ca	0.0005
Pass Car Hit by Loco	0.0013
Total	0.0137

	Totals
Pass Loco Hits Loco	0.0107
Pass Loco Hits Pass Ca	0.0011
Pass Loco Hits Freight Ca	0.0006
Pass Car Hit by Loco	0.0013
Total	0.0107

	Totals
Pass Loco Hits Loco	0.0009
Pass Loco Hits Pass Ca	0.0002
Pass Loco Hits Freight Ca	0.0001
Pass Car Hit by Loco	0.0002
Total	0.0014

	Totals
Pass Loco Hits Loco	0.0009
Pass Loco Hits Pass Ca	0.0002
Pass Loco Hits Freight Ca	0.0001
Pass Car Hit by Loco	0.0002
Total	0.0012

	Totals
Pass Loco Hits Loco	0.0000
Pass Loco Hits Pass Ca	0.0000
Pass Loco Hits Freight Ca	0.0000
Pass Car Hit by Loco	0.0000
Total	0.0000

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Table 2.5a: Freight trains In Train-to-Train Collisions (Trains in Collisions per Million Train-Miles)

	Freight Trains in Collisions	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty
Both TBE	0				
	1	0.0007		0.0007	
	2	0.0004		0.0004	
One TBE	1	0.0000	0.0000		
	1			0.0000	0.0000
	1			0.0000	0.0000
	2	0.0000	0.0000	0.0000	0.0000
Neither TBE	2		0.0000		0.0000
Checking tota		0.0011	0.0000	0.0011	0.0000

	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
Both TBE	0.0010		0.0010	
	0.0005		0.0005	
One TBE	0.0000	0.0000		
			0.0000	0.0000
			0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000
Neither TBE		0.0000		0.0000
Checking tota	0.0014	0.0000	0.0014	0.0000

	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty
Both TBE	0.0017		0.0007	
	0.0008		0.0004	
One TBE	0.0000	0.0000		
			0.0000	0.0000
			0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000
Neither TBE		0.0000		0.0000
Checking tota	0.0025	0.0000	0.0011	0.0000

	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
Both TBE	0.0020		0.0009	
	0.0004		0.0004	
One TBE	0.0000	0.0000		
			0.0000	0.0000
			0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000
Neither TBE		0.0000		0.0000
Checking tota	0.0030	0.0000	0.0013	0.0000

	Plain Track: Collision Distribution Head On	Plain Track: Collision Distribution Rear/Side	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
Both TBE			0.0001		0.0002	
			0.0001		0.0001	
One TBE			0.0000	0.0000		
					0.0000	0.0000
					0.0000	0.0000
			0.0000	0.0000	0.0000	0.0000
Neither TBE				0.0000		0.0000
Checking tota	0.0000	0.0000	0.0002	0.0000	0.0002	0.0000

	Totals
Freight Loco Hits Loco	0.0030
Freight Loco Hits Car	0.0004
Freight Car Hit By Loco	0.0009
Total	0.0043

	Totals
Freight Loco Hits Loco	0.0002
Freight Loco Hits Car	0.0001
Freight Car Hit By Loco	0.0002
Total	0.0004

	Totals
Freight Loco Hits Loco	0.0014
Freight Loco Hits Car	0.0004
Freight Car Hit By Loco	0.0010
Total	0.0029

	Totals
Freight Loco Hits Loco	0.0025
Freight Loco Hits Car	0.0004
Freight Car Hit By Loco	0.0007
Total	0.0036

	Totals
Freight Loco Hits Loco	0.0025
Freight Loco Hits Car	0.00036
Freight Car Hit By Loco	0.00072
Total	0.0025

	Totals
Freight Loco Hits Loco	0.0000
Freight Loco Hits Car	0.00043
Freight Car Hit By Loco	0.00101
Total	0.0014

	Totals
Freight Loco Hits Loco	0.0000
Freight Loco Hits Car	0.00032
Freight Car Hit By Loco	0.00076
Total	0.0011

	Totals
Freight Loco Hits Loco	0.0000
Freight Loco Hits Car	0.00000
Freight Car Hit By Loco	0.00000
Total	0.0000

	Totals
Freight Loco Hits Loco	0.0000
Freight Loco Hits Car	0.00000
Freight Car Hit By Loco	0.00000
Total	0.0000

	Totals
Freight Loco Hits Loco	0.0000
Freight Loco Hits Car	0.00000
Freight Car Hit By Loco	0.00000
Total	0.0000

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Table 2.5b: Freight Trains in Collisions at Diamonds

	Diamond Collisions: Rear End/Side Equip Guilty	Diamond Collisions: Rear End/Side Unequip Guilty	Train Pairs in In Collision	Train Pair Type
Both TBE			Pass-Pass	**Both TBE**
			Pass-TBE Freight	
			TBE Freight - TBE Freight	
One TBE			Pass - NE Freight, Head -On	**One TBE**
	0.003750	0.005366	Rear/Side, Pass into NE Frt	
	0.000750	0.001073	Rear/Side NE Frt into Pass	
	0.003000	0.005141	TBE Freight - NE Freight	
Neither TBE		0.040000	NE Freight - NE Freight	**Neither TBE**
Checking tota	0.00750	0.05158		
Scenario Totals - Freight			**Scenario Totals - Freight**	
Freight Loco Hits Loco			Freight Loco Hits Loco	
Freight Loco Hits Car	0.005250	0.023644	0.028894 Freight Loco Hits Car	
Freight Car Hit By Loco	0.002250	0.027937	0.030187 Freight Car Hit By Loco	
Total	0.007500	0.051581	0.059081 Total	

	Totals
Freight Loco Hits Loco	0.0000
Freight Loco Hits Car	0.00000
Freight Car Hit By Loco	0.00000
Total	0.0000

	Totals
Freight Loco Hits Loco	0.0002
Freight Loco Hits Car	0.0001
Freight Car Hit By Loco	0.0002
Total	0.0004

	Totals
Freight Loco Hits Loco	0.0002
Freight Loco Hits Car	0.00006
Freight Car Hit By Loco	0.00018
Total	0.0002

	Totals
Freight Loco Hits Loco	0.0000
Freight Loco Hits Car	0.00000
Freight Car Hit By Loco	0.00000
Total	0.0000

	Totals
Freight Loco Hits Loco	0.0000
Freight Loco Hits Car	0.00000
Freight Car Hit By Loco	0.00000
Total	0.0000

	Totals
Freight Loco Hits Loco	0.0000
Freight Loco Hits Car	0.00000
Freight Car Hit By Loco	0.00000
Total	0.0000

Freight Plus Passenger Totals (check): 0.0600 | 0.0090 | 0.0800 | 0.0120 | 0.1000 | 0.0150 | 0.1200 | 0.0180 | 0.0018

In rear-end/side collisions between like trains there is one loco hits car and one car hit by loco in each collision. In rear/side collisions between a passenger and freight trains, the ratio between passenger hits freight and freight loco hits passenger car are a function of the percentages given in Table IN-5b on the Inputs sheet. The values are given in the tables beneath the trains in collisions for each segment type.

Collision Ratios	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.8	0.2

Collision Ratios	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.80	0.20

Collision Ratios	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.75	0.25

Collision Ratios	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.75	0.25

Collision Ratios	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.83	0.17

Worksheet 3 - B,N,R: - Risk Calculations - Base Case II: Northeast Corridor ATC, 85% Preventability, Bloomington Sub-corridor, Rest of Year

Table 3.1: Consequences Look-up Tables (Data Sources: Previous ICF Passenger Corridor Project (passenger), FRA Accident Data 2001-5 (freight)

Passenger Trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 40 mph			Representative Speed 60 mph			Representative Speed 79 mph			Representative Speed 105 mph		
			Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Pass Loco hits Loco	0.083	0.002	502000	0.139	0.0049	1142000	0.24	0.0085	1976000	0.425	0.016	3495000
		Pass Loco hits Pass Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.008	1747000
		Pass Loco hits Frt Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.008	1747000
		Pass car hit by Loco	0.166	0.005	1005000	0.275	0.0119	2284000	0.476	0.0206	3951000	0.841	0.032	6989000
	Intrusion Collision (rollout)	Pass Loco hits Car	0.013	0.0005	113000	0.031	0.0011	257000	0.054	0.0019	445000	0.096	0.0034	786000
	Intrusion Collision (other))	Pass Loco hits Car	0.026	0.0009	226000	0.063	0.0022	514000	0.108	0.0038	889000	0.191	0.0068	1573000
	Overspeed		0.044	0.0004	667000	0.14	0.00186	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Broken Rail		0.044	0.0004	667000	0.14	0.00186	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Work Zone Violation		0.083	0.0083	0	0.125	0.0125	0	0.164	0.0164	0	0.218	0.0218	0

Freight trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 25 mph			Representative Speed 40 mph			Representative Speed 50 mph		
			Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Frt Loco hits Loco	0.43	0.043	105000	1.1	0.11	270000	1.7	0.17	422000
		Frt Loco hits Car	0.35	0.035	88000	0.9	0.09	225000	1.4	0.14	352000
		Frt car hit by Loco	0	0	44000	0	0	112000	0	0	176000
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Overspeed, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Overspeed, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Work Zone Viol'n, Equip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0
	Work Zone Viol'n, Unequip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0

Casualties and damage in Table 3.1 are per accident, except for Work Zone Violations which are per million train-miles

Table 3.2: Grade Crossing and Diamonds: Numbers by Representative Speed, and Accident Frequency and Consequences

Train Type	Representative Speed (mph)	Type of Grade-crossing	Number Crossings			Accident Frequency		Crossing Collision Consequences						Number Diamonds
			Passenger	HS Passenger	Freight	Per Million Crossing Passes		Pass. Occup't Casualty Prob/accident)			Freight Trains (per accident)			
						Passenger	Freight	Injuries	Fatalities	Cost $/Accid't	Injuries	Fatalities	Cost $	
Passenger	40	Public_gates_lights	7	7		0.350		0.0028	0.000047	50000				1
		Public_other	0	0		0.300								
		Private	0	0		0.100								
	60	Public_gates_lights	16	0		0.600		0.0068	0.000112	113000				0
		Public_other	0	0		0.500								
		Private	1	0		0.200								
	79	Public_gates_lights	16	16		0.800		0.0105	0.000156	196000				0
		Public_other	1	0		0.650								
		Private	6	1		0.300								
	105	Public_gates_lights	0	16		1.100		0.0186	0.000276	346000				0
		Public_other	0	1		0.800								
		Private	0	6		0.300								
Freight	25	Public_gates_lights			7		0.150				0.12	0.005	20000	0
		Public_other			0		0.120							
		Private			0		0.050							
	40	Public_gates_lights			16		0.300				0.25	0.013	50000	1
		Public_other			0		0.250							
		Private			1		0.100							
	50	Public_gates_lights			16		0.360				0.39	0.02	78000	0
		Public_other			1		0.300							
		Private			6		0.120							

Table 3.3a: Segment Data (for reference only, not used in calculations)

Segment Number	Start (Milepost)	End (Milepost)	Type	Length (miles)	Posted Speed (mph)			
					Freight	Pass	HS Pass (conseq)	HS Pass
14.0	88.35	90.55	Plain	2.20	50	79	79	105
15.0	90.55	92.47	CP Adjacent (M)	1.92	40	60	60	79
16.0	92.47	94.97	Siding (M)	2.50	50	79	79	105
17.0	94.97	96.81	CP Adjacent (M)	1.84	50	79	79	105
18.0	96.81	100.28	Plain	3.47	50	79	79	105
19.0	100.28	102.25	CP Adjacent (M)	1.97	40	60	60	79
20.0	102.25	102.25	Diamond	0.00	40	40	40	40
21.0	102.25	104.60	CP Adjacent (M)	2.35	40	60	60	79
22.0	104.60	106.43	CP Adjacent (M)	1.83	50	79	79	105
23.0	106.43	108.83	Siding (M)	2.40	50	79	79	105
24.0	108.83	111.36	CP Adjacent (M)	2.53	50	79	79	105
25.0	111.36	113.30	Plain	1.94	50	79	79	105
26.0	113.30	116.36	Plain	3.06	50	79	79	105
27.0	116.36	118.83	Plain	2.47	50	79	79	105
28.0	118.83	121.40	CP Adjacent (M)	2.57	50	79	79	105
29.0	121.40	123.57	Siding (M)	2.17	40	60	79	79
30.0	123.57	124.38	Siding (M)	0.81	25	40	40	40
31.0	124.38	124.86	Siding (M)	0.48	25	40	40	40
	Length Check	36.5		36.5				

Table 3.3b: Aggregate Segment Data: SegmentsTypes, Train Types, Speeds, and Lengths

Aggregate Segment Length by Type and Speed Band (from Seg Def and Preventability)

Segment Type	Train Type	Represent've Speed (mph)	Freight (miles)	Reg Pass (miles)	HS Pass Collision (mi)	HS Pass Other (mi)
Siding (mon)	Freight	25	1.29			
		40	2.17			
		50	4.9			
	Passenger	40		1.29	1.29	1.29
		60		2.17	0	0
		79		4.9	7.07	2.17
		105		0	0	4.9
Siding (unmon)	Freight	25	0			
		40	0			
		50	0			
	Passenger	40		0	0	0
		60		0	0	0
		79		0	0	0
		105		0	0	0
CP Adjacent (mon)	Freight	25	0			
		40	6.24			
		50	8.77			
	Passenger	40		0	0	0
		60		6.24	6.24	0
		79		8.77	8.77	6.24
		105		0	0	8.77
CP Adjacent (unmon)	Freight	25	0			
		40	0			
		50	0			
	Passenger	40		0	0	0
		60		0	0	0
		79		0	0	0
		105		0	0	0
Plain Track	Freight	25	0			
		40	0			
		50	13.14			
	Passenger	40		0	0	0
		60		0	0	0
		79		13.14	13.14	0
		105		0	0	13.14
Totals All Types	Freight	25	1.29			
		40	8.41			
		50	26.81			
	Passenger	40		1.29	1.29	1.29
		60		8.41	6.24	0
		79		26.81	28.98	8.41
		105		0	0	26.81
	Checking Totals		36.51	36.51	36.51	36.51

Table 3.4a: Traffic Inputs to Risk Calculation

Trips/Day		
Train Type	Summer	Rest of Year
Passenger	6.00	6.00
Equipped Freight	1.43	2.28
Unequipped Freight	0.00	0.00
Operating Days	91.00	274.00

Percent Train-Miles in	
Timeout (secs)	0.00
Normal Operating Mode	95.00
Timeout Mode	0.00
Fallback Mode	5.00

Passenger Train Occupancy	
Seats	320.00
Occupancy Factor	0.60

Table 3.4: Collision Frequencies by Segment Type and Collision Scenario (From Coll Matrix)

Scenarios	Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain	Diamond
Pass Loco Hits Loco	0.0034	0.0046	0.0089	0.0107	0.0009	0.000000
Pass Loco Hits Pass Car	0.0014	0.0018	0.0009	0.0011	0.0002	0.000000
Pass Loco Hits Freight Car	0.0006	0.0008	0.0005	0.0006	0.0001	0.009116
Pass Car Hit by Loco	0.0015	0.0020	0.0011	0.0013	0.0002	0.001823
Freight Loco Hits Loco	0.0011	0.0014	0.0025	0.0030	0.0002	0.000000
Freight Loco Hits Car	0.0003	0.0004	0.0004	0.0004	0.0001	0.028894
Freight Car Hit By Loco	0.0008	0.0010	0.0007	0.0009	0.0002	0.030187

Weighted Collision Accident Frequencies by Representative Speed (mph)

Scenarios	Freight			Passenger			
	25	40	50	40	60	79	105
Pass Loco Hits Loco				0.0034	0.0000	0.0075	0.0040
Pass Loco Hits Pass Car				0.0013	0.0000	0.0010	0.0006
Pass Loco Hits Freight Car				0.0006	0.0000	0.0005	0.0004
Pass Car Hit by Loco				0.0015	0.0000	0.0012	0.0007
Freight Loco Hits Loco	0.0011	0.0021	0.0011				
Freight Loco Hits Car	0.0003	0.0004	0.0002				
Freight Car Hit By Loco	0.0008	0.0007	0.0005				

Collision Frequencies for Passenger + Unequipped Freight Train

Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain
0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000

Mauve cells contain data imported from previous worksheet in a group of three worksheets covering one sub-corridor, season and operating state.

All train-to-train collision frequencies are in units of **trains in collisions per million train-miles operated in the sub-corridor by all train types.**

Table 3.5a: Risk Calculation - Passenger Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Table 3.5b: Risk Calculation - Collisions at Diamonds - Passenger

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Freq'y (per million tm)	Preventability	Adjusted Frequency	Trips/day	Trips per 10 years	Length of Track (miles)	Train-miles per 10 years	Accidents per 10 years	Number seats per train	Occupancy Factor	Passengers per train	Injuries per 10 years	Fatalities per 10 years	Damage $ per 10 years
40	Train-Train Collision	Pass Loco hits Loco	0.00342	Incl	0.00342	8.28	21553	1.29	27803	0.00010	320	0.6	192	0.0015	0.00004	0
		Pass Loco hits Pass Car	0.00135	Incl	0.00135	8.28	21553	1.29	27803	0.00004	320	0.6	192	0.0002	0.00001	0
		Pass Loco hits Frt Car	0.00058	Incl	0.00058	8.28	21553	1.29	27803	0.00002	320	0.6	192	0.0001	0.00000	0
		Pass car hit by Loco	0.00149	Incl	0.00149	8.28	21553	1.29	27803	0.00004	320	0.6	192	0.0013	0.00004	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	15618	1.29	20147	0.00010	320	0.6	192	0.0002	0.00001	0
	Intrusion Collision (other))	Pass Loco hits intruder	0.01440	0.12	0.01267	6.00	15618	1.29	20147	0.00026	320	0.6	192	0.0013	0.00004	0
	Overspeed		0.01100	0.00	0.01100	6.00	15618	1.29	20147	0.00022	320	0.6	192	0.0019	0.00002	0
	Broken Rail		0.01670	0.08	0.01536	6.00	15618	1.29	20147	0.00031	320	0.6	192	0.0026	0.00002	0
	Work Zone Violation			0.00		6.00	15618	1.29	20147					0.0017	0.00017	0
										0.00108				**0.01087**	**0.00035**	**1**
60	Train-Train Collision	Pass Loco hits Loco	0.00000	Incl	0.00000	8.28	21553	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Pass Car	0.00000	Incl	0.00000	8.28	21553	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Frt Car	0.00000	Incl	0.00000	8.28	21553	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00000	Incl	0.00000	8.28	21553	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	15618	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.12	0.01267	6.00	15618	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Overspeed		0.01100	0.00	0.01100	6.00	15618	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Broken Rail		0.01670	0.08	0.01536	6.00	15618	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Work Zone Violation			0.00		6.00	15618	0	0					0.0000	0.00000	0
										0.00000				**0.00000**	**0.00000**	**0**
79	Train-Train Collision	Pass Loco hits Loco	0.00747	Incl	0.00747	8.28	21553	8.41	181259	0.00135	320	0.6	192	0.062	0.0022	2676
		Pass Loco hits Pass Car	0.00102	Incl	0.00102	8.28	21553	8.41	181259	0.00018	320	0.6	192	0.003	0.0002	182
		Pass Loco hits Frt Car	0.00055	Incl	0.00055	8.28	21553	8.41	181259	0.00010	320	0.6	192	0.002	0.0001	98
		Pass car hit by Loco	0.00119	Incl	0.00119	8.28	21553	8.41	181259	0.00022	320	0.6	192	0.020	0.0009	850
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	15618	8.41	131347	0.00064	320	0.6	192	0.007	0.0002	287
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.12	0.01267	6.00	15618	8.41	131347	0.00166	320	0.6	192	0.035	0.0012	1480
	Overspeed		0.01100	0.00	0.01100	6.00	15618	8.41	131347	0.00144	320	0.6	192	0.058	0.0009	3757
	Broken Rail		0.01670	0.08	0.01536	6.00	15618	8.41	131347	0.00202	320	0.6	192	0.081	0.0013	5247
	Work Zone Violation			0.00		6.00	15618	8.41	131347					0.022	0.0022	0
										0.00762				**0.28969**	**0.00916**	**14575**
105	Train-Train Collision	Pass Loco hits Loco	0.00396	Incl	0.00396	8.28	21553	26.81	577832	0.00229	320	0.6	192	0.187	0.0070	7991
		Pass Loco hits Pass Car	0.00062	Incl	0.00062	8.28	21553	26.81	577832	0.00036	320	0.6	192	0.012	0.0006	626
		Pass Loco hits Frt Car	0.00035	Incl	0.00035	8.28	21553	26.81	577832	0.00020	320	0.6	192	0.007	0.0003	356
		Pass car hit by Loco	0.00072	Incl	0.00072	8.28	21553	26.81	577832	0.00042	320	0.6	192	0.067	0.0026	2907
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	15618	26.81	418719	0.00205	320	0.6	192	0.038	0.0013	1613
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.12	0.01267	6.00	15618	26.81	418719	0.00531	320	0.6	192	0.195	0.0069	8346
	Overspeed		0.01100	0.00	0.01100	6.00	15618	26.81	418719	0.00461	320	0.6	192	0.248	0.0040	21160
	Broken Rail		0.01670	0.08	0.01536	6.00	15618	26.81	418719	0.00643	320	0.6	192	0.346	0.0056	29554
	Work Zone Violation			0.00		6.00	15618	26.81	418719					0.091	0.0091	0
	Total									**0.02166**				**1.18934**	**0.03738**	**72553**
	Overall Totals									**0.03036**				**1.48990**	**0.04688**	**87129**
	Totals All Speeds	**Train-train Collisions**								**0.00531**				**0.36271**	**0.01383**	**15686**
		Intrusion Collisions								**0.01002**				**0.27512**	**0.00977**	**11726**
		Overspeed								**0.00627**				**0.30774**	**0.00493**	**24916**
		Broken Rail								**0.00876**				**0.42983**	**0.00689**	**34801**
		Work Zone Violation								**0.00000**				**0.11449**	**0.01145**	**0**

Number Diamonds	Freq'y per mill passes	Collisions (millions)	Injuries	Fatalities	Damage
1	0.000000	0.000000	0.000000	0.000000	0.00
1	0.000000	0.000000	0.000000	0.000000	0.00
1	0.009116	0.000196	0.001283	0.000038	49.32
1	0.001823	0.000039	0.001252	0.000038	39.49
		0.000236	**0.002535**	**0.000075**	**88.81**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.009116	0.000000	0.000000	0.000000	0.00
0	0.001823	0.000000	0.000000	0.000000	0.00
		0.000000	**0.00000**	**0.00000**	**0.00**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.009116	0.000000	0.000000	0.000000	0.00
0	0.001823	0.000000	0.000000	0.000000	0.00
		0.000000	**0.00000**	**0.00000**	**0.00**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.009116	0.000000	0.000000	0.000000	0.00
0	0.001823	0.000000	0.000000	0.000000	0.00
		0.000000	**0.00000**	**0.00000**	**0.00**
		0.000236	**0.002535**	**0.000075**	**89**

Table 3.6a: Risk Calculation - Freight Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Rate (per million tm)	Preventability	Adjusted Rate	Trips/day	Trips per 10 years	Length of Track (miles)	Per 10 years Train-miles	Accidents	Injuries	Fatalities	Damage $
25	Train-Train Collision	Frt Loco hits Loco	0.001079163	Incl	0.00108	8.28	21553	1.29	27803	0.00003	0.00001	0.000001	$3
		Frt Loco hits Car	0.000323749	Incl	0.00032	8.28	21553	1.29	27803	0.00001	0.00000	0.000000	$1
		Frt car hit by Loco	0.000755414	Incl	0.00076	8.28	21553	1.29	27803	0.00002	0.00000	0.000000	$1
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.43	0.00821	2.28	5935	1.29	7656	0.00006	0.00001	0.000001	$1
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.12	0.00757	2.28	5935	1.29	7656	0.00006	0.00001	0.000001	$1
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.00	0	1.29	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.00	0	1.29	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.00	0.01600	2.28	5935	1.29	7656	0.00012	0.00001	0.000001	$18
	Overspeed, Unequip		0.016	0.00	0.01600	0.00	0	1.29	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.08	0.05115	2.28	5935	1.29	7656	0.00039	0.00002	0.000002	$59
	Broken Rail, Unequip		0.056	0.00	0.05560	0.00	0	1.29	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.00		2.28	5935	1.29	7656		0.00032	0.000032	$0
	Work Zone Viol'n, Unequip			0.00		0.00	0	1.29	0		0.00000	0.000000	$0
	Totals									**0.0007**	**0.0004**	**0.00004**	**$83**
40	Train-Train Collision	Frt Loco hits Loco	0.0021	Incl	0.00215	8.28	21553	8.41	181259	0.00039	0.00043	0.000043	$105
		Frt Loco hits Car	0.0004	Incl	0.00035	8.28	21553	8.41	181259	0.00006	0.00006	0.000006	$14
		Frt car hit by Loco	0.0007	Incl	0.00073	8.28	21553	8.41	181259	0.00013	0.00000	0.000000	$15
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.43	0.00821	2.28	5935	8.41	49912	0.00041	0.00009	0.000009	$11
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.12	0.00757	2.28	5935	8.41	49912	0.00038	0.00008	0.000009	$11
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.00	0	8.41	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.00	0	8.41	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.00	0.01600	2.28	5935	8.41	49912	0.00080	0.00011	0.000011	$299
	Overspeed, Unequip		0.016	0.00	0.01600	0.00	0	8.41	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.08	0.05115	2.28	5935	8.41	49912	0.00255	0.00037	0.000037	$957
	Broken Rail, Unequip		0.056	0.00	0.05560	0.00	0	8.41	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.00		2.28	5935	8.41	49912		0.00329	0.000329	$0
	Work Zone Viol'n, Unequip			0.00		0.00	0	8.41	0		0.00000	0.000000	$0
	Totals									**0.00472**	**0.0044**	**0.00044**	**$1,413**
50	Train-Train Collision	Frt Loco hits Loco	0.0011	Incl	0.00111	8.28	21553	26.81	577832	0.00064	0.00109	0.000109	$272
		Frt Loco hits Car	0.0002	Incl	0.00021	8.28	21553	26.81	577832	0.00012	0.00017	0.000017	$42
		Frt car hit by Loco	0.0005	Incl	0.00046	8.28	21553	26.81	577832	0.00027	0.00000	0.000000	$47
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.43	0.00821	2.28	5935	26.81	159113	0.00131	0.00046	0.000046	$57
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.12	0.00757	2.28	5935	26.81	159113	0.00120	0.00042	0.000042	$53
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.00	0	26.81	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.00	0	26.81	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.00	0.01600	2.28	5935	26.81	159113	0.00255	0.00089	0.000089	$1,492
	Overspeed, Unequip		0.016	0.00	0.01600	0.00	0	26.81	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.08	0.05115	2.28	5935	26.81	159113	0.00814	0.00285	0.000285	$4,769
	Broken Rail, Unequip		0.056	0.00	0.05560	0.00	0	26.81	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.00		2.28	5935	26.81	159113		0.01321	0.001321	$0
	Work Zone Viol'n, Unequip			0.00		0.00	0	26.81	0		0.00000	0.000000	$0
	Totals									**0.01423**	**0.0191**	**0.00191**	**$6,733**
	Overall Totals									**0.01964**	**0.0239**	**0.0024**	**$8,229**
Totals All Speeds	**Train-Train Collisions**									**0.00168**	**0.00176**	**0.00018**	**500**
	Intrusion Collisions									**0.00342**	**0.00107**	**0.00011**	**134**
	Diamond Collisions									**0.00127**	**0.00056**	**0.00006**	**213**
	Overspeed									**0.00347**	**0.00101**	**0.00010**	**1810**
	Broken Rail									**0.01108**	**0.00324**	**0.00032**	**5786**
	Work Zone Violation									**0.00000**	**0.01682**	**0.00168**	**0**
	Grade Crossing Collisions												

Table 3.6b: Risk Calculation - Collisions at Diamonds - Freight

Number Diamonds	Freq'y per mill passes	Collisions (millions)	Injuries	Fatalities	Damage
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.028894	0.000000	0.000000	0.000000	0.00
0	0.030187	0.000000	0.000000	0.000000	0.00
		0.000000	**0.000000**	**0.000000**	**0.00**
1	0.000000	0.000000	0.000000	0.000000	0.00
1	0.028894	0.000623	0.000560	0.000056	140.12
1	0.030187	0.000651	0.000000	0.000000	72.87
		0.001273	**0.000560**	**0.000056**	**212.99**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.028894	0.000000	0.000000	0.000000	0.00
0	0.030187	0.000000	0.000000	0.000000	0.00
		0.000000	**0.000000**	**0.000000**	**0.00**
		0.001273	**0.000560**	**0.000056**	**$213**

Table 3.7: Risk Calculations: Passenger and Freight Trains; Grade Crossings

Train Type	Representative Speed (mph)	Type of Grade-crossing	Base Collision Frequency	Preventability Factor	Adjusted Collision Frequency	Trips per Day	Crossing Passes per Trip	Crossing Passes per 10 Years	Collisions per 10 Years	Seats per Train (Passenger)	Occupancy Factor	Passengers per Train	Passenger/ Crew Injuries per 10 Years	Passenger/ Crew Fatalities per 10 Years	Damage per 10 Years ($)
Passenger	40	Public_gates_lights	0.35	0%	0.350	6.00	7	109326	0.038	320	0.60	192	0.0206	0.0003	1913
		Public_other	0.30	0%	0.300	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Private	0.10	0%	0.100	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
	60	Public_gates_lights	0.60	0%	0.600	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Public_other	0.50	0%	0.500	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Private	0.20	0%	0.200	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
	79	Public_gates_lights	0.80	0%	0.800	6.00	16	249888	0.200	320	0.60	192	0.4030	0.0060	39182
		Public_other	0.65	0%	0.650	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Private	0.30	0%	0.300	6.00	1	15618	0.005	320	0.60	192	0.0094	0.0001	918
	105	Public_gates_lights	1.10	0%	1.100	6.00	16	249888	0.275	320	0.60	192	0.9816	0.0146	95107
		Public_other	0.80	0%	0.800	6.00	1	15618	0.012	320	0.60	192	0.0446	0.0007	4323
		Private	0.30	0%	0.300	6.00	6	93708	0.028	320	0.60	192	0.1004	0.0015	9727
Freight	25	Public_gates_lights	0.15	0%	0.150	2.28	7	41544	0.006				0.00075	0.00003	125
Equipped		Public_other	0.12	0%	0.120	2.28	0	0	0.000				0.00000	0.00000	0
		Private	0.05	0%	0.050	2.28	0	0	0.000				0.00000	0.00000	0
	40	Public_gates_lights	0.30	0%	0.300	2.28	16	94957	0.028				0.00712	0.00037	1424
		Public_other	0.25	0%	0.250	2.28	0	0	0.000				0.00000	0.00000	0
		Private	0.10	0%	0.100	2.28	1	5935	0.001				0.00015	0.00001	30
	50	Public_gates_lights	0.36	0%	0.360	2.28	16	94957	0.034				0.01333	0.00068	2666
		Public_other	0.30	0%	0.300	2.28	1	5935	0.002				0.00069	0.00004	139
		Private	0.12	0%	0.120	2.28	6	35609	0.004				0.00167	0.00009	333
Freight	25	Public_gates_lights	0.15	0%	0.150	0.00	7	0	0.000				0.00000	0.00000	0
Unequipped		Public_other	0.12	0%	0.120	0.00	0	0	0.000				0.00000	0.00000	0
		Private	0.05	0%	0.050	0.00	0	0	0.000				0.00000	0.00000	0
	40	Public_gates_lights	0.30	0%	0.300	0.00	16	0	0.000				0.00000	0.00000	0
		Public_other	0.25	0%	0.250	0.00	0	0	0.000				0.00000	0.00000	0
		Private	0.10	0%	0.100	0.00	1	0	0.000				0.00000	0.00000	0
	50	Public_gates_lights	0.36	0%	0.360	0.00	16	0	0.000				0.00000	0.00000	0
		Public_other	0.30	0%	0.300	0.00	1	0	0.000				0.00000	0.00000	0
		Private	0.12	0%	0.120	0.00	6	0	0.000				0.00000	0.00000	0
								Total - Passenger	**0.558**				**1.560**	**0.023**	**151171**
Risk Calculations: Passenger and Freight Trains; Diamonds								**Total - Freight**	**0.076**				**0.024**	**0.001**	**4717**
Train Type								**Totals - All Speeds**	**0.634**				**1.58**	**0.02**	**155889**

Table 3.8: Summary - All Risks

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00531	0.36271	0.01383	15686	93461
	Intrusion Collisions	0.01002	0.27512	0.00977	11726	68549
	Diamond Collisions	0.000236	0.00253	0.00008	89	569
	Overspeed	0.00627	0.30774	0.00493	24916	70493
	Broken Rail	0.00876	0.42983	0.00689	34801	98459
	Work Zone Violation	0.00000	0.11449	0.01145	0	45798
	Grade Crossing Collisions	0.55834	1.55969	0.02319	151171	376715
	Total, All Scenarios	0.58894	3.05212	0.07015	238389	754043
Freight	Train-Train Collisions	0.00168	0.00176	0.00018	500	1206
	Intrusion Collisions	0.00342	0.00107	0.00011	134	562
	Diamond Collisions	0.00127	0.00056	0.00006	213	437
	Overspeed	0.00347	0.00101	0.00010	1810	2215
	Broken Rail	0.01108	0.00324	0.00032	5786	7081
	Work Zone Violation	0.00000	0.01682	0.00168	0	6729
	Grade Crossing Collisions	0.07555	0.02371	0.00121	4717	10730
	Total, All Scenarios	0.09647	0.04818	0.00366	13159	28959
	Total Passenger + Freight	**0.68541**	**3.10030**	**0.07381**	**251548**	**783003**
	Unit Costs ($/Casualty)		100000	3000000		

Data exported to the Results Summary worksheet

Worksheet 2 - B,N,R: Collision Frequencies Calculation - Base Case II: Northeast Corridor ATC, 85% Preventability, Bloomington Sub-corridor, Summer

Table 2.1a: Collision Distribution Matrix (Fraction Accidents by Train Pair and Collision Type). Collisions Between Trains Operating on the IDOT Test Corridor Only (not diamonds and intrusions)

	Train Pairs in In Collision	Collision Scenario Prob (Top Level)	Siding - Monitored: Collision Distribution Head On	Siding - Monitored: Collision Distribution Rear/Side	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty
	Percent Guilty				100%	0%	100%	0%
Both Trains TBE (Note 3)	Pass-Pass	0.71	0.50	0.50	0.355	0	0.355	0
	Pass-TBE Freight	0.29	0.50	0.50	0.145	0	0.145	0
	TBE Freight - TBE Freight	0.00	0.50	0.50	0	0	0	0
	Percent Guilty				50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	0.00	1	0	0	0	0	0
	Rear/Side, Pass into NE Frt		0	1	0	0	0	0
	Rear/Side NE Frt into Pass		0	1	0	0	0	0
	TBE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0
	Percent Guilty				0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0
	Total Probability (checking)	1		1	0.5	0	0.5	0

	Train Pairs in In Collision	Siding - Unmonitored: Collision Distribution Head On	Siding - Unmonitored: Collision Distribution Rear/Side	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
	Percent Guilty			100%	0%	100%	0%
Both Trains TBE	Pass-Pass	0.8	0.2	0.568	0	0.142	0
	Pass-TBE Freight	0.7	0.3	0.203	0	0.087	0
	TBE Freight - TBE Freight	0.7	0.3	0	0	0	0
	Percent Guilty			50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	1	0	0	0	0	0
	Rear/Side, Pass into NE Frt	0	1	0	0	0	0
	Rear/Side NE Frt into Pass	0	1	0	0	0	0
	TBE Freight - NE Freight	0.7	0.3	0	0	0	0
	Percent Guilty			0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.7	0.3	0	0	0	0
		0.771	0	0.229	0		

	Train Pairs in In Collision	CP Adjacent - Monitored Siding: Collision Distribution Head On	CP Adjacent - Monitored Siding: Collision Distribution Rear/Side	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty
	Percent Guilty			100%	0%	100%	0%
Both Trains TBE	Pass-Pass	0.8	0.2	0.568	0	0.142	0
	Pass-TBE Freight	0.7	0.3	0.203	0	0.087	0
	TBE Freight - TBE Freight	0.7	0.3	0	0	0	0
	Percent Guilty			50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	1	0	0	0	0	0
	Rear/Side, Pass into NE Frt	0	1	0	0	0	0
	Rear/Side NE Frt into Pass	0	1	0	0	0	0
	TBE Freight - NE Freight	0.7	0.3	0	0	0	0
	Percent Guilty			0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.7	0.3	0	0	0	0
		0.771	0	0.229	0		

	Train Pairs in In Collision	CP Adjacent - Unmonitored Siding: Collision Distribution Head On	CP Adjacent - Unmonitored Siding: Collision Distribution Rear/Side	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
	Percent Guilty			100%	0%	100%	0%
Both Trains TBE	Pass-Pass	0.8	0.2	0.568	0	0.142	0
	Pass-TBE Freight	0.7	0.3	0.203	0	0.087	0
	TBE Freight - TBE Freight	0.7	0.3	0	0	0	0
	Percent Guilty			50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	1	0	0	0	0	0
	Rear/Side, Pass into NE Frt	0	1	0	0	0	0
	Rear/Side NE Frt into Pass	0	1	0	0	0	0
	TBE Freight - NE Freight	0.7	0.3	0	0	0	0
	Percent Guilty			0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.7	0.3	0	0	0	0
		1		0.771	0	0.229	0

	Train Pairs in In Collision	Plain Track: Collision Distribution Head On	Plain Track: Collision Distribution Rear/Side	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
	Percent Guilty			100%	0%	100%	0%
Both Trains TBE	Pass-Pass	0.70	0.30	0.497	0	0.213	0
	Pass-TBE Freight	0.40	0.60	0.116	0	0.174	0
	TBE Freight - TBE Freight	0.50	0.50	0	0	0	0
	Percent Guilty			50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	1.00	0.00	0	0	0	0
	Rear/Side, Pass into NE Frt	0.00	1.00	0	0	0	0
	Rear/Side NE Frt into Pass	0.00	1.00	0	0	0	0
	TBE Freight - NE Freight	0.50	0.50	0	0	0	0
	Percent Guilty			0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.50	0.50	0	0	0	0
	Total Probability (checking)		1	0.613	0	0.387	0

Table 2.1b: Collision Type Distribution - Diamonds

	Train Pairs in In Collision	Train Pair Type	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty
	Percent Guilty			
Both Trains TBE	Pass-Pass	Both Trains TBE		
	Pass-TBE Freight			
	TBE Freight - TBE Freight			
One Train TBE	**Percent Guilty**	One Train TBE	50%	50%
	Pass - NE Freight, Head -On		0	0
	Rear/Side, Pass into NE Frt		0.25	0.25
	Rear/Side NE Frt into Pass		0.05	0.05
	TBE Freight - NE Freight		0.1	0.1
Neither Train TBE	**Percent Guilty**			100%
	NE Freight - NE Freight		0	0.2
	Total Probability (checking)		0.4	0.6

Note. The gray cells on these rows are set at zero, because in every case, the condition represented by the cell does not exist - either because there are no unequipped passenger trains, or because of the kind of collision defined for the row.

Quantity in cell C18 is for all collisions between a passenger train and an unequipped freight train

Table 2.2: Preventability Data For Unequipped train Guilty, One Train TBE

Segment Type	Not Prevented of Mitigated: Freight	Not Prevented of Mitigated: Pass	Not Prevented of Mitigated: HS Pass	Mitigated: Freight	Mitigated: Pass	Mitigated: HS Pass	Prevented: Freight	Prevented: Pass	Prevented: HS Pass
Siding (M)	0.342	0.364	0.542	0.249	0.188	0.252	0.459	0.518	0.257
Siding (U)	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100
CP Adjacent (M)	0.269	0.342	0.526	0.230	0.187	0.296	0.550	0.521	0.229
CP Adjacent (U)	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100
Plain Track	0.308	0.391	0.601	0.000	0.000	0.020	0.100	0.100	0.080
Diamonds	0.135	0.265	0.253	0.172	0.000	0.200	0.743	0.785	0.597

Mauve cells contain data imported from previous worksheet in a group of three worksheets covering one sub-corridor, season and operating state.

Table 2.3a: Collision Preventability Matrix (Percent Accidents Preventable Relative to CTC Reference Case)

	Train Pairs in In Collision	Preventability Equipped Train Guilty	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	85%	85%		85%	
	Pass-TBE Freight	85%	85%		85%	
	TBE Freight - TBE Freight	85%	85%		85%	
One TBE	Pass - NE Freight, Head -On	85%	85%	26%		
	Rear/Side, Pass into NE Frt	85%			85%	26%
	Rear/Side NE Frt into Pass	85%			85%	0%
	TBE Freight - NE Freight	85%	85%	46%	85%	0%
Neither TBE	NE Freight - NE Freight			0%		0%
Reference Case (CTC) Collision Accident Likelihood by Segment Type (collisions/million train miles)		0.030				

	Train Pairs in In Collision	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	85%		85%	
	Pass-TBE Freight	85%		85%	
	TBE Freight - TBE Freight	85%		85%	
One TBE	Pass - NE Freight, Head -On	85%	10%		
	Rear/Side, Pass into NE Frt			85%	10%
	Rear/Side NE Frt into Pass			85%	0%
	TBE Freight - NE Freight	85%	10%	85%	0%
Neither TBE	NE Freight - NE Freight		0%		0%
		0.040			

	Train Pairs in In Collision	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	85%		85%	
	Pass-TBE Freight	85%		85%	
	TBE Freight - TBE Freight	85%		85%	
One TBE	Pass - NE Freight, Head -On	85%	23%		
	Rear/Side, Pass into NE Frt			85%	23%
	Rear/Side NE Frt into Pass			85%	0%
	TBE Freight - NE Freight	85%	55%	85%	0%
Neither TBE	NE Freight - NE Freight		0%		0%
		0.050			

	Train Pairs in In Collision	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	85%		85%	
	Pass-TBE Freight	85%		85%	
	TBE Freight - TBE Freight	85%		85%	
One TBE	Pass - NE Freight, Head -On	85%	10%		
	Rear/Side, Pass into NE Frt			85%	10%
	Rear/Side NE Frt into Pass			85%	0%
	TBE Freight - NE Freight	85%	10%	85%	0%
Neither TBE	NE Freight - NE Freight		0%		0%
		0.060			

	Train Pairs in In Collision	Plain Track: Collision Distribution Head On	Plain Track: Collision Distribution Rear/Side	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass			85%		85%	
	Pass-TBE Freight			85%		85%	
	TBE Freight - TBE Freight			85%		85%	
One TBE	Pass - NE Freight, Head -On			85%	8%		
	Rear/Side, Pass into NE Frt					85%	8%
	Rear/Side NE Frt into Pass					85%	0%
	TBE Freight - NE Freight			85%	10%	85%	0%
Neither TBE	NE Freight - NE Freight				0%		0%
		0.006				Collisions/million diamond passes	

Table 2.3b: Collision Preventability Matrix - Diamonds

	Train Pairs in In Collision	Train Pair Type	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	Both TBE		
	Pass-TBE Freight			
	TBE Freight - TBE Freight			
One TBE	Pass - NE Freight, Head -On	One TBE		
	Rear/Side, Pass into NE Frt		85%	78.54%
	Rear/Side NE Frt into Pass		85%	78.54%
	TBE Freight - NE Freight		85%	74.29%
Neither TBE	NE Freight - NE Freight	Neither TBE		0.00%
		0.1		

Table 2.4a: Passenger Trains in Train-to-Train Collisions (Trains in Collisions per Million Train-Miles)

	Train Pairs in In Collision	Passenger Trains in Collisions	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	2	0.0032		0.0032	
	Pass-TBE Freight	1	0.0007		0.0007	
	TBE Freight - TBE Freight	0				
One TBE	Pass - NE Freight, Head -On	1	0.0000	0.0000		
	Rear/Side, Pass into NE Frt	1			0.0000	0.0000
	Rear/Side NE Frt into Pass	1			0.0000	0.0000
	TBE Freight - NE Freight	0				
Neither TBE	NE Freight - NE Freight	0				
	Checking total		0.0038	0.0000	0.0038	0.0000
	Scenario Totals - Passenger	**Tots, P-UF**	**Totals**			
	Pass Loco Hits Loco	0.0000	0.0038	0.0038	0.0000	
	Pass Loco Hits Pass Car		0.0016			0.0016
	Pass Loco Hits Freight Car	0.0000	0.0005			0.0005
	Pass Car Hit by Loco	0.0000	0.0017			0.0017
	Total		0.0077	0.0038	0.0000	0.0038

	Train Pairs in In Collision	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	0.0043		0.0043	
	Pass-TBE Freight	0.0009		0.0009	
	TBE Freight - TBE Freight				
One TBE	Pass - NE Freight, Head -On	0.0000	0.0000		
	Rear/Side, Pass into NE Frt			0.0000	0.0000
	Rear/Side NE Frt into Pass			0.0000	0.0000
	TBE Freight - NE Freight				
Neither TBE	NE Freight - NE Freight		0.0000		0.0000
	Checking total	0.0051	0.0000	0.0051	0.0000
	Scenario Totals - Passenger	**Totals**			
	Pass Loco Hits Loco	0.0051	0.0000		
	Pass Loco Hits Pass Car	0.0021		0.0021	
	Pass Loco Hits Freight Car	0.0007		0.0007	
	Pass Car Hit by Loco	0.0023	0.0000	0.0023	0.0000
	Total	0.0103	0.0051	0.0000	0.0051

	Train Pairs in In Collision	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	0.0085		0.0021	
	Pass-TBE Freight	0.0015		0.0007	
	TBE Freight - TBE Freight				
One TBE	Pass - NE Freight, Head -On	0.0000	0.0000		
	Rear/Side, Pass into NE Frt			0.0000	0.0000
	Rear/Side NE Frt into Pass			0.0000	0.0000
	TBE Freight - NE Freight				
Neither TBE	NE Freight - NE Freight		0.0000		0.0000
	Checking total	0.0100	0.0000	0.0028	0.0000
	Scenario Totals - Passenger	**Totals**			
	Pass Loco Hits Loco	0.0000	0.0100		
	Pass Loco Hits Pass Car		0.0011		
	Pass Loco Hits Freight Car	0.0000	0.0005		
	Pass Car Hit by Loco	0.0000	0.0012	0.0000	0.0000
	Total	0.0128	0.0100	0.0000	0.0028

	Train Pairs in In Collision	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	0.0102		0.0026	
	Pass-TBE Freight	0.0018		0.0008	
	TBE Freight - TBE Freight				
One TBE	Pass - NE Freight, Head -On	0.0000	0.0000		
	Rear/Side, Pass into NE Frt			0.0000	0.0000
	Rear/Side NE Frt into Pass			0.0000	0.0000
	TBE Freight - NE Freight				
Neither TBE	NE Freight - NE Freight		0.0000		0.0000
	Checking total	0.0121	0.0000	0.0033	0.0000
	Scenario Totals - Passenger	**Totals**			
	Pass Loco Hits Loco	0.0000	0.0121		
	Pass Loco Hits Pass Car		0.0013		
	Pass Loco Hits Freight Car	0.0000	0.0006		
	Pass Car Hit by Loco	0.0000	0.0015	0.0000	0.0000
	Total	0.0154	0.0121	0.0000	0.0033

	Train Pairs in In Collision	Plain Track: Collision Distribution Head On	Plain Track: Collision Distribution Rear/Side	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass			0.0009		0.0004	
	Pass-TBE Freight			0.0001		0.0002	
	TBE Freight - TBE Freight						
One TBE	Pass - NE Freight, Head -On			0.0000	0.0000		
	Rear/Side, Pass into NE Frt					0.0000	0.0000
	Rear/Side NE Frt into Pass					0.0000	0.0000
	TBE Freight - NE Freight						
Neither TBE	NE Freight - NE Freight				0.0000		0.0000
	Checking total			0.0010	0.0000	0.0005	0.0000
	Scenario Totals - Passenger		**Totals**				
	Pass Loco Hits Loco		0.0010				
	Pass Loco Hits Pass Car					0.0002	
	Pass Loco Hits Freight Car					0.0001	
	Pass Car Hit by Loco		0.0002			0.0002	0.0000
	Total		0.0015	0.0010	0.0000	0.0005	0.0000

Table 2.4b: Passenger Trains in Collisions at Diamonds

	Train Pairs in In Collision	Train Pair Type	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	Both TBE		
	Pass-TBE Freight			
	TBE Freight - TBE Freight			
One TBE	Pass - NE Freight, Head -On	One TBE		
	Rear/Side, Pass into NE Frt		0.003750	0.005366
	Rear/Side NE Frt into Pass		0.000750	0.001073
	TBE Freight - NE Freight		0.000000	0.000000
Neither TBE	NE Freight - NE Freight	Neither TBE		0.000000
			0.00450	0.00644
	Scenario Totals - Passenger	**Totals**		
	Pass Loco Hits Loco			
	Pass Loco Hits Pass Car		0.003750	0.005366
	Pass Loco Hits Freight Car	0.009116	0.000750	0.001073
	Pass Car Hit by Loco	0.001823	0.000750	0.001073
	Total	0.010938	0.004500	0.006439

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Table 2.5a: Freight trains in Train-to-Train Collisions (Trains in Collisions per Million Train-Miles)

	Train Pairs in In Collision	Freight Trains in Collisions	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	0				
	Pass-TBE Freight	1	0.0007		0.0007	
	TBE Freight - TBE Freight	2	0.0000		0.0000	
One TBE	Pass - NE Freight, Head -On	1	0.0000	0.0000		
	Rear/Side, Pass into NE Frt	1			0.0000	0.0000
	Rear/Side NE Frt into Pass	1			0.0000	0.0000
	TBE Freight - NE Freight	2	0.0000	0.0000	0.0000	0.0000
Neither TBE	NE Freight - NE Freight	2		0.0000		0.0000
	Checking total		0.0007	0.0000	0.0007	0.0000
	Scenario Totals - Freight	**Totals**				
	Freight Loco Hits Loco	0.0000	0.0007	0.0007	0.0000	
	Freight Loco Hits Car	0.0000	0.0001			0.00013
	Freight Car Hit By Loco	0.0000	0.0005			0.00052
	Total		0.0013	0.0007	0.0000	0.0007

	Train Pairs in In Collision	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass				
	Pass-TBE Freight	0.0009		0.0009	
	TBE Freight - TBE Freight	0.0000		0.0000	
One TBE	Pass - NE Freight, Head -On	0.0000	0.0000		
	Rear/Side, Pass into NE Frt			0.0000	0.0000
	Rear/Side NE Frt into Pass			0.0000	0.0000
	TBE Freight - NE Freight	0.0000	0.0000	0.0000	0.0000
Neither TBE	NE Freight - NE Freight		0.0000		0.0000
	Checking total	0.0009	0.0000	0.0009	0.0000
	Scenario Totals - Freight	**Totals**			
	Freight Loco Hits Loco	0.0009	0.0000		
	Freight Loco Hits Car	0.0002		0.00017	0.00000
	Freight Car Hit By Loco	0.0007		0.00070	0.00000
	Total	0.0017	0.0009	0.0000	0.0009

	Train Pairs in In Collision	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass				
	Pass-TBE Freight	0.0015		0.0007	
	TBE Freight - TBE Freight	0.0000		0.0000	
One TBE	Pass - NE Freight, Head -On	0.0000	0.0000		
	Rear/Side, Pass into NE Frt			0.0000	0.0000
	Rear/Side NE Frt into Pass			0.0000	0.0000
	TBE Freight - NE Freight	0.0000	0.0000	0.0000	0.0000
Neither TBE	NE Freight - NE Freight		0.0000		0.0000
	Checking total	0.0015	0.0000	0.0007	0.0000
	Scenario Totals - Freight	**Totals**			
	Freight Loco Hits Loco	0.0015	0.0015	0.0000	
	Freight Loco Hits Car	0.0002			0.00016
	Freight Car Hit By Loco	0.0005			0.00049
	Total	0.0022	0.0015	0.0000	0.0007

	Train Pairs in In Collision	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass				
	Pass-TBE Freight	0.0018		0.0008	
	TBE Freight - TBE Freight	0.0000		0.0000	
One TBE	Pass - NE Freight, Head -On	0.0000	0.0000		
	Rear/Side, Pass into NE Frt			0.0000	0.0000
	Rear/Side NE Frt into Pass			0.0000	0.0000
	TBE Freight - NE Freight	0.0000	0.0000	0.0000	0.0000
Neither TBE	NE Freight - NE Freight		0.0000		0.0000
	Checking total	0.0018	0.0000	0.0008	0.0000
	Scenario Totals - Freight	**Totals**			
	Freight Loco Hits Loco	0.0018	0.0018	0.0000	
	Freight Loco Hits Car	0.0002			0.00020
	Freight Car Hit By Loco	0.0006			0.00059
	Total	0.0026	0.0018	0.0000	0.0008

	Train Pairs in In Collision	Plain Track: Collision Distribution Head On	Plain Track: Collision Distribution Rear/Side	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass						
	Pass-TBE Freight			0.0001		0.0002	
	TBE Freight - TBE Freight			0.0000		0.0000	
One TBE	Pass - NE Freight, Head -On			0.0000	0.0000		
	Rear/Side, Pass into NE Frt					0.0000	0.0000
	Rear/Side NE Frt into Pass					0.0000	0.0000
	TBE Freight - NE Freight			0.0000	0.0000	0.0000	0.0000
Neither TBE	NE Freight - NE Freight				0.0000		0.0000
	Checking total			0.0001	0.0000	0.0002	0.0000
	Scenario Totals - Freight		**Totals**				
	Freight Loco Hits Loco		0.0001	0.0001	0.0000		
	Freight Loco Hits Car		0.0000			0.00003	0.00000
	Freight Car Hit By Loco		0.0001			0.00013	0.00000
	Total		0.0003	0.0001	0.0000	0.0002	0.0000

Table 2.5b: Freight Trains in Collisions at Diamonds

	Train Pairs in In Collision	Train Pair Type	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	Both TBE		
	Pass-TBE Freight			
	TBE Freight - TBE Freight			
One TBE	Pass - NE Freight, Head -On	One TBE		
	Rear/Side, Pass into NE Frt		0.003750	0.005366
	Rear/Side NE Frt into Pass		0.000750	0.001073
	TBE Freight - NE Freight		0.003000	0.005141
Neither TBE	NE Freight - NE Freight	Neither TBE		0.040000
			0.00750	0.05158
	Scenario Totals - Freight	**Totals**		
	Freight Loco Hits Loco			
	Freight Loco Hits Car	0.028894	0.005250	0.023644
	Freight Car Hit By Loco	0.030187	0.002250	0.027937
	Total	0.059081	0.007500	0.051581

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Freight Plus Passenger Totals (check): 0.0600 0.0090 | 0.0800 0.0120 | 0.1000 0.0150 | 0.1200 0.0180 | 0.0018

In rear-end/side collisions between like trains there is one loco hits car and one car hit by loco in each collision. In rear/side collisions between a passenger and freight trains, the ratio between passenger hits freight and freight loco hits passenger car are a function of the percentages given in Table IN-5b on the Inputs sheet. The values are given in the tables beneath the trains in collisions for each segment type.

Collision Type	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.8	0.2

Collision Type	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.80	0.20

Collision Type	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.75	0.25

Collision Type	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.75	0.25

Collision Type	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.83	0.17

Worksheet 3 - B,N,S: - Risk Calculations - Base Case II: Northeast Corridor ATC, 85% Preventability, Bloomington Sub-corridor, Summer

Table 3.1: Consequences Look-up Tables (Data Sources: Previous ICF Passenger Corridor Project (passenger), FRA Accident Data 2001-5 (freight)

Passenger Trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 40 mph			Representative Speed 60 mph			Representative Speed 79 mph			Representative Speed 105 mph		
			Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Pass Loco hits Loco	0.083	0.002	502000	0.139	0.0049	1142000	0.24	0.0085	1976000	0.425	0.016	3495000
		Pass Loco hits Pass Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.008	1747000
		Pass Loco hits Frt Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.008	1747000
		Pass car hit by Loco	0.166	0.005	1005000	0.275	0.0119	2284000	0.476	0.0206	3951000	0.841	0.032	6989000
	Intrusion Collision (rollout)	Pass Loco hits Car	0.013	0.0005	113000	0.031	0.0011	257000	0.054	0.0019	445000	0.096	0.0034	786000
	Intrusion Collision (other))	Pass Loco hits Car	0.026	0.0009	226000	0.063	0.0022	514000	0.108	0.0038	889000	0.191	0.0068	1573000
	Overspeed		0.044	0.0004	667000	0.14	0.00186	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Broken Rail		0.044	0.0004	667000	0.14	0.00186	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Work Zone Violation		0.083	0.0083	0	0.125	0.0125	0	0.164	0.0164	0	0.218	0.0218	0

Freight trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 25 mph			Representative Speed 40 mph			Representative Speed 50 mph		
			Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Frt Loco hits Loco	0.43	0.043	105000	1.1	0.11	270000	1.7	0.17	422000
		Frt Loco hits Car	0.35	0.035	88000	0.9	0.09	225000	1.4	0.14	352000
		Frt car hit by Loco	0	0	44000	0	0	112000	0	0	176000
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Overspeed, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Overspeed, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Work Zone Viol'n, Equip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0
	Work Zone Viol'n, Unequip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0

Casualties and damage in Table 3.1 are per accident, except for Work Zone Violations which are per million train-miles

Table 3.2: Grade Crossing and Diamonds: Numbers by Rfepresentative Speed, and Accident Frequency and Consequences

Train Type	Representative Speed (mph)	Type of Grade-crossing	Number Crossings			Accident Frequency		Crossing Collision Consequences						Number Diamonds
			Passenger	HS Passenger	Freight	Per Million Crossing Passes		Pass. Occup't Casualty Prob/accident)			Freight Trains (per accident)			
						Passenger	Freight	Injuries	Fatalities	Cost $/Accid't	Injuries	Fatalities	Cost $	
Passenger	40	Public_gates_lights	7	7		0.350		0.0028	0.000047	50000				1
		Public_other	0	0		0.300								
		Private	0	0		0.100								
	60	Public_gates_lights	16	0		0.600		0.0068	0.000112	113000				0
		Public_other	0	0		0.500								
		Private	1	0		0.200								
	79	Public_gates_lights	16	16		0.800		0.0105	0.000156	196000				0
		Public_other	1	0		0.650								
		Private	6	1		0.300								
	105	Public_gates_lights	0	16		1.100		0.0186	0.000276	346000				0
		Public_other	0	1		0.800								
		Private	0	6		0.300								
Freight	25	Public_gates_lights			7	0.150					0.12	0.005	20000	0
		Public_other			0	0.120								
		Private			0	0.050								
	40	Public_gates_lights			16	0.300					0.25	0.013	50000	1
		Public_other			0	0.250								
		Private			1	0.100								
	50	Public_gates_lights			16	0.360					0.39	0.02	78000	0
		Public_other			1	0.300								
		Private			6	0.120								

Table 3.3a: Segment Data (for reference only, not used in calculations)

Segment Number	Start (Milepost)	End (Milepost)	Type	Length (miles)	Representative Speed (mph)			
					Freight	Pass	HS Pass (conseq)	HS Pass
14.0	88.35	90.55	Plain	2.20	50	79	79	105
15.0	90.55	92.47	CP Adjacent (M)	1.92	40	60	60	79
16.0	92.47	94.97	Siding (M)	2.50	50	79	79	105
17.0	94.97	96.81	CP Adjacent (M)	1.84	50	79	79	105
18.0	96.81	100.28	Plain	3.47	50	79	79	105
19.0	100.28	102.25	CP Adjacent (M)	1.97	40	60	60	79
20.0	102.25	102.25	Diamond	0.00	40	40	40	40
21.0	102.25	104.60	CP Adjacent (M)	2.35	40	60	60	79
22.0	104.60	106.43	CP Adjacent (M)	1.83	50	79	79	105
23.0	106.43	108.83	Siding (M)	2.40	50	79	79	105
24.0	108.83	111.36	CP Adjacent (M)	2.53	50	79	79	105
25.0	111.36	113.30	Plain	1.94	50	79	79	105
26.0	113.30	116.36	Plain	3.06	50	79	79	105
27.0	116.36	118.83	Plain	2.47	50	79	79	105
28.0	118.83	121.40	CP Adjacent (M)	2.57	50	79	79	105
29.0	121.40	123.57	Siding (M)	2.17	40	60	79	79
30.0	123.57	124.38	Siding (M)	0.81	25	40	40	40
31.0	124.38	124.86	Siding (M)	0.48	25	40	40	40
	Length Check	36.5		36.5				

Table 3.3b: Aggregate Segment Data: SegmentsTypes, Train Types, Speeds, and Lengths

Aggregate Segment Length by Type and Speed Band (from Seg Def and Preventability)

Segment Type	Train Type	Represent've Speed (mph)	Freight (miles)	Reg Pass (miles)	HS Pass Collision (mi)	HS Pass Other (mi)
Siding (mon)	Freight	25	1.29			
		40	2.17			
		50	4.9			
	Passenger	40		1.29	1.29	1.29
		60		2.17	0	0
		79		4.9	7.07	2.17
		105		0	0	4.9
Siding (unmon)	Freight	25	0			
		40	0			
		50	0			
	Passenger	40		0	0	0
		60		0	0	0
		79		0	0	0
		105		0	0	0
CP Adjacent (mon)	Freight	25	0			
		40	6.24			
		50	8.77			
	Passenger	40		0	0	0
		60		6.24	6.24	0
		79		8.77	8.77	6.24
		105		0	0	8.77
CP Adjacent (unmon)	Freight	25	0			
		40	0			
		50	0			
	Passenger	40		0	0	0
		60		0	0	0
		79		0	0	0
		105		0	0	0
Plain Track	Freight	25	0			
		40	0			
		50	13.14			
	Passenger	40		0	0	0
		60		0	0	0
		79		13.14	13.14	0
		105		0	0	13.14
Totals All Types	Freight	25	1.29			
		40	8.41			
		50	26.81			
	Passenger	40		1.29	1.29	1.29
		60		8.41	6.24	0
		79		26.81	28.98	8.41
		105		0	0	26.81
	Checking Totals		36.51	36.51	36.51	36.51

Table 3.4a: Traffic Inputs to Risk Calculation

Trips/Day		
Train Type	Summer	Rest of Year
Passenger	6.00	6.00
Equipped Freight	1.43	2.28
Unequipped Freight	0.00	0.00
Operating Days	91.00	274.00

Percent Train-Miles in	
Timeout (secs)	0.00
Normal Operating Mode	95.00
Timeout Mode	0.00
Fallback Mode	5.00

Passenger Train Occupancy	
Seats	320.00
Occupancy Factor	0.60

Table 3.4: Collision Frequencies by Segment Type and Collision Scenario (From Coll Matrix)

Scenarios	Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain	Diamond
Pass Loco Hits Loco	0.0038	0.0051	0.0100	0.0121	0.0010	0.000000
Pass Loco Hits Pass Car	0.0016	0.0021	0.0011	0.0013	0.0002	0.000000
Pass Loco Hits Freight Car	0.0005	0.0007	0.0005	0.0006	0.0001	0.009116
Pass Car Hit by Loco	0.0017	0.0023	0.0012	0.0015	0.0002	0.001823
Freight Loco Hits Loco	0.0007	0.0009	0.0015	0.0018	0.0001	0.000000
Freight Loco Hits Car	0.0001	0.0002	0.0002	0.0002	0.0000	0.028894
Freight Car Hit By Loco	0.0005	0.0007	0.0005	0.0006	0.0001	0.030187

Collision Frequencies for Passenger + Unequipped Freight Train

Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain
0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000

Mauve cells contain data imported from previous worksheet in a group of three worksheets covering one sub-corridor, season and operating state.

All train-to-train collision frequencies are in units of **trains in collisions per million train-miles operated in the sub-corridor by all train types.**

Weighted Collision Accident Frequencies by Representative Speed (mph)

Scenarios	Freight			Passenger			
	25	40	50	40	60	79	105
Pass Loco Hits Loco				0.0038	0.0000	0.0084	0.0045
Pass Loco Hits Pass Car				0.0016	0.0000	0.0012	0.0007
Pass Loco Hits Freight Car				0.0005	0.0000	0.0005	0.0003
Pass Car Hit by Loco				0.0017	0.0000	0.0014	0.0008
Freight Loco Hits Loco	0.0007	0.0013	0.0007				
Freight Loco Hits Car	0.0001	0.0002	0.0001				
Freight Car Hit By Loco	0.0005	0.0005	0.0003				

Table 3.5a: Risk Calculation - Passenger Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Table 3.5b: Risk Calculation - Collisions at Diamonds - Passenger

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Freq'y (per million tm)	Preventability	Adjusted Frequency	Trips/day	Trips per 10 years	Length of Track (miles)	Train-miles per 10 years	Accidents per 10 years	Number seats per train	Occupancy Factor	Passengers per train	Injuries per 10 years	Fatalities per 10 years	Damage $ per 10 years
40	Train-Train Collision	Pass Loco hits Loco	0.00384	Incl	0.00384	7.43	6423	1.29	8286	0.00003	320	0.6	192	0.0005	0.00001	0
		Pass Loco hits Pass Car	0.00160	Incl	0.00160	7.43	6423	1.29	8286	0.00001	320	0.6	192	0.0001	0.00000	0
		Pass Loco hits Frt Car	0.00052	Incl	0.00052	7.43	6423	1.29	8286	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00173	Incl	0.00173	7.43	6423	1.29	8286	0.00001	320	0.6	192	0.0005	0.00001	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	5187	1.29	6691	0.00003	320	0.6	192	0.0001	0.00000	0
	Intrusion Collision (other))	Pass Loco hits intruder	0.01440	0.12	0.01267	6.00	5187	1.29	6691	0.00008	320	0.6	192	0.0004	0.00001	0
	Overspeed		0.01100	0.00	0.01100	6.00	5187	1.29	6691	0.00007	320	0.6	192	0.0006	0.00001	0
	Broken Rail		0.01670	0.08	0.01536	6.00	5187	1.29	6691	0.00010	320	0.6	192	0.0009	0.00001	0
	Work Zone Violation			0.00		6.00	5187	1.29	6691					0.0000	0.00006	0
										0.00036				**0.00308**	**0.00012**	**0**
60	Train-Train Collision	Pass Loco hits Loco	0.00000	Incl	0.00000	7.43	6423	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Pass Car	0.00000	Incl	0.00000	7.43	6423	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Frt Car	0.00000	Incl	0.00000	7.43	6423	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00000	Incl	0.00000	7.43	6423	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	5187	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.12	0.01267	6.00	5187	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Overspeed		0.01100	0.00	0.01100	6.00	5187	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Broken Rail		0.01670	0.08	0.01536	6.00	5187	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Work Zone Violation			0.00		6.00	5187	0	0					0.0000	0.00000	0
										0.00000				**0.00000**	**0.00000**	**0**
79	Train-Train Collision	Pass Loco hits Loco	0.00844	Incl	0.00844	7.43	6423	8.41	54019	0.00046	320	0.6	192	0.021	0.0007	901
		Pass Loco hits Pass Car	0.00120	Incl	0.00120	7.43	6423	8.41	54019	0.00006	320	0.6	192	0.001	0.0001	64
		Pass Loco hits Frt Car	0.00050	Incl	0.00050	7.43	6423	8.41	54019	0.00003	320	0.6	192	0.001	0.0000	27
		Pass car hit by Loco	0.00136	Incl	0.00136	7.43	6423	8.41	54019	0.00007	320	0.6	192	0.007	0.0003	290
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	5187	8.41	43623	0.00021	320	0.6	192	0.002	0.0001	95
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.12	0.01267	6.00	5187	8.41	43623	0.00055	320	0.6	192	0.011	0.0004	491
	Overspeed		0.01100	0.00	0.01100	6.00	5187	8.41	43623	0.00048	320	0.6	192	0.019	0.0003	1248
	Broken Rail		0.01670	0.08	0.01536	6.00	5187	8.41	43623	0.00067	320	0.6	192	0.027	0.0004	1743
	Work Zone Violation			0.00		6.00	5187	8.41	43623					0.007	0.0007	0
										0.00254				**0.09663**	**0.00306**	**4858**
105	Train-Train Collision	Pass Loco hits Loco	0.00448	Incl	0.00448	7.43	6423	26.81	172207	0.00077	320	0.6	192	0.063	0.0024	2695
		Pass Loco hits Pass Car	0.00073	Incl	0.00073	7.43	6423	26.81	172207	0.00013	320	0.6	192	0.004	0.0002	221
		Pass Loco hits Frt Car	0.00032	Incl	0.00032	7.43	6423	26.81	172207	0.00006	320	0.6	192	0.002	0.0001	96
		Pass car hit by Loco	0.00082	Incl	0.00082	7.43	6423	26.81	172207	0.00014	320	0.6	192	0.023	0.0009	992
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	5187	26.81	139063	0.00068	320	0.6	192	0.013	0.0004	536
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.12	0.01267	6.00	5187	26.81	139063	0.00176	320	0.6	192	0.065	0.0023	2772
	Overspeed		0.01100	0.00	0.01100	6.00	5187	26.81	139063	0.00153	320	0.6	192	0.082	0.0013	7027
	Broken Rail		0.01670	0.08	0.01536	6.00	5187	26.81	139063	0.00214	320	0.6	192	0.115	0.0018	9815
	Work Zone Violation			0.00		6.00	5187	26.81	139063					0.030	0.0030	0
	Total									**0.00720**				**0.39640**	**0.01246**	**24155**
	Overall Totals									**0.01010**				**0.49612**	**0.01564**	**29013**
	Totals All Speeds	**Train-train Collisions**								**0.00178**				**0.12230**	**0.00466**	**5286**
		Intrusion Collisions								**0.00333**				**0.09137**	**0.00324**	**3894**
		Overspeed								**0.00208**				**0.10221**	**0.00164**	**8275**
		Broken Rail								**0.00291**				**0.14275**	**0.00229**	**11558**
		Work Zone Violation								**0.00000**				**0.03748**	**0.00380**	**0**

Table 3.6a: Risk Calculation - Freight Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Freq'y (per million tm)	Preventability	Adjusted Frequency	Trips/day	Trips per 10 years	Length of Track (miles)	Per 10 years Train-miles	Accidents	Injuries	Fatalities	Damage $
25	Train-Train Collision	Frt Loco hits Loco	0.000651995	Incl	0.00065	7.43	6423	1.29	8286	0.00001	0.00000	0.000000	$1
		Frt Loco hits Car	0.000130399	Incl	0.00013	7.43	6423	1.29	8286	0.00000	0.00000	0.000000	$0
		Frt car hit by Loco	0.000521596	Incl	0.00052	7.43	6423	1.29	8286	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.43	0.00821	1.43	1236	1.29	1595	0.00001	0.00000	0.000000	$0
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.12	0.00757	1.43	1236	1.29	1595	0.00001	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.00	0	1.29	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.00	0	1.29	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.00	0.01600	1.43	1236	1.29	1595	0.00003	0.00000	0.000000	$4
	Overspeed, Unequip		0.016	0.00	0.01600	0.00	0	1.29	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.08	0.05115	1.43	1236	1.29	1595	0.00008	0.00000	0.000000	$12
	Broken Rail, Unequip		0.056	0.00	0.05560	0.00	0	1.29	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.00		1.43	1236	1.29	1595		0.00007	0.000007	$0
	Work Zone Viol'n, Unequip			0.00		0.00	0	1.29	0		0.00000	0.000000	$0
	Totals									**0.0001**	**0.0001**	**0.00001**	**$17**
40	Train-Train Collision	Frt Loco hits Loco	0.0013	Incl	0.00130	7.43	6423	8.41	54019	0.00007	0.00008	0.000008	$19
		Frt Loco hits Car	0.0002	Incl	0.00015	7.43	6423	8.41	54019	0.00001	0.00001	0.000001	$2
		Frt car hit by Loco	0.0005	Incl	0.00050	7.43	6423	8.41	54019	0.00003	0.00000	0.000000	$3
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.43	0.00821	1.43	1236	8.41	10397	0.00009	0.00002	0.000002	$2
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.12	0.00757	1.43	1236	8.41	10397	0.00008	0.00002	0.000002	$2
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.00	0	8.41	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.00	0	8.41	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.00	0.01600	1.43	1236	8.41	10397	0.00017	0.00002	0.000002	$62
	Overspeed, Unequip		0.016	0.00	0.01600	0.00	0	8.41	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.08	0.05115	1.43	1236	8.41	10397	0.00053	0.00008	0.000008	$199
	Broken Rail, Unequip		0.056	0.00	0.05560	0.00	0	8.41	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.00		1.43	1236	8.41	10397		0.00069	0.000069	$0
	Work Zone Viol'n, Unequip			0.00		0.00	0	8.41	0		0.00000	0.000000	$0
	Totals									**0.00097**	**0.0009**	**0.00009**	**$290**
50	Train-Train Collision	Frt Loco hits Loco	0.0007	Incl	0.00067	7.43	6423	26.81	172207	0.00012	0.00020	0.000020	$49
		Frt Loco hits Car	0.0001	Incl	0.00009	7.43	6423	26.81	172207	0.00002	0.00002	0.000002	$5
		Frt car hit by Loco	0.0003	Incl	0.00032	7.43	6423	26.81	172207	0.00006	0.00000	0.000000	$10
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.43	0.00821	1.43	1236	26.81	33143	0.00027	0.00010	0.000010	$12
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.12	0.00757	1.43	1236	26.81	33143	0.00025	0.00009	0.000009	$11
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.00	0	26.81	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.00	0	26.81	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.00	0.01600	1.43	1236	26.81	33143	0.00053	0.00019	0.000019	$311
	Overspeed, Unequip		0.016	0.00	0.01600	0.00	0	26.81	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.08	0.05115	1.43	1236	26.81	33143	0.00170	0.00059	0.000059	$993
	Broken Rail, Unequip		0.056	0.00	0.05560	0.00	0	26.81	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.00		1.43	1236	26.81	33143		0.00275	0.000275	$0
	Work Zone Viol'n, Unequip			0.00		0.00	0	26.81	0		0.00000	0.000000	$0
	Totals									**0.00293**	**0.0039**	**0.00039**	**$1,391**
	Overall Totals									**0.00404**	**0.0049**	**0.0005**	**$1,698**
Totals All Speeds	**Train-Train Collisions**									**0.00030**	**0.00030**	**0.00003**	**88**
	Intrusion Collisions									**0.00071**	**0.00022**	**0.00002**	**28**
	Diamond Collisions									**0.00038**	**0.00017**	**0.00002**	**63**
	Overspeed									**0.00072**	**0.00021**	**0.00002**	**377**
	Broken Rail									**0.00231**	**0.00067**	**0.00007**	**1205**
	Work Zone Violation									**0.00000**	**0.00350**	**0.00035**	**0**
	Grade Crossing Collisions												

Table 3.6b: Risk Calculation - Collisions at Diamonds - Freight

Number Diamonds	Freq'y per mill passes	Collisions (millions)	Injuries	Fatalities	Damage
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.028894	0.000000	0.000000	0.000000	0.00
0	0.030187	0.000000	0.000000	0.000000	0.00

Table 3.7: Risk Calculations: Passenger and Freight Trains; Grade Crossings

Train Type	Representative Speed (mph)	Type of Grade-crossing	Base Collision Frequency	Preventability Factor	Adjusted Collision Frequency	Trips per Day	Crossing Passes per Trip	Crossing Passes per 10 Years	Collisions per 10 Years	Seats per Train (Passenger)	Occupancy Factor	Passengers per Train	Passenger/ Crew Injuries per 10 Years	Passenger/ Crew Fatalities per 10 Years	Damage per 10 Years ($)
Passenger	40	Public_gates_lights	0.35	0%	0.350	6.00	7	36309	0.013	320	0.60	192	0.0068	0.0001	635
		Public_other	0.30	0%	0.300	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Private	0.10	0%	0.100	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
	60	Public_gates_lights	0.60	0%	0.600	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Public_other	0.50	0%	0.500	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Private	0.20	0%	0.200	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
	79	Public_gates_lights	0.80	0%	0.800	6.00	16	82992	0.066	320	0.60	192	0.1338	0.0020	13013
		Public_other	0.65	0%	0.650	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Private	0.30	0%	0.300	6.00	1	5187	0.002	320	0.60	192	0.0031	0.0000	305
	105	Public_gates_lights	1.10	0%	1.100	6.00	16	82992	0.091	320	0.60	192	0.3260	0.0048	31587
		Public_other	0.80	0%	0.800	6.00	1	5187	0.004	320	0.60	192	0.0148	0.0002	1436
		Private	0.30	0%	0.300	6.00	6	31122	0.009	320	0.60	192	0.0333	0.0005	3230
Freight	25	Public_gates_lights	0.15	0%	0.150	1.43	7	8654	0.001				0.00016	0.00001	26
Equipped		Public_other	0.12	0%	0.120	1.43	0	0	0.000				0.00000	0.00000	0
		Private	0.05	0%	0.050	1.43	0	0	0.000				0.00000	0.00000	0
	40	Public_gates_lights	0.30	0%	0.300	1.43	16	19780	0.006				0.00148	0.00008	297
		Public_other	0.25	0%	0.250	1.43	0	0	0.000				0.00000	0.00000	0
		Private	0.10	0%	0.100	1.43	1	1236	0.000				0.00003	0.00000	6
	50	Public_gates_lights	0.36	0%	0.360	1.43	16	19780	0.007				0.00278	0.00014	555
		Public_other	0.30	0%	0.300	1.43	1	1236	0.000				0.00014	0.00001	29
		Private	0.12	0%	0.120	1.43	6	7417	0.001				0.00035	0.00002	69
Freight	25	Public_gates_lights	0.15	0%	0.150	0.00	7	0	0.000				0.00000	0.00000	0
Unequipped		Public_other	0.12	0%	0.120	0.00	0	0	0.000				0.00000	0.00000	0
		Private	0.05	0%	0.050	0.00	0	0	0.000				0.00000	0.00000	0
	40	Public_gates_lights	0.30	0%	0.300	0.00	16	0	0.000				0.00000	0.00000	0
		Public_other	0.25	0%	0.250	0.00	0	0	0.000				0.00000	0.00000	0
		Private	0.10	0%	0.100	0.00	1	0	0.000				0.00000	0.00000	0
	50	Public_gates_lights	0.36	0%	0.360	0.00	16	0	0.000				0.00000	0.00000	0
		Public_other	0.30	0%	0.300	0.00	1	0	0.000				0.00000	0.00000	0
		Private	0.12	0%	0.120	0.00	6	0	0.000				0.00000	0.00000	0
								Total - Passenger	**0.185**				**0.518**	**0.008**	**50207**
Risk Calculations: Passenger and Freight Trains; Diamonds								**Total - Freight**	**0.016**				**0.005**	**0.000**	**983**
Train Type								**Totals - All Speeds**	**0.201**				**0.52**	**0.01**	**51189**

Table 3.8: Summary - All Risks

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00178	0.12230	0.00466	5286	31504
	Intrusion Collisions	0.00333	0.09137	0.00324	3894	22766
	Diamond Collisions	0.000070	0.00076	0.00002	26	169
	Overspeed	0.00208	0.10221	0.00164	8275	23412
	Broken Rail	0.00291	0.14275	0.00229	11558	32700
	Work Zone Violation	0.00000	0.03748	0.00380	0	15156
	Grade Crossing Collisions	0.18544	0.51800	0.00770	50207	125113
	Total, All Scenarios	0.19561	1.01487	0.02336	79246	250820
Freight	Train-Train Collisions	0.00030	0.00030	0.00003	88	210
	Intrusion Collisions	0.00071	0.00022	0.00002	28	117
	Diamond Collisions	0.00038	0.00017	0.00002	63	130
	Overspeed	0.00072	0.00021	0.00002	377	461
	Broken Rail	0.00231	0.00067	0.00007	1205	1475
	Work Zone Violation	0.00000	0.00350	0.00035	0	1402
	Grade Crossing Collisions	0.01574	0.00494	0.00025	983	2235
	Total, All Scenarios	0.02016	0.01002	0.00076	2744	6031
Total Passenger + Freight		**0.21577**	**1.02490**	**0.02412**	**81991**	**256851**
	Unit Costs ($/Casualty)		100000	3000000		

Data exported to the Results Summary worksheet

Worksheet 1-Sp,N: IDOT Risk Model: Braking Distances and Collision Zone Calculations, Base Case II: Northeast Corridor ATC, 85% Preventability, Springfield Sub-corridor

Table 1.1: Stopping Distance Parameters and Calculations, Including Timeout and ACS Response Delay

Train/System Type	Braking Formula Inputs: Parameter	Value
Freight	Coefficient P	0.035
	App'n Time (sec)	13.8
	Train Weight (lb)	37600000
	Brake Force (lb)	779683
Passenger	Coefficient A	0.666
	Coefficient B	0
	Safety Factor	1.25
Train Control	Latency/T-out (sec)	3
	ACS Response (sec)	0
Guilty Train Speed (mph)		15

Braking Distance Calculations (including free running in TO) (ft) Train Type	Speeds (mph)	To Stop	Decel-eration (ft/sec²)	Braking Duration (secs) Reduction to RedCon*	RedCon* to Stop	Guilty Train Distance (ft) Reduction to RedCon*	RedCon* to Stop	Total Zone Lengths (ft) Reduction to RedCon*	RedCon* to Stop	Full Speed to Stop
Freight	25	1671	0.668	58	0	1275	0	2946	0	2946
	40	3686	0.668	14	77	308	1692	1927	3760	5686
	50	5452	0.668	36	77	791	1692	4176	3760	7935
Passenger	40	1452	1.293	48	0	1065	0	2517	0	2517
	60	3177	1.293	71	0	1565	0	4742	0	4742
	79	5433	1.293	25	68	541	1499	3576	3896	7472
	105	9493	1.293	54	68	1190	1499	8286	3896	12182
Fct RedYd Consp	35	1125	1.293							

Blue cells contain data imported from the Inputs worksheet

*Note: RedCon refers to the speed at which collision consequences will be significantly reduced

60 mph for passenger trains and 35 mph for freight trains

If train speed is lower that this speed, then there are no reduced consequences and Zone A2 has zero length

Sight Distance (ft): 2500

Table 1.2: Segment Definitions: Springfield Sub-Corridor, MP 124.9 (Bloomington) - MP 181.0 (Ridgely)

Segment Number	Start (milepost	End (milepost)	Type	Variant	Length Miles	Length Feet	Posted Speed (mph) Freight	Posted Speed (mph) Pass	Posted Speed (mph) HS Pass	Representative Speed (mph) Freight	Representative Speed (mph) Pass	Representative Speed (mph) HS Pass (Consq*)	Representative Speed (mph) HS Pass (Other)	Industry Siding Number	Industry Siding Name	Passenger Stops
32.0	124.9	126.5	CP Adjacent (M)		1.6	8659.2	25.0	40.0	40.0	25.0	40.0	40.0	40.0		Bloom Yard	
33.0	126.5	126.5	Diamond		0.0	0.0	25.0	40.0	40.0	25.0	40.0	40.0	40.0			
34.0	126.5	128.8	CP Adjacent (M)		2.3	11932.8	30.0	50.0	50.0	25.0	60.0	60.0	79.0			
35.0	128.8	131.0	Main		2.2	11616.0	60.0	79.0	90.0	50.0	79.0	79.0	79.0			
36.0	131.0	131.7	Main		0.7	3696.0	60.0	79.0	110.0	50.0	79.0	79.0	105.0			
37.0	131.7	136.9	Main		5.2	27456.0	60.0	79.0	110.0	50.0	79.0	79.0	105.0			
38.0	136.9	138.6	CP Adjacent (M)		1.7	9134.4	60.0	79.0	110.0	50.0	79.0	79.0	105.0			
39.0	138.6	141.3	Siding (M)	McLean (sg'd)	2.7	14097.6	60.0	79.0	110.0	50.0	79.0	79.0	105.0	1.0	McLean	
40.0	141.3	143.4	CP Adjacent (M)		2.0	10824.0	60.0	79.0	110.0	50.0	79.0	79.0	105.0			
41.0	143.4	148.3	Main		5.0	26136.0	60.0	79.0	110.0	50.0	60.0	79.0	79.0	2.0	Fertilizer, Atlanta	
42.0	148.3	151.0	Main		2.7	14044.8	60.0	79.0	110.0	50.0	79.0	79.0	105.0	1.0	Lincoln Grain	
43.0	151.0	153.6	CP Adjacent (U)		2.6	13728.0	60.0	79.0	110.0	50.0	79.0	79.0	105.0	1.0	Knauer	
44.0	153.6	155.6	Siding (U)	Elkhart (Unsig'd)	2.0	10612.8	60.0	79.0	110.0	50.0	60.0	60.0	79.0			
45.0	155.6	155.6	Diamond		0.0	0.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0			
46.0	155.6	157.3	CP Adjacent (U)		1.7	8923.2	50.0	70.0	70.0	50.0	60.0	60.0	79.0	1.0	Havana Ind	Lincoln
47.0	157.3	160.1	Main		2.8	14731.2	60.0	79.0	90.0	50.0	79.0	79.0	79.0			
48.0	160.1	162.1	Main		2.1	10876.8	60.0	79.0	110.0	50.0	79.0	79.0	105.0			
49.0	162.1	164.0	Main		1.9	10180.4	60.0	79.0	110.0	50.0	79.0	79.0	105.0			
50.0	164.0	166.2	Main		2.1	11193.6	60.0	79.0	110.0	50.0	79.0	79.0	105.0			
51.0	166.2	168.3	CP Adjacent (U)		2.2	11510.4	60.0	79.0	110.0	50.0	79.0	79.0	105.0	1.0	Elkhart Grain	
52.0	168.3	170.4	Siding (U)	Elkhart (Unsig'd)	2.1	10876.8	60.0	79.0	110.0	50.0	79.0	79.0	105.0			
53.0	170.4	172.3	CP Adjacent (U)		1.9	10243.2	60.0	79.0	110.0	50.0	79.0	79.0	105.0			
54.0	172.3	175.8	Main		3.5	18480.0	60.0	79.0	110.0	50.0	79.0	79.0	105.0			
55.0	175.8	179.5	Main		3.7	19272.0	60.0	79.0	110.0	50.0	79.0	79.0	79.0			
56.0	179.5	181.0	CP Adjacent (M)		1.5	7920.0	60.0	79.0	110.0	50.0	79.0	79.0	79.0			

Check Total: 56.1

Table 1.3: Mitigation and Prevention Zones - All Segments - Lengths in Feet

Zone A1: Limited Speed Reduction No Prevention or Mitigation Freight	Pass	HS Pass	Zone A2: Reduced Speed to Stop Severity Mitigation Freight	Pass	HS Pass	Zone B: Able to Stop Full Prevention Freight	Pass	HS Pass	Overlap of Stopping Distance into Zone C Freight	Pass	HS Pass	Distance in Timeout in Zone C Freight	Pass	HS Pass	Overlap of Zone A1 into Zone C Freight	Pass	HS Pass	Overlap of Zone A1 into Zone C within Sight Distance Freight	Pass	HS Pass	Overlap of Zone A2 into Zone C within Sight Distance Freight	Pass	HS Pass
2946	2517	2517	0	0	0	5713	6142	6142	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2946	4742	3576	0	0	3896	8987	7191	4461	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	3576	3896	3896	3896	3544	4144	4144	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	8286	3896	3896	3896	6501	7101	2391	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	8286	3760	3896	3896	8855	9319	4609	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	8286	3896	3896	849	1063	1663	0	0	0	3047	0	0	462	0	0	0	0	0	2500	0	0	0
4176	3576	8286	3896	3896	3896	6026	6626	1916	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	8286	3896	3896	2538	2752	3352	0	0	0	1358	0	0	462	0	0	0	0	0	1358	0	0	0
4176	4742	3576	0	0	3896	21960	21394	18564	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	8286	3896	3896	3896	5973	6573	1863	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	8286	3896	3896	3896	5656	6256	1546	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	4742	3576	0	0	3896	6437	5871	3141	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	4742	3576	3760	0	3896	988	4182	1452	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	3576	3760	3896	3896	6796	7260	7260	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	8286	3760	3896	2591	2942	3405	0	0	0	1305	0	0	462	0	0	0	0	0	1305	0	0	0
4176	3576	8286	3760	3896	1905	2255	2719	0	0	0	1991	0	0	462	0	0	0	0	0	1991	0	0	0
4176	3576	8286	3760	3896	2908	3258	3722	0	0	0	988	0	0	462	0	0	0	0	0	988	0	0	0
4176	3576	8286	3760	3896	3225	3575	4039	0	0	0	671	0	0	462	0	0	0	0	0	671	0	0	0
4176	3576	8286	3760	3896	2591	2942	3405	0	0	0	1305	0	0	462	0	0	0	0	0	1305	0	0	0
4176	3576	8286	3760	3896	1958	2308	2772	0	0	0	1939	0	0	462	0	0	0	0	0	1939	0	0	0
4176	3576	8286	3760	3896	3896	10545	11008	6298	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	3576	3896	3896	3896	11337	11800	11800	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	3576	3744	3896	3896	0	448	448	15	0	0	15	0	0	0	0	0	0	0	0	15	0	0

Table 1.4: Breakdown of Segments Lengths by Representative Speed (miles)

Segment Number	Freight Speeds (mph) 25	40	50	Convent'l Pass Speeds (mph) 40	60	79	HS Pass. Speeds - Coll'n Conseq. (mph) 40	60	79	105	HS Pass. Speeds - Other (mph) 40	60	79	105
32.0	1.64	0	0	1.64	0	0	1.64	0	0	0	1.64	0	0	0
34.0	2.26	0	0	0	2.26	0	0	2.26	0	0	0	2.26	0	0
35.0	0	0	2.2	0	0	2.2	0	0	2.2	0	0	0	2.2	0
36.0	0	0	0	2.76	0	0	2.76	0	0	0	2.76	0	0	0
37.0	0	0	0	3.18	0	0	0	3.18	0	0	0	3.18	0	0
38.0	0	0	1.73	0	0	1.73	0	0	1.73	0	0	0	1.73	0
39.0	0	0	0	2.67	0	0	2.67	0	0	0	2.67	0	0	0
40.0	0	0	2.05	0	0	2.05	0	0	2.05	0	0	0	2.05	0
41.0	0	0	4.95	0	0	4.95	0	0	4.95	0	0	0	4.95	0
42.0	0	0	0	2.66	0	0	2.66	0	0	0	2.66	0	0	0
43.0	0	0	2.6	0	0	2.6	0	0	2.6	0	0	0	2.6	0
44.0	0	0	2.01	0	2.01	0	0	2.01	0	0	0	0	2.01	0
46.0	0	0	1.69	0	1.69	0	0	1.69	0	0	0	1.69	0	0
47.0	0	0	0	2.79	0	0	2.79	0	0	0	2.79	0	0	0
48.0	0	0	2.06	0	0	2.06	0	0	2.06	0	0	0	0	2.06
49.0	0	0	1.93	0	0	1.93	0	0	1.93	0	0	0	0	1.93
50.0	0	0	2.12	0	0	2.12	0	0	2.12	0	0	0	0	2.12
51.0	0	0	2.18	0	0	2.18	0	0	2.18	0	0	0	0	2.18
52.0	0	0	2.06	0	0	2.06	0	0	2.06	0	0	0	0	2.06
53.0	0	0	1.94	0	0	1.94	0	0	1.94	0	0	0	0	1.94
54.0	0	0	3.5	0	0	3.5	0	0	3.5	0	0	0	0	3.5
55.0	0	0	3.65	0	0	3.65	0	0	3.65	0	0	0	0	3.65
56.0	0	0	1.5	0	0	1.5	0	0	1.5	0	0	0	0	1.5

Table 1.5: Aggregate Segment Length by Segment Type and Speed

Segment Type	Train Type	Representative Speed (mph)	Aggregate Length of Segments by Train and Segment Types: Freight Miles	Freight Feet	Conv passenger Miles	Conv passenger Feet	High Speed Passenger Collision Consq* Miles	High Speed Passenger Collision Consq* Feet	High Speed Passenger Other Miles	High Speed Passenger Other Feet
Siding (mon)	Freight	25	0.0	0						
		40	0.0	0						
		50	2.7	14097.6						
	Passenger	40			0.0	0	0.0	0	0.0	0
		60			0.0	0	0.0	0	0.0	0
		79			2.7	14097.6	2.7	14097.6	0.0	0
		105					0.0	0	2.7	14097.6
Siding (unmon)	Freight	25	0.0	0						
		40	0.0	0						
		50	4.1	21489.6						
	Passenger	40			0.0	0	0.0	0	0.0	0
		60			2.0	10612.8	2.0	10612.8	0.0	0
		79			2.1	10876.8	2.1	10876.8	2.0	10612.8
		105					0.0	0	2.1	10876.8
CP Adjacent (mon)	Freight	25	3.9	20592						
		40	0.0	0						
		50	5.3	27878.4						
	Passenger	40			1.6	8659.2	1.6	8659.2	1.6	8659.2
		60			2.3	11932.8	2.3	11932.8	0.0	0
		79			5.3	27878.4	5.3	27878.4	3.8	19852.8
		105					0.0	0	3.8	19958.4
CP Adjacent (unmon)	Freight	25	0.0	0						
		40	0.0	0						
		50	8.4	44404.8						
	Passenger	40			0.0	0	0.0	0	0.0	0
		60			1.7	8923.2	1.7	8923.2	0.0	0
		79			6.7	35481.6	6.7	35481.6	1.7	8923.2
		105					0.0	0	6.7	35481.6
Plain Track	Freight	25	0.0	0						
		40	0.0	0						
		50	31.8	167904						
	Passenger	40			0.0	0	0.0	0	0.0	0
		60			5.0	26136	2.8	14572.8	0.0	0
		79			26.9	141768	29.0	153331.2	13.6	71755.2
		105					0.0	0	18.2	96148.8
Check Total			56.1		56.1		56.1		56.1	

*This speed is used to calculate collision consequences in collisions between an equipped and an unequipped train ONLY, reflecting the IDOT PTC speed restriction when an equipped train nears an unequipped train

Yellow cells contain data exported to the next sectsheet in the sequence of three sheets that perform the calculations for one sub-corridor, season and operating state

Table 1.6a: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for Siding (M) Segments

Lengths in Zone C	A1	A2	B
Total Length, Siding (M) Segments (ft)	14097.6		
Number Siding (M) Segments	1		
Average distance in Zone C (ft) Freight	0	0	2500
Passenger	0	0	2500
HS Pass	0	0	2500

	Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass
Sum Zone Lengths A1, A2, B (ft)	4176	3576	8286	3896	3896	3896	6026	6626	1916
Fraction of total length in zone	0.296	0.254	0.588	0.276	0.276	0.276	0.427	0.470	0.136
Collision Accident Mitigation Probabilities: Combined All Zones.	0.281	0.241	0.558	0.263	0.263	0.263	0.506	0.547	0.229

Values transferred to Collision Matrix

Distribution of train location at time of	In Block	0.95
violation in Reference Case accidents	Previous Block	0.05
PTC Risk Increment in Zone C		2
Potential danger length in Zone C (ft)		2500

Table 1.6b: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for Siding (U) Segments

Lengths in Zone C	A1	A2	B
Total Length, Siding (U) Segments (ft)	21489.6		
Number Siding (M) Segments	2		
Average distance in Zone C (ft) Freight	0	0	2500
Passenger	0	0	2500
HS Pass	0	652	1848

	Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass
Zone lengths A1, A2, B (ft)	8351	8317	11861	3760	3896	6487	9379	9276	3141
Fraction of total length in zone	0.389	0.387	0.552	0.175	0.181	0.302	0.436	0.432	0.146
Collision Accident Mitigation Probabilities: Combined All Zones.	0.369	0.368	0.524	0.166	0.172	0.313	0.515	0.510	0.213

Values transferred to Collision Matrix

Distribution of train location at time of	In Block	0.95
violation in Reference Case accidents	Previous Block	0.05
PTC Risk Increment in Zone C		2
Potential danger length in Zone C (ft)		2500

Table 1.6c: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for CP Adjacent (M) Segments

Lengths in Zone C	A1	A2	B
Total Length, CP Adjacent (M) Segments (ft)	48470.4		
Number CP Adjacent Segments	5		
Average distance in Zone C FT0 Freight	0	3	2497
Passenger	0	0	2500
HS Pass	0	772	1728

	Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass
Zone lengths A1, A2, B (ft)	18418	17985	26239	11537	11688	11179	18516	18797	11052
Fraction of total length in zone	0.380	0.371	0.541	0.238	0.241	0.231	0.382	0.388	0.228
Collision Accident Mitigation Probabilities: Combined All Zones.	0.361	0.353	0.514	0.226	0.229	0.250	0.463	0.468	0.286

Values transferred to Collision Matrix

Distribution of train location at time of	In Block	0.95
violation in Reference Case accidents	Previous Block	0.05
PTC Risk Increment in Zone C		2
Potential danger length in Zone C (ft)		2500

Table 1.6d: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for CP Adjacent (U)Segments

Lengths in Zone C	A1	A2	B
Total Length, CP Adjacent (U) Segments (ft)	44404.8		
Number CP Adjacent Segments	4		
Average distance in Zone C (ft) Freight	0	0	2500
Passenger	0	0	2500
HS Pass	0	652	1848

	Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass
Zone lengths A1, A2, B (ft)	16702	15468	28432	15175	11688	12975	12527	17248	2998
Fraction of total length in zone	0.376	0.348	0.640	0.342	0.263	0.292	0.282	0.388	0.068
Collision Accident Mitigation Probabilities: Combined All Zones.	0.357	0.331	0.608	0.325	0.250	0.304	0.368	0.469	0.138

Values transferred to Collision Matrix

Distribution of train location at time of	In Block	0.95
violation in Reference Case accidents	Previous Block	0.05
PTC Risk Increment in Zone C		2
Potential danger length in Zone C (ft)		2500

Table 1.6e: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for Plain Track Segments

Lengths in Zone C	A1	A2	B
Total Length, Plain Track Segments (ft)	167904		
Number CP Adjacent Segments	11		

	Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass

| | | |

Worksheet 2 - Sp,N,R: Collision Frequencies Calculation - Base Case II: Northeast Corridor ATC, 85% Preventability, Springfield Sub-corridor, Rest of Year

Table 2.1a: Collision Distribution Matrix (Fraction Accidents by Train Pair and Collision Type). Collisions Between Trains Operating on the IDOT Test Corridor Only (not diamonds and intrusions)

	Train Pairs in In Collision	Collision Scenario Prob (Top Level)	Siding - Monitored: Collision Distribution Head On	Siding - Monitored: Collision Distribution Rear/Side	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty
	Percent Guilty				100%	0%	100%	0%
Both Trains TBE (Note 3)	Pass-Pass	0.62	0.50	0.50	0.31	0	0.31	0
	Pass-TBE Freight	0.30	0.50	0.50	0.15	0	0.15	0
	TBE Freight - TBE Freight	0.08	0.50	0.50	0.04	0	0.04	0
	Percent Guilty				50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	0.00	1	0	0	0	0	0
	Rear/Side, Pass into NE Frt		0	1	0	0	0	0
	Rear/Side NE Frt into Pass		0	1	0	0	0	0
	TBE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0
	Percent Guilty				0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0
	Total Probability (checking)	1		1	0.5	0	0.5	0

	Siding - Unmonitored: Collision Distribution Head On	Siding - Unmonitored: Collision Distribution Rear/Side	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
			100%	0%	100%	0%
Both Trains TBE (Note 3)	0.5	0.5	0.31	0	0.31	0
	0.5	0.5	0.15	0	0.15	0
	0.5	0.5	0.04	0	0.04	0
			50%	50%	50%	50%
One Train TBE	1	0	0	0	0	0
	0	1	0	0	0	0
	0	1	0	0	0	0
	0.5	0.5	0	0	0	0
			0%	100%	0%	100%
Neither Train TBE	0.5	0.5	0	0	0	0
		1	0.5	0	0.5	0

	CP Adjacent - Monitored Siding: Collision Distribution Head On	CP Adjacent - Monitored Siding: Collision Distribution Rear/Side	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty
			100%	0%	100%	0%
Both Trains TBE (Note 3)	0.8	0.2	0.496	0	0.124	0
	0.7	0.3	0.21	0	0.09	0
	0.7	0.3	0.056	0	0.024	0
			50%	50%	50%	50%
One Train TBE	1	0	0	0	0	0
	0	1	0	0	0	0
	0	1	0	0	0	0
	0.7	0.3	0	0	0	0
			0%	100%	0%	100%
Neither Train TBE	0.7	0.3	0	0	0	0
		1	0.762	0	0.238	0

	CP Adjacent - Unmonitored Siding: Collision Distribution Head On	CP Adjacent - Unmonitored Siding: Collision Distribution Rear/Side	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
			100%	0%	100%	0%
Both Trains TBE (Note 3)	0.8	0.2	0.496	0	0.124	0
	0.7	0.3	0.21	0	0.09	0
	0.7	0.3	0.056	0	0.024	0
			50%	50%	50%	50%
One Train TBE	1	0	0	0	0	0
	0	1	0	0	0	0
	0	1	0	0	0	0
	0.7	0.3	0	0	0	0
			0%	100%	0%	100%
Neither Train TBE	0.7	0.3	0	0	0	0
		1	0.762	0	0.238	0

	Plain Track: Collision Distribution Head On	Plain Track: Collision Distribution Rear/Side	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
			100%	0%	100%	0%
Both Trains TBE (Note 3)	0.70	0.30	0.434	0	0.186	0
	0.40	0.60	0.12	0	0.18	0
	0.50	0.50	0.04	0	0.04	0
			50%	50%	50%	50%
One Train TBE	1.00	0.00	0	0	0	0
	0.00	1.00	0	0	0	0
	0.00	1.00	0	0	0	0
	0.50	0.50	0	0	0	0
			0%	100%	0%	100%
Neither Train TBE	0.50	0.50	0	0	0	0
		1	0.594	0	0.406	0

Table 2.1b: Collision Type Distribution - Diamonds

	Train Pairs in In Collision	Train Pair Type	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty
	Percent Guilty			
Both Trains TBE	Pass-Pass			
	Pass-TBE Freight			
	TBE Freight - TBE Freight			
One Train TBE	**Percent Guilty**		50%	50%
	Pass - NE Freight, Head -On		0	0
	Rear/Side, Pass into NE Frt		0.25	0.25
	Rear/Side NE Frt into Pass		0.05	0.05
	TBE Freight - NE Freight		0.1	0.1
	Percent Guilty			100%
Neither Train TBE	NE Freight - NE Freight		0	0.2
	Total Probability (checking)		0.4	0.6

Note. The gray cells on these rows are set at zero, because in every case, the condition represented by the cell does not exist - either because there are no unequipped passenger trains, or because of the kind of collision defined for the row.

Quantity in cell C18 is for all collisions between a passenger train and an unequipped freight train

Table 2.2: Preventability Data For Unequipped train Guilty, One Train TBE

Segment Type	Not Prevented of Mitigated Freight	Not Prevented of Mitigated Pass	Not Prevented of Mitigated HS Pass	Mitigated Freight	Mitigated Pass	Mitigated HS Pass	Prevented Freight	Prevented Pass	Prevented HS Pass
Siding (M)	0.281	0.241	0.558	0.263	0.263	0.263	0.506	0.547	0.229
Siding (U)	0.369	0.368	0.524	0.166	0.172	0.313	0.515	0.510	0.213
CP Adjacent (M)	0.361	0.353	0.514	0.226	0.229	0.250	0.463	0.468	0.286
CP Adjacent (U)	0.357	0.331	0.608	0.325	0.250	0.304	0.368	0.469	0.138
Plain Track	0.104	0.102	0.148	0.000	0.000	0.016	0.100	0.100	0.084
Diamonds	0.239	0.260	0.250	0.098	0.000	0.170	0.713	0.790	0.630

Mauve cells contain data imported from previous worksheet in a group of three worksheets covering one sub-corridor, season and operating state.

Table 2.3a: Collision Preventability Matrix (Percent Accidents Preventable Relative to CTC Reference Case)

	Train Pairs in Collision	Preventability Equipped Train Guilty	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	85%	85%		85%		85%		85%	
	Pass-TBE Freight	85%	85%		85%		85%		85%	
	TBE Freight - TBE Freight	85%	85%		70%		85%		85%	
One TBE	Pass - NE Freight, Head -On	85%	85%	23%			85%	21%		
	Rear/Side, Pass into NE Frt	85%			85%	23%			85%	21%
	Rear/Side NE Frt into Pass	85%			85%	0%			85%	0%
	TBE Freight - NE Freight	85%	85%	51%	85%	0%	85%	51%	85%	0%
Neither TBE	NE Freight - NE Freight			0%		0%		0%		0%
Reference Case (CTC) Collision Accident Likelihood by Segment Type (collisions/million train miles)		0.030					0.040			

	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
Both TBE	85%		85%		85%		85%	
	85%		85%		85%		85%	
	85%		85%		85%		85%	
One TBE	85%	29%			85%	14%		
			85%	29%			85%	14%
			85%	0%			85%	0%
	85%	46%	85%	0%	85%	37%	85%	0%
Neither TBE		0%		0%		0%		0%
	0.050				0.060			

	Plain Track: Collision Distribution Head On	Plain Track: Collision Distribution Rear/Side	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
Both TBE			85%		85%	
			85%		85%	
			85%		85%	
One TBE			85%	8%		
					85%	8%
					85%	0%
			85%	10%	85%	0%
Neither TBE				0%		0%
	0.006				Collisions/million diamond passes	

Table 2.3b: Collision Preventability Matrix - Diamonds

	Train Pairs in In Collision	Train Pair Type	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty
Both TBE	Pass-Pass			
	Pass-TBE Freight			
	TBE Freight - TBE Freight			
One TBE	Pass - NE Freight, Head -On			
	Rear/Side, Pass into NE Frt		85%	79.00%
	Rear/Side NE Frt into Pass		85%	79.00%
	TBE Freight - NE Freight		85%	71.27%
Neither TBE	NE Freight - NE Freight			0.00%
			0.1	

Table 2.4a: Passenger Trains in Train-to-Train Collisions (Trains in Collisions per Million Train-Miles)

	Train Pairs in Collision	Passenger Trains in Collisions	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	2	0.0028		0.0028		0.0037		0.0037	
	Pass-TBE Freight	1	0.0007		0.0007		0.0009		0.0009	
	TBE Freight - TBE Freight	0								
One TBE	Pass - NE Freight, Head -On	1	0.0000	0.0000			0.0000	0.0000		
	Rear/Side, Pass into NE Frt	1			0.0000	0.0000			0.0000	0.0000
	Rear/Side NE Frt into Pass	1			0.0000	0.0000			0.0000	0.0000
	TBE Freight - NE Freight	0								
Neither TBE	NE Freight - NE Freight	0								
	Checking total		0.0035	0.0000	0.0035	0.0000	0.0046	0.0000	0.0046	0.0000

	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
Both TBE	0.0074		0.0019		0.0089		0.0022	
	0.0016		0.0007		0.0019		0.0008	
One TBE	0.0000	0.0000			0.0000	0.0000		
			0.0000	0.0000			0.0000	0.0000
			0.0000	0.0000			0.0000	0.0000
Neither TBE								
	0.0090	0.0000	0.0025	0.0000	0.0108	0.0000	0.0030	0.0000

	Plain Track: Collision Distribution Head On	Plain Track: Collision Distribution Rear/Side	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
Both TBE			0.0008		0.0003	
			0.0001		0.0002	
One TBE			0.0000	0.0000		
					0.0000	0.0000
					0.0000	0.0000
Neither TBE						
			0.0009	0.0000	0.0005	0.0000

Table 2.4b: Passenger Trains in Collisions at Diamonds

	Train Pairs in In Collision	Train Pair Type	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty
Both TBE	Pass-Pass			
	Pass-TBE Freight			
	TBE Freight - TBE Freight			
One TBE	Pass - NE Freight, Head -On			
	Rear/Side, Pass into NE Frt		0.003750	0.005250
	Rear/Side NE Frt into Pass		0.000750	0.001050
	TBE Freight - NE Freight		0.000000	0.000000
Neither TBE	NE Freight - NE Freight			0.000000
			0.00450	0.00630

	Scenario Totals - Passenger	Tots, P-UF	Totals
	Pass Loco Hits Loco	0.0000	0.0035
	Pass Loco Hits Pass Car		0.0014
	Pass Loco Hits Freight Car	0.0000	0.0005
	Pass Car Hit by Loco	0.0000	0.0015
	Total		0.0069

	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty	Totals	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty	Totals
	0.0035	0.0000	0.0035	0.0000	0.0000	0.0046	0.0000			0.0000
			0.0014		0.0019			0.0019		
	0.0005		0.0005		0.0000	0.0007		0.0007		0.0000
	0.0015		0.0015	0.0000	0.0000	0.0020	0.0000	0.0020	0.0000	0.0000
	0.0069	0.0035	0.0000	0.0035	0.0000	0.0092	0.0046	0.0000	0.0046	0.0000

	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty	Totals	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty	Totals
	0.0090	0.0000			0.0000	0.0108	0.0000			0.0000
			0.0009	0.0000	0.0000			0.0011	0.0002	0.0000
			0.0005		0.0000	0.0006		0.0006	0.0001	0.0000
			0.0011	0.0000	0.0000	0.0013	0.0000	0.0013	0.0002	0.0000
	0.0090	0.0000	0.0025	0.0000	0.0000	0.0139	0.0108	0.0000	0.0030	0.0000

	Plain Track: Collision Distribution Head On	Plain Track: Collision Distribution Rear/Side	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty	Totals
	0.0000	0.0000	0.0009	0.0000			0.0000
					0.0002		
	0.0000	0.0001			0.0001		0.0000
	0.0000	0.0002			0.0002		0.0000
	0.0000	0.0002			0.0002	0.0000	0.0000
	0.0000	0.0000	0.0014	0.0009	0.0000	0.0005	0.0000

	Train Pairs in In Collision	Train Pair Type	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty	Totals
	Pass Loco Hits Loco				
	Pass Loco Hits Pass Car				
	Pass Loco Hits Freight Car		0.003750	0.005250	0.009000
	Pass Car Hit by Loco		0.000750	0.001050	0.001800
	Total		0.004500	0.006300	0.010800

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Table 2.5a: Freight trains in Train-to-Train Collisions (Trains in Collisions per Million Train-Miles)

	Train Pairs in Collision	Freight Trains in Collisions	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	0								
	Pass-TBE Freight	1	0.0007		0.0007		0.0009		0.0009	
	TBE Freight - TBE Freight	2	0.0004		0.0007		0.0005		0.0005	
One TBE	Pass - NE Freight, Head -On	1	0.0000	0.0000			0.0000	0.0000		
	Rear/Side, Pass into NE Frt	1			0.0000	0.0000			0.0000	0.0000
	Rear/Side NE Frt into Pass	1			0.0000	0.0000			0.0000	0.0000
	TBE Freight - NE Freight	2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Neither TBE	NE Freight - NE Freight	2		0.0000		0.0000		0.0000		0.0000
	Checking total		0.0010	0.0000	0.0014	0.0000	0.0014	0.0000	0.0014	0.0000

	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
Both TBE	0.0016		0.0007		0.0019		0.0008	
	0.0008		0.0004		0.0010		0.0004	
One TBE	0.0000	0.0000			0.0000	0.0000		
			0.0000	0.0000			0.0000	0.0000
			0.0000	0.0000			0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Neither TBE		0.0000		0.0000		0.0000		0.0000
	0.0024	0.0000	0.0010	0.0000	0.0029	0.0000	0.0012	0.0000

	Plain Track: Collision Distribution Head On	Plain Track: Collision Distribution Rear/Side	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
Both TBE			0.0001		0.0002	
			0.0001		0.0001	
One TBE			0.0000	0.0000		
					0.0000	0.0000
					0.0000	0.0000
			0.0000	0.0000	0.0000	0.0000
Neither TBE				0.0000		0.0000
			0.0002	0.0000	0.0002	0.0000

	Train Pairs in In Collision	Train Pair Type	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty	Totals
	Freight Loco Hits Loco				
	Freight Loco Hits Car		0.005250	0.023923	0.029173
	Freight Car Hit By Loco		0.002250	0.028123	0.030373
	Total		0.007500	0.052046	0.059546

	Scenario Totals - Freight	Totals
	Freight Loco Hits Loco	0.0010
	Freight Loco Hits Car	0.0005
	Freight Car Hit By Loco	0.0009
	Total	0.0024

	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty	Totals	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty	Totals
	0.0010	0.0000			0.0000	0.0014	0.0000			0.0000
			0.00050	0.00000	0.0000	0.0004		0.00042	0.00000	0.0000
	b		0.00090	0.00000	0.0000	0.0010		0.00096	0.00000	0.0000
	0.0010	0.0000	0.0014	0.0000	0.0000	0.0028	0.0014	0.0000	0.0014	0.0000

	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty	Totals	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty	Totals
	0.0024	0.0000			0.0000	0.0029	0.0029	0.0000		0.0000
	0.0003		0.00035	0.00000	0.0000	0.0004		0.00042	0.00000	0.0000
	0.0007		0.00069	0.00000	0.0000	0.0008		0.00082	0.00000	0.0000
	0.0024	0.0000	0.0010	0.0000	0.0000	0.0041	0.0029	0.0000	0.0012	0.0000

	Plain Track: Collision Distribution Head On	Plain Track: Collision Distribution Rear/Side	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty	Totals
			0.0002	0.0000			0.0000
			0.0001		0.0000	0.0000	0.0000
					0.00017	0.00000	0.0000
			0.0004	0.0002	0.0000	0.0002	0.0000

	Train Pairs in In Collision	Train Pair Type	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty	Totals
	Freight Loco Hits Loco				
	Freight Loco Hits Car		0.005250	0.023923	0.029173
	Freight Car Hit By Loco		0.002250	0.028123	0.030373
	Total		0.007500	0.052046	0.059546

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

	Freight Plus Passenger Totals (check)										
		0.0600	0.0094			0.0800	0.0120			0.1000	0.0150

	CP Adjacent - Monitored Siding				CP Adjacent - Unmonitored Siding				Plain Track			

Worksheet 3 - Sp,N,R: - Risk Calculations - Base Case II: Northeast Corridor ATC, 85% Preventability, Springfield Subcorridor, Rest of Year

Table 3.1: Consequences Look-up Tables (Data Sources: Previous ICF Passenger Corridor Project (passenger), FRA Accident Data 2001-5 (freight)

Passenger Trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 40 mph			Representative Speed 60 mph			Representative Speed 79 mph			Representative Speed 105 mph		
			Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Pass Loco hits Loco	0.083	0.002	502000	0.139	0.0049	1142000	0.24	0.0085	1976000	0.425	0.016	3495000
		Pass Loco hits Pass Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.008	1747000
		Pass Loco hits Frt Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.008	1747000
		Pass car hit by Loco	0.166	0.005	1005000	0.275	0.0119	2284000	0.476	0.0206	3951000	0.841	0.032	6989000
	Intrusion Collision (rollout)	Pass Loco hits Car	0.013	0.0005	113000	0.031	0.0011	257000	0.054	0.0019	445000	0.096	0.0034	786000
	Intrusion Collision (other))	Pass Loco hits Car	0.026	0.0009	226000	0.063	0.0022	514000	0.108	0.0038	889000	0.191	0.0068	1573000
	Overspeed		0.044	0.0004	667000	0.14	0.00186	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Broken Rail		0.044	0.0004	667000	0.14	0.00186	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Work Zone Violation		0.083	0.0083	0	0.125	0.0125	0	0.164	0.0164	0	0.218	0.0218	0

Freight trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 25 mph			Representative Speed 40 mph			Representative Speed 50 mph		
			Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Frt Loco hits Loco	0.43	0.043	105000	1.1	0.11	270000	1.7	0.17	422000
		Frt Loco hits Car	0.35	0.035	88000	0.9	0.09	225000	1.4	0.14	352000
		Frt car hit by Loco	0	0	44000	0	0	112000	0	0	176000
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Overspeed, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Overspeed, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Work Zone Viol'n, Equip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0
	Work Zone Viol'n, Unequip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0

Casualties and damage in Table 3.1 are per accident, except for Work Zone Violations which are per million train-miles

Table 3.2: Grade Crossing and Diamonds: Numbers by Representative Speed, and Accident Frequency and Consequences

Train Type	Representative Speed (mph)	Type of Grade-crossing	Number Crossings			Accident Frequency		Crossing Collision Consequences						Number Diamonds
			Passenger	HS Passenger	Freight	Per Million Crossing Passes		Pass. Occup't Casualty Prob/accident)			Freight Trains (per accident)			
						Passenger	Freight	Injuries	Fatalities	Cost $/Accid't	Injuries	Fatalities	Cost $	
Passenger	40	Public_gates_lights	0	0		0.350		0.0028	0.000047	50000				2
		Public_other	0	0		0.300								
		Private	0	0		0.100								
	60	Public_gates_lights	14	0		0.600		0.0068	0.000112	113000				0
		Public_other	0	0		0.500								
		Private	0	0		0.200								
	79	Public_gates_lights	15	16		0.800		0.0105	0.000156	196000				0
		Public_other	5	1		0.650								
		Private	5	1		0.300								
	105	Public_gates_lights	0	13		1.100		0.0186	0.000276	346000				0
		Public_other	0	4		0.800								
		Private	0	4		0.300								
Freight	25	Public_gates_lights			3	0.150					0.12	0.005	20000	0
		Public_other			0	0.120								
		Private			0	0.050								
	40	Public_gates_lights			0	0.300					0.25	0.013	50000	2
		Public_other			0	0.250								
		Private			0	0.100								
	50	Public_gates_lights			26	0.360					0.39	0.02	78000	0
		Public_other			5	0.300								
		Private			5	0.120								

Table 3.3a: Segment Data (for reference only, not used in calculations)

Segment Number	Start (Milepost)	End (Milepost)	Type	Length (miles)	Representative Speed (mph)			
					Freight	Pass	HS Pass	HS Pass
32	$124.86	$126.50	CP Adjacent (M)	1.64	25	40	40	40
33	$126.50	$126.50	Diamond	0.00	25	40	40	40
34	$126.50	$128.76	CP Adjacent (M)	2.26	25	60	60	79
35	$128.76	$130.96	Plain	2.20	50	79	79	79
36	$130.96	$133.72	Plain	2.76	50	79	60	105
37	$133.72	$136.90	Plain	3.18	50	79	79	105
38	$136.90	$138.63	CP Adjacent (M)	1.73	50	79	79	105
39	$138.63	$141.30	Siding (M)	2.67	50	79	79	105
40	$141.30	$143.35	CP Adjacent (M)	2.05	50	79	79	105
41	$143.35	$148.30	Plain	4.95	50	60	79	79
42	$148.30	$150.96	Plain	2.66	50	79	79	105
43	$150.96	$153.56	CP Adjacent (U)	2.60	50	79	79	105
44	$153.56	$155.57	Siding (U)	2.01	50	60	60	79
45	$155.57	$155.57	Diamond	0.00	40	40	40	40
46	$155.57	$157.26	CP Adjacent (U)	1.69	50	60	60	79
47	$157.26	$160.05	Plain	2.79	50	79	79	79
48	$160.05	$162.11	Plain	2.06	50	79	79	105
49	$162.11	$164.04	Plain	1.93	50	79	79	105
50	$164.04	$166.16	Plain	2.12	50	79	79	105
51	$166.16	$168.34	CP Adjacent (U)	2.18	50	79	79	105
52	$168.34	$170.40	Siding (U)	2.06	50	79	79	105
53	$170.40	$172.34	CP Adjacent (U)	1.94	50	79	79	105
54	$172.34	$175.84	Plain	3.50	50	79	79	105
55	$175.84	$179.49	Plain	3.65	50	79	79	79
56	$179.49	$180.99	CP Adjacent (M)	1.50	50	79	79	79

Table 3.3b: Aggregate Segment Data: SegmentsTypes, Train Types, Speeds, and Lengths

Aggregate Segment Length by Type and Speed Band (from Seg Def and Preventability)

Segment Type	Train Type	Represent've Speed (mph)	Freight (miles)	Reg Pass (miles)	HS Pass Collision (mi)	HS Pass Other (mi)
Siding (mon)	Freight	25	0			
		40	0			
		50	2.67			
	Passenger	40		0	0	0
		60		0	0	0
		79		2.67	2.67	0
		105		0	0	2.67
Siding (unmon)	Freight	25	0			
		40	0			
		50	4.07			
	Passenger	40		0	0	0
		60		2.01	2.01	0
		79		2.06	2.06	2.01
		105		0	0	2.06
CP Adjacent (mon)	Freight	25	3.9			
		40	0			
		50	5.28			
	Passenger	40		1.64	1.64	1.64
		60		2.26	2.26	0
		79		5.28	5.28	3.76
		105		0	0	3.78
CP Adjacent (unmon)	Freight	25	0			
		40	0			
		50	8.41			
	Passenger	40		0	0	0
		60		1.69	1.69	0
		79		6.72	6.72	1.69
		105		0	0	6.72
Plain Track	Freight	25	0			
		40	0			
		50	31.8			
	Passenger	40		0	0	0
		60		4.95	2.76	0
		79		26.85	29.04	13.59
		105		0	0	18.21
Totals All Types	Freight	25	3.9			
		40	0			
		50	52.23			
	Passenger	40		1.64	1.64	1.64
		60		10.91	8.72	0
		79		43.58	45.77	21.05
		105		0	0	33.44
		Check Totals		56.13	56.13	56.13	56.13

Table 3.4a: Traffic Inputs to Risk Calculation

Train Type	Trips/Day Summer	Rest of Year
Passenger	6.00	6.00
Equipped Freight	1.73	3.16
Unequipped Freight	0.00	0.00
Operating Days	91	274

Percent Train-Miles in	
Timeout (secs)	0
Normal Operating Mode	95.00
Timeout Mode	0.00
Fallback Mode	5

Passenger Train Occupancy	
Seats	320
Occupancy Factor	0.60

Table 3.4: Collision Frequencies by Segment Type and Collision Scenario (From Coll Matrix)

Scenarios	Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain	Diamond
Pass Loco Hits Loco	0.0035	0.0046	0.0090	0.0108	0.0009	0.000000
Pass Loco Hits Pass Car	0.0014	0.0019	0.0009	0.0011	0.0002	0.000000
Pass Loco Hits Freight Car	0.0005	0.0007	0.0005	0.0006	0.0001	0.009000
Pass Car Hit by Loco	0.0015	0.0020	0.0011	0.0013	0.0002	0.001800
Freight Loco Hits Loco	0.0010	0.0014	0.0024	0.0029	0.0002	0.000000
Freight Loco Hits Car	0.0005	0.0004	0.0003	0.0004	0.0001	0.029173
Freight Car Hit By Loco	0.0009	0.0010	0.0007	0.0008	0.0002	0.030373

Collision Frequencies for Passenger + Unequipped Freight Train

Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain
0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000

Mauve cells contain data imported from previous worksheet in a group of three worksheets covering one sub-corridor, season and operating state.

Weighted Collision Accident Frequencies by Representative Speed (mph)

Scenarios	Freight			Passenger			
	25	40	50	40	60	79	105
Pass Loco Hits Loco				0.0090	0.0000	0.0035	0.0042
Pass Loco Hits Pass Car				0.0009	0.0000	0.0005	0.0006
Pass Loco Hits Freight Car				0.0005	0.0000	0.0003	0.0003
Pass Car Hit by Loco				0.0011	0.0000	0.0006	0.0007
Freight Loco Hits Loco	0.0024	0.0000	0.0010				
Freight Loco Hits Car	0.0003	0.0000	0.0002				
Freight Car Hit By Loco	0.0007	0.0000	0.0004				

All train-to-train collision frequencies are in units of **trains in collisions per million train-miles operated in the sub-corridor by all train types.**

Table 3.5a: Risk Calculation - Passenger Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Table 3.5b: Risk Calculation - Collisions at Diamonds - Passenger

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Freq'y (per million tm)	Preventability	Adjusted Frequency	Trips/day	Trips per 10 years	Length of Track (miles)	Train-miles per 10 years	Accidents per 10 years	Number seats per train	Occupancy Factor	Passengers per train	Injuries per 10 years	Fatalities per 10 years	Damage $ per 10 years
40	Train-Train Collision	Pass Loco hits Loco	0.00901	Incl	0.00901	9.16	23843	1.64	39103	0.00035	320	0.6	192	0.0056	0.00014	0
		Pass Loco hits Pass Car	0.00093	Incl	0.00093	9.16	23843	1.64	39103	0.00004	320	0.6	192	0.0002	0.00001	0
		Pass Loco hits Frt Car	0.00051	Incl	0.00051	9.16	23843	1.64	39103	0.00002	320	0.6	192	0.0001	0.00000	0
		Pass car hit by Loco	0.00110	Incl	0.00110	9.16	23843	1.64	39103	0.00004	320	0.6	192	0.0014	0.00004	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	15618	1.64	25614	0.00013	320	0.6	192	0.0003	0.00001	0
	Intrusion Collision (other))	Pass Loco hits intruder	0.01440	0.12	0.01267	6.00	15618	1.64	25614	0.00032	320	0.6	192	0.0016	0.00006	0
	Overspeed		0.01100	0.00	0.01100	6.00	15618	1.64	25614	0.00028	320	0.6	192	0.0024	0.00002	0
	Broken Rail		0.01670	0.08	0.01536	6.00	15618	1.64	25614	0.00039	320	0.6	192	0.0033	0.00003	0
	Work Zone Violation			0.00		6.00	15618	1.64	25614					0.0021	0.00021	0
										0.00158				**0.01711**	**0.00052**	**1**
60	Train-Train Collision	Pass Loco hits Loco	0.00000	Incl	0.00000	9.16	23843	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Pass Car	0.00000	Incl	0.00000	9.16	23843	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Frt Car	0.00000	Incl	0.00000	9.16	23843	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00000	Incl	0.00000	9.16	23843	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	15618	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.12	0.01267	6.00	15618	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Overspeed		0.01100	0.00	0.01100	6.00	15618	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Broken Rail		0.01670	0.08	0.01536	6.00	15618	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Work Zone Violation			0.00		6.00	15618	0	0					0.0000	0.00000	0
										0.00000				**0.00000**	**0.00000**	**0**
79	Train-Train Collision	Pass Loco hits Loco	0.00349	Incl	0.00349	9.16	23843	21.05	501905	0.00175	320	0.6	192	0.081	0.0029	3465
		Pass Loco hits Pass Car	0.00054	Incl	0.00054	9.16	23843	21.05	501905	0.00027	320	0.6	192	0.005	0.0002	268
		Pass Loco hits Frt Car	0.00030	Incl	0.00030	9.16	23843	21.05	501905	0.00015	320	0.6	192	0.003	0.0001	146
		Pass car hit by Loco	0.00062	Incl	0.00062	9.16	23843	21.05	501905	0.00031	320	0.6	192	0.029	0.0012	1234
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	15618	21.05	328759	0.00161	320	0.6	192	0.017	0.0006	717
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.12	0.01267	6.00	15618	21.05	328759	0.00417	320	0.6	192	0.086	0.0030	3704
	Overspeed		0.01100	0.00	0.01100	6.00	15618	21.05	328759	0.00362	320	0.6	192	0.146	0.0023	9403
	Broken Rail		0.01670	0.08	0.01536	6.00	15618	21.05	328759	0.00505	320	0.6	192	0.204	0.0033	13133
	Work Zone Violation			0.00		6.00	15618	21.05	328759					0.054	0.0054	0
										0.01693				**0.62365**	**0.01910**	**32070**
105	Train-Train Collision	Pass Loco hits Loco	0.00424	Incl	0.00424	9.16	23843	33.44	797326	0.00338	320	0.6	192	0.276	0.0104	11811
		Pass Loco hits Pass Car	0.00065	Incl	0.00065	9.16	23843	33.44	797326	0.00052	320	0.6	192	0.017	0.0008	901
		Pass Loco hits Frt Car	0.00034	Incl	0.00034	9.16	23843	33.44	797326	0.00027	320	0.6	192	0.009	0.0004	474
		Pass car hit by Loco	0.00074	Incl	0.00074	9.16	23843	33.44	797326	0.00059	320	0.6	192	0.096	0.0036	4139
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	15618	33.44	522266	0.00256	320	0.6	192	0.047	0.0017	2012
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.12	0.01267	6.00	15618	33.44	522266	0.00662	320	0.6	192	0.243	0.0086	10410
	Overspeed		0.01100	0.00	0.01100	6.00	15618	33.44	522266	0.00574	320	0.6	192	0.309	0.0050	26392
	Broken Rail		0.01670	0.08	0.01536	6.00	15618	33.44	522266	0.00802	320	0.6	192	0.431	0.0069	36863
	Work Zone Violation			0.00		6.00	15618	33.44	522266					0.114	0.0114	0
	Total									**0.02771**				**1.54119**	**0.04882**	**93002**
	Overall Totals									**0.04621**				**2.18196**	**0.06845**	**125073**
	Totals All Speeds	**Train-train Collisions**								**0.00770**				**0.52175**	**0.01988**	**22439**
		Intrusion Collisions								**0.01541**				**0.39492**	**0.01401**	**16843**
		Overspeed								**0.00964**				**0.45704**	**0.00733**	**35795**
		Broken Rail								**0.01347**				**0.63836**	**0.01024**	**49996**
		Work Zone Violation								**0.00000**				**0.16990**	**0.01699**	**0**

Table 3.6a: Risk Calculation - Freight Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Freq'y (per million tm)	Preventability	Adjusted Frequency	Trips/day	Trips per 10 years	Length of Track (miles)	Per 10 years Train-miles	Accidents	Injuries	Fatalities	Damage $
25	Train-Train Collision	Frt Loco hits Loco	0.002414381	Incl	0.00241	9.16	23843	3.9	92990	0.00022	0.00010	0.000010	$24
		Frt Loco hits Car	0.000348661	Incl	0.00035	9.16	23843	3.9	92990	0.00003	0.00001	0.000001	$3
		Frt car hit by Loco	0.000686074	Incl	0.00069	9.16	23843	3.9	92990	0.00006	0.00000	0.000000	$3
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.43	0.00821	3.16	8225	3.9	32079	0.00026	0.00002	0.000002	$3
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.12	0.00757	3.16	8225	3.9	32079	0.00024	0.00002	0.000002	$3
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.00	0	3.9	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.00	0	3.9	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.00	0.01600	3.16	8225	3.9	32079	0.00051	0.00003	0.000003	$77
	Overspeed, Unequip		0.016	0.00	0.01600	0.00	0	3.9	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.08	0.05115	3.16	8225	3.9	32079	0.00164	0.00009	0.000009	$246
	Broken Rail, Unequip		0.056	0.00	0.05560	0.00	0	3.9	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.00		3.16	8225	3.9	32079		0.00135	0.000135	$0
	Work Zone Viol'n, Unequip			0.00		0.00	0	3.9	0		0.00000	0.000000	$0
	Totals									**0.0030**	**0.0016**	**0.00016**	**$358**
40	Train-Train Collision	Frt Loco hits Loco	0.0000	Incl	0.00000	9.16	23843	0	0	0.00000	0.00000	0.000000	$0
		Frt Loco hits Car	0.0000	Incl	0.00000	9.16	23843	0	0	0.00000	0.00000	0.000000	$0
		Frt car hit by Loco	0.0000	Incl	0.00000	9.16	23843	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.43	0.00821	3.16	8225	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.12	0.00757	3.16	8225	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.00	0	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.00	0	0	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.00	0.01600	3.16	8225	0	0	0.00000	0.00000	0.000000	$0
	Overspeed, Unequip		0.016	0.00	0.01600	0.00	0	0	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.08	0.05115	3.16	8225	0	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Unequip		0.056	0.00	0.05560	0.00	0	0	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.00	0.00000	3.16	8225	0	0		0.00000	0.000000	$0
	Work Zone Viol'n, Unequip			0.00		0.00	0	0	0		0.00000	0.000000	$0
	Totals									**0.00000**	**0.0000**	**0.00000**	**$0**
50	Train-Train Collision	Frt Loco hits Loco	0.0010	Incl	0.00098	9.16	23843	52.23	1245345	0.00122	0.00208	0.000208	$515
		Frt Loco hits Car	0.0002	Incl	0.00020	9.16	23843	52.23	1245345	0.00025	0.00035	0.000035	$87
		Frt car hit by Loco	0.0004	Incl	0.00043	9.16	23843	52.23	1245345	0.00053	0.00000	0.000000	$94
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.43	0.00821	3.16	8225	52.23	429617	0.00353	0.00123	0.000123	$155
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.12	0.00757	3.16	8225	52.23	429617	0.00325	0.00114	0.000114	$143
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.00	0	52.23	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.00	0	52.23	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.00	0.01600	3.16	8225	52.23	429617	0.00687	0.00241	0.000241	$4,028
	Overspeed, Unequip		0.016	0.00	0.01600	0.00	0	52.23	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.08	0.05115	3.16	8225	52.23	429617	0.02198	0.00769	0.000769	$12,878
	Broken Rail, Unequip		0.056	0.00	0.05560	0.00	0	52.23	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.00		3.16	8225	52.23	429617		0.03566	0.003566	$0
	Work Zone Viol'n, Unequip			0.00		0.00	0	52.23	0		0.00000	0.000000	$0
	Totals									**0.03763**	**0.0506**	**0.00506**	**$17,900**
	Overall Totals									**0.04061**	**0.0522**	**0.0052**	**$18,258**
Totals All Speeds	**Train-Train Collisions**									**0.00232**	**0.00253**	**0.00025**	**725**
	Intrusion Collisions									**0.00728**	**0.00242**	**0.00024**	**304**
	Diamond Collisions									**0.00284**	**0.00125**	**0.00013**	**475**
	Overspeed									**0.00739**	**0.00243**	**0.00024**	**4105**
	Broken Rail									**0.02362**	**0.00778**	**0.00078**	**13124**
	Work Zone Violation									**0.00000**	**0.03701**	**0.00370**	**0**
	Grade Crossing Collisions												

Table 3.6b: Risk Calculation - Collisions at Diamonds - Freight

Number Diamonds	Freq'y per mill passes	Collisions (millions)	Injuries	Fatalities	Damage
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.030373	0.000000	0.000000	0.000000	0.00
2	0.000000	0.000000	0.000000	0.000000	0.00
2	0.000000	0.000000	0.000000	0.000000	0.00
2	0.009000	0.000429	0.002802	0.000082	107.73
2	0.001800	0.000086	0.002736	0.000082	86.27
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.009000	0.000000	0.000000	0.000000	0.00
0	0.001800	0.000000	0.000000	0.000000	0.00
		0.000515	**0.005538**	**0.000165**	**194.00**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.009000	0.000000	0.000000	0.000000	0.00
0	0.001800	0.000000	0.000000	0.000000	0.00
		0.000000	**0.00000**	**0.00000**	**0.00**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.009000	0.000000	0.000000	0.000000	0.00
0	0.001800	0.000000	0.000000	0.000000	0.00
		0.000000	**0.00000**	**0.00000**	**0.00**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.009000	0.000000	0.000000	0.000000	0.00
0	0.001800	0.000000	0.000000	0.000000	0.00
		0.000000	**0.00000**	**0.00000**	**0.00**
		0.000515	**0.005538**	**0.000165**	**194**

Number Diamonds	Freq'y per mill passes	Collisions (millions)	Injuries	Fatalities	Damage
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.029173	0.000000	0.000000	0.000000	0.00
0	0.030373	0.000000	0.000000	0.000000	0.00
2	0.000000	0.000000	0.000000	0.000000	0.00
2	0.029173	0.001391	0.001252	0.000125	313.01
2	0.030373	0.001448	0.000000	0.000000	162.22
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.029173	0.000000	0.000000	0.000000	0.00
0	0.030373	0.000000	0.000000	0.000000	0.00
		0.002840	**0.001252**	**0.000125**	**475.23**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.029173	0.000000	0.000000	0.000000	0.00
0	0.030373	0.000000	0.000000	0.000000	0.00
		0.002840	**0.001252**	**0.000125**	**$475**

Table 3.7: Risk Calculations: Passenger and Freight Trains; Grade Crossings

Train Type	Representative Speed (mph)	Type of Grade-crossing	Base Collision Frequency	Preventability Factor	Adjusted Collision Frequency	Trips per Day	Crossing Passes per Trip	Crossing Passes per 10 Years	Collisions per 10 Years	Seats per Train (Passenger)	Occupancy Factor	Passengers per Train	Passenger/ Crew Injuries per 10 Years	Passenger/ Crew Fatalities per 10 Years	Damage per 10 Years ($)
Passenger	40	Public_gates_lights	0.35	0%	0.350	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Public_other	0.30	0%	0.300	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Private	0.10	0%	0.100	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
	60	Public_gates_lights	0.60	0%	0.600	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Public_other	0.50	0%	0.500	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Private	0.20	0%	0.200	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
	79	Public_gates_lights	0.80	0%	0.800	6.00	16	249888	0.200	320	0.60	192	0.4030	0.0060	39182
		Public_other	0.65	0%	0.650	6.00	1	15618	0.010	320	0.60	192	0.0205	0.0003	1990
		Private	0.30	0%	0.300	6.00	1	15618	0.005	320	0.60	192	0.0094	0.0001	918
	105	Public_gates_lights	1.10	0%	1.100	6.00	13	203034	0.223	320	0.60	192	0.7976	0.0118	77275
		Public_other	0.80	0%	0.800	6.00	4	62472	0.050	320	0.60	192	0.1785	0.0026	17292
		Private	0.30	0%	0.300	6.00	4	62472	0.019	320	0.60	192	0.0669	0.0010	6485
Freight	25	Public_gates_lights	0.15	0%	0.150	3.16	3	24676	0.004				0.00044	0.00002	74
Equipped		Public_other	0.12	0%	0.120	3.16	0	0	0.000				0.00000	0.00000	0
		Private	0.05	0%	0.050	3.16	0	0	0.000				0.00000	0.00000	0
	40	Public_gates_lights	0.30	0%	0.300	3.16	0	0	0.000				0.00000	0.00000	0
		Public_other	0.25	0%	0.250	3.16	0	0	0.000				0.00000	0.00000	0
		Private	0.10	0%	0.100	3.16	0	0	0.000				0.00000	0.00000	0
	50	Public_gates_lights	0.36	0%	0.360	3.16	26	213862	0.077				0.03003	0.00154	6005
		Public_other	0.30	0%	0.300	3.16	5	41127	0.012				0.00481	0.00025	962
		Private	0.12	0%	0.120	3.16	5	41127	0.005				0.00192	0.00010	385
Freight	25	Public_gates_lights	0.15	0%	0.150	0.00	3	0	0.000				0.00000	0.00000	0
Unequipped		Public_other	0.12	0%	0.120	0.00	0	0	0.000				0.00000	0.00000	0
		Private	0.05	0%	0.050	0.00	0	0	0.000				0.00000	0.00000	0
	40	Public_gates_lights	0.30	0%	0.300	0.00	0	0	0.000				0.00000	0.00000	0
		Public_other	0.25	0%	0.250	0.00	0	0	0.000				0.00000	0.00000	0
		Private	0.10	0%	0.100	0.00	0	0	0.000				0.00000	0.00000	0
	50	Public_gates_lights	0.36	0%	0.360	0.00	26	0	0.000				0.00000	0.00000	0
		Public_other	0.30	0%	0.300	0.00	5	0	0.000				0.00000	0.00000	0
		Private	0.12	0%	0.120	0.00	5	0	0.000				0.00000	0.00000	0
								Total - Passenger	**0.507**				**1.476**	**0.022**	**143142**
Risk Calculations: Passenger and Freight Trains; Diamonds								**Total - Freight**	**0.098**				**0.037**	**0.002**	**7427**
Train Type								**Totals - All Speeds**	**0.605**				**1.51**	**0.02**	**150569**

Table 3.8: Summary - All Risks

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00770	0.52175	0.01988	22439	134242
	Intrusion Collisions	0.01541	0.39492	0.01401	16843	98358
	Diamond Collisions	0.000515	0.00554	0.00016	194	1242
	Overspeed	0.00964	0.45704	0.00733	35795	103495
	Broken Rail	0.01347	0.63836	0.01024	49996	144554
	Work Zone Violation	0.00000	0.16990	0.01699	0	67959
	Grade Crossing Collisions	0.50680	1.47592	0.02191	143142	356461
	Total, All Scenarios	0.55353	3.66342	0.09052	268409	906311
Freight	Train-Train Collisions	0.00232	0.00253	0.00025	725	1738
	Intrusion Collisions	0.00728	0.00242	0.00024	304	1271
	Diamond Collisions	0.00284	0.00125	0.00013	475	976
	Overspeed	0.00739	0.00243	0.00024	4105	5079
	Broken Rail	0.02362	0.00778	0.00078	13124	16237
	Work Zone Violation	0.00000	0.03701	0.00370	0	14802
	Grade Crossing Collisions	0.09797	0.03721	0.00190	7427	16859
	Total, All Scenarios	0.14141	0.09063	0.00725	26160	56962
Total Passenger + Freight		**0.69495**	**3.75405**	**0.09777**	**294569**	**963273**
	Unit Costs ($/Casualty)		100000	3000000		

Data exported to the Results Summary worksheet

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Worksheet 2 - Sp,N,S: Collision Frequencies Calculation - Base Case II: Northeast Corridor ATC, 85% Preventability, Springfield Sub-corridor, Summer

Table 2.1a: Collision Distribution Matrix (Fraction Accidents by Train Pair and Collision Type). Collisions Between Trains Operating on the IDOT Test Corridor Only (not diamonds and intrusions)

	Train Pairs in In Collision	Collision Scenario Prob (Top Level)	Siding - Monitored: Collision Distribution Head On	Siding - Monitored: Collision Distribution Rear/Side	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty
	Percent Guilty				100%	0%	100%	0%
Both Trains TBE (Note 3)	Pass-Pass	0.80	0.50	0.50	0.4	0	0.4	0
	Pass-TBE Freight	0.20	0.50	0.50	0.1	0	0.1	0
	TBE Freight - TBE Freight	0.00	0.50	0.50	0	0	0	0
	Percent Guilty				50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	0.00	1	0	0	0	0	0
	Rear/Side, Pass into NE Frt		0	1	0	0	0	0
	Rear/Side NE Frt into Pass		0	1	0	0	0	0
	TBE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0
	Percent Guilty				0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0
	Total Probability (checking)	1		1	0.5	0	0.5	0

	Train Pairs in In Collision	Train Pair Type	Siding - Unmonitored: Collision Distribution Head On	Siding - Unmonitored: Collision Distribution Rear/Side	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
	Percent Guilty				100%	0%	100%	0%
Both Trains TBE	Pass-Pass	Both Trains TBE	0.8	0.2	0.64	0	0.16	0
	Pass-TBE Freight		0.7	0.3	0.14	0	0.06	0
	TBE Freight - TBE Freight		0.7	0.3	0	0	0	0
	Percent Guilty				50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	One Train TBE	1	0	0	0	0	0
	Rear/Side, Pass into NE Frt		0	1	0	0	0	0
	Rear/Side NE Frt into Pass		0	1	0	0	0	0
	TBE Freight - NE Freight		0.7	0.3	0	0	0	0
	Percent Guilty				0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	Neither Train TBE	0.7	0.3	0	0	0	0
	Total Probability (checking)			1	0.78	0	0.22	0

	Train Pairs in In Collision	Train Pair Type	CP Adjacent - Monitored Siding: Collision Distribution Head On	CP Adjacent - Monitored Siding: Collision Distribution Rear/Side	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty
	Percent Guilty				100%	0%	100%	0%
Both Trains TBE	Pass-Pass	Both Trains TBE	0.8	0.2	0.64	0	0.16	0
	Pass-TBE Freight		0.7	0.3	0.14	0	0.06	0
	TBE Freight - TBE Freight		0.7	0.3	0	0	0	0
	Percent Guilty				50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	One Train TBE	1	0	0	0	0	0
	Rear/Side, Pass into NE Frt		0	1	0	0	0	0
	Rear/Side NE Frt into Pass		0	1	0	0	0	0
	TBE Freight - NE Freight		0.7	0.3	0	0	0	0
	Percent Guilty				0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	Neither Train TBE	0.7	0.3	0	0	0	0
	Total Probability (checking)			1	0.78	0	0.22	0

	Train Pairs in In Collision	Train Pair Type	CP Adjacent - Unmonitored Siding: Collision Distribution Head On	CP Adjacent - Unmonitored Siding: Collision Distribution Rear/Side	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
	Percent Guilty				100%	0%	100%	0%
Both Trains TBE	Pass-Pass	Both Trains TBE	0.8	0.2	0.64	0	0.16	0
	Pass-TBE Freight		0.7	0.3	0.14	0	0.06	0
	TBE Freight - TBE Freight		0.7	0.3	0	0	0	0
	Percent Guilty				50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	One Train TBE	1	0	0	0	0	0
	Rear/Side, Pass into NE Frt		0	1	0	0	0	0
	Rear/Side NE Frt into Pass		0	1	0	0	0	0
	TBE Freight - NE Freight		0.7	0.3	0	0	0	0
	Percent Guilty				0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	Neither Train TBE	0.7	0.3	0	0	0	0
	Total Probability (checking)			1	0.78	0	0.22	0

	Train Pairs in In Collision	Train Pair Type	Plain Track: Collision Distribution Head On	Plain Track: Collision Distribution Rear/Side	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
	Percent Guilty				100%	0%	100%	0%
Both Trains TBE	Pass-Pass	Both Trains TBE	0.70	0.30	0.56	0	0.24	0
	Pass-TBE Freight		0.40	0.60	0.08	0	0.12	0
	TBE Freight - TBE Freight		0.50	0.50	0	0	0	0
	Percent Guilty				50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	One Train TBE	1.00	0.00	0	0	0	0
	Rear/Side, Pass into NE Frt		0.00	1.00	0	0	0	0
	Rear/Side NE Frt into Pass		0.00	1.00	0	0	0	0
	TBE Freight - NE Freight		0.50	0.50	0	0	0	0
	Percent Guilty				0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	Neither Train TBE	0.50	0.50	0	0	0	0
	Total Probability (checking)			1	0.64	0	0.36	0

Table 2.1b: Collision Type Distribution - Diamonds

	Train Pairs in In Collision	Train Pair Type	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty
	Percent Guilty			
Both Trains TBE	Pass-Pass	Both Trains TBE		
	Pass-TBE Freight			
	TBE Freight - TBE Freight			
One Train TBE	**Percent Guilty**	One Train TBE	50%	50%
	Pass - NE Freight, Head -On		0	0
	Rear/Side, Pass into NE Frt		0.25	0.25
	Rear/Side NE Frt into Pass		0.05	0.05
	TBE Freight - NE Freight		0.1	0.1
Neither Train TBE	**Percent Guilty**			100%
	NE Freight - NE Freight		0	0.2
	Total Probability (checking)		0.4	0.6

Note: The gray cells on these rows are set at zero, because in every case, the condition represented by the cell does not exist - either because there are no unequipped passenger trains, or because of the kind of collision defined for the row.

Quantity in cell C18 is for all collisions between a passenger train and an unequipped freight train

Table 2.2: Preventability Data For Unequipped train Guilty, One Train TBE

Segment Type	Not Prevented of Mitigated Freight	Not Prevented of Mitigated Pass	Not Prevented of Mitigated HS Pass	Mitigated Freight	Mitigated Pass	Mitigated HS Pass	Prevented Freight	Prevented Pass	Prevented HS Pass
Siding (M)	0.281	0.241	0.558	0.263	0.263	0.263	0.506	0.547	0.229
Siding (U)	0.369	0.368	0.524	0.166	0.172	0.313	0.515	0.510	0.213
CP Adjacent (M)	0.361	0.353	0.514	0.226	0.229	0.250	0.463	0.468	0.286
CP Adjacent (U)	0.357	0.331	0.608	0.325	0.250	0.304	0.368	0.469	0.138
Plain Track	0.104	0.102	0.148	0.000	0.000	0.016	0.100	0.100	0.084
Diamonds	0.239	0.260	0.250	0.098	0.000	0.170	0.713	0.790	0.630

Mauve cells contain data imported from Worksheet 1 in this group of three worksheets covering this sub-corridor, season and operating state.

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Worksheet 3 - Sp,N,R: - Risk Calculations - Base Case II: Northeast Corridor ATC, 85% Preventability, Springfield Subcorridor, Summer

Table 3.1: Consequences Look-up Tables (Data Sources: Previous ICF Passenger Corridor Project (passenger), FRA Accident Data 2001-5 (freight)

Passenger Trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 40 mph			Representative Speed 60 mph			Representative Speed 79 mph			Representative Speed 105 mph		
			Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Pass Loco hits Loco	0.083	0.002	502000	0.139	0.0049	1142000	0.24	0.0085	1976000	0.425	0.016	3495000
		Pass Loco hits Pass Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.008	1747000
		Pass Loco hits Frt Car	0.034	0.001	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.008	1747000
		Pass car hit by Loco	0.166	0.005	1005000	0.275	0.0119	2284000	0.476	0.0206	3951000	0.841	0.032	6989000
	Intrusion Collision (rollout)	Pass Loco hits Car	0.013	0.0005	113000	0.031	0.0011	257000	0.054	0.0019	445000	0.096	0.0034	786000
	Intrusion Collision (other))	Pass Loco hits Car	0.026	0.0009	226000	0.063	0.0022	514000	0.108	0.0038	889000	0.191	0.0068	1573000
	Overspeed		0.044	0.0004	667000	0.14	0.00186	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Broken Rail		0.044	0.0004	667000	0.14	0.00186	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Work Zone Violation		0.083	0.0083	0	0.125	0.0125	0	0.164	0.0164	0	0.218	0.0218	0

Freight trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 25 mph			Representative Speed 40 mph			Representative Speed 50 mph		
			Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Frt Loco hits Loco	0.43	0.043	105000	1.1	0.11	270000	1.7	0.17	422000
		Frt Loco hits Car	0.35	0.035	88000	0.9	0.09	225000	1.4	0.14	352000
		Frt car hit by Loco	0	0	44000	0	0	112000	0	0	176000
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Overspeed, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Overspeed, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Work Zone Viol'n, Equip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0
	Work Zone Viol'n, Unequip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0

Casualties and damage in Table 3.1 are per accident, except for Work Zone Violations which are per million train-miles

Table 3.2: Grade Crossing and Diamonds: Numbers by Representative Speed, and Accident Frequency and Consequences

Train Type	Representative Speed (mph)	Type of Grade-crossing	Number Crossings			Accident Frequency		Crossing Collision Consequences						Number Diamonds
			Passenger	HS Passenger	Freight	Per Million Crossing Passes		Pass. Occup't Casualty Prob/accident)			Freight Trains (per accident)			
						Passenger	Freight	Injuries	Fatalities	Cost $/Accid't	Injuries	Fatalities	Cost $	
Passenger	40	Public_gates_lights	0	0		0.350		0.0028	0.000047	50000				2
		Public_other	0	0		0.300								
		Private	0	0		0.100								
	60	Public_gates_lights	14	0		0.600		0.0068	0.000112	113000				0
		Public_other	0	0		0.500								
		Private	0	0		0.200								
	79	Public_gates_lights	15	16		0.800		0.0105	0.000156	196000				0
		Public_other	5	1		0.650								
		Private	5	1		0.300								
	105	Public_gates_lights	0	13		1.100		0.0186	0.000276	346000				0
		Public_other	0	4		0.800								
		Private	0	4		0.300								
Freight	25	Public_gates_lights			3	0.150					0.12	0.005	20000	0
		Public_other			0	0.120								
		Private			0	0.050								
	40	Public_gates_lights			0	0.300					0.25	0.013	50000	2
		Public_other			0	0.250								
		Private			0	0.100								
	50	Public_gates_lights			26	0.360					0.39	0.02	78000	0
		Public_other			5	0.300								
		Private			5	0.120								
		Check Totals	39	39	39									

Table 3.3a: Segment Data (for reference only, not used in calculations)

Segment Number	Start (Milepost)	End (Milepost)	Type	Length (miles)	Representative Speed (mph)			
					Freight	Pass	HS Pass	HS Pass
32	$124.86	$126.50	CP Adjacent (M	1.64	25	40	40	40
33	$126.50	$126.50	Diamond	0.00	25	40	40	40
34	$126.50	$128.76	CP Adjacent (M	2.26	25	60	60	79
35	$128.76	$130.96	Plain	2.20	50	79	79	79
36	$130.96	$133.72	Plain	2.76	50	79	60	105
37	$133.72	$136.90	Plain	3.18	50	79	79	105
38	$136.90	$138.63	CP Adjacent (M	1.73	50	79	79	105
39	$138.63	$141.30	Siding (M)	2.67	50	79	79	105
40	$141.30	$143.35	CP Adjacent (M	2.05	50	79	79	105
41	$143.35	$148.30	Plain	4.95	50	60	79	79
42	$148.30	$150.96	Plain	2.66	50	79	79	105
43	$150.96	$153.56	CP Adjacent (U	2.60	50	79	79	105
44	$153.56	$155.57	Siding (U)	2.01	50	60	60	79
45	$155.57	$155.57	Diamond	0.00	40	40	40	40
46	$155.57	$157.26	CP Adjacent (U	1.69	50	60	60	79
47	$157.26	$160.05	Plain	2.79	50	79	79	79
48	$160.05	$162.11	Plain	2.06	50	79	79	105
49	$162.11	$164.04	Plain	1.93	50	79	79	105
50	$164.04	$166.16	Plain	2.12	50	79	79	105
51	$166.16	$168.34	CP Adjacent (U	2.18	50	79	79	105
52	$168.34	$170.40	Siding (U)	2.06	50	79	79	105
53	$170.40	$172.34	CP Adjacent (U	1.94	50	79	79	105
54	$172.34	$175.84	Plain	3.50	50	79	79	105
55	$175.84	$179.49	Plain	3.65	50	79	79	79
56	$179.49	$180.99	CP Adjacent (M	1.50	50	79	79	79

Table 3.3b: Aggregate Segment Data: SegmentsTypes, Train Types, Speeds, and Lengths

Aggregate Segment Length by Type and Speed Band (from Seg Def and Preventability)

Segment Type	Train Type	Represent've Speed (mph)	Freight (miles)	Reg Pass (miles)	HS Pass Collision (mi)	HS Pass Other (mi)
Siding (mon)	Freight	25	0			
		40	0			
		50	2.67			
	Passenger	40		0	0	0
		60		0	0	0
		79		2.67	2.67	0
		105		0	0	2.67
Siding (unmon)	Freight	25	0			
		40	0			
		50	4.07			
	Passenger	40		0	0	0
		60		2.01	2.01	0
		79		2.06	2.06	2.01
		105		0	0	2.06
CP Adjacent (mon)	Freight	25	3.9			
		40	0			
		50	5.28			
	Passenger	40		1.64	1.64	1.64
		60		2.26	2.26	0
		79		5.28	5.28	3.76
		105		0	0	3.78
CP Adjacent (unmon)	Freight	25	0			
		40	0			
		50	8.41			
	Passenger	40		0	0	0
		60		1.69	1.69	0
		79		6.72	6.72	1.69
		105		0	0	6.72
Plain Track	Freight	25	0			
		40	0			
		50	31.8			
	Passenger	40		0	0	0
		60		4.95	2.76	0
		79		26.85	29.04	13.59
		105		0	0	18.21
Totals All Types	Freight	25	3.9			
		40	0			
		50	52.23			
	Passenger	40		1.64	1.64	1.64
		60		10.91	8.72	0
		79		43.58	45.77	21.05
		105		0	0	33.44
		Check Totals		56.13	56.13	56.13	56.13

Table 3.4a: Traffic Inputs to Risk Calculation

Train Type	Trips/Day Summer	Trips/Day Rest of Year
Passenger	6.00	6.00
Equipped Freight	1.73	3.16
Unequipped Freight	0.00	0.00
Operating Days	91	274

Percent Train-Miles in	
Timeout (secs)	0
Normal Operating Mode	95.00
Timeout Mode	0.00
Fallback Mode	5

Passenger Train Occupancy	
Seats	320
Occupancy Factor	0.60

Table 3.4: Collision Frequencies by Segment Type and Collision Scenario (From Coll Matrix)

Scenarios	Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain	Diamond
Pass Loco Hits Loco	0.0041	0.0054	0.0107	0.0128	0.0011	0.000000
Pass Loco Hits Pass Car	0.0018	0.0024	0.0012	0.0014	0.0002	0.000000
Pass Loco Hits Freight Car	0.0004	0.0005	0.0003	0.0004	0.0001	0.009000
Pass Car Hit by Loco	0.0019	0.0025	0.0013	0.0016	0.0002	0.001800
Freight Loco Hits Loco	0.0005	0.0006	0.0011	0.0013	0.0001	0.000000
Freight Loco Hits Car	0.0001	0.0001	0.0001	0.0001	0.0000	0.029173
Freight Car Hit By Loco	0.0004	0.0005	0.0003	0.0004	0.0001	0.030373

Collision Frequencies for Passenger + Unequipped Freight Train

Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain
0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000

Mauve cells contain data imported from Worksheet 2 in this group of three worksheets covering this sub-corridor, season and operating state.

Weighted Collision Accident Frequencies by Representative Speed (mph)

Scenarios	Freight 25	Freight 40	Freight 50	Passenger 40	Passenger 60	Passenger 79	Passenger 105
Pass Loco Hits Loco				0.0106	0.0000	0.0041	0.0050
Pass Loco Hits Pass Car				0.0012	0.0000	0.0007	0.0008
Pass Loco Hits Freight Car				0.0003	0.0000	0.0002	0.0002
Pass Car Hit by Loco				0.0013	0.0000	0.0008	0.0009
Freight Loco Hits Loco	0.0010	0.0000	0.0004				
Freight Loco Hits Car	0.0001	0.0000	0.0001				
Freight Car Hit By Loco	0.0003	0.0000	0.0002				

All train-to-train collision frequencies are in units of **trains in collisions per million train-miles operated in the sub-corridor by all train types.**

Table 3.5a: Risk Calculation - Passenger Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Table 3.5b: Risk Calculation - Collisions at Diamonds - Passenger

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Freq'y (per million tm)	Preventability	Adjusted Frequency	Trips/day	Trips per 10 years	Length of Track (miles)	Train-miles per 10 years	Accidents per 10 years	Number seats per train	Occupancy Factor	Passengers per train	Injuries per 10 years	Fatalities per 10 years	Damage $ per 10 years
40	Train-Train Collision	Pass Loco hits Loco	0.01064	Incl	0.01064	7.73	6683	1.64	10959	0.00012	320	0.6	192	0.0019	0.00004	0
		Pass Loco hits Pass Car	0.00120	Incl	0.00120	7.73	6683	1.64	10959	0.00001	320	0.6	192	0.0001	0.00000	0
		Pass Loco hits Frt Car	0.00034	Incl	0.00034	7.73	6683	1.64	10959	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00131	Incl	0.00131	7.73	6683	1.64	10959	0.00001	320	0.6	192	0.0005	0.00001	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	5187	1.64	8507	0.00004	320	0.6	192	0.0001	0.00000	0
	Intrusion Collision (other))	Pass Loco hits intruder	0.01440	0.12	0.01267	6.00	5187	1.64	8507	0.00011	320	0.6	192	0.0005	0.00002	0
	Overspeed		0.01100	0.00	0.01100	6.00	5187	1.64	8507	0.00009	320	0.6	192	0.0008	0.00001	0
	Broken Rail		0.01670	0.08	0.01536	6.00	5187	1.64	8507	0.00013	320	0.6	192	0.0011	0.00001	0
	Work Zone Violation			0.00		6.00	5187	1.64	8507					0.0007	0.00007	0
										0.00052				**0.00567**	**0.00017**	**0**
60	Train-Train Collision	Pass Loco hits Loco	0.00000	Incl	0.00000	7.73	6683	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Pass Car	0.00000	Incl	0.00000	7.73	6683	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Frt Car	0.00000	Incl	0.00000	7.73	6683	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00000	Incl	0.00000	7.73	6683	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	5187	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.12	0.01267	6.00	5187	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Overspeed		0.01100	0.00	0.01100	6.00	5187	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Broken Rail		0.01670	0.08	0.01536	6.00	5187	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Work Zone Violation			0.00		6.00	5187	0	0					0.0000	0.00000	0
										0.00000				**0.00000**	**0.00000**	**0**
79	Train-Train Collision	Pass Loco hits Loco	0.00414	Incl	0.00414	7.73	6683	21.05	140668	0.00058	320	0.6	192	0.027	0.0010	1151
		Pass Loco hits Pass Car	0.00070	Incl	0.00070	7.73	6683	21.05	140668	0.00010	320	0.6	192	0.002	0.0001	97
		Pass Loco hits Frt Car	0.00020	Incl	0.00020	7.73	6683	21.05	140668	0.00003	320	0.6	192	0.001	0.0000	27
		Pass car hit by Loco	0.00075	Incl	0.00075	7.73	6683	21.05	140668	0.00011	320	0.6	192	0.010	0.0004	418
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	5187	21.05	109186	0.00054	320	0.6	192	0.006	0.0002	238
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.12	0.01267	6.00	5187	21.05	109186	0.00138	320	0.6	192	0.029	0.0010	1230
	Overspeed		0.01100	0.00	0.01100	6.00	5187	21.05	109186	0.00120	320	0.6	192	0.048	0.0008	3123
	Broken Rail		0.01670	0.08	0.01536	6.00	5187	21.05	109186	0.00168	320	0.6	192	0.068	0.0011	4362
	Work Zone Violation			0.00		6.00	5187	21.05	109186					0.018	0.0018	0
										0.00561				**0.20707**	**0.00634**	**10646**
105	Train-Train Collision	Pass Loco hits Loco	0.00502	Incl	0.00502	7.73	6683	33.44	223466	0.00112	320	0.6	192	0.091	0.0034	3918
		Pass Loco hits Pass Car	0.00083	Incl	0.00083	7.73	6683	33.44	223466	0.00019	320	0.6	192	0.006	0.0003	326
		Pass Loco hits Frt Car	0.00023	Incl	0.00023	7.73	6683	33.44	223466	0.00005	320	0.6	192	0.002	0.0001	89
		Pass car hit by Loco	0.00090	Incl	0.00090	7.73	6683	33.44	223466	0.00020	320	0.6	192	0.032	0.0012	1403
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	5187	33.44	173453	0.00085	320	0.6	192	0.016	0.0006	668
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.12	0.01267	6.00	5187	33.44	173453	0.00220	320	0.6	192	0.081	0.0029	3457
	Overspeed		0.01100	0.00	0.01100	6.00	5187	33.44	173453	0.00191	320	0.6	192	0.103	0.0016	8765
	Broken Rail		0.01670	0.08	0.01536	6.00	5187	33.44	173453	0.00266	320	0.6	192	0.143	0.0023	12243
	Work Zone Violation			0.00		6.00	5187	33.44	173453					0.038	0.0038	0
	Total									**0.00918**				**0.51160**	**0.01620**	**30869**
	Overall Totals									**0.01531**				**0.72434**	**0.02271**	**41515**
	Totals All Speeds	**Train-train Collisions**								**0.00252**				**0.17296**	**0.00658**	**7429**
		Intrusion Collisions								**0.00512**				**0.13116**	**0.00465**	**5594**
		Overspeed								**0.00320**				**0.15179**	**0.00244**	**11888**
		Broken Rail								**0.00447**				**0.21201**	**0.00340**	**16604**
		Work Zone Violation								**0.00000**				**0.05643**	**0.00564**	**0**

Table 3.6a: Risk Calculation - Freight Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Freq'y (per million tm)	Preventability	Adjusted Frequency	Trips/day	Trips per 10 years	Length of Track (miles)	Per 10 years Train-miles	Accidents	Injuries	Fatalities	Damage $
25	Train-Train Collision	Frt Loco hits Loco	0.001049731	Incl	0.00105	7.73	6683	3.9	26062	0.00003	0.00001	0.000001	$3
		Frt Loco hits Car	0.000112471	Incl	0.00011	7.73	6683	3.9	26062	0.00000	0.00000	0.000000	$0
		Frt car hit by Loco	0.000337413	Incl	0.00034	7.73	6683	3.9	26062	0.00001	0.00000	0.000000	$0
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.43	0.00821	1.73	1496	3.9	5833	0.00005	0.00000	0.000000	$1
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.12	0.00757	1.73	1496	3.9	5833	0.00004	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.00	0	3.9	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.00	0	3.9	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.00	0.01600	1.73	1496	3.9	5833	0.00009	0.00001	0.000001	$14
	Overspeed, Unequip		0.016	0.00	0.01600	0.00	0	3.9	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.08	0.05115	1.73	1496	3.9	5833	0.00030	0.00002	0.000002	$45
	Broken Rail, Unequip		0.056	0.00	0.05560	0.00	0	3.9	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.00		1.73	1496	3.9	5833		0.00024	0.000024	$0
	Work Zone Viol'n, Unequip			0.00		0.00	0	3.9	0		0.00000	0.000000	$0
	Totals									**0.0005**	**0.0003**	**0.00003**	**$63**
40	Train-Train Collision	Frt Loco hits Loco	0.0000	Incl	0.00000	7.73	6683	0	0	0.00000	0.00000	0.000000	$0
		Frt Loco hits Car	0.0000	Incl	0.00000	7.73	6683	0	0	0.00000	0.00000	0.000000	$0
		Frt car hit by Loco	0.0000	Incl	0.00000	7.73	6683	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.43	0.00821	1.73	1496	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.12	0.00757	1.73	1496	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.00	0	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.00	0	0	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.00	0.01600	1.73	1496	0	0	0.00000	0.00000	0.000000	$0
	Overspeed, Unequip		0.016	0.00	0.01600	0.00	0	0	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.08	0.05115	1.73	1496	0	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Unequip		0.056	0.00	0.05560	0.00	0	0	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.00		1.73	1496	0	0		0.00000	0.000000	$0
	Work Zone Viol'n, Unequip			0.00		0.00	0	0	0		0.00000	0.000000	$0
	Totals									**0.00000**	**0.0000**	**0.00000**	**$0**
50	Train-Train Collision	Frt Loco hits Loco	0.0004	Incl	0.00042	7.73	6683	52.23	349031	0.00015	0.00025	0.000025	$62
		Frt Loco hits Car	0.0001	Incl	0.00006	7.73	6683	52.23	349031	0.00002	0.00003	0.000003	$7
		Frt car hit by Loco	0.0002	Incl	0.00021	7.73	6683	52.23	349031	0.00007	0.00000	0.000000	$13
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.43	0.00821	1.73	1496	52.23	78114	0.00064	0.00022	0.000022	$28
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.12	0.00757	1.73	1496	52.23	78114	0.00059	0.00021	0.000021	$26
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.00	0	52.23	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.00	0	52.23	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.00	0.01600	1.73	1496	52.23	78114	0.00125	0.00044	0.000044	$732
	Overspeed, Unequip		0.016	0.00	0.01600	0.00	0	52.23	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.08	0.05115	1.73	1496	52.23	78114	0.00400	0.00140	0.000140	$2,341
	Broken Rail, Unequip		0.056	0.00	0.05560	0.00	0	52.23	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.00		1.73	1496	52.23	78114		0.00648	0.000648	$0
	Work Zone Viol'n, Unequip			0.00		0.00	0	52.23	0		0.00000	0.000000	$0
	Totals									**0.00672**	**0.0090**	**0.00090**	**$3,210**
	Overall Totals									**0.00724**	**0.0093**	**0.0009**	**$3,274**
Totals All Speeds	**Train-Train Collisions**									**0.00028**	**0.00029**	**0.00003**	**86**
	Intrusion Collisions									**0.00132**	**0.00044**	**0.00004**	**55**
	Diamond Collisions									**0.00080**	**0.00035**	**0.00004**	**133**
	Overspeed									**0.00134**	**0.00044**	**0.00004**	**746**
	Broken Rail									**0.00429**	**0.00142**	**0.00014**	**2386**
	Work Zone Violation									**0.00000**	**0.00673**	**0.00067**	**0**
	Grade Crossing Collisions												

Table 3.6b: Risk Calculation - Collisions at Diamonds - Freight

Number Diamonds	Freq'y per mill passes	Collisions (millions)	Injuries	Fatalities	Damage
0	0.000000	0.000000	0.000000	0.000000	0.00
2	0.000000	0.000000	0.000000	0.000000	0.00
2	0.009000	0.000120	0.000785	0.000023	30.19
2	0.001800	0.000024	0.000767	0.000023	24.18
		0.000144	**0.001552**	**0.000046**	**54.37**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.009000	0.000000	0.000000	0.000000	0.00
0	0.001800	0.000000	0.000000	0.000000	0.00
		0.000000	**0.00000**	**0.00000**	**0.00**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.009000	0.000000	0.000000	0.000000	0.00
0	0.001800	0.000000	0.000000	0.000000	0.00
		0.000000	**0.00000**	**0.00000**	**0.00**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.009000	0.000000	0.000000	0.000000	0.00
0	0.001800	0.000000	0.000000	0.000000	0.00
		0.000000	**0.00000**	**0.00000**	**0.00**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.029173	0.000000	0.000000	0.000000	0.00
0	0.030373	0.000000	0.000000	0.000000	0.00
		0.000000	**0.000000**	**0.000000**	**0.00**
2	0.000000	0.000000	0.000000	0.000000	0.00
2	0.029173	0.000390	0.000351	0.000035	87.73
2	0.030373	0.000406	0.000000	0.000000	45.47
		0.000796	**0.000351**	**0.000035**	**133.19**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.029173	0.000000	0.000000	0.000000	0.00
0	0.030373	0.000000	0.000000	0.000000	0.00
		0.000000	**0.000000**	**0.000000**	**0.00**
		0.000796	**0.000351**	**0.000035**	**$133**

Table 3.7: Risk Calculations: Passenger and Freight Trains; Grade Crossings

Train Type	Representative Speed (mph)	Type of Grade-crossing	Base Collision Frequency	Preventability Factor	Adjusted Collision Frequency	Trips per Day	Crossing Passes per Trip	Crossing Passes per 10 Years	Collisions per 10 Years	Seats per Train (Passenger)	Occupancy Factor	Passengers per Train	Passenger/ Crew Injuries per 10 Years	Passenger/ Crew Fatalities per 10 Years	Damage per 10 Years ($)
Passenger	40	Public_gates_lights	0.35	0%	0.350	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Public_other	0.30	0%	0.300	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Private	0.10	0%	0.100	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
	60	Public_gates_lights	0.60	0%	0.600	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Public_other	0.50	0%	0.500	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Private	0.20	0%	0.200	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
	79	Public_gates_lights	0.80	0%	0.800	6.00	16	82992	0.066	320	0.60	192	0.1338	0.0020	13013
		Public_other	0.65	0%	0.650	6.00	1	5187	0.003	320	0.60	192	0.0068	0.0001	661
		Private	0.30	0%	0.300	6.00	1	5187	0.002	320	0.60	192	0.0031	0.0000	305
	105	Public_gates_lights	1.10	0%	1.100	6.00	13	67431	0.074	320	0.60	192	0.2649	0.0039	25664
		Public_other	0.80	0%	0.800	6.00	4	20748	0.017	320	0.60	192	0.0593	0.0009	5743
		Private	0.30	0%	0.300	6.00	4	20748	0.006	320	0.60	192	0.0222	0.0003	2154
Freight	25	Public_gates_lights	0.15	0%	0.150	1.73	3	4487	0.001				0.00008	0.00000	13
Equipped		Public_other	0.12	0%	0.120	1.73	0	0	0.000				0.00000	0.00000	0
		Private	0.05	0%	0.050	1.73	0	0	0.000				0.00000	0.00000	0
	40	Public_gates_lights	0.30	0%	0.300	1.73	0	0	0.000				0.00000	0.00000	0
		Public_other	0.25	0%	0.250	1.73	0	0	0.000				0.00000	0.00000	0
		Private	0.10	0%	0.100	1.73	0	0	0.000				0.00000	0.00000	0
	50	Public_gates_lights	0.36	0%	0.360	1.73	26	38885	0.014				0.00546	0.00028	1092
		Public_other	0.30	0%	0.300	1.73	5	7478	0.002				0.00087	0.00004	175
		Private	0.12	0%	0.120	1.73	5	7478	0.001				0.00035	0.00002	70
Freight	25	Public_gates_lights	0.15	0%	0.150	0.00	3	0	0.000				0.00000	0.00000	0
Unequipped		Public_other	0.12	0%	0.120	0.00	0	0	0.000				0.00000	0.00000	0
		Private	0.05	0%	0.050	0.00	0	0	0.000				0.00000	0.00000	0
	40	Public_gates_lights	0.30	0%	0.300	0.00	0	0	0.000				0.00000	0.00000	0
		Public_other	0.25	0%	0.250	0.00	0	0	0.000				0.00000	0.00000	0
		Private	0.10	0%	0.100	0.00	0	0	0.000				0.00000	0.00000	0
	50	Public_gates_lights	0.36	0%	0.360	0.00	26	0	0.000				0.00000	0.00000	0
		Public_other	0.30	0%	0.300	0.00	5	0	0.000				0.00000	0.00000	0
		Private	0.12	0%	0.120	0.00	5	0	0.000				0.00000	0.00000	0
								Total - Passenger	**0.168**				**0.490**	**0.007**	**47540**
Risk Calculations: Passenger and Freight Trains; Diamonds								**Total - Freight**	**0.018**				**0.007**	**0.000**	**1350**
Train Type								**Totals - All Speeds**	**0.186**				**0.50**	**0.01**	**48890**

Table 3.8: Summary - All Risks

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00252	0.17296	0.00658	7429	44468
	Intrusion Collisions	0.00512	0.13116	0.00465	5594	32666
	Diamond Collisions	0.000144	0.00155	0.00005	54	348
	Overspeed	0.00320	0.15179	0.00244	11888	34372
	Broken Rail	0.00447	0.21201	0.00340	16604	48009
	Work Zone Violation	0.00000	0.05643	0.00564	0	22570
	Grade Crossing Collisions	0.16832	0.49018	0.00728	47540	118387
	Total, All Scenarios	0.18378	1.21607	0.03003	89110	300821
Freight	Train-Train Collisions	0.00028	0.00029	0.00003	86	203
	Intrusion Collisions	0.00132	0.00044	0.00004	55	231
	Diamond Collisions	0.00080	0.00035	0.00004	133	274
	Overspeed	0.00134	0.00044	0.00004	746	923
	Broken Rail	0.00429	0.00142	0.00014	2386	2952
	Work Zone Violation	0.00000	0.00673	0.00067	0	2691
	Grade Crossing Collisions	0.01781	0.00677	0.00035	1350	3065
	Total, All Scenarios	0.02585	0.01643	0.00131	4757	10340
Total Passenger + Freight		**0.20963**	**1.23251**	**0.03135**	**93867**	**311161**
	Unit Costs ($/Casualty)		100000	3000000		

Data exported to the Results Summary worksheet

Results Summary: Base Case II, Northeast Corridor ATC 85% Preventability with Severity Reduction

Table R1a: Full Year, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00474	0.28229	0.01082	12306	72991
	Intrusion Collisions	0.00941	0.25179	0.00895	10793	62812
	Diamond Collisions	0.00026	0.00226	0.00007	79	507
	Overspeed	0.00589	0.30214	0.00486	24896	69680
	Broken Rail	0.00823	0.40934	0.00658	33729	94404
	Work Zone Violation	0.00000	0.11143	0.01114	0	44572
	Grade Crossing Collisions	0.59710	1.92530	0.02857	186625	464876
	Total, All Scenarios	0.62565	3.28454	0.07099	268427	809842
Freight	Train-Train Collisions	0.00080	0.00069	0.00007	202	480
	Intrusion Collisions	0.00201	0.00047	0.00005	60	250
	Diamond Collisions	0.00149	0.00053	0.00005	200	411
	Overspeed	0.00204	0.00064	0.00006	1117	1372
	Broken Rail	0.00653	0.00198	0.00020	3465	4255
	Work Zone Violation	0.00000	0.01020	0.00102	0	4078
	Grade Crossing Collisions	0.04820	0.01713	0.00088	3426	7781
	Total, All Scenarios	0.06108	0.03164	0.00233	8469	18627
Total Passenger + Freight		**0.68673**	**3.31617**	**0.07332**	**276897**	**828468**

Table R1b: Rest of Year, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00531	0.29017	0.01107	12549	74769
	Intrusion Collisions	0.01002	0.25338	0.00900	10801	63137
	Diamond Collisions	0.00024	0.00203	0.00006	71	455
	Overspeed	0.00627	0.30774	0.00493	24916	70493
	Broken Rail	0.00876	0.41694	0.00668	33757	95505
	Work Zone Violation	0.00000	0.11449	0.01145	0	45798
	Grade Crossing Collisions	0.55834	1.55969	0.02319	151171	376715
	Total, All Scenarios	0.58894	2.94443	0.06639	233265	726871
Freight	Train-Train Collisions	0.00168	0.00141	0.00014	400	965
	Intrusion Collisions	0.00342	0.00077	0.00008	96	404
	Diamond Collisions	0.00127	0.00045	0.00004	170	350
	Overspeed	0.00347	0.00101	0.00010	1810	2215
	Broken Rail	0.01108	0.00314	0.00031	5612	6868
	Work Zone Violation	0.00000	0.01682	0.00168	0	6729
	Grade Crossing Collisions	0.07555	0.02371	0.00121	4717	10730
	Total, All Scenarios	0.09647	0.04731	0.00357	12806	28261
Total Passenger + Freight		**0.68541**	**2.99175**	**0.06996**	**246071**	**755132**

Table R1c: Rest of Year, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00770	0.41740	0.01590	17951	107394
	Intrusion Collisions	0.01541	0.36371	0.01290	15515	90592
	Diamond Collisions	0.00052	0.00443	0.00013	155	994
	Overspeed	0.00964	0.45704	0.00733	35795	103495
	Broken Rail	0.01347	0.61921	0.00993	48496	140218
	Work Zone Violation	0.00000	0.16990	0.01699	0	67959
	Grade Crossing Collisions	0.50680	1.47592	0.02191	143142	356461
	Total, All Scenarios	0.55353	3.50760	0.08510	261054	867112
Freight		0.00000	0.00000	0.00000	0	0
	Train-Train Collisions	0.00232	0.00203	0.00020	580	1390
	Intrusion Collisions	0.00728	0.00174	0.00017	219	915
	Diamond Collisions	0.00284	0.00100	0.00010	380	781
	Overspeed	0.00739	0.00243	0.00024	4105	5079
	Broken Rail	0.02362	0.00755	0.00075	12730	15750
	Work Zone Violation	0.00000	0.03701	0.00370	0	14802
	Grade Crossing Collisions	0.09797	0.03721	0.00190	7427	16859
	Total, All Scenarios	0.14141	0.08896	0.00708	25441	55576
Total Passenger + Freight		0.69495	3.59657	0.09218	286495	922688

Table R1d: Rest of Year, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01775	0.98985	0.03779	42805	255154
	Intrusion Collisions	0.03484	0.86888	0.03085	37108	216541
	Diamond Collisions	0.00101	0.00872	0.00026	305	1955
	Overspeed	0.02181	1.06692	0.01712	85607	243668
	Broken Rail	0.03046	1.44549	0.02320	115982	330127
	Work Zone Violation	0.00000	0.39582	0.03958	0	158328
	Grade Crossing Collisions	1.66225	4.96091	0.07367	480938	1198052
	Total, All Scenarios	1.76812	9.73658	0.22247	762747	2403825
Freight	Train-Train Collisions	0.00480	0.00413	0.00041	1182	2834
	Intrusion Collisions	0.01272	0.00298	0.00030	375	1569
	Diamond Collisions	0.00560	0.00198	0.00020	750	1542
	Overspeed	0.01290	0.00408	0.00041	7032	8666
	Broken Rail	0.04123	0.01267	0.00127	21807	26874
	Work Zone Violation	0.00000	0.06402	0.00640	0	25609
	Grade Crossing Collisions	0.22171	0.07805	0.00400	15570	35370
	Total, All Scenarios	0.29896	0.16791	0.01299	46716	102464
Total Passenger + Freight		**2.06708**	**9.90449**	**0.23546**	**809463**	**2506289**

Table R2a: Summer, Joliet *(Included in Full Year Table)*

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Freight	Train-Train Collisions					
	Intrusion Collisions					
	Diamond Collisions					
	Overspeed					
	Broken Rail					
	Work Zone Violation					
	Grade Crossing Collisions					
	Total, All Scenarios					
Total Passenger + Freight						

There are no seasonal traffic variations on the Joliet Sub-corridor. Therefore only one risk calculation is needed for the full year, and there is no separate summer calculation

Table R2b: Summer, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00178	0.09784	0.00373	4229	25203
	Intrusion Collisions	0.00333	0.08415	0.00299	3587	20969
	Diamond Collisions	0.00007	0.00060	0.00002	21	136
	Overspeed	0.00208	0.10221	0.00164	8275	23412
	Broken Rail	0.00291	0.13847	0.00222	11211	31719
	Work Zone Violation	0.00000	0.03748	0.00380	0	15156
	Grade Crossing Collisions	0.18544	0.51800	0.00770	50207	125113
	Total, All Scenarios	0.19561	0.97876	0.02210	77530	241707
Freight	Train-Train Collisions	0.00030	0.00024	0.00002	71	168
	Intrusion Collisions	0.00071	0.00016	0.00002	20	84
	Diamond Collisions	0.00038	0.00013	0.00001	51	104
	Overspeed	0.00072	0.00021	0.00002	377	461
	Broken Rail	0.00231	0.00065	0.00007	1169	1431
	Work Zone Violation	0.00000	0.00350	0.00035	0	1402
	Grade Crossing Collisions	0.01574	0.00494	0.00025	983	2235
	Total, All Scenarios	0.02016	0.00985	0.00074	2670	5885
Total Passenger + Freight		**0.21577**	**0.98860**	**0.02284**	**80200**	**247592**

Table R2c: Summer, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00252	0.13837	0.00526	5943	35575
	Intrusion Collisions	0.00512	0.12079	0.00429	5153	30087
	Diamond Collisions	0.00014	0.00124	0.00004	43	279
	Overspeed	0.00320	0.15179	0.00244	11888	34372
	Broken Rail	0.00447	0.20565	0.00330	16106	46569
	Work Zone Violation	0.00000	0.05643	0.00564	0	22570
	Grade Crossing Collisions	0.16832	0.49018	0.00728	47540	118387
	Total, All Scenarios	0.18378	1.16445	0.02824	86673	287838
Freight	Train-Train Collisions	0.00028	0.00023	0.00002	69	162
	Intrusion Collisions	0.00132	0.00032	0.00003	40	166
	Diamond Collisions	0.00080	0.00028	0.00003	107	219
	Overspeed	0.00134	0.00044	0.00004	746	923
	Broken Rail	0.00429	0.00137	0.00014	2315	2864
	Work Zone Violation	0.00000	0.00673	0.00067	0	2691
	Grade Crossing Collisions	0.01781	0.00677	0.00035	1350	3065
	Total, All Scenarios	0.02585	0.01614	0.00128	4626	10091
Total Passenger + Freight		**0.20963**	**1.18059**	**0.02952**	**91300**	**297929**

Table R2d: Summer, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00430	0.23621	0.00900	10172	60778
	Intrusion Collisions	0.00844	0.20495	0.00727	8740	51056
	Diamond Collisions	0.00021	0.00185	0.00005	65	414
	Overspeed	0.00529	0.25400	0.00407	20163	57784
	Broken Rail	0.00738	0.34412	0.00552	27318	78288
	Work Zone Violation	0.00000	0.09391	0.00945	0	37726
	Grade Crossing Collisions	0.35375	1.00818	0.01498	97746	243500
	Total, All Scenarios	0.37938	2.14320	0.05034	164203	529545
Freight	Train-Train Collisions	0.00058	0.00048	0.00005	139	330
	Intrusion Collisions	0.00204	0.00048	0.00005	60	251
	Diamond Collisions	0.00118	0.00041	0.00004	157	323
	Overspeed	0.00207	0.00065	0.00007	1123	1385
	Broken Rail	0.00660	0.00203	0.00020	3484	4294
	Work Zone Violation	0.00000	0.01023	0.00102	0	4093
	Grade Crossing Collisions	0.03355	0.01170	0.00060	2333	5300
	Total, All Scenarios	0.04601	0.02599	0.00203	7296	15977
Total Passenger + Freight		**0.42539**	**2.16919**	**0.05237**	**171500**	**545522**

Table R3a: All Year, Joliet

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00474	0.28229	0.01082	12306	72991
	Intrusion Collisions	0.00941	0.25179	0.00895	10793	62812
	Diamond Collisions	0.00026	0.00226	0.00007	79	507
	Overspeed	0.00589	0.30214	0.00486	24896	69680
	Broken Rail	0.00823	0.40934	0.00658	33729	94404
	Work Zone Violation	0.00000	0.11143	0.01114	0	44572
	Grade Crossing Collisions	0.59710	1.92530	0.02857	186625	464876
	Total, All Scenarios	0.62565	3.28454	0.07099	268427	809842
Freight	Train-Train Collisions	0.00080	0.00069	0.00007	202	480
	Intrusion Collisions	0.00201	0.00047	0.00005	60	250
	Diamond Collisions	0.00149	0.00053	0.00005	200	411
	Overspeed	0.00204	0.00064	0.00006	1117	1372
	Broken Rail	0.00653	0.00198	0.00020	3465	4255
	Work Zone Violation	0.00000	0.01020	0.00102	0	4078
	Grade Crossing Collisions	0.04820	0.01713	0.00088	3426	7781
	Total, All Scenarios	0.06108	0.03164	0.00233	8469	18627
Total Passenger + Freight		0.68673	3.31617	0.07332	276897	828468

Table R3b: All Year, Bloomington

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00709	0.38801	0.01480	16777	99972
	Intrusion Collisions	0.01335	0.33753	0.01199	14388	84105
	Diamond Collisions	0.00031	0.00263	0.00008	92	590
	Overspeed	0.00836	0.40995	0.00657	33191	93905
	Broken Rail	0.01167	0.55541	0.00891	44968	127224
	Work Zone Violation	0.00000	0.15197	0.01525	0	60953
	Grade Crossing Collisions	0.74378	2.07769	0.03089	201378	501828
	Total, All Scenarios	0.78455	3.92319	0.08849	310795	968578
Freight	Train-Train Collisions	0.00198	0.00166	0.00017	471	1133
	Intrusion Collisions	0.00413	0.00093	0.00009	116	489
	Diamond Collisions	0.00165	0.00058	0.00006	221	454
	Overspeed	0.00419	0.00122	0.00012	2187	2676
	Broken Rail	0.01339	0.00380	0.00038	6781	8299
	Work Zone Violation	0.00000	0.02033	0.00203	0	8130
	Grade Crossing Collisions	0.09129	0.02865	0.00147	5700	12965
	Total, All Scenarios	0.11663	0.05716	0.00432	15476	34147
Total Passenger + Freight		0.90118	3.98035	0.09281	326271	1002725

Table R3c: All Year, Springfield

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.01022	0.55576	0.02117	23894	142968
	Intrusion Collisions	0.02052	0.48451	0.01719	20667	120679
	Diamond Collisions	0.00066	0.00567	0.00017	199	1272
	Overspeed	0.01285	0.60883	0.00977	47683	137868
	Broken Rail	0.01794	0.82486	0.01323	64602	186786
	Work Zone Violation	0.00000	0.22632	0.02263	0	90529
	Grade Crossing Collisions	0.67512	1.96610	0.02919	190682	474847
	Total, All Scenarios	0.73731	4.67205	0.11334	347727	1154950
Freight	Train-Train Collisions	0.00260	0.00226	0.00023	649	1552
	Intrusion Collisions	0.00861	0.00206	0.00021	258	1081
	Diamond Collisions	0.00364	0.00128	0.00013	487	1000
	Overspeed	0.00873	0.00288	0.00029	4851	6002
	Broken Rail	0.02791	0.00892	0.00089	15045	18614
	Work Zone Violation	0.00000	0.04373	0.00437	0	17494
	Grade Crossing Collisions	0.11578	0.04397	0.00225	8777	19924
	Total, All Scenarios	0.16726	0.10510	0.00836	30068	65667
Total Passenger + Freight		0.90457	4.77716	0.12170	377795	1220618

Table R3d: All Year, Whole Corridor

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.02205	1.22606	0.04678	52977	315931
	Intrusion Collisions	0.04329	1.07382	0.03812	45848	267597
	Diamond Collisions	0.00123	0.01056	0.00031	370	2369
	Overspeed	0.02709	1.32091	0.02120	105770	301452
	Broken Rail	0.03784	1.78961	0.02872	143300	408415
	Work Zone Violation	0.00000	0.48973	0.04903	0	196054
	Grade Crossing Collisions	2.01600	5.96909	0.08865	578685	1441552
	Total, All Scenarios	2.14750	11.87978	0.27281	926950	2933370
Freight	Train-Train Collisions	0.00538	0.00461	0.00046	1321	3165
	Intrusion Collisions	0.01475	0.00346	0.00035	434	1819
	Diamond Collisions	0.00678	0.00239	0.00024	908	1865
	Overspeed	0.01496	0.00474	0.00047	8155	10051
	Broken Rail	0.04783	0.01469	0.00147	25291	31168
	Work Zone Violation	0.00000	0.07426	0.00743	0	29702
	Grade Crossing Collisions	0.25526	0.08975	0.00460	17903	40670
	Total, All Scenarios	0.34497	0.19390	0.01501	54013	118440
Total Passenger + Freight		**2.49248**	**12.07368**	**0.28783**	**980962**	3051811

Model Inputs: Base Case II: Northeast Corridor ATC 85% Preventability with Severity Reduction

Table IN-1a: Braking Formula Inputs

Train/System Type	Parameter	Value
Freight	Coefficient P	0.035
	Appl'n Time (secs)	13.8
	Train Weight (lb)	37600000
	Brake Force (lb)	775683
Passenger	Coefficient A	0.666
	Coefficient B	0
	Safety Factor	1.25
Train Control	PTC Timeout (secs)	3
	PTC Latency (secs)	3
	ACS Response (secs)	8
Gutlly Train Speed (mph)		15

Table IN-1b: Miscellaneous Inputs

Parameter		Value	Units
Sight Distance		2500	ft
Distribution of train location at time of	In Block	0.95	Probability
violation in Reference Case accidents	Previous Block	0.05	Probability
PTC Risk Increment in Zone C (PTC Models ONLY)		2	Ratio
Potential danger length in Zone C (PTC Models ONLY)		2500	ft
Unit Cost Per Casualty	Injury	100000	Dollars
	Fatality	3000000	Dollars

PTC Timeout and Latency values in Table IN-1a used only for PTC calculations.

Table IN-1c:Traffic and Related Data

Train Type	Average One-Way Trips/Day					
	Joliet Sub-Corridor		Bloomington Sub-Corridor		Springfield Sub-Corridor	
	Summer	Rest of Year	Summer	Rest of Year	Summer	Rest of Year
Passenger	6.00	6.00	6.00	6.00	6.00	6.00
Equipped Freight	1.43	1.43	1.43	2.28	1.73	3.16
Unequipped Freight	0.00	0.00	0.00	0.00	0.00	0.00
Operating Days	91.0	274.0	91.0	274.0	91.0	274.0
Percent Train-Miles in						
Timeout (secs)	0		0		0	
Normal Operating Mode	95.00		95.00		95.00	
Timeout Mode	0.00		0.00		0.00	
Fallback Mode	5.00		5.00		5.00	
Passenger Train Occupancy						
Seats	320		320		320	
Occupancy Factor	0.6		0.6		0.6	

Table IN-2a: Segment Definitions: Joliet Sub-Corridor: MP 62.7 (Mazonia) - MP 88.3 (Bunge)

Segment Number	Start (milepost)	End (milepost)	Type	Variant	Length		Posted Speed (mph)			Representative Speed (mph)				Industry Siding		Passenger Stops
					Miles	Feet	Freight	Pass	HS Pass	Freight	Pass	HS Pass (Consa*)	HS Pass (Other)	Number	Name	
1.0	62.60	64.80	CP Adjacent (M)		2.20	11616	60.0	79.0	110	50	79	79	105	0		
2.0	64.80	66.55	Plain		1.75	9240	60.0	79.0	110	50	79	79	105	0		
3.0	66.55	68.23	Plain		1.68	8870.4	60.0	79.0	110	50	79	79	105	0		
4.0	68.23	70.17	CP Adjacent (M)		1.94	10243.2	60.0	79.0	110	50	79	79	105	0		
5.0	70.17	72.80	Siding (M)	Dwight (sigctl)	2.63	13886.4	60.0	79.0	110	40	60	79	105	0		
6.0	72.80	72.80	Diamond		0.00	0	40.0	40.0	40	40	40	40	40	0		
7.0	72.80	74.94	CP Adjacent (M)		2.14	11299.2	60.0	79.0	110	40	60	79	105	0		
8.0	74.94	77.27	Plain		2.33	12302.4	60.0	79.0	110	50	79	79	105	0		
9.0	77.27	80.13	Plain		2.86	15100.8	60.0	79.0	110	50	79	79	105	0		
10.0	80.13	81.99	CP Adjacent (M)		1.86	9820.8	60.0	79.0	110	50	79	79	105	0		
11.0	81.99	84.65	Siding (M)	Odell (sigctl)	2.66	14044.8	60.0	79.0	110	50	79	79	105	0		
12.0	84.65	86.43	CP Adjacent (M)		1.78	9398.4	60.0	79.0	110	50	79	79	105	0		
13.0	86.43	88.35	Plain		1.92	10137.6	60.0	79.0	110	50	79	79	105	0		
Check Total					25.8											

Table IN-2b: Segment Definitions: Bloomington Sub-Corridor: MP 88.3 (Bunge) - MP 124.9 (Bloomington)

Segment Number	Start (MP)	End (MP)	Type	Variant	Length		Posted Speed (mph)			Representative Speed (mph)				Industry Siding		Passenger Stops
					Miles	Feet	Freight	Pass	HS Pass	Freight	Pass	HS Pass (Consa*)	HS Pass (Other)	Number	Name	
14.0	88.35	90.55	Plain		2.20	11616	60.0	79.0	110	50	79	79	105	1	Bunge	
15.0	90.55	92.47	CP Adjacent (M)		1.92	10137.6	49.0	50.0	50	40	60	60	79	1	Donnley	
16.0	92.47	94.97	Siding (M)	Pontiac (Sigctl)	2.50	13200	60.0	79.0	110	50	79	79	105	0		Pontiac
17.0	94.97	96.81	CP Adjacent (M)		1.84	9715.2	60.0	79.0	110	50	79	79	105	0	Ocoya	
18.0	96.81	100.28	Plain		3.47	18321.6	60.0	79.0	110	50	79	79	105	0		
19.0	100.28	102.25	CP Adjacent (M)		1.97	10401.6	60.0	79.0	110	40	60	60	79	0		
20.0	102.25	102.25	Diamond		0.00	0	40.0	40.0	40	40	40	40	40	0		
21.0	102.25	104.60	CP Adjacent (M)		2.35	12408	60.0	79.0	110	40	60	60	79	0		
22.0	104.60	106.43	CP Adjacent (M)		1.83	9662.4	60.0	79.0	110	50	79	79	105	0		
23.0	106.43	108.83	Siding (M)	Ballard (Sigctl)	2.40	12672	60.0	79.0	110	50	79	79	105	0		
24.0	108.83	111.36	CP Adjacent (M)		2.53	13358.4	60.0	79.0	110	50	79	79	105	0		
25.0	111.36	113.30	Plain		1.94	10243.2	60.0	79.0	110	50	79	79	105	0		
26.0	113.30	116.36	Plain		3.06	16156.8	60.0	79.0	110	50	79	79	105	0		
27.0	116.36	118.83	Plain		2.47	13041.6	60.0	79.0	110	50	79	79	105	1	Tiawanda	
28.0	118.83	121.40	CP Adjacent (M)		2.57	13569.6	60.0	79.0	110	50	79	79	105	0		
29.0	121.40	123.57	Siding (M)	Bloomington Yard	2.17	11457.6	60.0	79.0	110	40	60	79	79	1	Bloomington	
30.0	123.57	124.38	Siding (M)	Bloomington Yard	0.81	4276.8	25.0	40.0	40	25	40	40	40	1	Bloomington	Bloomingom
31.0	124.38	124.86	Siding (M)	Bloomington Yard	0.48	2534.4	25.0	40.0	40	25	40	40	40	1	Bloomington	
Check Total					36.5											

Table IN-2c: Segment Definitions: Springfield Sub-Corridor: MP 124.9 (Bloomington) - MP 181.0 (Ridgely)

Segment Number	Start	End	Type	Variant	Length		Posted Speed (mph)			Representative Speed (mph)				Industry Siding		Passenger Stops
					Miles	Feet	Freight	Pass	HS Pass	Freight	Pass	HS Pass (Consa*)	HS Pass (Other)	Number	Name	
32.0	124.86	126.50	CP Adjacent (M)		1.6	8659.2	25.0	40.0	40	25	40	40	40	0	Bloom Yard	
33.0	126.50	126.50	Diamond		0.0	0	25.0	40.0	40	25	40	40	40	0		
34.0	126.50	128.76	CP Adjacent (M)		2.3	11932.8	30.0	50.0	50	25	60	60	79	0		
35.0	128.76	130.96	Plain		2.2	11616	60.0	79.0	90	50	79	79	79	0		
36.0	130.96	133.72	Plain		2.8	14572.8	60.0	79.0	110	50	79	79	105	0		
37.0	133.72	136.90	Plain		3.2	16790.4	60.0	79.0	110	50	79	79	105	0		
38.0	136.90	138.63	CP Adjacent (M)		1.7	9134.4	60.0	79.0	110	50	79	79	105	0		
39.0	138.63	141.30	Siding (M)	McLean (sigctl)	2.7	14097.6	60.0	79.0	110	50	79	79	105	1	McLean	
40.0	141.30	143.35	CP Adjacent (M)		2.0	10824	60.0	79.0	110	50	79	79	105	0		
41.0	143.35	148.30	Plain		5.0	26136	60.0	79.0	110	50	79	79	105	2	FTS Fertilizer, Atlanta	
42.0	148.30	150.96	Plain		2.7	14044.8	60.0	79.0	110	50	79	79	105	1	E Lincoln Grain	
43.0	150.96	153.56	CP Adjacent (U)		2.6	13728	60.0	79.0	110	50	79	79	105	1	Kruger	
44.0	153.56	155.57	Siding (U)	Elkhart (Unsigtl)	2.0	10612.8	60.0	79.0	110	50	60	60	79	0		
45.0	155.57	155.57	Diamond		0.0	0	40.0	40.0	40	40	40	40	40	0		
46.0	155.57	157.26	CP Adjacent (U)		1.7	8823.2	50.0	70.0	70	50	60	60	79	1	Havana Ind	Lincoln
47.0	157.26	160.05	Plain		2.8	14731.2	60.0	79.0	90	50	79	79	79	0		
48.0	160.05	162.11	Plain		2.1	10876.8	60.0	79.0	110	50	79	79	105	0		
49.0	162.11	164.04	Plain		1.9	10190.4	60.0	79.0	110	50	79	79	105	0		
50.0	164.04	166.16	Plain		2.1	11193.6	60.0	79.0	110	50	79	79	105	0		
51.0	166.16	168.34	CP Adjacent (U)		2.2	11510.4	60.0	79.0	110	50	79	79	105	1	Elkhart Grain	
52.0	168.34	170.40	Siding (U)	Elkhart (Unsigtl)	2.1	10876.8	60.0	79.0	110	50	79	79	105	0		
53.0	170.40	172.34	CP Adjacent (U)		1.9	10243.2	60.0	79.0	110	50	79	79	105	0		
54.0	172.34	175.84	Plain		3.5	18480	60.0	79.0	110	50	79	79	105	0		
55.0	175.84	179.49	Plain		3.7	19272	60.0	79.0	110	50	79	79	79	0		
56.0	179.49	180.99	CP Adjacent (M)		1.5	7920	60.0	79.0	110	50	79	79	79	0		
Check Total					56.1											

Table IN-3a: Crossing and Diamond Data, Joliet Sub-Corridor

Train Type	Representative Speed (mph)	Type of Grade-crossing	Number Crossings			Number Diamonds
			Passenger	HS Passenger	Freight	
Passenger	40	Public_gates_lights	0	0		1
		Public_other	0	0		
		Private	0	0		
	60	Public_gates_lights	8	0		0
		Public_other	0	0		
		Private	0	0		
	79	Public_gates_lights	20	8		0
		Public_other	0	0		
		Private	1	0		
	105	Public_gates_lights	0	20		0
		Public_other	0	0		
		Private	0	1		
Freight	25	Public_gates_lights			0	0
		Public_other			0	
		Private			0	
	40	Public_gates_lights			8	1
		Public_other			0	
		Private			0	
	50	Public_gates_lights			20	0
		Public_other			0	
		Private			0	
Check Totals			29	29	28	

Table IN-3b: Crossing Data, Bloomington Sub-Corridor

Train Type	Representative Speed (mph)	Type of Grade-crossing	Number Crossings			Number Diamonds
			Passenger	HS Passenger	Freight	
Passenger	40	Public_gates_lights	7	7		
		Public_other				
		Private				
	60	Public_gates_lights	16			
		Public_other				
		Private	1			
	79	Public_gates_lights	16	16		
		Public_other	1	1		
		Private	6	1		
	105	Public_gates_lights		16		
		Public_other		1		
		Private		6		
Freight	25	Public_gates_lights			7	
		Public_other				
		Private				
	40	Public_gates_lights			16	
		Public_other				
		Private			1	
	50	Public_gates_lights			16	
		Public_other			1	
		Private			6	
Check Totals			47	47	47	

Table IN-3c: Crossing Data, Springfield Sub-Corridor

Train Type	Representative Speed (mph)	Type of Grade-crossing	Number Crossings			Number Diamonds
			Passenger	HS Passenger	Freight	
Passenger	40	Public_gates_lights				
		Public_other				
		Private				
	60	Public_gates_lights	14			
		Public_other				
		Private				
	79	Public_gates_lights	15	16		
		Public_other	5	1		
		Private	5	1		
	105	Public_gates_lights		13		
		Public_other		4		
		Private		4		
Freight	25	Public_gates_lights			3	
		Public_other				
		Private				
	40	Public_gates_lights				
		Public_other				
		Private			1	
	50	Public_gates_lights			26	
		Public_other			5	
		Private			5	
Check Totals			39	39	39	

Table IN-3d: Grade Crossings: Collision Frequency and Consequences

Train Type	Representative Speed (mph)	Type of Grade-crossing	Accident Frequency Per Million Crossing Passes			Crossing Collision Consequences					
						Pass. Occup't Casualty Prob(accident)			Freight Trains (per accident)		
			Passenger	Freight		Injuries	Fatalities	Cost $/Accid't	Injuries	Fatalities	Cost $
Passenger	40	Public_gates_lights	0.350			0.0028	0.000047	50,000			
		Public_other	0.300								
		Private	0.100								
	60	Public_gates_lights	0.600			0.0068	0.000112	113,000			
		Public_other	0.500								
		Private	0.200								
	79	Public_gates_lights	0.800			0.0105	0.000156	196,000			
		Public_other	0.650								
		Private	0.300								
	105	Public_gates_lights	1.100			0.0186	0.000276	346,000			
		Public_other	0.800								
		Private	0.300								
Freight	25	Public_gates_lights			0.150				0.12	0.005	20000
		Public_other			0.120						
		Private			0.050						
	40	Public_gates_lights			0.300				0.25	0.013	50000
		Public_other			0.250						
		Private			0.100						
	50	Public_gates_lights			0.360				0.39	0.02	78000
		Public_other			0.300						
		Private			0.120						

Table IN-4: Consequences Look-up Tables (Data Sources: Previous ICF Passenger Corridor Project (passenger), FRA Accident Data 2001-5 (freight)

Passenger Trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 40 mph			Representative Speed 60 mph			Representative Speed 79 mph			Representative Speed 105 mph		
			Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Pass Loco hits Loco	0.066	0.002	401600	0.111	0.0039	913600	0.192	0.0068	1580800	0.340	0.0128	2796000
		Pass Loco hits Pass Car	0.027	0.001	209800	0.045	0.0021	456800	0.078	0.0036	790400	0.137	0.0064	1397600
		Pass Loco hits Frt Car	0.027	0.001	209800	0.045	0.0021	456800	0.078	0.0036	790400	0.137	0.0064	1397600
		Pass car hit by Loco	0.133	0.004	804000	0.220	0.0095	1827200	0.381	0.0165	3160800	0.673	0.0256	5591200
	Intrusion Collision (rollout)	Pass Loco hits Car	0.009	0.000	81360	0.022	0.0008	185040	0.039	0.0014	320400	0.069	0.0024	565920
	Intrusion Collision (other)\	Pass Loco hits Car	0.025	0.001	216960	0.060	0.0021	493440	0.104	0.0036	853440	0.183	0.0065	1533080
	Overspeed		0.044	0.000	667000	0.140	0.0019	15000000	0.210	0.0034	2600000	0.280	0.0045	4594000
	Broken Rail		0.043	0.000	646960	0.136	0.0018	1450000	0.204	0.0033	2522000	0.272	0.0044	4456180
	Work Zone Violation		0.083	0.008	0	0.125	0.013	0	0.164	0.0164	0	0.218	0.0218	0

Freight trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 25 mph			Representative Speed 40 mph			Representative Speed 50 mph		
			Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Frt Loco hits Loco	0.344	0.0344	84000	0.88	0.088	216000	1.36	0.136	337600
		Frt Loco hits Car	0.28	0.028	70400	0.72	0.072	180000	1.12	0.112	281600
		Frt car hit by Loco	0	0	35200	0	0	89600	0	0	140800
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.06336	0.00648	7920	0.162	0.01656	20160	0.252	0.0252	31680
	Intrusion Coll'n equip (other)\	Frt Loco hits Car	0.06336	0.00648	7920	0.162	0.01656	20160	0.252	0.0252	31680
	Intrusion Coll'n Unequip (rollo	Frt Loco hits Car	0.08448	0.00864	10560	0.216	0.02208	26880	0.336	0.0336	42240
	Intrusion Coll'n Unequip (other	Frt Loco hits Car	0.08448	0.00864	10560	0.216	0.02208	26880	0.336	0.0336	42240
	Overspeed, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Overspeed, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Equip		0.05432	0.005432	145500	0.13968	0.013968	363750	0.3395	0.03395	568420
	Broken Rail, Unequip		0.05432	0.005432	145500	0.13968	0.013968	363750	0.3395	0.03395	568420
	Work Zone Viol'n, Equip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0
	Work Zone Viol'n, Unequip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0

Casualties and damage in Table IN-4 are per accident, except for Work Zone Violations which are per million train-miles.

Table IN-5a: Reference Case Collision Accident Frequencies by Sub-Corridor and Season

Train-Train Collision Frequency by Segment Type, Sub Corridor and Season - (Collision Frequency in Collisions per Million Train Miles)

Segment Type	Joliet Sub-Corridor		Bloomington Sub-Corridor		Springfield Sub-Corridor	
	Summer	Rest of Year	Summer	Rest of Year	Summer	Rest of Year
Siding - Monitored	0.030	0.030	0.030	0.030	0.030	0.030
Siding - Unmonitored	0.040	0.040	0.040	0.040	0.040	0.040
CP-Adjacent, Monitored	0.050	0.050	0.050	0.050	0.050	0.050
CP-Adjacent, Unmonitored	0.060	0.060	0.060	0.060	0.060	0.060
Plain Track	0.006	0.006	0.006	0.006	0.006	0.006

Table IN-5b: Collision Distributions Between Head-on and Rear/Side by trains Involved and Segment type

Head-on and Rear/Side Train-Train Collision Distributions by Segment Type

Segment Type	Passenger to Passenger		Passenger to Freight			Freight to Freight	
	Head-on	Rear/Side	Head-on	RS P into F	RS F into P	Head-on	Rear/Side
Siding - Monitored	50%	50%	50%	40%	10%	50%	50%
Siding - Unmonitored	50%	50%	50%	40%	10%	50%	50%
CP-Adjacent, Monitored	90%	10%	80%	15%	5%	75%	25%
CP-Adjacent, Unmonitored	90%	10%	80%	15%	5%	75%	25%
Plain Track	80%	20%	70%	25%	5%	50%	50%

Table IN-5c: Reference Case Frequencies for Other Accident Types

All Other Accident Frequencies

Accident Type	Units	Frequencies	
		Passenger	Freight
Intrusion Collision (rollout)	Per million train-miles	0.0066	0.0144
Intrusion Collision (other)\	Per million train-miles	0.0144	0.0086
Overspeed	Per million train-miles	0.0110	0.0160
Broken Rail	Per million train-miles	0.0167	0.0556
Work Zone Violation	Per million train-miles	See Consequence Table	
Diamonds	Per million diamond passe	0.1000	0.1000

Table IN-5d: Reference Case Collision Distributions by Sub-Corridor and Train Type

Train-Train Collision Distributions by Train Types

Collision Types	Joliet Sub-Corridor		Bloomington Sub-Corridor		Springfield Sub-Corridor	
	Summer	Rest of Year	Summer	Rest of Year	Summer	Rest of Year
Passenger-Passenger	0.71	0.71	0.71	0.80	0.80	0.62
Passenger - Equip Freight	0.29	0.29	0.29	0.32	0.20	0.30
Passenger - Unequip Freight	0.00	0.00	0.00	0.00	0.00	0.00
Equip Freight - Equip Freight	0.00	0.00	0.00	0.08	0.00	0.08
Equip Freight - Unequip Freight	0.00	0.00	0.00	0.00	0.00	0.00
Unequip _Freight - Unequip Freight	0.00	0.00	0.00	0.00	0.00	0.00
Checking	1.00	1.00	1.00	1.00	1.00	1.00

Note: Since all trains are equipped in Cab Signal and ATC cases, there are no collisions involving unequipped trains.

Table IN-6a: Preventability for Other Accident Types

Accident Type	Preventability Factors - ATC		Prev'ty Factors - PTC Timeout	
	Passenger	Freight	Passenger	Freight
Intrusion Collision (rollout)	0.43	0.43	0.00	0.00
Intrusion Collision (other)\	0.12	0.12	0.00	0.00
Overspeed	0.00	0.00	0.90	0.90
Broken Rail	0.08	0.08	0.00	0.00
Work Zone Violation	0.00	0.00	0.90	0.90
Grade Crossings	0.00	0.00	0.00	0.00

Prev'ty Factors - PTC Timeout only used in PTC cases.

Equipped Train Preventability Values

Collision Type		Preventability
Both TBE	Pass-Pass	0.85
	Pass-TBE Freight	0.85
	TBE Freight - TBE Freight	0.85
One TBE	Pass - NE Freight, Head -On	0.85
	Rear/Side, Pass into NE Frt	0.85
	Rear/Side NE Frt into Pass	0.85
	TBE Freight - NE Freight	0.85

Tables IN-7: Base Consequences Look-up Table (Data Sources: Previous ICF Passenger Corridor Project (passenger), FRA Accident Data 2001-5 (freight)

Passenger Trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 40 mph			Representative Speed 60 mph			Representative Speed 79 mph			Representative Speed 105 mph		
			Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Pass Loco hits Loco	0.083	0.0020	502000	0.139	0.0049	1142000	0.240	0.0085	1976000	0.425	0.0160	3495000
		Pass Loco hits Pass Car	0.034	0.0010	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.0080	1747000
		Pass Loco hits Frt Car	0.034	0.0010	251000	0.056	0.0026	571000	0.097	0.0045	988000	0.171	0.0080	1747000
		Pass car hit by Loco	0.166	0.0050	1005000	0.275	0.0119	2284000	0.476	0.0206	3951000	0.841	0.0320	6989000
	Intrusion Collision (rollout)	Pass Loco hits Car	0.013	0.0005	113000	0.031	0.0011	257000	0.054	0.0019	445000	0.096	0.0034	786000
	Intrusion Collision (other)\	Pass Loco hits Car	0.026	0.0009	226000	0.063	0.0022	514000	0.108	0.0038	889000	0.191	0.0068	1573000
	Overspeed		0.044	0.0004	667000	0.140	0.0019	1500000	0.210	0.0034	2600000	0.280	0.0045	4594000

Table IN-7A: Consequence Adjustment Factors

Consequence Adjustment Factors by Representative Speed				
40 mph	60 mph	79 mph	105 mph
0.80	0.80	0.80	0.80
0.80	0.80	0.80	0.80
0.80	0.80	0.80	0.80
0.80	0.80	0.80	0.80
0.72	0.72	0.72	0.72
0.96	0.96	0.96	0.96
1.00	1.00	1.00	1.00

	Broken Rail		0.044	0.0004	667000	0.140	0.0019	1500000	0.210	0.0034	2600000	0.280	0.0045	4594000	0
	Work Zone Violation		0.083	0.0083	0	0.125	0.0125	0	0.164	0.0164	0	0.218	0.0218	0	0

	Broken Rail		0.97	0.97	0.97	0.97
	Work Zone Violation		1.00	1.00	1.00	1.00

Freight trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 25 mph			Representative Speed 40 mph			Representative Speed 50 mph		
			Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Frt Loco hits Loco	0.43	0.043	105000	1.1	0.11	270000	1.7	0.17	422000
		Frt Loco hits Car	0.35	0.035	88000	0.9	0.09	225000	1.4	0.14	352000
		Frt car hit by Loco	0	0	44000	0	0	112000	0	0	176000
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n Unequip (rollo	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Intrusion Coll'n Unequip (othe	Frt Loco hits Car	0.088	0.009	11000	0.225	0.023	28000	0.35	0.035	44000
	Overspeed, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Overspeed, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Work Zone Viol'n, Equip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0
	Work Zone Viol'n, Unequip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0

Casualties and damage in Table IN-7 are per accident, except for Work Zone Violations which are per million train-miles.

Consequence Adjustment Factors by Representative Speed			
25 mph	40 mph	50 mph	
0.80	0.80	0.80	0.80
0.80	0.80	0.80	0.80
0.80	0.80	0.80	0.80
0.72	0.72	0.72	0.72
0.72	0.72	0.72	0.72
0.96	0.96	0.96	0.96
0.96	0.96	0.96	0.96
1.00	1.00	1.00	1.00
1.00	1.00	1.00	1.00
0.97	0.97	0.97	0.97
0.97	0.97	0.97	0.97
1.00	1.00	1.00	1.00
1.00	1.00	1.00	1.00

Tables IN-8: Adjusted Consequences Look-up Table (Data Sources: Previous ICF Passenger Corridor Project (passenger), FRA Accident Data 2001-5 (freight)

Passenger Trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 40 mph			Representative Speed 60 mph			Representative Speed 79 mph			Representative Speed 105 mph		
			Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Pass Loco hits Loco	0.066	0.0016	401600	0.111	0.0039	913900	0.192	0.0068	1580800	0.340	0.0128	2796000
		Pass Loco hits Pass Car	0.027	0.0008	200800	0.045	0.0021	456800	0.078	0.0036	790400	0.137	0.0064	1397600
		Pass Loco hits Frt Car	0.027	0.0008	200800	0.045	0.0021	456800	0.078	0.0036	790400	0.137	0.0064	1397600
		Pass car hit by Loco	0.133	0.0040	804000	0.220	0.0095	1827200	0.381	0.0165	3160800	0.673	0.0256	5691200
	Intrusion Collison (rollout)	Pass Loco hits Car	0.009	0.0004	81360	0.022	0.0008	185040	0.039	0.0014	320400	0.069	0.0024	565920
	Intrusion Collison (other')	Pass Loco hits Car	0.025	0.0009	216960	0.060	0.0021	493440	0.104	0.0036	853440	0.183	0.0065	1510080
	Overspeed		0.044	0.0004	667000	0.140	0.0019	1500000	0.210	0.0034	2600000	0.280	0.0045	4594000
	Broken Rail		0.043	0.0004	646990	0.136	0.0018	1455000	0.204	0.0033	2522000	0.272	0.0044	4456180
	Work Zone Violation		0.083	0.0083	0	0.125	0.0125	0	0.164	0.0164	0	0.218	0.0218	0

Freight trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 25 mph			Representative Speed 40 mph			Representative Speed 50 mph		
			Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Frt Loco hits Loco	0.344	0.0344	84000	0.88	0.088	216000	1.36	0.136	337600
		Frt Loco hits Car	0.28	0.028	70400	0.72	0.072	180000	1.12	0.112	281600
		Frt car hit by Loco	0	0	35200	0	0	89600	0	0	140800
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.06336	0.00648	7920	0.162	0.01656	20160	0.252	0.0252	31680
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.06336	0.00648	7920	0.162	0.01656	20160	0.252	0.0252	31680
	Intrusion Coll'n Unequip (rollo	Frt Loco hits Car	0.08448	0.00864	10560	0.216	0.02208	26880	0.336	0.0336	42240
	Intrusion Coll'n Unequip (othe	Frt Loco hits Car	0.08448	0.00864	10560	0.216	0.02208	26880	0.336	0.0336	42240
	Overspeed, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Overspeed, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Equip		0.05432	0.005432	145500	0.13968	0.013968	363750	0.3395	0.03395	568420
	Broken Rail, Unequip		0.05432	0.005432	145500	0.13968	0.013968	363750	0.3395	0.03395	568420
	Work Zone Viol'n, Equip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0
	Work Zone Viol'n, Unequip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0

Casualties and damage in Table IN-8 are per accident, except for Work Zone Violations which are per million train-miles.

Worksheet 1-JN: IDOT Risk Model: Braking Distances and Collision Zone Calculations, Base Case II: Northeast Corridor ATC, 85% Preventability with Severity Reduction, Joliet Sub-corridor

Table 1.1: Stopping Distance Parameters and Calculations, Including Timeout and ACS Response Delay

Braking Formula Inputs		
Train/System Type	Parameter	Value
Freight	Coefficient P	0.035
	App'n Time (secs)	13.8
	Train Weight (lb)	376000000
	Brake Force (lb)	279683
Passenger	Coefficient A	0.666
	Coefficient B	0
	Safety Factor	1.25
Train Control	Latency/T-out (sec)	3
	ACS Response (sec	0
Guilty Train Speed (mph)		15

Braking Distance Calculations (including free running in TO) (ft)																				
Train Type	Speeds (mph)	To Stop	Reduction to RedCon*	RedCon* to Stop	Deceleration (ft/sec²)	Braking Duration (secs) Reduction to RedCon*	RedCon* to Stop	Guilty Train Distance (ft) Reduction to RedCon*	RedCon* to Stop	Total Zone Lengths (ft) Reduction to RedCon*	RedCon* to Stop	Full Speed to Stop								
Freight	25	1671	1671	0	0.668	58	0	1275	0	2946	0	2946								
	40	3686	1619	2068	0.668	14	77	308	1692	1927	3760	5686								
	50	5452	3384	2068	0.668	36	77	791	1692	4176	3760	7935								
Passenger	40	1452	1452	0	1.293	48	0	1065	0	2517	0	2517								
	60	3177	3177	0	1.293	71	0	1565	0	4742	0	4742								
	79	5433	3035	2398	1.293	25	68	541	1499	3576	3896	7472								
	105	9493	7096	2398	1.293	54	68	1190	1499	8286	3896	12182								
Fr.Red'd Consp	35	1125	NA	NA	1.293															

Blue cells contain data imported from the Inputs worksheet

Sight Distance (ft)	2500

Note: RedCon refers to the speed at which collision consequences will be significantly reduced
60 mph for passenger trains and 35 mph for freight trains
If train speed is lower that this speed, then there are no reduced consequences and Zone A2 has zero length

Table 1.2: Segment Definitions: Sub-Corridor 1: MP 62.7 (Manzonia) - MP 88.3 (Bunge)

Segment Number	Start (milepost)	End (milepost)	Type	Variant	Length Miles	Length Feet	Posted Speed (mph) Freight	Posted Speed (mph) Pass	Posted Speed (mph) HS Pass	Representative Speed (mph) Freight	Representative Speed (mph) Pass	Representative Speed (mph) HS Pass (Consq*)	Representative Speed (mph) HS Pass (Other)	Industry Siding Number	Industry Siding Name	Passenger Stops
1.0	62.6	64.8	CP Adjacent (M)		2.2	11616	60	79	110	50	79	79	105	0		
2.0	64.8	66.6	Plain		1.8	9240	60	79	110	50	79	79	105	0		
3.0	66.6	68.2	Plain		1.7	8970.4	60	79	110	50	79	79	105	0		
4.0	68.2	70.2	CP Adjacent (M)		1.9	10243.2	60	79	110	50	79	79	105	0		
5.0	70.2	72.8	Siding (M)	Dwight (sg/g)	2.6	13886.4	60	79	110	40	60	60	79	0		
6.0	72.8	72.8	Diamond		0.0	0	40	40	40	40	40	40	40	0		
7.0	72.8	74.9	CP Adjacent (M)		2.1	11299.2	60	79	110	40	60	60	79	0		
8.0	74.9	77.3	Plain		2.3	12302.4	60	79	110	50	79	79	105	0		
9.0	77.3	80.1	Plain		2.9	15100.8	60	79	110	50	79	79	105	0		
10.0	80.1	82.0	CP Adjacent (M)		1.9	9820.8	60	79	110	50	79	79	105	0		
11.0	82.0	84.7	Siding (M)	Odell (Sq/dt)	2.7	14044.8	60	79	110	50	79	79	105	0		
12.0	84.7	86.4	CP Adjacent (M)		1.8	9398.4	60	79	110	50	79	79	105	0		
13.0	86.4	88.4	Plain		1.9	10137.6	60	79	110	50	79	79	105	0		

Check Total 25.8

Table 1.3: Mitigation and Prevention Zones - All Segments - Lengths in Feet)

Zone A1: Limited Speed Reduction No Prevention or Mitigation			Zone A2: Reduced Speed to Stop Severity Mitigation			Zone B: Able to Stop Full Prevention			Overlap of Stopping Distance into Zone C			Distance in Timeout in Zone C			Overlap of Zone A1 into Zone C			Overlap of Zone A1 Into Zone C within Sight Distance			Overlap of Zone A2 into Zone C within Sight Distance		
Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass
4176	3576	8286	3760	3896	3330	3681	4144	0	0	0	566	0	0	462	0	0	0	0	0	0	0	0	566
4176	3576	8286	3896	3896	954	1168	1768	0	0	0	462	0	0	0	0	0	0	0	0	0	0	0	2500
4176	3576	8286	3896	3896	585	799	1399	0	0	0	3311	0	0	462	0	0	0	0	0	0	0	0	2500
4176	3576	8286	3896	3896	1958	2172	2772	0	0	0	1939	0	0	462	0	0	0	0	0	0	0	0	1939
1927	4742	3576	0	0	3896	11960	9145	6415	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1927	4742	3576	0	0	3896	9373	6558	3828	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	8286	3896	3896	3896	4231	4831	121	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	8286	3896	3896	3896	7029	7629	2919	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	8286	3896	3896	1535	1749	2349	0	0	0	2361	0	0	462	0	0	0	0	0	0	0	0	2361
4176	3576	8286	3896	3896	3896	5973	6573	1863	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	8286	3896	3896	1113	1327	1927	0	0	0	2783	0	0	462	0	0	0	0	0	0	0	0	2500
4176	3576	8286	3896	3896	1852	2066	2666	0	0	0	2044	0	0	462	0	0	0	0	0	0	0	0	2044

Table 1.4: Breakdown of Segments Lengths by Representative Speed (miles)

Segment Number	Freight Speeds (mph) 25	40	50	Convent'l Pass Speeds (mph) 40	60	79	HS Pass. Speeds - Coll'n Conseq. (mph) 40	60	79	105	HS Pass. Speeds - Other (mph) 40	60	79	105
1.0	0	0	2.2	0	0	2.2	0	0	2.2	0	0	0	0	2.2
2.0	0	0	1.75	0	0	1.75	0	0	1.75	0	0	0	0	1.75
3.0	0	0	1.68	0	0	1.68	0	0	1.68	0	0	0	0	1.68
4.0	0	0	1.94	0	0	1.94	0	0	1.94	0	0	0	0	1.94
5.0	0	2.63	0	0	2.63	0	0	2.63	0	0	0	0	2.63	0
6.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.0	0	2.14	0	0	2.14	0	0	2.14	0	0	0	0	2.14	0
8.0	0	0	2.33	0	0	2.33	0	0	2.33	0	0	0	0	2.33
9.0	0	0	2.86	0	0	2.86	0	0	2.86	0	0	0	0	2.86
10.0	0	0	1.86	0	0	1.86	0	0	1.86	0	0	0	0	1.86
11.0	0	0	2.66	0	0	2.66	0	0	2.66	0	0	0	0	2.66
12.0	0	0	1.78	0	0	1.78	0	0	1.78	0	0	0	0	1.78
13.0	0	0	1.92	0	0	1.92	0	0	1.92	0	0	0	0	1.92

Table 1.5: Aggregate Segment Length by Segment Type and Speed

Segment Type	Train Type	Representative Speed (mph)	Aggregate Length of Segments by Train and Segment Types: Freight Miles	Freight Feet	Conv passenger Miles	Conv passenger Feet	High Speed Passenger Collision Consq* Miles	Collision Consq* Feet	Other Miles	Other Feet
Siding (mon)	Freight	25	0.0	0						
		40	2.6	13886.4						
		50	2.7	14044.8						
	Passenger	40			0.0	0	0.0	0	0.0	0
		60			2.6	13886.4	2.6	13886.4	0.0	0
		79			2.7	14044.8	2.7	14044.8	2.6	13886.4
		105					0.0	0	2.7	14044.8
Siding (unmon)	Freight	25	0.0	0						
		40	0.0	0						
		50	0.0	0						
	Passenger	40			0.0	0	0.0	0	0.0	0
		60			0.0	0	0.0	0	0.0	0
		79			0.0	0	0.0	0	0.0	0
		105					0.0	0	0.0	0
CP Adjacent (mon)	Freight	25	0.0	0						
		40	2.1	11299.2						
		50	7.8	41078.4						
	Passenger	40			0.0	0	0.0	0	0.0	0
		60			2.1	11299.2	2.1	11299.2	0.0	0
		79			7.8	41078.4	7.8	41078.4	2.1	11299.2
		105					0.0	0	7.8	41078.4
CP Adjacent (unmon)	Freight	25	0.0	0						
		40	0.0	0						
		50	0.0	0						
	Passenger	40			0.0	0	0.0	0	0.0	0
		60			0.0	0	0.0	0	0.0	0
		79			0.0	0	0.0	0	0.0	0
		105					0.0	0	0.0	0
Plain Track	Freight	25	0.0	0						
		40	0.0	0						
		50	10.5	55651.2						
	Passenger	40			0.0	0	0.0	0	0.0	0
		60			0.0	0	0.0	0	0.0	0
		79			10.5	55651.2	10.5	55651.2	0.0	0
		105					0.0	0	10.5	55651.2
Check Total			25.8		25.8		25.8		25.8	

*This speed is used to calculate collision consequences in collisions between an equipped and an unequipped train ONLY, reflecting the IDOT PTC speed restriction when an equipped train nears an unequipped train

Yellow cells contain data exported to the next sec/sheet in the sequence of three sheets that perform the calculations for one sub-corridor, season and operating state

Table 1.6a: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for Siding (M) Segments

Lengths in Zone C	A1	A2	B
Total Length, Siding (M) Segments (ft)	27931.2		
Number Siding (M) Segments	2		
Average distance in Zone C (ft) Freight	0	0	2500
Passenger	0	0	2500
HS Pass	0	0	2500

Sum Zone Lengths A1, A2, B (ft): 6102 8317 11861 3896 3896 7792 17933 15718 8278
Fraction of total length in zone: 0.218 0.298 0.425 0.139 0.139 0.279 0.642 0.563 0.296

Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass	
0.208	0.283	0.403	0.133	0.133	0.265	0.710	0.635	0.382	Values transferred to Collision Matrix

Collision Accident Mitigation Probabilities: Combined All Zones.

Distribution of train location at time of	In Block	0.95
violation in Reference Case accidents	Previous Block	0.05
PTC Risk Increment in Zone C		2
Potential danger length in Zone C (ft)		2500

Table 1.6b: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for Siding (U) Segments

Lengths in Zone C	A1	A2	B
Total Length, Siding (U) Segments (ft)	1		
Number Siding (M) Segments	0.001		
Average distance in Zone C (ft) Freight	0	0	2500
Passenger	0	0	2500
HS Pass	0	0	2500

Zone lengths A1, A2, B (ft): 0 0 0 0 0 0 0 0 0
Fraction of total length in zone: 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000

Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass	
0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100	Values transferred to Collision Matrix

Collision Accident Mitigation Probabilities: Combined All Zones.

Distribution of train location at time of	In Block	0.95
violation in Reference Case accidents	Previous Block	0.05
PTC Risk Increment in Zone C		2
Potential danger length in Zone C (ft)		2500

Table 1.6c: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for CP Adjacent (M) Segments

Lengths in Zone C	A1	A2	B
Total Length, CP Adjacent (M) Segments (ft)	52377.6		
Number CP Adjacent Segments	5		
Average distance in Zone C (ft) Freight	0	0	2500
Passenger	0	0	2500
HS Pass	0	1473	1027

Zone lengths A1, A2, B (ft): 18629 19044 36718 15448 15584 11832 18301 17749 3828
Fraction of total length in zone: 0.356 0.364 0.701 0.295 0.298 0.226 0.349 0.339 0.073

Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass	
0.338	0.345	0.666	0.280	0.283	0.274	0.432	0.422	0.111	Values transferred to Collision Matrix

Collision Accident Mitigation Probabilities: Combined All Zones.

Distribution of train location at time of	In Block	0.95
violation in Reference Case accidents	Previous Block	0.05
PTC Risk Increment in Zone C		2
Potential danger length in Zone C (ft)		2500

Table 1.6d: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for CP Adjacent (U)Segments

Lengths in Zone C	A1	A2	B
Total Length, CP Adjacent (U) Segments (ft)	1		
Number CP Adjacent Segments	0.001		
Average distance in Zone C (ft) Freight	0	0	2500
Passenger	0	0	2500
HS Pass	0	0	2500

Zone lengths A1, A2, B (ft): 0 0 0 0 0 0 0 0 0
Fraction of total length in zone: 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000

Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass	
0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100	Values transferred to Collision Matrix

Collision Accident Mitigation Probabilities: Combined All Zones.

Distribution of train location at time of	In Block	0.95
violation in Reference Case accidents	Previous Block	0.05
PTC Risk Increment in Zone C		2
Potential danger length in Zone C (ft)		2500

Table 1.6e: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for Plain Track Segments

Lengths in Zone C	A1	A2	B
Total Length, Plain Track Segments (ft)	55651.2		
Number CP Adjacent Segments	5		

Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass

| | | |

Worksheet 2 - J,N,R: Collision Frequencies Calculation - Base Case II: Northeast Corridor ATC, 85% Preventability with Severity Reduction, Joliet Sub-corridor, Rest of Year

Table 2.1a: Collision Distribution Matrix (Fraction Accidents by Train Pair and Collision Type). Collisions Between Trains Operating on the IDOT Test Corridor Only (not diamonds and intrusions)

	Train Pairs in In Collision	Collision Scenario Prob (Top Level)	Siding - Monitored: Collision Distribution Head On	Siding - Monitored: Collision Distribution Rear/Side	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty
	Percent Guilty				100%	0%	100%	0%
Both Trains TBE	Pass-Pass	0.71	0.50	0.50	0.355	0	0.355	0
	Pass-TBE Freight	0.29	0.50	0.50	0.145	0	0.145	0
(Note 3)	TBE Freight - TBE Freight	0.00	0.50	0.50	0	0	0	0
	Percent Guilty				50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	0.00	1	0	0	0	0	0
	Rear/Side, Pass into NE Frt		0	1	0	0	0	0
	Rear/Side NE Frt into Pass		0	1	0	0	0	0
	TBE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0
	Percent Guilty				0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0
	Total Probability (checking)	1		1	0.5	0	0.5	0

	Train Pairs in In Collision	Siding - Unmonitored: Collision Distribution Head On	Siding - Unmonitored: Collision Distribution Rear/Side	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
	Percent Guilty			100%	0%	100%	0%
Both Trains TBE	Pass-Pass	0.8	0.2	0.568	0	0.142	0
	Pass-TBE Freight	0.7	0.3	0.203	0	0.087	0
	TBE Freight - TBE Freight	0.7	0.3	0	0	0	0
	Percent Guilty			50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	1	0	0	0	0	0
	Rear/Side, Pass into NE Frt	0	1	0	0	0	0
	Rear/Side NE Frt into Pass	0	1	0	0	0	0
	TBE Freight - NE Freight	0.7	0.3	0	0	0	0
	Percent Guilty			0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.7	0.3	0	0	0	0
	Total Probability (checking)		1	0.771	0	0.229	0

	Train Pairs in In Collision	CP Adjacent - Monitored Siding: Collision Distribution Head On	CP Adjacent - Monitored Siding: Collision Distribution Rear/Side	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty
	Percent Guilty			100%	0%	100%	0%
Both Trains TBE	Pass-Pass	0.8	0.2	0.568	0	0.142	0
	Pass-TBE Freight	0.7	0.3	0.203	0	0.087	0
	TBE Freight - TBE Freight	0.7	0.3	0	0	0	0
	Percent Guilty			50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	1	0	0	0	0	0
	Rear/Side, Pass into NE Frt	0	1	0	0	0	0
	Rear/Side NE Frt into Pass	0	1	0	0	0	0
	TBE Freight - NE Freight	0.7	0.3	0	0	0	0
	Percent Guilty			0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.7	0.3	0	0	0	0
	Total Probability (checking)		1	0.771	0	0.229	0

	Train Pairs in In Collision	CP Adjacent - Unmonitored Siding: Collision Distribution Head On	CP Adjacent - Unmonitored Siding: Collision Distribution Rear/Side	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
	Percent Guilty			100%	0%	100%	0%
Both Trains TBE	Pass-Pass	0.8	0.2	0.568	0	0.142	0
	Pass-TBE Freight	0.7	0.3	0.203	0	0.087	0
	TBE Freight - TBE Freight	0.7	0.3	0	0	0	0
	Percent Guilty			50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	1	0	0	0	0	0
	Rear/Side, Pass into NE Frt	0	1	0	0	0	0
	Rear/Side NE Frt into Pass	0	1	0	0	0	0
	TBE Freight - NE Freight	0.7	0.3	0	0	0	0
	Percent Guilty			0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.7	0.3	0	0	0	0
	Total Probability (checking)		1	0.771	0	0.229	0

	Train Pairs in In Collision	Plain Track: Collision Distribution Head On	Plain Track: Collision Distribution Rear/Side	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
	Percent Guilty			100%	0%	100%	0%
Both Trains TBE	Pass-Pass	0.70	0.30	0.497	0	0.213	0
	Pass-TBE Freight	0.40	0.60	0.116	0	0.174	0
	TBE Freight - TBE Freight	0.50	0.50	0	0	0	0
	Percent Guilty			50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	1.00	0.00	0	0	0	0
	Rear/Side, Pass into NE Frt	0.00	1.00	0	0	0	0
	Rear/Side NE Frt into Pass	0.00	1.00	0	0	0	0
	TBE Freight - NE Freight	0.50	0.50	0	0	0	0
	Percent Guilty			0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.50	0.50	0	0	0	0
	Total Probability (checking)		1	0.613	0	0.387	0

Table 2.1b: Collision Type Distribution - Diamonds

	Train Pairs in In Collision	Train Pair Type	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty
	Percent Guilty			
Both Trains TBE	Pass-Pass	Both Trains TBE		
	Pass-TBE Freight			
	TBE Freight - TBE Freight			
	Percent Guilty		50%	50%
One Train TBE	Pass - NE Freight, Head -On	One Train TBE	0	0
	Rear/Side, Pass into NE Frt		0.25	0.25
	Rear/Side NE Frt into Pass		0.05	0.05
	TBE Freight - NE Freight		0.1	0.1
	Percent Guilty			100%
Neither Train TBE	NE Freight - NE Freight	Neither Train TBE	0	0.2
	Total Probability (checking)		0.4	0.6

Note. The gray cells on these rows are set at zero, because in every case, the condition represented by the cell does not exist - either because there are no unequipped passenger trains, or because of the kind of collision defined for the row.

Quantity in cell C18 is for all collisions between a passenger train and an unequipped freight train

Table 2.2: Preventability Data For Unequipped train Guilty, One Train TBE

Segment Type	Not Prevented of Mitigated Freight	Not Prevented of Mitigated Pass	Not Prevented of Mitigated HS Pass	Mitigated Freight	Mitigated Pass	Mitigated HS Pass	Prevented Freight	Prevented Pass	Prevented HS Pass
Siding (M)	0.208	0.283	0.403	0.133	0.133	0.265	0.710	0.635	0.382
Siding (U)	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100
CP Adjacent (M)	0.338	0.345	0.666	0.280	0.283	0.274	0.432	0.422	0.111
CP Adjacent (U)	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100
Plain Track	0.318	0.325	0.627	0.000	0.000	0.056	0.100	0.100	0.044
Diamonds	0.122	0.240	0.229	0.156	0.000	0.181	0.772	0.810	0.640

Mauve cells contain data imported from previous worksheet in a group of three worksheets covering one sub-corridor, season and operating plan.

Table 2.3a: Collision Preventability Matrix (Percent Accidents Preventable Relative to CTC Reference Case)

	Train Pairs in In Collision	Preventability Equipped Train Guilty	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	85%	85%		85%	
	Pass-TBE Freight	85%	85%		85%	
	TBE Freight - TBE Freight	85%	85%		85%	
One TBE	Pass - NE Freight, Head -On	85%	85%	38%		
	Rear/Side, Pass into NE Frt	85%			85%	38%
	Rear/Side NE Frt into Pass	85%			85%	0%
	TBE Freight - NE Freight	85%	85%	71%	85%	0%
Neither TBE	NE Freight - NE Freight			0%		0%
Reference Case (CTC) Collision Accident Likelihood by Segment Type (collisions/million train miles)		0.030				

	Train Pairs in In Collision	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	85%		85%	
	Pass-TBE Freight	85%		85%	
	TBE Freight - TBE Freight	85%		85%	
One TBE	Pass - NE Freight, Head -On	85%	10%		
	Rear/Side, Pass into NE Frt			85%	10%
	Rear/Side NE Frt into Pass			85%	0%
	TBE Freight - NE Freight	85%	10%	85%	0%
Neither TBE	NE Freight - NE Freight		0%		0%
		0.040			

	Train Pairs in In Collision	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	85%		85%	
	Pass-TBE Freight	85%		85%	
	TBE Freight - TBE Freight	85%		85%	
One TBE	Pass - NE Freight, Head -On	85%	11%		
	Rear/Side, Pass into NE Frt			85%	11%
	Rear/Side NE Frt into Pass			85%	0%
	TBE Freight - NE Freight	85%	43%	85%	0%
Neither TBE	NE Freight - NE Freight		0%		0%
		0.050			

	Train Pairs in In Collision	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	85%		85%	
	Pass-TBE Freight	85%		85%	
	TBE Freight - TBE Freight	85%		85%	
One TBE	Pass - NE Freight, Head -On	85%	10%		
	Rear/Side, Pass into NE Frt			85%	10%
	Rear/Side NE Frt into Pass			85%	0%
	TBE Freight - NE Freight	85%	10%	85%	0%
Neither TBE	NE Freight - NE Freight		0%		0%
		0.060			

	Train Pairs in In Collision	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	85%		85%	
	Pass-TBE Freight	85%		85%	
	TBE Freight - TBE Freight	85%		85%	
One TBE	Pass - NE Freight, Head -On	85%	4%		
	Rear/Side, Pass into NE Frt			85%	4%
	Rear/Side NE Frt into Pass			85%	0%
	TBE Freight - NE Freight	85%	10%	85%	0%
Neither TBE	NE Freight - NE Freight		0%		0%
		0.006		Collisions/million diamond passes	

Table 2.3b: Collision Preventability Matrix - Diamonds

	Train Pairs in In Collision	Train Pair Type	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	Both TBE		
	Pass-TBE Freight			
	TBE Freight - TBE Freight			
One TBE	Pass - NE Freight, Head -On	One TBE		
	Rear/Side, Pass into NE Frt		85%	81.03%
	Rear/Side NE Frt into Pass		85%	81.03%
	TBE Freight - NE Freight		85%	77.19%
Neither TBE	NE Freight - NE Freight	Neither TBE		0.00%
		0.1		

Table 2.4a: Passenger Trains in Train-to-Train Collisions (Trains in Collisions per Million Train-Miles)

	Train Pairs in In Collision	Passenger Trains in Collisions	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	2	0.0032		0.0032	
	Pass-TBE Freight	1	0.0007		0.0007	
	TBE Freight - TBE Freight	0				
One TBE	Pass - NE Freight, Head -On	1	0.0000	0.0000		
	Rear/Side, Pass into NE Frt	1			0.0000	0.0000
	Rear/Side NE Frt into Pass	1			0.0000	0.0000
	TBE Freight - NE Freight	0				
Neither TBE	NE Freight - NE Freight	0				
	Checking total		0.0038	0.0000	0.0038	0.0000
	Scenario Totals - Passenger	**Tots, P-UF**	**Totals**			
	Pass Loco Hits Loco	0.0000	0.0038	0.0038	0.0000	
	Pass Loco Hits Pass Ca		0.0016			0.0016
	Pass Loco Hits Freight Ca	0.0000	0.0005			0.0005
	Pass Car Hit by Loco	0.0000	0.0017			0.0017
	Total		0.0077	0.0038	0.0000	0.0038

	Train Pairs in In Collision	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	0.0043		0.0043	
	Pass-TBE Freight	0.0009		0.0009	
	TBE Freight - TBE Freight				
One TBE	Pass - NE Freight, Head -On	0.0000	0.0000		
	Rear/Side, Pass into NE Frt			0.0000	0.0000
	Rear/Side NE Frt into Pass			0.0000	0.0000
	TBE Freight - NE Freight				
Neither TBE	NE Freight - NE Freight				
	Checking total	0.0051	0.0000	0.0051	0.0000
	Scenario Totals - Passenger	**Totals**			
	Pass Loco Hits Loco	0.0051	0.0000		
	Pass Loco Hits Pass Ca	0.0021		0.0021	
	Pass Loco Hits Freight Ca	0.0007		0.0007	
	Pass Car Hit by Loco	0.0023		0.0023	0.0000
	Total	0.0103	0.0051	0.0000	0.0051

	Train Pairs in In Collision	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	0.0085		0.0021	
	Pass-TBE Freight	0.0015		0.0007	
	TBE Freight - TBE Freight				
One TBE	Pass - NE Freight, Head -On	0.0000	0.0000		
	Rear/Side, Pass into NE Frt			0.0000	0.0000
	Rear/Side NE Frt into Pass			0.0000	0.0000
	TBE Freight - NE Freight				
Neither TBE	NE Freight - NE Freight				
	Checking total	0.0100	0.0000	0.0028	0.0000
	Scenario Totals - Passenger	**Totals**			
	Pass Loco Hits Loco	0.0000	0.0100		
	Pass Loco Hits Pass Ca		0.0011		
	Pass Loco Hits Freight Ca	0.0000	0.0005		
	Pass Car Hit by Loco	0.0000	0.0012	0.0000	0.0000
	Total		0.0128	0.0100	0.0000

	Train Pairs in In Collision	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	0.0102		0.0026	
	Pass-TBE Freight	0.0018		0.0008	
	TBE Freight - TBE Freight				
One TBE	Pass - NE Freight, Head -On	0.0000	0.0000		
	Rear/Side, Pass into NE Frt			0.0000	0.0000
	Rear/Side NE Frt into Pass			0.0000	0.0000
	TBE Freight - NE Freight				
Neither TBE	NE Freight - NE Freight				
	Checking total	0.0121	0.0000	0.0033	0.0000
	Scenario Totals - Passenger	**Totals**			
	Pass Loco Hits Loco	0.0121	0.0000		
	Pass Loco Hits Pass Ca	0.0013		0.0013	
	Pass Loco Hits Freight Ca	0.0006		0.0006	
	Pass Car Hit by Loco	0.0015	0.0000	0.0015	0.0000
	Total	0.0154	0.0121	0.0000	0.0033

	Train Pairs in In Collision	Plain Track: Collision Distribution Head On	Plain Track: Collision Distribution Rear/Side	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass			0.0009		0.0004	
	Pass-TBE Freight			0.0001		0.0002	
	TBE Freight - TBE Freight						
One TBE	Pass - NE Freight, Head -On			0.0000	0.0000		
	Rear/Side, Pass into NE Frt					0.0000	0.0000
	Rear/Side NE Frt into Pass					0.0000	0.0000
	TBE Freight - NE Freight						
Neither TBE	NE Freight - NE Freight						
	Checking total			0.0010	0.0000	0.0005	0.0000
	Scenario Totals - Passenger		**Totals**				
	Pass Loco Hits Loco		0.0010	0.0000			
	Pass Loco Hits Pass Ca					0.0002	
	Pass Loco Hits Freight Ca					0.0001	
	Pass Car Hit by Loco		0.0002	0.0000	0.0000	0.0002	0.0000
	Total		0.0015	0.0010	0.0000	0.0005	0.0000

Table 2.4b: Passenger Trains in Collisions at Diamonds

	Train Pairs in In Collision	Train Pair Type	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	Both TBE		
	Pass-TBE Freight			
	TBE Freight - TBE Freight			
One TBE	Pass - NE Freight, Head -On	One TBE		
	Rear/Side, Pass into NE Frt		0.003750	0.004742
	Rear/Side NE Frt into Pass		0.000750	0.000948
	TBE Freight - NE Freight		0.000000	0.000000
Neither TBE	NE Freight - NE Freight	Neither TBE		0.000000
			0.00450	0.00569
	Scenario Totals - Passenger	**Totals**		
	Pass Loco Hits Loco			
	Pass Loco Hits Pass Ca		0.003750	0.004742
	Pass Loco Hits Freight Ca	0.008492	0.000750	0.000948
	Pass Car Hit by Loco	0.001698	0.000750	0.000948
	Total	0.010190	0.004500	0.005690

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Table 2.5a: Freight trains in train-to-Train Collisions (Trains in Collisions per Million Train-Miles)

	Train Pairs in In Collision	Freight Trains in Collisions	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	0				
	Pass-TBE Freight	1	0.0007		0.0007	
	TBE Freight - TBE Freight	2	0.0000		0.0000	
One TBE	Pass - NE Freight, Head -On	1	0.0000	0.0000		
	Rear/Side, Pass into NE Frt	1			0.0000	0.0000
	Rear/Side NE Frt into Pass	1			0.0000	0.0000
	TBE Freight - NE Freight	2	0.0000	0.0000	0.0000	0.0000
Neither TBE	NE Freight - NE Freight	2		0.0000		0.0000
	Checking total		0.0007	0.0000	0.0007	0.0000
	Scenario Totals - Freight		**Totals**			
	Freight Loco Hits Loco		0.0007	0.0000		
	Freight Loco Hits Car		0.0001		0.00013	0.00000
	Freight Car Hit By Loco		0.0005		0.00052	0.00000
	Total		0.0013	0.0007	0.0000	0.0007

	Train Pairs in In Collision	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	0.0009		0.0009	
	Pass-TBE Freight	0.0002		0.0002	
	TBE Freight - TBE Freight				
One TBE	Pass - NE Freight, Head -On	0.0000	0.0000		
	Rear/Side, Pass into NE Frt			0.0000	0.0000
	Rear/Side NE Frt into Pass			0.0000	0.0000
	TBE Freight - NE Freight	0.0000	0.0000	0.0000	0.0000
Neither TBE	NE Freight - NE Freight		0.0000		0.0000
		0.0009	0.0000	0.0009	0.0000
	Totals				
	Freight Loco Hits Loco	0.0009	0.0000		
	Freight Loco Hits Car	0.0002		0.00017	0.00000
	Freight Car Hit By Loco	0.0007		0.00070	0.00000
	Total	0.0017	0.0009	0.0000	0.0009

	Train Pairs in In Collision	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	0.0015		0.0007	
	Pass-TBE Freight	0.0000		0.0000	
	TBE Freight - TBE Freight				
One TBE	Pass - NE Freight, Head -On	0.0000	0.0000		
	Rear/Side, Pass into NE Frt			0.0000	0.0000
	Rear/Side NE Frt into Pass			0.0000	0.0000
	TBE Freight - NE Freight	0.0000	0.0000	0.0000	0.0000
Neither TBE	NE Freight - NE Freight		0.0000		0.0000
		0.0015	0.0000	0.0007	0.0000
	Totals				
	Freight Loco Hits Loco	0.0015	0.0000		
	Freight Loco Hits Car	0.0002		0.00016	0.00000
	Freight Car Hit By Loco	0.0005		0.00049	0.00000
	Total	0.0022	0.0015	0.0000	0.0007

	Train Pairs in In Collision	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	0.0018		0.0008	
	Pass-TBE Freight	0.0000		0.0000	
	TBE Freight - TBE Freight				
One TBE	Pass - NE Freight, Head -On	0.0000	0.0000		
	Rear/Side, Pass into NE Frt			0.0000	0.0000
	Rear/Side NE Frt into Pass			0.0000	0.0000
	TBE Freight - NE Freight	0.0000	0.0000	0.0000	0.0000
Neither TBE	NE Freight - NE Freight		0.0000		0.0000
		0.0018	0.0000	0.0008	0.0000
	Totals				
	Freight Loco Hits Loco	0.0018	0.0000		
	Freight Loco Hits Car	0.0002		0.00020	0.00000
	Freight Car Hit By Loco	0.0006		0.00059	0.00000
	Total	0.0026	0.0018	0.0000	0.0008

	Train Pairs in In Collision	Plain Track: Collision Distribution Head On	Plain Track: Collision Distribution Rear/Side	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass			0.0001		0.0002	
	Pass-TBE Freight			0.0000		0.0000	
	TBE Freight - TBE Freight						
One TBE	Pass - NE Freight, Head -On			0.0000	0.0000		
	Rear/Side, Pass into NE Frt					0.0000	0.0000
	Rear/Side NE Frt into Pass					0.0000	0.0000
	TBE Freight - NE Freight			0.0000	0.0000	0.0000	0.0000
Neither TBE	NE Freight - NE Freight				0.0000		0.0000
				0.0001	0.0000	0.0002	0.0000
	Totals						
	Freight Loco Hits Loco			0.0001	0.0000		
	Freight Loco Hits Car			0.0000		0.00003	0.00000
	Freight Car Hit By Loco			0.0000		0.00013	0.00000
	Total			0.0003	0.0001	0.0000	0.0002

Table 2.5b: Freight Trains in Collisions at Diamonds

	Train Pairs in In Collision	Train Pair Type	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	Both TBE		
	Pass-TBE Freight			
	TBE Freight - TBE Freight			
One TBE	Pass - NE Freight, Head -On	One TBE		
	Rear/Side, Pass into NE Frt		0.003750	0.004742
	Rear/Side NE Frt into Pass		0.000750	0.000948
	TBE Freight - NE Freight		0.003000	0.004562
Neither TBE	NE Freight - NE Freight	Neither TBE		0.040000
			0.00750	0.05025
	Scenario Totals - Freight	**Totals**		
	Freight Loco Hits Loco			
	Freight Loco Hits Car	0.028479	0.005250	0.023229
	Freight Car Hit By Loco	0.029273	0.002250	0.027023
	Total		0.007500	0.050252

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

	Train Pairs in In Collision	Train Pair Type
Both TBE	Pass-Pass	Both TBE
	Pass-TBE Freight	
	TBE Freight - TBE Freight	
One TBE	Pass - NE Freight, Head -On	One TBE
	Rear/Side, Pass into NE Frt	
	Rear/Side NE Frt into Pass	
	TBE Freight - NE Freight	
Neither TBE	NE Freight - NE Freight	Neither TBE
	Totals	
	Pass Loco Hits Loco	
	Pass Loco Hits Pass Ca	
	Pass Loco Hits Freight Ca	
	Pass Car Hit by Loco	
	Total	

Freight Plus Passenger Totals (check) 0.0600 0.0090 | 0.0800 0.0120 | 0.1000 0.0150 | 0.1200 0.0180 | 0.0018

In rear-end/side collisions between like trains there is one loco hits car and one car hit by loco in each collision. In rear/side collisions between a passenger and freight trains, the ratio between passenger hits freight and freight loco hits passenger car are a function of the percentages given in Table IN-5b on the Inputs sheet. The values are given in the tables beneath the trains in collisions for each segment type.

Collision Ratios	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.8	0.2

Collision Ratios	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.80	0.20

Collision Ratios	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.75	0.25

Collision Ratios	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.75	0.25

Collision Ratios	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.83	0.17

Worksheet 3 - J,N,R: - Risk Calculations - Base Case II: Northeast Corridor ATC, 85% Preventability with Severity Reduction, Joliet Subcorridor, Rest of Year

Table 3.1: Consequences Look-up Tables (Data Sources: Previous ICF Passenger Corridor Project (passenger), FRA Accident Data 2001-5 (freight)

Passenger Trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 40 mph			Representative Speed 60 mph			Representative Speed 79 mph			Representative Speed 105 mph		
			Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Pass Loco hits Loco	0.0664	0.0016	401600	0.1112	0.00392	913600	0.192	0.0068	1580800	0.34	0.0128	2796000
		Pass Loco hits Pass Car	0.0272	0.0008	200800	0.0448	0.00208	456800	0.0776	0.0036	790400	0.1368	0.0064	1397600
		Pass Loco hits Frt Car	0.0272	0.0008	200800	0.0448	0.00208	456800	0.0776	0.0036	790400	0.1368	0.0064	1397600
		Pass car hit by Loco	0.1328	0.004	804000	0.22	0.00952	1827200	0.3808	0.01648	3160800	0.6728	0.0256	5591200
	Intrusion Collision (rollout)	Pass Loco hits Car	0.00936	0.00036	81360	0.02232	0.000792	185040	0.03888	0.001368	329400	0.06912	0.002448	565920
	Intrusion Collision (other))	Pass Loco hits Car	0.02496	0.000864	216960	0.06048	0.002112	493440	0.10368	0.003648	853440	0.18336	0.006528	1510080
	Overspeed		0.044	0.0004	667000	0.14	0.00186	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Broken Rail		0.04268	0.000388	646990	0.1358	0.0018042	1455000	0.2037	0.0032786	2522000	0.2716	0.004365	4456180
	Work Zone Violation		0.083	0.0083	0	0.125	0.0125	0	0.164	0.0164	0	0.218	0.0218	0

Freight trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 25 mph			Representative Speed 40 mph			Representative Speed 50 mph		
			Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Frt Loco hits Loco	0.344	0.0344	84000	0.88	0.088	216000	1.36	0.136	337600
		Frt Loco hits Car	0.28	0.028	70400	0.72	0.072	180000	1.12	0.112	281600
		Frt car hit by Loco	0	0	35200	0	0	89600	0	0	140800
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.06336	0.00648	7920	0.162	0.01656	20160	0.252	0.0252	31680
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.06336	0.00648	7920	0.162	0.01656	20160	0.252	0.0252	31680
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.08448	0.00864	10560	0.216	0.02208	26880	0.336	0.0336	42240
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.08448	0.00864	10560	0.216	0.02208	26880	0.336	0.0336	42240
	Overspeed, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Overspeed, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Equip		0.05432	0.005432	145500	0.13968	0.013968	363750	0.3395	0.03395	568420
	Broken Rail, Unequip		0.05432	0.005432	145500	0.13968	0.013968	363750	0.3395	0.03395	568420
	Work Zone Viol'n, Equip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0
	Work Zone Viol'n, Unequip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0

Casualties and damage in Table 3.1 are per accident, except for Work Zone Violations which are per million train-miles

Table 3.2: Grade Crossing and Diamonds: Numbers by Representative Speed, and Accident Frequency and Consequences

Train Type	Representative Speed (mph)	Type of Grade-crossing	Number Crossings			Accident Frequency Per Million Crossing Passes		Crossing Collision Consequences						Number Diamonds
								Pass. Occup't Casualty Prob/accident)			Freight Trains (per accident)			
			Passenger	HS Passenger	Freight	Passenger	Freight	Injuries	Fatalities	Cost $/Accid't	Injuries	Fatalities	Cost $	
Passenger	40	Public_gates_lights	0	0		0.350		0.0028	0.000047	50000				1
		Public_other	0	0		0.300								
		Private	0	0		0.100								
	60	Public_gates_lights	8	0		0.600		0.0068	0.000112	113000				0
		Public_other	0	0		0.500								
		Private	0	0		0.200								
	79	Public_gates_lights	20	8		0.800		0.0105	0.000156	196000				0
		Public_other	0	0		0.650								
		Private	1	0		0.300								
	105	Public_gates_lights	0	20		1.100		0.0186	0.000276	346000				0
		Public_other	0	0		0.800								
		Private	0	1		0.300								
Freight	25	Public_gates_lights			0		0.150				0.12	0.005	20000	0
		Public_other			0		0.120							
		Private			0		0.050							
	40	Public_gates_lights			8		0.300				0.25	0.013	50000	1
		Public_other			0		0.250							
		Private			0		0.100							
	50	Public_gates_lights			20		0.360				0.39	0.02	78000	0
		Public_other			0		0.300							
		Private			1		0.120							

Table 3.4: Collision Frequencies by Segment Type and Collision Scenario (From Coll Matrix)

Scenarios	Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain	Diamond
Pass Loco Hits Loco	0.0038	0.0051	0.0100	0.0121	0.0010	0.000000
Pass Loco Hits Pass Car	0.0016	0.0021	0.0011	0.0013	0.0002	0.000000
Pass Loco Hits Freight Car	0.0005	0.0007	0.0005	0.0006	0.0001	0.008492
Pass Car Hit by Loco	0.0017	0.0023	0.0012	0.0015	0.0002	0.001698
Freight Loco Hits Loco	0.0007	0.0009	0.0015	0.0018	0.0001	0.000000
Freight Loco Hits Car	0.0001	0.0002	0.0002	0.0002	0.0000	0.028479
Freight Car Hit By Loco	0.0005	0.0007	0.0005	0.0006	0.0001	0.029273

Collision Frequencies for Passenger + Unequipped Freight Train				
Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain
0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000

Mauve cells contain data imported from previous worksheet in a group of three worksheets covering one sub-corridor, season and operating state.

All train-to-train collision frequencies are in units of **trains in collisions per million train-miles operated in the sub-corridor by all train types.**

Table 3.3a: Segment Data (for reference only, not used in calculations)

Segment Number	Start (Milepost)	End (Milepost)	Type	Length (miles)	Representative Speed (mph)			
					Freight	Pass	HS Pass-Cons	HS Pass
1.0	62.60	64.80	CP Adjacent (M	2.20	50	79	79	105
2.0	64.80	66.55	Plain	1.75	50	79	79	105
3.0	66.55	68.23	Plain	1.68	50	79	79	105
4.0	68.23	70.17	CP Adjacent (M	1.94	50	79	79	105
5.0	70.17	72.80	Siding (M)	2.63	40	60	60	79
6.0	72.80	72.80	Diamond	0.00	40	40	40	40
7.0	72.80	74.94	CP Adjacent (M	2.14	40	60	60	79
8.0	74.94	77.27	Plain	2.33	50	79	79	105
9.0	77.27	80.13	Plain	2.86	50	79	79	105
10.0	80.13	81.99	CP Adjacent (M	1.86	50	79	79	105
11.0	81.99	84.65	Siding (M)	2.66	50	79	79	105
12.0	84.65	86.43	CP Adjacent (M	1.78	50	79	79	105
13.0	86.43	88.35	Plain	1.92	50	79	79	105
	Length Check	-64.8		25.8				

Table 3.3b: Aggregate Segment Data: SegmentsTypes, Train Types, Speeds, and Lengths (miles)

Segment Type	Train Type	Represent've Speed (mph)	Freight (miles)	Reg Pass (miles)	HS Pass Collision (mi)	HS Pass Other (mi)
Siding (mon)	Freight	25	0.00			
		40	2.63			
		50	2.66			
	Passenger	40		0.00	0.00	0.00
		60		2.63	2.63	0.00
		79		2.66	2.66	2.63
		105		0.00	0.00	2.66
Siding (unmon)	Freight	25	0.00			
		40	0.00			
		50	0.00			
	Passenger	40		0.00	0.00	0.00
		60		0.00	0.00	0.00
		79		0.00	0.00	0.00
		105		0.00	0.00	0.00
CP Adjacent (mon)	Freight	25	0.00			
		40	2.14			
		50	7.78			
	Passenger	40		0.00	0.00	0.00
		60		2.14	2.14	0.00
		79		7.78	7.78	2.14
		105		0.00	0.00	7.78
CP Adjacent (unmon)	Freight	25	0.00			
		40	0.00			
		50	0.00			
	Passenger	40		0.00	0.00	0.00
		60		0.00	0.00	0.00
		79		0.00	0.00	0.00
		105		0.00	0.00	0.00
Plain Track	Freight	25	0.00			
		40	0.00			
		50	10.54			
	Passenger	40		0.00	0.00	0.00
		60		0.00	0.00	0.00
		79		10.54	10.54	0.00
		105		0.00	0.00	10.54
Totals All Types	Freight	25	0.00			
		40	4.77			
		50	20.98			
	Passenger	40		0.00	0.00	0.00
		60		4.77	4.77	0.00
		79		20.98	20.98	4.77
		105		0.00	0.00	20.98
	Checking Total		25.75	25.75	25.75	25.75

Weighted Collision Accident Frequencies by Representative Speed (mph)

Scenarios	Freight			Passenger			
	25	40	50	40	60	79	105
Pass Loco Hits Loco				0.0000	0.0000	0.0066	0.0047
Pass Loco Hits Pass Car				0.0000	0.0000	0.0014	0.0007
Pass Loco Hits Freight Car				0.0000	0.0000	0.0005	0.0003
Pass Car Hit by Loco				0.0000	0.0000	0.0015	0.0008
Freight Loco Hits Loco	0.0000	0.0010	0.0007				
Freight Loco Hits Car	0.0000	0.0001	0.0001				
Freight Car Hit By Loco	0.0000	0.0005	0.0003				

Table 3.4a: Traffic Inputs to Risk Calculation

Trips/Day		
Train Type	Summer	Rest of Year
Passenger	6.00	6.00
Equipped Freight	1.43	1.43
Unequipped Freight	0.00	0.00
Operating Days	91.00	274.00

Percent Train-Miles in	
Timeout (secs)	0
Normal Operating Mode	95.00
Timeout Mode	0.00
Fallback Mode	5

Passenger Train Occupancy	
Seats	320
Occupancy Factor	0.6

Table 3.5a: Risk Calculation - Passenger Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Table 3.5b: Risk Calculation - Collisions at Diamonds - Passenger

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Freq'y (per mill. t-m)	Preventability	Adjusted Frequency	Trips/day	Trips per 10 years	Length of Track (miles)	Train-miles per 10 years	Accidents per 10 years	Number seats per train	Occupancy Factor	Passengers per train	Injuries per 10 years	Fatalities per 10 years	Damage $ per 10 years
40	Train-Train Collision	Pass Loco hits Loco	0.00000	Incl	0.00000	7.43	25764	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Pass Car	0.00000	Incl	0.00000	7.43	25764	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Frt Car	0.00000	Incl	0.00000	7.43	25764	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00000	Incl	0.00000	7.43	25764	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	20805	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (other))	Pass Loco hits intruder	0.01440	0.12	0.01267	6.00	20805	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Overspeed		0.01100	0.00	0.01100	6.00	20805	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Broken Rail		0.01670	0.08	0.01536	6.00	20805	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Work Zone Violation			0.00		6.00	20805	0	0					0.0000	0.00000	0
										0.00000				**0.00000**	**0.00000**	**0**
60	Train-Train Collision	Pass Loco hits Loco	0.00000	Incl	0.00000	7.43	25764	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Pass Car	0.00000	Incl	0.00000	7.43	25764	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Frt Car	0.00000	Incl	0.00000	7.43	25764	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00000	Incl	0.00000	7.43	25764	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	20805	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.12	0.01267	6.00	20805	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Overspeed		0.01100	0.00	0.01100	6.00	20805	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Broken Rail		0.01670	0.08	0.01536	6.00	20805	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Work Zone Violation			0.00		6.00	20805	0	0					0.0000	0.00000	0
										0.00000				**0.00000**	**0.00000**	**0**
79	Train-Train Collision	Pass Loco hits Loco	0.00663	Incl	0.00663	7.43	25764	4.77	122892	0.00081	320	0.6	192	0.030	0.0011	1287
		Pass Loco hits Pass Car	0.00136	Incl	0.00136	7.43	25764	4.77	122892	0.00017	320	0.6	192	0.002	0.0001	132
		Pass Loco hits Frt Car	0.00051	Incl	0.00051	7.43	25764	4.77	122892	0.00006	320	0.6	192	0.001	0.0000	49
		Pass car hit by Loco	0.00150	Incl	0.00150	7.43	25764	4.77	122892	0.00018	320	0.6	192	0.014	0.0006	584
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	20805	4.77	99240	0.00049	320	0.6	192	0.004	0.0001	156
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.12	0.01267	6.00	20805	4.77	99240	0.00126	320	0.6	192	0.025	0.0009	1073
	Overspeed		0.01100	0.00	0.01100	6.00	20805	4.77	99240	0.00109	320	0.6	192	0.044	0.0007	2838
	Broken Rail		0.01670	0.08	0.01536	6.00	20805	4.77	99240	0.00152	320	0.6	192	0.060	0.0010	3845
	Work Zone Violation			0.00		6.00	20805	4.77	99240					0.016	0.0016	0
										0.00559				**0.19553**	**0.00611**	**9965**
105	Train-Train Collision	Pass Loco hits Loco	0.00471	Incl	0.00471	7.43	25764	20.98	540519	0.00255	320	0.6	192	0.166	0.0063	7124
		Pass Loco hits Pass Car	0.00069	Incl	0.00069	7.43	25764	20.98	540519	0.00037	320	0.6	192	0.010	0.0005	524
		Pass Loco hits Frt Car	0.00031	Incl	0.00031	7.43	25764	20.98	540519	0.00017	320	0.6	192	0.004	0.0002	237
		Pass car hit by Loco	0.00078	Incl	0.00078	7.43	25764	20.98	540519	0.00042	320	0.6	192	0.055	0.0021	2369
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	20805	20.98	436489	0.00214	320	0.6	192	0.028	0.0010	1211
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.12	0.01267	6.00	20805	20.98	436489	0.00553	320	0.6	192	0.195	0.0069	8353
	Overspeed		0.01100	0.00	0.01100	6.00	20805	20.98	436489	0.00480	320	0.6	192	0.258	0.0041	22058
	Broken Rail		0.01670	0.08	0.01536	6.00	20805	20.98	436489	0.00671	320	0.6	192	0.350	0.0056	29884
	Work Zone Violation			0.00		6.00	20805	20.98	436489					0.095	0.0095	0
	Total									**0.02269**				**1.16146**	**0.03624**	**71758**
	Overall Totals									**0.02828**				**1.35698**	**0.04235**	**81723**
	Totals All Speeds	**Train-train Collisions**								**0.00474**				**0.28229**	**0.01082**	**12306**
		Intrusion Collisions								**0.00941**				**0.25179**	**0.00895**	**10793**
		Overspeed								**0.00589**				**0.30214**	**0.00486**	**24896**
		Broken Rail								**0.00823**				**0.40934**	**0.00658**	**33729**
		Work Zone Violation								**0.00000**				**0.11143**	**0.01114**	**0**

Number Diamonds	Freq'y per mill passes	Collisions (millions)	Injuries	Fatalities	Damage
1	0.000000	0.000000	0.000000	0.000000	0.00
1	0.000000	0.000000	0.000000	0.000000	0.00
1	0.008492	0.000219	0.001143	0.000034	43.93
1	0.001698	0.000044	0.001116	0.000034	35.18
		0.000263	**0.002258**	**0.000067**	**79.11**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.008492	0.000000	0.000000	0.000000	0.00
0	0.001698	0.000000	0.000000	0.000000	0.00
		0.000000	**0.00000**	**0.00000**	**0.00**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.008492	0.000000	0.000000	0.000000	0.00
0	0.001698	0.000000	0.000000	0.000000	0.00
		0.000000	**0.00000**	**0.00000**	**0.00**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.008492	0.000000	0.000000	0.000000	0.00
0	0.001698	0.000000	0.000000	0.000000	0.00
		0.000000	**0.00000**	**0.00000**	**0.00**
		0.000263	**0.002258**	**0.000067**	**79**

Table 3.6a: Risk Calculation - Freight Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Freq'y (per mill t-m)	Preventability	Adjusted Frequency	Trips/day	Trips per 10 years	Length of Track (miles)	Per 10 years: Train-miles	Accidents	Injuries	Fatalities	Damage $
25	Train-Train Collision	Frt Loco hits Loco	0	Incl	0.00000	7.43	25764	0	0	0.00000	0.00000	0.000000	$0
		Frt Loco hits Car	0	Incl	0.00000	7.43	25764	0	0	0.00000	0.00000	0.000000	$0
		Frt car hit by Loco	0	Incl	0.00000	7.43	25764	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.43	0.00821	1.43	4959	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.12	0.00757	1.43	4959	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.00	0	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.00	0	0	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.00	0.01600	1.43	4959	0	0	0.00000	0.00000	0.000000	$0
	Overspeed, Unequip		0.016	0.00	0.01600	0.00	0	0	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.08	0.05115	1.43	4959	0	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Unequip		0.056	0.00	0.05560	0.00	0	0	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.00		1.43	4959	0	0		0.00000	0.000000	$0
	Work Zone Viol'n, Unequip			0.00		0.00	0	0	0		0.00000	0.000000	$0
	Totals									**0.0000**	**0.00000**	**0.000000**	**$0**
40	Train-Train Collision	Frt Loco hits Loco	0.0010	Incl	0.00104	7.43	25764	4.77	122892	0.00013	0.00011	0.000011	$28
		Frt Loco hits Car	0.0001	Incl	0.00015	7.43	25764	4.77	122892	0.00002	0.00001	0.000001	$3
		Frt car hit by Loco	0.0005	Incl	0.00051	7.43	25764	4.77	122892	0.00006	0.00000	0.000000	$6
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.43	0.00821	1.43	4959	4.77	23652	0.00019	0.00003	0.000003	$4
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.12	0.00757	1.43	4959	4.77	23652	0.00018	0.00003	0.000003	$4
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.00	0	4.77	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.00	0	4.77	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.00	0.01600	1.43	4959	4.77	23652	0.00038	0.00005	0.000005	$142
	Overspeed, Unequip		0.016	0.00	0.01600	0.00	0	4.77	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.08	0.05115	1.43	4959	4.77	23652	0.00121	0.00017	0.000017	$440
	Broken Rail, Unequip		0.056	0.00	0.05560	0.00	0	4.77	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.00		1.43	4959	4.77	23652		0.00156	0.000156	$0
	Work Zone Viol'n, Unequip			0.00		0.00	0	4.77	0		0.00000	0.000000	$0
	Totals									**0.00217**	**0.0020**	**0.00020**	**$626**
50	Train-Train Collision	Frt Loco hits Loco	0.0007	Incl	0.00070	7.43	25764	20.98	540519	0.00038	0.00051	0.000051	$128
		Frt Loco hits Car	0.0001	Incl	0.00009	7.43	25764	20.98	540519	0.00005	0.00005	0.000005	$14
		Frt car hit by Loco	0.0003	Incl	0.00031	7.43	25764	20.98	540519	0.00017	0.00000	0.000000	$24
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.43	0.00821	1.43	4959	20.98	104030	0.00085	0.00022	0.000022	$27
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.12	0.00757	1.43	4959	20.98	104030	0.00079	0.00020	0.000020	$25
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.00	0	20.98	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.00	0	20.98	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.00	0.01600	1.43	4959	20.98	104030	0.00166	0.00058	0.000058	$975
	Overspeed, Unequip		0.016	0.00	0.01600	0.00	0	20.98	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.08	0.05115	1.43	4959	20.98	104030	0.00532	0.00181	0.000181	$3,025
	Broken Rail, Unequip		0.056	0.00	0.05560	0.00	0	20.98	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.00		1.43	4959	20.98	104030		0.00863	0.000863	$0
	Work Zone Viol'n, Unequip			0.00		0.00	0	20.98	0		0.00000	0.000000	$0
	Totals									**0.00922**	**0.0120**	**0.00120**	**$4,217**
	Overall Totals									**0.01139**	**0.0140**	**0.0014**	**$4,843**
Totals All Speeds	**Train-Train Collisions**									**0.00080**	**0.00069**	**0.00007**	**202**
	Intrusion Collisions									**0.00201**	**0.00047**	**0.00005**	**60**
	Diamond Collisions									**0.00149**	**0.00053**	**0.00005**	**200**
	Overspeed									**0.00204**	**0.00064**	**0.00006**	**1117**
	Broken Rail									**0.00653**	**0.00198**	**0.00020**	**3465**
	Work Zone Violation									**0.00000**	**0.01020**	**0.00102**	**0**
	Grade Crossing Collisions												

Table 3.6b: Risk Calculation - Collisions at Diamonds - Freight

Number Diamonds	Freq'y per mill passes	Collisions (millions)	Injuries	Fatalities	Damage
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.028479	0.000000	0.000000	0.000000	0.00
0	0.029273	0.000000	0.000000	0.000000	0.00
		0.000000	**0.000000**	**0.000000**	**0.00**
1	0.000000	0.000000	0.000000	0.000000	0.00
1	0.028479	0.000734	0.000528	0.000053	132.07
1	0.029273	0.000754	0.000000	0.000000	67.57
		0.001488	**0.000528**	**0.000053**	**199.65**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.028479	0.000000	0.000000	0.000000	0.00
0	0.029273	0.000000	0.000000	0.000000	0.00
		0.000000	**0.000000**	**0.000000**	**0.00**
		0.001488	**0.000528**	**0.000053**	**$200**

Table 3.7: Risk Calculations: Passenger and Freight Trains; Grade Crossings

Train Type	Representative Speed	Type of Grade-crossing	Base Collision Frequency	Preventability Factor	Adjusted Collision Frequency	Trips per Day	Crossing Passes per Trip	Crossing Passes per 10 Years	Collisions per 10 Years	Seats per Train (Passenger)	Occupancy Factor	Passengers per Train	Passenger/ Crew Injuries per 10 Years	Passenger/ Crew Fatalities per 10 Years	Damage per 10 Years ($)
Passenger	40	Public_gates_lights	0.35	0%	0.350	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Public_other	0.30	0%	0.300	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Private	0.10	0%	0.100	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
	60	Public_gates_lights	0.60	0%	0.600	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Public_other	0.50	0%	0.500	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Private	0.20	0%	0.200	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
	79	Public_gates_lights	0.80	0%	0.800	6.00	8	166440	0.133	320	0.60	192	0.2684	0.0040	26098
		Public_other	0.65	0%	0.650	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Private	0.30	0%	0.300	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
	105	Public_gates_lights	1.10	0%	1.100	6.00	20	416100	0.458	320	0.60	192	1.6346	0.0243	158368
		Public_other	0.80	0%	0.800	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Private	0.30	0%	0.300	6.00	1	20805	0.006	320	0.60	192	0.0223	0.0003	2160
Freight	25	Public_gates_lights	0.15	0%	0.150	1.43	0	0	0.000				0.00000	0.00000	0
Equipped		Public_other	0.12	0%	0.120	1.43	0	0	0.000				0.00000	0.00000	0
		Private	0.05	0%	0.050	1.43	0	0	0.000				0.00000	0.00000	0
	40	Public_gates_lights	0.30	0%	0.300	1.43	8	39668.2	0.012				0.00298	0.00015	595
		Public_other	0.25	0%	0.250	1.43	0	0	0.000				0.00000	0.00000	0
		Private	0.10	0%	0.100	1.43	0	0	0.000				0.00000	0.00000	0
	50	Public_gates_lights	0.36	0%	0.360	1.43	20	99170.5	0.036				0.01392	0.00071	2785
		Public_other	0.30	0%	0.300	1.43	0	0	0.000				0.00000	0.00000	0
		Private	0.12	0%	0.120	1.43	1	4958.525	0.001				0.00023	0.00001	46
Freight	25	Public_gates_lights	0.15	0%	0.150	0.00	0	0	0.000				0.00000	0.00000	0
Unequipped		Public_other	0.12	0%	0.120	0.00	0	0	0.000				0.00000	0.00000	0
		Private	0.05	0%	0.050	0.00	0	0	0.000				0.00000	0.00000	0
	40	Public_gates_lights	0.30	0%	0.300	0.00	8	0	0.000				0.00000	0.00000	0
		Public_other	0.25	0%	0.250	0.00	0	0	0.000				0.00000	0.00000	0
		Private	0.10	0%	0.100	0.00	0	0	0.000				0.00000	0.00000	0
	50	Public_gates_lights	0.36	0%	0.360	0.00	20	0	0.000				0.00000	0.00000	0
		Public_other	0.30	0%	0.300	0.00	0	0	0.000				0.00000	0.00000	0
		Private	0.12	0%	0.120	0.00	1	0	0.000				0.00000	0.00000	0

	Total - Passenger	**0.597**
Risk Calculations: Passenger and Freight Trains; Diamonds	**Total - Freight**	**0.048**
Train Type	**Totals - All Speeds**	**0.645**

		1.925
		0.017
		1.94

		0.029
		0.001
		0.03

		186625
		3426
		190051

Table 3.8: Summary - All Risks

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00474	0.28229	0.01082	12306	72991
	Intrusion Collisions	0.00941	0.25179	0.00895	10793	62812
	Diamond Collisions	0.000263	0.00226	0.00007	79	507
	Overspeed	0.00589	0.30214	0.00486	24896	69680
	Broken Rail	0.00823	0.40934	0.00658	33729	94404
	Work Zone Violation	0.00000	0.11143	0.01114	0	44572
	Grade Crossing Collisions	0.59710	1.92530	0.02857	186625	464876
	Total, All Scenarios	0.62565	3.28454	0.07099	268427	809842
Freight	Train-Train Collisions	0.00080	0.00069	0.00007	202	480
	Intrusion Collisions	0.00201	0.00047	0.00005	60	250
	Diamond Collisions	0.00149	0.00053	0.00005	200	411
	Overspeed	0.00204	0.00064	0.00006	1117	1372
	Broken Rail	0.00653	0.00198	0.00020	3465	4255
	Work Zone Violation	0.00000	0.01020	0.00102	0	4078
	Grade Crossing Collisions	0.04820	0.01713	0.00088	3426	7781
	Total, All Scenarios	0.06108	0.03164	0.00233	8469	18627
	Total Passenger + Freight	**0.68673**	**3.31617**	**0.07332**	**276897**	**828468**
	Unit Costs ($/Casualty)		100000	3000000		

Data exported to the Results Summary worksheet

Worksheet 1-B,N: IDOT Risk Model: Braking Distances and Collision Zone Calculations, Base Case II: Northeast Corridor ATC, 85% Preventability with Severity Reduction, Bloomington Sub-corridor

Table 1.1: Stopping Distance Parameters and Calculations, Including Timeout and ACS Response Delay

Braking Formula Inputs			Braking Distance Calculations (including free running in TO) (ft)					Braking Duration (secs)		Guilty Train Distance (ft)		Total Zone Lengths (ft)	
Train/System Type	Parameter	Value	Train Type	Speeds (mph)	To Stop	Reduction to RedCon*	RedCon* to Stop	Deceleration (ft/sec²)	Reduction to RedCon*	RedCon* to Stop	Reduction to RedCon*	RedCon* to Stop	Reduction to RedCon*	Full Speed to Stop
Freight	Coefficient P	0.035	Freight	25	1671	1671	0	0.668	58	0	1275	0	2946	0	2946
	Appl'n Time (sec)	13.8		40	3686	1619	2068	0.668	14	77	308	1692	1927	3760	5686
	Train Weight (lb)	37600000		50	5452	3384	2068	0.668	36	77	791	1692	4176	3760	7935
	Brake Force (lb)	779683	Passenger	40	1452	1452	0	1.293	48	0	1065	0	2517	0	2517
Passenger	Coefficient A	0.666		60	3177	3177	0	1.293	71	0	1565	0	4742	0	4742
	Coefficient B	0		79	5433	3035	2398	1.293	25	68	541	1499	3576	3896	7472
	Safety Factor	1.25		105	9493	7096	2398	1.293	54	68	1190	1499	8286	3896	12182
Train Control	Latency/T-out (sec)	3	Frt Red'd Consc	35	1125	NA	NA	1.293							
	ACS Response (sec	0													
Guilty Train Speed (mph)		15													

Blue cells contain data imported from the Inputs worksheet

Sight Distance (ft): 2500

Note: RedCon refers to the speed at which collision consequences will be significantly reduced
60 mph for passenger trains and 35 mph for freight trains
If train speed is lower that this speed, then there are no reduced consequences and Zone A2 has zero length

Table 1.2: Segment Definitions: Bloomington Sub-Corridor: MP 88.4 (Bunge) - MP 124.9 (Bloomington)

Segment Number	Start (milepost	End (milepost)	Type	Variant	Length		Posted Speed (mph)			Representative Speed (mph)			Industry Siding		Passenger Stops
					Miles	Feet	Freight	Pass	HS Pass	Freight	Pass	HS Pass (Consq*)	HS Pass (Other)	Number	Name	
14.0	88.4	90.6	Plain		2.2	11616	60.0	79.0	110.0	50.0	79.0	79.0	105.0	1.0	Bunge	
15.0	90.6	92.5	CP Adjacent (M)		1.9	10137.6	49.0	50.0	50.0	40.0	60.0	60.0	79.0	1.0	Donnley	
16.0	92.5	95.0	Siding (M)	Pontiac (Sag'd)	2.5	13200	60.0	79.0	110.0	50.0	79.0	79.0	105.0	0.0		Pontiac
17.0	95.0	96.8	CP Adjacent (M)		1.8	9715.2	60.0	79.0	110.0	50.0	79.0	79.0	105.0	0.0	Ooiya	
18.0	96.8	100.3	Plain		3.5	18321.6	60.0	79.0	110.0	50.0	79.0	79.0	105.0	0.0		
19.0	100.3	102.3	CP Adjacent (M)		2.0	10401.6	60.0	79.0	110.0	40.0	60.0	60.0	79.0	0.0		
20.0	102.3	102.3	Diamond		0.0	0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	0.0		
21.0	102.3	104.6	CP Adjacent (M)		2.3	12408	60.0	79.0	110.0	40.0	60.0	60.0	79.0	0.0		
22.0	104.6	106.4	CP Adjacent (M)		1.8	9662.4	60.0	79.0	110.0	50.0	79.0	79.0	105.0	0.0		
23.0	106.4	108.8	Siding (M)	Ballard (Sag'd)	2.4	12672	60.0	79.0	110.0	50.0	79.0	79.0	105.0	0.0		
24.0	108.8	111.4	CP Adjacent (M)		2.5	13358.4	60.0	79.0	110.0	50.0	79.0	79.0	105.0	0.0		
25.0	111.4	113.3	Plain		1.9	10243.2	60.0	79.0	110.0	50.0	79.0	79.0	105.0	0.0		
26.0	113.3	116.4	Plain		3.1	16156.8	60.0	79.0	110.0	50.0	79.0	79.0	105.0	0.0		
27.0	116.4	118.8	Plain		2.5	13041.6	60.0	79.0	110.0	50.0	79.0	79.0	105.0	1.0	Towanda	
28.0	118.8	121.4	CP Adjacent (M)		2.6	13569.6	60.0	79.0	110.0	50.0	79.0	79.0	105.0	0.0		
29.0	121.4	123.6	Siding (M)	Bloomington Yard	2.2	11457.6	60.0	79.0	110.0	40.0	60.0	79.0	79.0	1.0	Bloomington	
30.0	123.6	124.4	Siding (M)	Bloomington Yard	0.8	4276.8	25.0	40.0	40.0	25.0	40.0	40.0	40.0	1.0	Bloomington	Bloomington
31.0	124.4	124.9	Siding (M)	Bloomington Yard	0.5	2534.4	25.0	40.0	40.0	25.0	40.0	40.0	40.0	1.0	Bloomington	

Check Total: 36.5

Table 1.3: Mitigation and Prevention Zones - All Segments - Lengths in Feet

Zone A1: Limited Speed Reduction No Prevention or Mitigation			Zone A2: Reduced Speed to Stop Severity Mitigation			Zone B: Able to Stop Full Prevention			Overlap of Stopping Distance into Zone C			Distance in Timeout in Zone C			Overlap of Zone A1 into Zone C			Overlap of Zone A1 into Zone C within Sight Distance			Overlap of Zone A2 into Zone C within Sight Distance		
Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass
4176	3576	8286	3760	3896	3330	3681	4144	0	0	0	566	0	0	462	0	0	0	0	0	0	0	0	566
1927	4742	3576	0	0	3896	8211	5396	2666	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	8286	3896	3896	3896	5128	6012	5728	1018	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	8286	3896	3896	1430	1644	2244	0	0	0	2467	0	0	462	0	0	0	0	0	0	0	0	2467
4176	3576	8286	3896	3896	3896	10250	10850	6140	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1927	4742	3576	3760	0	3896	4715	5660	2930	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1927	4742	3576	0	0	3896	10481	7666	4936	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	8286	3896	3896	1377	1591	2191	0	0	0	2519	0	0	462	0	0	0	0	0	0	0	0	2500
4176	3576	8286	3896	3896	3896	4600	5200	490	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	8286	3896	3896	3896	5287	5887	1177	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	8286	3896	3896	1958	2172	2772	0	0	0	1939	0	0	462	0	0	0	0	0	0	0	0	1939
4176	3576	8286	3896	3896	3896	8085	8685	3975	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	8286	3760	3896	3896	5106	5570	860	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	8286	3760	3896	3896	5634	6098	1388	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1927	4742	3576	3760	0	3896	5771	6716	3986	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2946	2517	2517	0	0	0	1331	1760	1760	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2534	2517	2517	0	0	0	0	17	17	411	0	0	110	0	0	411	0	0	411	0	0	0	0	0

Table 1.4: Breakdown of Segments Lengths by Representative Speed (miles)

Segment Number	Freight Speeds (mph)			Convent'l Pass Speeds (mph)			HS Pass. Speeds - Coll'n Conseq. (mph)			HS Pass. Speeds - Other (mph)			
	25	40	50	40	60	79	40	60	79	105	40	60	79
14.0	0	0	2.2	0	0	2.2	0	0	2.2	0	0	0	2.2
15.0	0	1.92	0	0	1.92	0	0	1.92	0	0	0	0	1.92
16.0	0	0	2.5	0	0	2.5	0	0	2.5	0	0	0	2.5
17.0	0	0	1.84	0	0	1.84	0	0	1.84	0	0	0	1.84
18.0	0	0	3.47	0	0	3.47	0	0	3.47	0	0	0	3.47
19.0	0	1.97	0	0	1.97	0	0	1.97	0	0	0	0	1.97
20.0	0	0	0	0	0	0	0	0	0	0	0	0	0
21.0	0	2.35	0	0	2.35	0	0	2.35	0	0	0	0	2.35
22.0	0	0	1.83	0	0	1.83	0	0	1.83	0	0	0	1.83
23.0	0	0	2.4	0	0	2.4	0	0	2.4	0	0	0	2.4
24.0	0	0	2.53	0	0	2.53	0	0	2.53	0	0	0	2.53
25.0	0	0	1.94	0	0	1.94	0	0	1.94	0	0	0	1.94
26.0	0	0	3.06	0	0	3.06	0	0	3.06	0	0	0	3.06
27.0	0	0	2.47	0	0	2.47	0	0	2.47	0	0	0	2.47
28.0	0	0	2.57	0	0	2.57	0	0	2.57	0	0	0	2.57
29.0	0	2.17	0	0	2.17	0	0	2.17	0	0	0	0	2.17
30.0	0.81	0	0	0.81	0	0	0.81	0	0	0	0.81	0	0
31.0	0.48	0	0	0.48	0	0	0.48	0	0	0	0.48	0	0

Table 1.5: Aggregate Segment Length by Segment Type and Speed

Segment Type	Train Type	Representative Speed	Aggregate Length of Segments by Train and Segment Types							
			Freight		Conv passenger		High Speed Passenger			
							Collision Conseq*		Other	
			Miles	Feet	Miles	Feet	Miles	Feet	Miles	Feet
Siding (mon)	Freight	25	1.29	6811						
		40	2.17	11458						
		50	4.90	25872						
	Passenger	40			1.29	6811	1.29	6811	1.29	6811
		60			2.17	11458	0.00	0	0.00	0
		79			4.90	25872	7.07	37330	2.17	11458
		105					0.00	0	4.90	25872
Siding (unmon)	Freight	25	0.00	0						
		40	0.00	0						
		50	0.00	0						
	Passenger	40			0.00	0	0.00	0	0.00	0
		60			0.00	0	0.00	0	0.00	0
		79			0.00	0	0.00	0	0.00	0
		105					0.00	0	0.00	0
CP Adjacent (mon)	Freight	25	0.00	0						
		40	6.24	32947						
		50	8.77	46306						
	Passenger	40			0.00	0	0.00	0	0.00	0
		60			6.24	32947	6.24	32947	0.00	0
		79			8.77	46306	8.77	46306	6.24	32947
		105					0.00	0	8.77	46306
CP Adjacent (unmon)	Freight	25	0.00	0						
		40	0.00	0						
		50	0.00	0						
	Passenger	40			0.00	0	0.00	0	0.00	0
		60			0.00	0	0.00	0	0.00	0
		79			0.00	0	0.00	0	0.00	0
		105					0.00	0	0.00	0
Plain Track	Freight	25	0.00	0						
		40	0.00	0						
		50	13.14	69379						
	Passenger	40			0.00	0	0.00	0	0.00	0
		60			0.00	0	0.00	0	0.00	0
		79			13.14	69379	13.14	69379	0.00	0
		105					0.00	0	13.14	69379
Check Total			36.51		36.51		36.51		36.51	

*This speed is used to calculate collision consequences in collisions between an equipped and an unequipped train ONLY, reflecting the IDOT PTC speed restriction when an equipped train nears an unequipped train

Yellow cells contain data exported to the next sec/sheet in the sequence of three sheets that perform the calculations for one sub-corridor, season and operating state

Table 1.6a: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for Siding (M) Segments

Lengths in Zone C	A1	A2	B
Total Length, Siding (M) Segments (ft)	44140.8		
Number Siding (M) Segments	5		
Average distance in Zone C (ft) Freight	82	0	2418
Passenger	0	0	2500
HS Pass	0	0	2500

	Zone A1 Totals			Zone A2 Totals			Zone B Totals		
	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass
Sum Zone Lengths A1, A2, B (ft)	15758	16927	25181	11552	7792	11688	16831	19422	7272
Fraction of total length in zone	0.357	0.383	0.570	0.262	0.177	0.265	0.381	0.440	0.165
Collision Accident Mitigation Probabilities: Combined All Zones.	0.342	0.364	0.542	0.249	0.168	0.252	0.459	0.518	0.257

Values transferred to Collision Matrix

Distribution of train location at time of	In Block	0.95
violation in Reference Case accidents	Previous Block	0.05
PTC Risk Increment in Zone C		2
Potential danger length in Zone C (ft)		2500

Table 1.6b: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for Siding (U) Segments

Lengths in Zone C	A1	A2	B
Total Length, Siding (U) Segments (ft)	1		
Number Siding (M) Segments	0.001		
Average distance in Zone C (ft) Freight	0	0	2500
Passenger	0	0	2500
HS Pass	0	0	2500

	Zone A1 Totals			Zone A2 Totals			Zone B Totals		
	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass
Zone lengths A1, A2, B (ft)	0	0	0	0	0	0	0	0	0
Fraction of total length in zone	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Collision Accident Mitigation Probabilities: Combined All Zones.	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100

Values transferred to Collision Matrix

Distribution of train location at time of	In Block	0.95
violation in Reference Case accidents	Previous Block	0.05
PTC Risk Increment in Zone C		2
Potential danger length in Zone C (ft)		2500

Table 1.6c: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for CP Adjacent (M) Segments

Lengths in Zone C	A1	A2	B
Total Length, CP Adjacent (M) Segments (ft)	76252.8		
Number CP Adjacent Segments	7		
Average distance in Zone C (ft) Freight	0	0	2500
Passenger	0	0	2500
HS Pass	0	710	1790

	Zone A1 Totals			Zone A2 Totals			Zone B Totals		
	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass
Zone lengths A1, A2, B (ft)	22482	28527	43869	19208	15584	22287	37563	35142	13097
Fraction of total length in zone	0.284	0.360	0.554	0.242	0.197	0.281	0.474	0.443	0.165
Collision Accident Mitigation Probabilities: Combined All Zones.	0.269	0.342	0.526	0.230	0.187	0.296	0.550	0.521	0.229

Values transferred to Collision Matrix

Distribution of train location at time of	In Block	0.95
violation in Reference Case accidents	Previous Block	0.05
PTC Risk Increment in Zone C		2
Potential danger length in Zone C (ft)		2500

Table 1.6d: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for CP Adjacent (U)Segments

Lengths in Zone C	A1	A2	B
Total Length, CP Adjacent (U) Segments (ft)	1		
Number CP Adjacent Segments	0.001		
Average distance in Zone C (ft) Freight	0	0	2500
Passenger	0	0	2500
HS Pass	0	0	2500

	Zone A1 Totals			Zone A2 Totals			Zone B Totals		
	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass
Zone lengths A1, A2, B (ft)	0	0	0	0	0	0	0	0	0
Fraction of total length in zone	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Collision Accident Mitigation Probabilities: Combined All Zones.	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100

Values transferred to Collision Matrix

Distribution of train location at time of	In Block	0.95
violation in Reference Case accidents	Previous Block	0.05
PTC Risk Increment in Zone C		2
Potential danger length in Zone C (ft)		2500

Table 1.6e: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for Plain Track Segments

Lengths in Zone C	A1	A2	B
Total Length, Plain Track Segments (ft)	69379.2		
Number CP Adjacent Segments	5		

Zone A1 Totals			Zone A2 Totals			Zone B Totals		
Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass

| | | |

Worksheet 2 - B,N,R: Collision Frequencies Calculation - Base Case II: Northeast Corridor ATC, 85% Preventability with Severity Reduction, Bloomington Sub-corridor, Rest of Year

Table 2.1a: Collision Distribution Matrix (Fraction Accidents by Train Pair and Collision Type). Collisions Between Trains Operating on the IDOT Test Corridor Only (not diamonds and intrusions)

	Train Pairs in In Collision	Collision Scenario Prob (Top Level)	Siding - Monitored: Collision Distribution		Siding - Monitored: Head On		Siding - Monitored: Rear End/Side	
			Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty
	Percent Guilty				100%	0%	100%	0%
Both Trains TBE	Pass-Pass	0.60	0.50	0.50	0.3	0	0.3	0
	Pass-TBE Freight	0.32	0.50	0.50	0.16	0	0.16	0
(Note 3)	TBE Freight - TBE Freight	0.08	0.50	0.50	0.04	0	0.04	0
	Percent Guilty				50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	0.00	1	0	0	0	0	0
	Rear/Side, Pass into NE Frt		0	1	0	0	0	0
	Rear/Side NE Frt into Pass		0	1	0	0	0	0
	TBE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0
	Percent Guilty				0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0
	Total Probability (checking)	1		1	0.5	0	0.5	0

	Train Pairs in In Collision	Siding - Unmonitored: Collision Distribution		Siding - Unmonitored: Head On		Siding - Unmonitored: Rear End/Side	
		Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty
	Percent Guilty			100%	0%	100%	0%
Both Trains TBE	Pass-Pass	0.8	0.2	0.48	0	0.12	0
	Pass-TBE Freight	0.2	0.8	0.224	0	0.096	0
	TBE Freight - TBE Freight	0.3	0.7	0.056	0	0.024	0
	Percent Guilty			50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	1	0	0	0	0	0
	Rear/Side, Pass into NE Frt	0	1	0	0	0	0
	Rear/Side NE Frt into Pass	0	1	0	0	0	0
	TBE Freight - NE Freight	0.3	0.7	0	0	0	0
	Percent Guilty			0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.3	0.7	0	0	0	0
	Total Probability (checking)	1		0.76	0	0.24	0

	Train Pairs in In Collision	CP Adjacent - Monitored Siding: Collision Distribution		CP Adjacent - Monitored Siding: Head On		CP Adjacent - Monitored Siding: Rear End/Side	
		Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty
	Percent Guilty			100%	0%	100%	0%
Both Trains TBE	Pass-Pass	0.8	0.2	0.48	0	0.12	0
	Pass-TBE Freight	0.2	0.8	0.224	0	0.096	0
	TBE Freight - TBE Freight	0.3	0.7	0.056	0	0.024	0
	Percent Guilty			50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	1	0	0	0	0	0
	Rear/Side, Pass into NE Frt	0	1	0	0	0	0
	Rear/Side NE Frt into Pass	0	1	0	0	0	0
	TBE Freight - NE Freight	0.3	0.7	0	0	0	0
	Percent Guilty			0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.3	0.7	0	0	0	0
	Total Probability (checking)	1		0.76	0	0.24	0

	Train Pairs in In Collision	CP Adjacent - Unmonitored Siding: Collision Distribution		CP Adjacent - Unmonitored Siding: Head On		CP Adjacent - Unmonitored Siding: Rear End/Side	
		Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty
	Percent Guilty			100%	0%	100%	0%
Both Trains TBE	Pass-Pass	0.8	0.2	0.48	0	0.12	0
	Pass-TBE Freight	0.2	0.8	0.224	0	0.096	0
	TBE Freight - TBE Freight	0.3	0.7	0.056	0	0.024	0
	Percent Guilty			50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	1	0	0	0	0	0
	Rear/Side, Pass into NE Frt	0	1	0	0	0	0
	Rear/Side NE Frt into Pass	0	1	0	0	0	0
	TBE Freight - NE Freight	0.3	0.7	0	0	0	0
	Percent Guilty			0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.3	0.7	0	0	0	0
	Total Probability (checking)	1		0.76	0	0.24	0

	Train Pairs in In Collision	Plain Track: Collision Distribution		Plain Track: Head On		Plain Track: Rear End/Side	
		Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty
	Percent Guilty			100%	0%	100%	0%
Both Trains TBE	Pass-Pass	0.70	0.30	0.42	0	0.18	0
	Pass-TBE Freight	0.40	0.60	0.128	0	0.192	0
	TBE Freight - TBE Freight	0.50	0.50	0.04	0	0.04	0
	Percent Guilty			50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	1.00	0.00	0	0	0	0
	Rear/Side, Pass into NE Frt	0.00	1.00	0	0	0	0
	Rear/Side NE Frt into Pass	0.00	1.00	0	0	0	0
	TBE Freight - NE Freight	0.50	0.50	0	0	0	0
	Percent Guilty			0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.50	0.50	0	0	0	0
	Total Probability (checking)		1	0.588	0	0.412	0

Table 2.1b: Collision Type Distribution - Diamonds

	Train Pairs in In Collision	Diamond Collisions: Rear End/Side Equip Guilty	Diamond Collisions: Rear End/Side Unequip Guilty
	Percent Guilty		
Both Trains TBE	Pass-Pass		
	Pass-TBE Freight		
	TBE Freight - TBE Freight		
	Percent Guilty	50%	50%
One Train TBE	Pass - NE Freight, Head -On	0	0
	Rear/Side, Pass into NE Frt	0.25	0.25
	Rear/Side NE Frt into Pass	0.05	0.05
	TBE Freight - NE Freight	0.1	0.1
	Percent Guilty		100%
Neither Train TBE	NE Freight - NE Freight	0	0.2
	Total Probability (checking)	0.4	0.6

Note. The gray cells on these rows are set at zero, because in every case, the condition represented by the cell does not exist - either because there are no unequipped passenger trains, or because of the kind of collision defined for the row.

Quantity in cell C18 is for all collisions between a passenger train and an unequipped freight train

Table 2.2: Preventability Data For Unequipped train Guilty, One Train TBE

Segment Type	Not Prevented of Mitigated: Freight	Pass	HS Pass	Mitigated: Freight	Pass	HS Pass	Prevented: Freight	Pass	HS Pass
Siding (M)	0.342	0.364	0.542	0.249	0.168	0.252	0.459	0.518	0.257
Siding (U)	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100
CP Adjacent (M)	0.269	0.342	0.526	0.230	0.187	0.296	0.550	0.521	0.229
CP Adjacent (U)	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100
Plain Track	0.308	0.391	0.601	0.000	0.000	0.020	0.100	0.100	0.080
Diamonds	0.135	0.265	0.253	0.172	0.000	0.200	0.743	0.785	0.597

Mauve cells contain data imported from previous worksheet in a group of three worksheets covering one sub-corridor, season and operating plan.

Table 2.3a: Collision Preventability Matrix (Percent Accidents Preventable Relative to CTC Reference Case)

	Train Pairs in In Collision	Preventability Equipped Train Guilty	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	85%	85%		85%	
	Pass-TBE Freight	85%	85%		85%	
	TBE Freight - TBE Freight	85%	85%		85%	
One TBE	Pass - NE Freight, Head -On	85%	85%	26%		
	Rear/Side, Pass into NE Frt	85%			85%	26%
	Rear/Side NE Frt into Pass	85%			85%	0%
	TBE Freight - NE Freight	85%	85%	46%	85%	0%
Neither TBE	NE Freight - NE Freight			0%		0%
Reference Case (CTC) Collision Accident Likelihood by Segment Type (collisions/million train miles)		0.030				

	Train Pairs in In Collision	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	85%		85%	
	Pass-TBE Freight	85%		85%	
	TBE Freight - TBE Freight	85%		85%	
One TBE	Pass - NE Freight, Head -On	85%	10%		
	Rear/Side, Pass into NE Frt			85%	10%
	Rear/Side NE Frt into Pass			85%	0%
	TBE Freight - NE Freight	85%	10%	85%	0%
Neither TBE	NE Freight - NE Freight		0%		0%
		0.040			

	Train Pairs in In Collision	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	85%		85%	
	Pass-TBE Freight	85%		85%	
	TBE Freight - TBE Freight	85%		85%	
One TBE	Pass - NE Freight, Head -On	85%	23%		
	Rear/Side, Pass into NE Frt			85%	23%
	Rear/Side NE Frt into Pass			85%	0%
	TBE Freight - NE Freight	85%	55%	85%	0%
Neither TBE	NE Freight - NE Freight		0%		0%
		0.050			

	Train Pairs in In Collision	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	85%		85%	
	Pass-TBE Freight	85%		85%	
	TBE Freight - TBE Freight	85%		85%	
One TBE	Pass - NE Freight, Head -On	85%	10%		
	Rear/Side, Pass into NE Frt			85%	10%
	Rear/Side NE Frt into Pass			85%	0%
	TBE Freight - NE Freight	85%	10%	85%	0%
Neither TBE	NE Freight - NE Freight		0%		0%
		0.060			

	Train Pairs in In Collision	Plain Track: Collision Distribution Head On	Plain Track: Collision Distribution Rear/Side	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass			85%		85%	
	Pass-TBE Freight			85%		85%	
	TBE Freight - TBE Freight			85%		85%	
One TBE	Pass - NE Freight, Head -On			85%	8%		
	Rear/Side, Pass into NE Frt					85%	8%
	Rear/Side NE Frt into Pass					85%	0%
	TBE Freight - NE Freight			85%	10%	85%	0%
Neither TBE	NE Freight - NE Freight				0%		0%
		0.006				Collisions/million diamond passes	

	Train Pairs in In Collision	Diamond Collisions: Rear End/Side Equip Guilty	Diamond Collisions: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass		
	Pass-TBE Freight		
	TBE Freight - TBE Freight		
One TBE	Pass - NE Freight, Head -On		
	Rear/Side, Pass into NE Frt	85%	78.54%
	Rear/Side NE Frt into Pass	85%	78.54%
	TBE Freight - NE Freight	85%	74.29%
Neither TBE	NE Freight - NE Freight		0.00%
		0.1	

Table 2.3b: Collision Preventability Matrix - Diamonds

Table 2.4a: Passenger Trains in Train-to-Train Collisions (Trains in Collisions per Million Train-Miles)

	Train Pairs in In Collision	Passenger Trains in Collisions	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	2	0.0027		0.0027	
	Pass-TBE Freight	1	0.0007		0.0007	
	TBE Freight - TBE Freight	0				
One TBE	Pass - NE Freight, Head -On	1	0.0000	0.0000		
	Rear/Side, Pass into NE Frt	1			0.0000	0.0000
	Rear/Side NE Frt into Pass	1			0.0000	0.0000
	TBE Freight - NE Freight	0				
Neither TBE	NE Freight - NE Freight	0				
	Checking total		0.0034	0.0000	0.0034	0.0000
	Scenario Totals - Passenger	**Tots, P-UF**	**Totals**			
	Pass Loco Hits Loco	0.0000	0.0034	0.0034	0.0000	
	Pass Loco Hits Pass Car		0.0014		0.0014	
	Pass Loco Hits Freight Car	0.0000	0.0006		0.0006	
	Pass Car Hit by Loco	0.0000	0.0015		0.0015	0.0000
	Total		0.0068	0.0034	0.0000	0.0034	0.0000

	Train Pairs in In Collision	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	0.0036		0.0036	
	Pass-TBE Freight	0.0010		0.0010	
	TBE Freight - TBE Freight				
One TBE	Pass - NE Freight, Head -On	0.0000	0.0000		
	Rear/Side, Pass into NE Frt			0.0000	0.0000
	Rear/Side NE Frt into Pass			0.0000	0.0000
	TBE Freight - NE Freight				
Neither TBE	NE Freight - NE Freight		0.0000		0.0000
	Checking total	0.0046	0.0000	0.0046	0.0000
	Scenario Totals - Passenger	**Totals**			
	Pass Loco Hits Loco	0.0046	0.0000		
	Pass Loco Hits Pass Car	0.0018			
	Pass Loco Hits Freight Car	0.0008			
	Pass Car Hit by Loco	0.0020	0.0000	0.0020	0.0000
	Total	0.0091	0.0046	0.0000	0.0046	0.0000

	Train Pairs in In Collision	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	0.0072		0.0018	
	Pass-TBE Freight	0.0017		0.0007	
	TBE Freight - TBE Freight				
One TBE	Pass - NE Freight, Head -On	0.0000	0.0000		
	Rear/Side, Pass into NE Frt			0.0000	0.0000
	Rear/Side NE Frt into Pass			0.0000	0.0000
	TBE Freight - NE Freight				
Neither TBE	NE Freight - NE Freight		0.0000		0.0000
	Checking total	0.0089	0.0000	0.0025	0.0000
	Scenario Totals - Passenger	**Totals**			
	Pass Loco Hits Loco	0.0089	0.0000		
	Pass Loco Hits Pass Car	0.0009			
	Pass Loco Hits Freight Car	0.0005			
	Pass Car Hit by Loco	0.0011	0.0000	0.0011	0.0000
	Total	0.0114	0.0089	0.0000	0.0025	0.0000

	Train Pairs in In Collision	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	0.0086		0.0022	
	Pass-TBE Freight	0.0020		0.0009	
	TBE Freight - TBE Freight				
One TBE	Pass - NE Freight, Head -On	0.0000	0.0000		
	Rear/Side, Pass into NE Frt			0.0000	0.0000
	Rear/Side NE Frt into Pass			0.0000	0.0000
	TBE Freight - NE Freight				
Neither TBE	NE Freight - NE Freight		0.0000		0.0000
	Checking total	0.0107	0.0000	0.0030	0.0000
	Scenario Totals - Passenger	**Totals**			
	Pass Loco Hits Loco	0.0107	0.0000		
	Pass Loco Hits Pass Car	0.0011			
	Pass Loco Hits Freight Car	0.0006			
	Pass Car Hit by Loco	0.0013	0.0000	0.0013	0.0000
	Total	0.0137	0.0107	0.0000	0.0030	0.0000

	Train Pairs in In Collision	Plain Track: Collision Distribution Head On	Plain Track: Collision Distribution Rear/Side	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass			0.0008		0.0003	
	Pass-TBE Freight			0.0001		0.0002	
	TBE Freight - TBE Freight						
One TBE	Pass - NE Freight, Head -On			0.0000	0.0000		
	Rear/Side, Pass into NE Frt					0.0000	0.0000
	Rear/Side NE Frt into Pass					0.0000	0.0000
	TBE Freight - NE Freight			0.0000	0.0000	0.0000	0.0000
Neither TBE	NE Freight - NE Freight				0.0000		0.0000
	Checking total			0.0009	0.0000	0.0005	0.0000
	Scenario Totals - Passenger		**Totals**				
	Pass Loco Hits Loco		0.0000	0.0009	0.0000		
	Pass Loco Hits Pass Car		0.0002			0.0002	
	Pass Loco Hits Freight Car		0.0001			0.0001	
	Pass Car Hit by Loco		0.0000	0.0002		0.0002	0.0000
	Total		0.0003	0.0014	0.0009	0.0000	0.0005	0.0000

	Train Pairs in In Collision	Diamond Collisions: Rear End/Side Equip Guilty	Diamond Collisions: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass		
	Pass-TBE Freight		
	TBE Freight - TBE Freight		
One TBE	Pass - NE Freight, Head -On		
	Rear/Side, Pass into NE Frt	0.003750	0.005366
	Rear/Side NE Frt into Pass	0.000750	0.001073
	TBE Freight - NE Freight	0.000000	0.000000
Neither TBE	NE Freight - NE Freight		0.000000
	Checking total	0.00450	0.00644
	Scenario Totals - Passenger	**Totals**	
	Pass Loco Hits Loco		
	Pass Loco Hits Pass Car		
	Pass Loco Hits Freight Car	0.003750	0.005366	0.009116
	Pass Car Hit by Loco	0.000750	0.001073	0.001823
	Total	0.004500	0.006439	0.010938

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Table 2.4b: Passenger Trains in Collisions at Diamonds

Table 2.5a: Freight trains in Train-to-Train Collisions (Trains in Collisions per Million Train-Miles)

	Train Pairs in In Collision	Freight Trains in Collisions	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	0				
	Pass-TBE Freight	1	0.0007		0.0007	
	TBE Freight - TBE Freight	2	0.0004		0.0004	
One TBE	Pass - NE Freight, Head -On	1	0.0000	0.0000		
	Rear/Side, Pass into NE Frt	1			0.0000	0.0000
	Rear/Side NE Frt into Pass	1			0.0000	0.0000
	TBE Freight - NE Freight	2	0.0000	0.0000	0.0000	0.0000
Neither TBE	NE Freight - NE Freight	2		0.0000		0.0000
	Checking total		0.0011	0.0000	0.0011	0.0000
	Scenario Totals - Freight		**Totals**			
	Freight Loco Hits Loco		0.0011	0.0000		
	Freight Loco Hits Car		0.0003		0.00032	0.00000
	Freight Car Hit By Loco		0.0008		0.00076	0.00000
	Total		0.0022	0.0011	0.0000	0.0011	0.0000

	Train Pairs in In Collision	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass				
	Pass-TBE Freight	0.0010		0.0010	
	TBE Freight - TBE Freight	0.0005		0.0005	
One TBE	Pass - NE Freight, Head -On	0.0000	0.0000		
	Rear/Side, Pass into NE Frt			0.0000	0.0000
	Rear/Side NE Frt into Pass			0.0000	0.0000
	TBE Freight - NE Freight	0.0000	0.0000	0.0000	0.0000
Neither TBE	NE Freight - NE Freight		0.0000		0.0000
	Checking total	0.0014	0.0000	0.0014	0.0000
	Scenario Totals - Freight	**Totals**			
	Freight Loco Hits Loco	0.0014	0.0014	0.0000	
	Freight Loco Hits Car	0.0004		0.00043	0.00000
	Freight Car Hit By Loco	0.0010		0.00101	0.00000
	Total	0.0029	0.0014	0.0000	0.0014	0.0000

	Train Pairs in In Collision	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass				
	Pass-TBE Freight	0.0017		0.0007	
	TBE Freight - TBE Freight	0.0008		0.0004	
One TBE	Pass - NE Freight, Head -On	0.0000	0.0000		
	Rear/Side, Pass into NE Frt			0.0000	0.0000
	Rear/Side NE Frt into Pass			0.0000	0.0000
	TBE Freight - NE Freight	0.0000	0.0000	0.0000	0.0000
Neither TBE	NE Freight - NE Freight		0.0000		0.0000
	Checking total	0.0025	0.0000	0.0011	0.0000
	Scenario Totals - Freight	**Totals**			
	Freight Loco Hits Loco	0.0025	0.0025	0.0000	
	Freight Loco Hits Car	0.0004		0.00036	0.00000
	Freight Car Hit By Loco	0.0007		0.00072	0.00000
	Total	0.0036	0.0025	0.0000	0.0011	0.0000

	Train Pairs in In Collision	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass				
	Pass-TBE Freight	0.0020		0.0009	
	TBE Freight - TBE Freight	0.0010		0.0004	
One TBE	Pass - NE Freight, Head -On	0.0000	0.0000		
	Rear/Side, Pass into NE Frt			0.0000	0.0000
	Rear/Side NE Frt into Pass			0.0000	0.0000
	TBE Freight - NE Freight	0.0000	0.0000	0.0000	0.0000
Neither TBE	NE Freight - NE Freight		0.0000		0.0000
	Checking total	0.0030	0.0000	0.0013	0.0000
	Scenario Totals - Freight	**Totals**			
	Freight Loco Hits Loco	0.0030	0.0030	0.0000	
	Freight Loco Hits Car	0.0004		0.00043	0.00000
	Freight Car Hit By Loco	0.0009		0.00086	0.00000
	Total	0.0043	0.0030	0.0000	0.0013	0.0000

	Train Pairs in In Collision	Plain Track: Collision Distribution Head On	Plain Track: Collision Distribution Rear/Side	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass						
	Pass-TBE Freight			0.0001		0.0002	
	TBE Freight - TBE Freight			0.0001		0.0001	
One TBE	Pass - NE Freight, Head -On			0.0000	0.0000		
	Rear/Side, Pass into NE Frt					0.0000	0.0000
	Rear/Side NE Frt into Pass					0.0000	0.0000
	TBE Freight - NE Freight			0.0000	0.0000	0.0000	0.0000
Neither TBE	NE Freight - NE Freight				0.0000		0.0000
	Checking total			0.0002	0.0000	0.0002	0.0000
	Scenario Totals - Freight		**Totals**				
	Freight Loco Hits Loco		0.0002	0.0002	0.0000		
	Freight Loco Hits Car		0.0001			0.00006	0.00000
	Freight Car Hit By Loco		0.0002			0.00018	0.00000
	Total		0.0004	0.0002	0.0000	0.0002	0.0000

	Train Pairs in In Collision	Diamond Collisions: Rear End/Side Equip Guilty	Diamond Collisions: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass		
	Pass-TBE Freight		
	TBE Freight - TBE Freight		
One TBE	Pass - NE Freight, Head -On		
	Rear/Side, Pass into NE Frt	0.005250	0.023644	0.028894
	Rear/Side NE Frt into Pass	0.000750	0.001073	
	TBE Freight - NE Freight	0.003000	0.005141	
Neither TBE	NE Freight - NE Freight		0.040000	
	Checking total	0.00750	0.05158	
	Scenario Totals - Freight		**Totals**
	Freight Loco Hits Loco		
	Freight Loco Hits Car	0.005250	0.023644	0.028894
	Freight Car Hit By Loco	0.002250	0.027937	0.030187
	Total	0.007500	0.051581	0.059081

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Table 2.5b: Freight Trains in Collisions at Diamonds

In rear-end/side collisions between like trains there is one loco hits car and one car hit by loco in each collision. In rear/side collisions between a passenger and freight trains, the ratio between passenger hits freight and freight loco hits passenger car are a function of the percentages given in Table IN-5b on the Inputs sheet. The values are given in the tables beneath the trains in collisions for each segment type.

Collision Type	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.8	0.2

Collision Type	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.80	0.20

Collision Type	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.75	0.25

Collision Type	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.75	0.25

Collision Type	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.83	0.17

Freight Plus Passenger Totals (check): 0.0600, 0.0090 | 0.0800, 0.0120 | 0.1000, 0.0150 | 0.1200, 0.0180 | 0.0018

Worksheet 3 - B,N,R: - Risk Calculations - Base Case II: Northeast Corridor ATC, 85% Preventability with Severity Reduction, Bloomington Sub-corridor, Rest of Year

Table 3.1: Consequences Look-up Tables (Data Sources: Previous ICF Passenger Corridor Project (passenger), FRA Accident Data 2001-5 (freight)

Passenger Trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 40 mph			Representative Speed 60 mph			Representative Speed 79 mph			Representative Speed 105 mph		
			Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Pass Loco hits Loco	0.0664	0.0016	401600	0.1112	0.00392	913600	0.192	0.0068	1580800	0.34	0.0128	2796000
		Pass Loco hits Pass Car	0.0272	0.0008	200800	0.0448	0.00208	456800	0.0776	0.0036	790400	0.1368	0.0064	1397600
		Pass Loco hits Frt Car	0.0272	0.0008	200800	0.0448	0.00208	456800	0.0776	0.0036	790400	0.1368	0.0064	1397600
		Pass car hit by Loco	0.1328	0.004	804000	0.22	0.00952	1827200	0.3808	0.01648	3160800	0.6728	0.0256	5591200
	Intrusion Collision (rollout)	Pass Loco hits Car	0.00936	0.00036	81360	0.02232	0.000792	185040	0.03888	0.001368	320400	0.06912	0.002448	565920
	Intrusion Collision (other))	Pass Loco hits Car	0.02496	0.000864	216960	0.06048	0.002112	493440	0.10368	0.003648	853440	0.18336	0.006528	1510080
	Overspeed		0.044	0.0004	667000	0.14	0.00186	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Broken Rail		0.04268	0.000388	646990	0.1358	0.0018042	1455000	0.2037	0.0032786	2522000	0.2716	0.004365	4456180
	Work Zone Violation		0.083	0.0083	0	0.125	0.0125	0	0.164	0.0164	0	0.218	0.0218	0

Freight trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 25 mph			Representative Speed 40 mph			Representative Speed 50 mph		
			Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Frt Loco hits Loco	0.344	0.0344	84000	0.88	0.088	216000	1.36	0.136	337600
		Frt Loco hits Car	0.28	0.028	70400	0.72	0.072	180000	1.12	0.112	281600
		Frt car hit by Loco	0	0	35200	0	0	89600	0	0	140800
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.06336	0.00648	7920	0.162	0.01656	20160	0.252	0.0252	31680
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.06336	0.00648	7920	0.162	0.01656	20160	0.252	0.0252	31680
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.08448	0.00864	10560	0.216	0.02208	26880	0.336	0.0336	42240
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.08448	0.00864	10560	0.216	0.02208	26880	0.336	0.0336	42240
	Overspeed, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Overspeed, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Equip		0.05432	0.005432	145500	0.13968	0.013968	363750	0.3395	0.03395	568420
	Broken Rail, Unequip		0.05432	0.005432	145500	0.13968	0.013968	363750	0.3395	0.03395	568420
	Work Zone Viol'n, Equip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0
	Work Zone Viol'n, Unequip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0

Casualties and damage in Table 3.1 are per accident, except for Work Zone Violations which are per million train-miles

Table 3.2: Grade Crossing and Diamonds: Numbers by Representative Speed, and Accident Frequency and Consequences

Train Type	Representative Speed (mph)	Type of Grade-crossing	Number Crossings			Accident Frequency		Crossing Collision Consequences						Number Diamonds
			Passenger	HS Passenger	Freight	Per Million Crossing Passes		Pass. Occup't Casualty Prob/accident)			Freight Trains (per accident)			
						Passenger	Freight	Injuries	Fatalities	Cost $/Accid't	Injuries	Fatalities	Cost $	
Passenger	40	Public_gates_lights	7	7		0.350		0.0028	0.000047	50000				1
		Public_other	0	0		0.300								
		Private	0	0		0.100								
	60	Public_gates_lights	16	0		0.600		0.0068	0.000112	113000				0
		Public_other	0	0		0.500								
		Private	1	0		0.200								
	79	Public_gates_lights	16	16		0.800		0.0105	0.000156	196000				0
		Public_other	1	0		0.650								
		Private	6	1		0.300								
	105	Public_gates_lights	0	16		1.100		0.0186	0.000276	346000				0
		Public_other	0	1		0.800								
		Private	0	6		0.300								
Freight	25	Public_gates_lights			7	0.150					0.12	0.005	20000	0
		Public_other			0	0.120								
		Private			0	0.050								
	40	Public_gates_lights			16	0.300					0.25	0.013	50000	1
		Public_other			0	0.250								
		Private			1	0.100								
	50	Public_gates_lights			16	0.360					0.39	0.02	78000	0
		Public_other			1	0.300								
		Private			6	0.120								

Table 3.3a: Segment Data (for reference only, not used in calculations)

Segment Number	Start (Milepost)	End (Milepost)	Type	Length (miles)	Posted Speed (mph)			
					Freight	Pass	HS Pass (conseq)	HS Pass
14.0	88.35	90.55	Plain	2.20	50	79	79	105
15.0	90.55	92.47	CP Adjacent (M)	1.92	40	60	60	79
16.0	92.47	94.97	Siding (M)	2.50	50	79	79	105
17.0	94.97	96.81	CP Adjacent (M)	1.84	50	79	79	105
18.0	96.81	100.28	Plain	3.47	50	79	79	105
19.0	100.28	102.25	CP Adjacent (M)	1.97	40	60	60	79
20.0	102.25	102.25	Diamond	0.00	40	40	40	40
21.0	102.25	104.60	CP Adjacent (M)	2.35	40	60	60	79
22.0	104.60	106.43	CP Adjacent (M)	1.83	50	79	79	105
23.0	106.43	108.83	Siding (M)	2.40	50	79	79	105
24.0	108.83	111.36	CP Adjacent (M)	2.53	50	79	79	105
25.0	111.36	113.30	Plain	1.94	50	79	79	105
26.0	113.30	116.36	Plain	3.06	50	79	79	105
27.0	116.36	118.83	Plain	2.47	50	79	79	105
28.0	118.83	121.40	CP Adjacent (M)	2.57	50	79	79	105
29.0	121.40	123.57	Siding (M)	2.17	40	60	79	79
30.0	123.57	124.38	Siding (M)	0.81	25	40	40	40
31.0	124.38	124.86	Siding (M)	0.48	25	40	40	40
	Length Check	36.5		36.5				

Table 3.3b: Aggregate Segment Data: SegmentsTypes, Train Types, Speeds, and Lengths

Aggregate Segment Length by Type and Speed Band (from Seg Def and Preventability)

Segment Type	Train Type	Represent've Speed (mph)	Freight (miles)	Reg Pass (miles)	HS Pass Collision (mi)	HS Pass Other (mi)
Siding (mon)	Freight	25	1.29			
		40	2.17			
		50	4.9			
	Passenger	40		1.29	1.29	1.29
		60		2.17	0	0
		79		4.9	7.07	2.17
		105		0	0	4.9
Siding (unmon)	Freight	25	0			
		40	0			
		50	0			
	Passenger	40		0	0	0
		60		0	0	0
		79		0	0	0
		105		0	0	0
CP Adjacent (mon)	Freight	25	0			
		40	6.24			
		50	8.77			
	Passenger	40		0	0	0
		60		6.24	6.24	0
		79		8.77	8.77	6.24
		105		0	0	8.77
CP Adjacent (unmon)	Freight	25	0			
		40	0			
		50	0			
	Passenger	40		0	0	0
		60		0	0	0
		79		0	0	0
		105		0	0	0
Plain Track	Freight	25	0			
		40	0			
		50	13.14			
	Passenger	40		0	0	0
		60		0	0	0
		79		13.14	13.14	0
		105		0	0	13.14
Totals All Types	Freight	25	1.29			
		40	8.41			
		50	26.81			
	Passenger	40		1.29	1.29	1.29
		60		8.41	6.24	0
		79		26.81	28.98	8.41
		105		0	0	26.81
	Checking Totals		36.51	36.51	36.51	36.51

Table 3.4a: Traffic Inputs to Risk Calculation

Trips/Day		
Train Type	Summer	Rest of Year
Passenger	6.00	6.00
Equipped Freight	1.43	2.28
Unequipped Freight	0.00	0.00
Operating Days	91.00	274.00

Percent Train-Miles in	
Timeout (secs)	0.00
Normal Operating Mode	95.00
Timeout Mode	0.00
Fallback Mode	5.00

Passenger Train Occupancy	
Seats	320.00
Occupancy Factor	0.60

Table 3.4: Collision Frequencies by Segment Type and Collision Scenario (From Coll Matrix)

Scenarios	Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain	Diamond
Pass Loco Hits Loco	0.0034	0.0046	0.0089	0.0107	0.0009	0.000000
Pass Loco Hits Pass Car	0.0014	0.0018	0.0009	0.0011	0.0002	0.000000
Pass Loco Hits Freight Car	0.0006	0.0008	0.0005	0.0006	0.0001	0.009116
Pass Car Hit by Loco	0.0015	0.0020	0.0011	0.0013	0.0002	0.001823
Freight Loco Hits Loco	0.0011	0.0014	0.0025	0.0030	0.0002	0.000000
Freight Loco Hits Car	0.0003	0.0004	0.0004	0.0004	0.0001	0.028894
Freight Car Hit By Loco	0.0008	0.0010	0.0007	0.0009	0.0002	0.030187

Collision Frequencies for Passenger + Unequipped Freight Train

Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain
0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000

Mauve cells contain data imported from previous worksheet in a group of three worksheets covering one sub-corridor, season and operating state.

All train-to-train collision frequencies are in units of **trains in collisions per million train-miles operated in the sub-corridor by all train types.**

Weighted Collision Accident Frequencies by Representative Speed (mph)

Scenarios	Freight			Passenger			
	25	40	50	40	60	79	105
Pass Loco Hits Loco				0.0034	0.0000	0.0075	0.0040
Pass Loco Hits Pass Car				0.0013	0.0000	0.0010	0.0006
Pass Loco Hits Freight Car				0.0006	0.0000	0.0005	0.0004
Pass Car Hit by Loco				0.0015	0.0000	0.0012	0.0007
Freight Loco Hits Loco	0.0011	0.0021	0.0011				
Freight Loco Hits Car	0.0003	0.0004	0.0002				
Freight Car Hit By Loco	0.0008	0.0007	0.0005				

Table 3.5a: Risk Calculation - Passenger Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Table 3.5b: Risk Calculation - Collisions at Diamonds - Passenger

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Freq'y (per million tm)	Preventability	Adjusted Frequency	Trips/day	Trips per 10 years	Length of Track (miles)	Train-miles per 10 years	Accidents per 10 years	Number seats per train	Occupancy Factor	Passengers per train	Injuries per 10 years	Fatalities per 10 years	Damage $ per 10 years
40	Train-Train Collision	Pass Loco hits Loco	0.00342	Incl	0.00342	8.28	21553	1.29	27803	0.00010	320	0.6	192	0.0012	0.00003	0
		Pass Loco hits Pass Car	0.00135	Incl	0.00135	8.28	21553	1.29	27803	0.00004	320	0.6	192	0.0002	0.00001	0
		Pass Loco hits Frt Car	0.00058	Incl	0.00058	8.28	21553	1.29	27803	0.00002	320	0.6	192	0.0001	0.00000	0
		Pass car hit by Loco	0.00149	Incl	0.00149	8.28	21553	1.29	27803	0.00004	320	0.6	192	0.0011	0.00003	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	15618	1.29	20147	0.00010	320	0.6	192	0.0002	0.00001	0
	Intrusion Collision (other))	Pass Loco hits intruder	0.01440	0.12	0.01267	6.00	15618	1.29	20147	0.00026	320	0.6	192	0.0012	0.00004	0
	Overspeed		0.01100	0.00	0.01100	6.00	15618	1.29	20147	0.00022	320	0.6	192	0.0019	0.00002	0
	Broken Rail		0.01670	0.08	0.01536	6.00	15618	1.29	20147	0.00031	320	0.6	192	0.0025	0.00002	0
	Work Zone Violation			0.00		6.00	15618	1.29	20147					0.0017	0.00017	0
										0.00108				**0.01003**	**0.00033**	**0**
60	Train-Train Collision	Pass Loco hits Loco	0.00000	Incl	0.00000	8.28	21553	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Pass Car	0.00000	Incl	0.00000	8.28	21553	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Frt Car	0.00000	Incl	0.00000	8.28	21553	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00000	Incl	0.00000	8.28	21553	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	15618	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.12	0.01267	6.00	15618	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Overspeed		0.01100	0.00	0.01100	6.00	15618	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Broken Rail		0.01670	0.08	0.01536	6.00	15618	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Work Zone Violation			0.00		6.00	15618	0	0					0.0000	0.00000	0
										0.00000				**0.00000**	**0.00000**	**0**
79	Train-Train Collision	Pass Loco hits Loco	0.00747	Incl	0.00747	8.28	21553	8.41	181259	0.00135	320	0.6	192	0.050	0.0018	2140
		Pass Loco hits Pass Car	0.00102	Incl	0.00102	8.28	21553	8.41	181259	0.00018	320	0.6	192	0.003	0.0001	146
		Pass Loco hits Frt Car	0.00055	Incl	0.00055	8.28	21553	8.41	181259	0.00010	320	0.6	192	0.001	0.0001	79
		Pass car hit by Loco	0.00119	Incl	0.00119	8.28	21553	8.41	181259	0.00022	320	0.6	192	0.016	0.0007	680
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	15618	8.41	131347	0.00064	320	0.6	192	0.005	0.0002	206
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.12	0.01267	6.00	15618	8.41	131347	0.00166	320	0.6	192	0.033	0.0012	1420
	Overspeed		0.01100	0.00	0.01100	6.00	15618	8.41	131347	0.00144	320	0.6	192	0.058	0.0009	3757
	Broken Rail		0.01670	0.08	0.01536	6.00	15618	8.41	131347	0.00202	320	0.6	192	0.079	0.0013	5089
	Work Zone Violation			0.00		6.00	15618	8.41	131347					0.022	0.0022	0
										0.00762				**0.26653**	**0.00834**	**13517**
105	Train-Train Collision	Pass Loco hits Loco	0.00396	Incl	0.00396	8.28	21553	26.81	577832	0.00229	320	0.6	192	0.149	0.0056	6393
		Pass Loco hits Pass Car	0.00062	Incl	0.00062	8.28	21553	26.81	577832	0.00036	320	0.6	192	0.009	0.0004	501
		Pass Loco hits Frt Car	0.00035	Incl	0.00035	8.28	21553	26.81	577832	0.00020	320	0.6	192	0.005	0.0003	285
		Pass car hit by Loco	0.00072	Incl	0.00072	8.28	21553	26.81	577832	0.00042	320	0.6	192	0.054	0.0020	2326
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	15618	26.81	418719	0.00205	320	0.6	192	0.027	0.0010	1162
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.12	0.01267	6.00	15618	26.81	418719	0.00531	320	0.6	192	0.187	0.0067	8012
	Overspeed		0.01100	0.00	0.01100	6.00	15618	26.81	418719	0.00461	320	0.6	192	0.248	0.0040	21160
	Broken Rail		0.01670	0.08	0.01536	6.00	15618	26.81	418719	0.00643	320	0.6	192	0.335	0.0054	28667
	Work Zone Violation			0.00		6.00	15618	26.81	418719					0.091	0.0091	0
	Total									**0.02166**				**1.10615**	**0.03447**	**68505**
	Overall Totals									**0.03036**				**1.38271**	**0.04314**	**82023**
	Totals All Speeds	**Train-train Collisions**								**0.00531**				**0.29017**	**0.01107**	**12549**
		Intrusion Collisions								**0.01002**				**0.25338**	**0.00900**	**10801**
		Overspeed								**0.00627**				**0.30774**	**0.00493**	**24916**
		Broken Rail								**0.00876**				**0.41694**	**0.00668**	**33757**
		Work Zone Violation								**0.00000**				**0.11449**	**0.01145**	**0**

Number Diamonds	Freq'y per mill passes	Collisions (millions)	Injuries	Fatalities	Damage
1	0.000000	0.000000	0.000000	0.000000	0.00
1	0.000000	0.000000	0.000000	0.000000	0.00
1	0.009116	0.000196	0.001026	0.000030	39.45
1	0.001823	0.000039	0.001002	0.000030	31.59
		0.000236	**0.002028**	**0.000060**	**71.05**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.009116	0.000000	0.000000	0.000000	0.00
0	0.001823	0.000000	0.000000	0.000000	0.00
		0.000000	**0.00000**	**0.00000**	**0.00**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.009116	0.000000	0.000000	0.000000	0.00
0	0.001823	0.000000	0.000000	0.000000	0.00
		0.001273	**0.00000**	**0.00000**	**0.00**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.009116	0.000000	0.000000	0.000000	0.00
0	0.001823	0.000000	0.000000	0.000000	0.00
		0.000236	**0.002028**	**0.000060**	**71**
		0.000000	**0.00000**	**0.00000**	**0.00**
		0.000236	**0.002028**	**0.000060**	**71**
		0.001273	**0.000448**	**0.000045**	**170.39**

Table 3.6a: Risk Calculation - Freight Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Rate (per million tm)	Preventability	Adjusted Rate	Trips/day	Trips per 10 years	Length of Track (miles)	Per 10 years: Train-miles	Accidents	Injuries	Fatalities	Damage $
25	Train-Train Collision	Frt Loco hits Loco	0.001079163	Incl	0.00108	8.28	21553	1.29	27803	0.00003	0.00001	0.000001	$3
		Frt Loco hits Car	0.000323749	Incl	0.00032	8.28	21553	1.29	27803	0.00001	0.00000	0.000000	$1
		Frt car hit by Loco	0.000755414	Incl	0.00076	8.28	21553	1.29	27803	0.00002	0.00000	0.000000	$1
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.43	0.00821	2.28	5935	1.29	7656	0.00006	0.00000	0.000000	$0
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.12	0.00757	2.28	5935	1.29	7656	0.00006	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.00	0	1.29	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.00	0	1.29	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.00	0.01600	2.28	5935	1.29	7656	0.00012	0.00001	0.000001	$18
	Overspeed, Unequip		0.016	0.00	0.01600	0.00	0	1.29	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.08	0.05115	2.28	5935	1.29	7656	0.00039	0.00002	0.000002	$57
	Broken Rail, Unequip		0.056	0.00	0.05560	0.00	0	1.29	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.00		2.28	5935	1.29	7656		0.00032	0.000032	$0
	Work Zone Viol'n, Unequip			0.00		0.00	0	1.29	0		0.00000	0.000000	$0
	Totals									**0.0007**	**0.0004**	**0.00004**	**$80**
40	Train-Train Collision	Frt Loco hits Loco	0.0021	Incl	0.00215	8.28	21553	8.41	181259	0.00039	0.00034	0.000034	$84
		Frt Loco hits Car	0.0004	Incl	0.00035	8.28	21553	8.41	181259	0.00006	0.00005	0.000005	$11
		Frt car hit by Loco	0.0007	Incl	0.00073	8.28	21553	8.41	181259	0.00013	0.00000	0.000000	$12
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.43	0.00821	2.28	5935	8.41	49912	0.00041	0.00007	0.000007	$8
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.12	0.00757	2.28	5935	8.41	49912	0.00038	0.00006	0.000006	$8
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.00	0	8.41	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.00	0	8.41	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.00	0.01600	2.28	5935	8.41	49912	0.00080	0.00011	0.000011	$299
	Overspeed, Unequip		0.016	0.00	0.01600	0.00	0	8.41	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.08	0.05115	2.28	5935	8.41	49912	0.00255	0.00036	0.000036	$929
	Broken Rail, Unequip		0.056	0.00	0.05560	0.00	0	8.41	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.00		2.28	5935	8.41	49912		0.00329	0.000329	$0
	Work Zone Viol'n, Unequip			0.00		0.00	0	8.41	0		0.00000	0.000000	$0
	Totals									**0.00472**	**0.0043**	**0.00043**	**$1,351**
50	Train-Train Collision	Frt Loco hits Loco	0.0011	Incl	0.00111	8.28	21553	26.81	577832	0.00064	0.00087	0.000087	$217
		Frt Loco hits Car	0.0002	Incl	0.00021	8.28	21553	26.81	577832	0.00012	0.00014	0.000014	$34
		Frt car hit by Loco	0.0005	Incl	0.00046	8.28	21553	26.81	577832	0.00027	0.00000	0.000000	$38
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.43	0.00821	2.28	5935	26.81	159113	0.00131	0.00033	0.000033	$41
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.12	0.00757	2.28	5935	26.81	159113	0.00120	0.00030	0.000030	$38
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.00	0	26.81	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.00	0	26.81	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.00	0.01600	2.28	5935	26.81	159113	0.00255	0.00089	0.000089	$1,492
	Overspeed, Unequip		0.016	0.00	0.01600	0.00	0	26.81	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.08	0.05115	2.28	5935	26.81	159113	0.00814	0.00276	0.000276	$4,626
	Broken Rail, Unequip		0.056	0.00	0.05560	0.00	0	26.81	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.00		2.28	5935	26.81	159113		0.01321	0.001321	$0
	Work Zone Viol'n, Unequip			0.00		0.00	0	26.81	0		0.00000	0.000000	$0
	Totals									**0.01423**	**0.0185**	**0.00185**	**$6,486**
	Overall Totals									**0.01964**	**0.0232**	**0.0023**	**$7,918**
Totals All Speeds	**Train-Train Collisions**									**0.00168**	**0.00141**	**0.00014**	**400**
	Intrusion Collisions									**0.00342**	**0.00077**	**0.00008**	**96**
	Diamond Collisions									**0.00127**	**0.00045**	**0.00004**	**170**
	Overspeed									**0.00347**	**0.00101**	**0.00010**	**1810**
	Broken Rail									**0.01108**	**0.00314**	**0.00031**	**5612**
	Work Zone Violation									**0.00000**	**0.01682**	**0.00168**	**0**
	Grade Crossing Collisions												

Table 3.6b: Risk Calculation - Collisions at Diamonds - Freight

Number Diamonds	Freq'y per mill passes	Collisions (millions)	Injuries	Fatalities	Damage
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.028894	0.000000	0.000000	0.000000	0.00
0	0.030187	0.000000	0.000000	0.000000	0.00
		0.000000	**0.000000**	**0.000000**	**0.00**
1	0.000000	0.000000	0.000000	0.000000	0.00
1	0.028894	0.000623	0.000448	0.000045	112.09
1	0.030187	0.000651	0.000000	0.000000	58.29
		0.001273	**0.000448**	**0.000045**	**170.39**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.028894	0.000000	0.000000	0.000000	0.00
0	0.030187	0.000000	0.000000	0.000000	0.00
		0.000000	**0.000000**	**0.000000**	**0.00**
		0.001273	**0.000448**	**0.000045**	**$170**

Table 3.7: Risk Calculations: Passenger and Freight Trains; Grade Crossings

Train Type	Representative Speed (mph)	Type of Grade-crossing	Base Collision Frequency	Preventability Factor	Adjusted Collision Frequency	Trips per Day	Crossing Passes per Trip	Crossing Passes per 10 Years	Collisions per 10 Years	Seats per Train (Passenger)	Occupancy Factor	Passengers per Train	Passenger/ Crew Injuries per 10 Years	Passenger/ Crew Fatalities per 10 Years	Damage per 10 Years ($)
Passenger	40	Public_gates_lights	0.35	0%	0.350	6.00	7	109326	0.038	320	0.60	192	0.0206	0.0003	1913
		Public_other	0.30	0%	0.300	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Private	0.10	0%	0.100	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
	60	Public_gates_lights	0.60	0%	0.600	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Public_other	0.50	0%	0.500	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Private	0.20	0%	0.200	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
	79	Public_gates_lights	0.80	0%	0.800	6.00	16	249888	0.200	320	0.60	192	0.4030	0.0060	39182
		Public_other	0.65	0%	0.650	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Private	0.30	0%	0.300	6.00	1	15618	0.005	320	0.60	192	0.0094	0.0001	918
	105	Public_gates_lights	1.10	0%	1.100	6.00	16	249888	0.275	320	0.60	192	0.9816	0.0146	95107
		Public_other	0.80	0%	0.800	6.00	1	15618	0.012	320	0.60	192	0.0446	0.0007	4323
		Private	0.30	0%	0.300	6.00	6	93708	0.028	320	0.60	192	0.1004	0.0015	9727
Freight	25	Public_gates_lights	0.15	0%	0.150	2.28	7	41544	0.006				0.00075	0.00003	125
Equipped		Public_other	0.12	0%	0.120	2.28	0	0	0.000				0.00000	0.00000	0
		Private	0.05	0%	0.050	2.28	0	0	0.000				0.00000	0.00000	0
	40	Public_gates_lights	0.30	0%	0.300	2.28	16	94957	0.028				0.00712	0.00037	1424
		Public_other	0.25	0%	0.250	2.28	0	0	0.000				0.00000	0.00000	0
		Private	0.10	0%	0.100	2.28	1	5935	0.001				0.00015	0.00001	30
	50	Public_gates_lights	0.36	0%	0.360	2.28	16	94957	0.034				0.01333	0.00068	2666
		Public_other	0.30	0%	0.300	2.28	1	5935	0.002				0.00069	0.00004	139
		Private	0.12	0%	0.120	2.28	6	35609	0.004				0.00167	0.00009	333
Freight	25	Public_gates_lights	0.15	0%	0.150	0.00	7	0	0.000				0.00000	0.00000	0
Unequipped		Public_other	0.12	0%	0.120	0.00	0	0	0.000				0.00000	0.00000	0
		Private	0.05	0%	0.050	0.00	0	0	0.000				0.00000	0.00000	0
	40	Public_gates_lights	0.30	0%	0.300	0.00	16	0	0.000				0.00000	0.00000	0
		Public_other	0.25	0%	0.250	0.00	0	0	0.000				0.00000	0.00000	0
		Private	0.10	0%	0.100	0.00	1	0	0.000				0.00000	0.00000	0
	50	Public_gates_lights	0.36	0%	0.360	0.00	16	0	0.000				0.00000	0.00000	0
		Public_other	0.30	0%	0.300	0.00	1	0	0.000				0.00000	0.00000	0
		Private	0.12	0%	0.120	0.00	6	0	0.000				0.00000	0.00000	0
								Total - Passenger	**0.558**				**1.560**	**0.023**	**151171**
Risk Calculations: Passenger and Freight Trains; Diamonds								**Total - Freight**	**0.076**				**0.024**	**0.001**	**4717**
Train Type								**Totals - All Speeds**	**0.634**				**1.58**	**0.02**	**155889**

Table 3.8: Summary - All Risks

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00531	0.29017	0.01107	12549	74769
	Intrusion Collisions	0.01002	0.25338	0.00900	10801	63137
	Diamond Collisions	0.000236	0.00203	0.00006	71	455
	Overspeed	0.00627	0.30774	0.00493	24916	70493
	Broken Rail	0.00876	0.41694	0.00668	33757	95505
	Work Zone Violation	0.00000	0.11449	0.01145	0	45798
	Grade Crossing Collisions	0.55834	1.55969	0.02319	151171	376715
	Total, All Scenarios	0.58894	2.94443	0.06639	233265	726871
Freight	Train-Train Collisions	0.00168	0.00141	0.00014	400	965
	Intrusion Collisions	0.00342	0.00077	0.00008	96	404
	Diamond Collisions	0.00127	0.00045	0.00004	170	350
	Overspeed	0.00347	0.00101	0.00010	1810	2215
	Broken Rail	0.01108	0.00314	0.00031	5612	6868
	Work Zone Violation	0.00000	0.01682	0.00168	0	6729
	Grade Crossing Collisions	0.07555	0.02371	0.00121	4717	10730
	Total, All Scenarios	0.09647	0.04731	0.00357	12806	28261
	Total Passenger + Freight	**0.68541**	**2.99175**	**0.06996**	**246071**	**755132**
	Unit Costs ($/Casualty)		100000	3000000		

Data exported to the Results Summary worksheet

Worksheet 2 - B,N,R: Collision Frequencies Calculation - Base Case II: Northeast Corridor ATC, 85% Preventability with Severity Reduction, Bloomington Sub-corridor, Summer

Table 2.1a: Collision Distribution Matrix (Fraction Accidents by Train Pair and Collision Type). Collisions Between Trains Operating on the IDOT Test Corridor Only (not diamonds and intrusions)

	Train Pairs in In Collision	Collision Scenario Prob (Top Level)	Siding - Monitored: Collision Distribution Head On	Siding - Monitored: Collision Distribution Rear/Side	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty
	Percent Guilty				100%	0%	100%	0%
Both Trains TBE (Note 3)	Pass-Pass	0.71	0.50	0.50	0.355	0	0.355	0
	Pass-TBE Freight	0.29	0.50	0.50	0.145	0	0.145	0
	TBE Freight - TBE Freight	0.00	0.50	0.50	0	0	0	0
	Percent Guilty				50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	0.00	1	0	0	0	0	0
	Rear/Side, Pass into NE Frt		0	1	0	0	0	0
	Rear/Side NE Frt into Pass		0	1	0	0	0	0
	TBE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0
	Percent Guilty				0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0
	Total Probability (checking)	1		1	0.5	0	0.5	0

	Train Pairs in In Collision	Siding - Unmonitored: Collision Distribution Head On	Siding - Unmonitored: Collision Distribution Rear/Side	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
	Percent Guilty			100%	0%	100%	0%
Both Trains TBE	Pass-Pass	0.8	0.2	0.568	0	0.142	0
	Pass-TBE Freight	0.7	0.3	0.203	0	0.087	0
	TBE Freight - TBE Freight	0.7	0.3	0	0	0	0
	Percent Guilty			50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	1	0	0	0	0	0
	Rear/Side, Pass into NE Frt	0	1	0	0	0	0
	Rear/Side NE Frt into Pass	0	1	0	0	0	0
	TBE Freight - NE Freight	0.7	0.3	0	0	0	0
	Percent Guilty			0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.7	0.3	0	0	0	0
	Total Probability (checking)		1	0.771	0	0.229	0

	Train Pairs in In Collision	CP Adjacent - Monitored Siding: Collision Distribution Head On	CP Adjacent - Monitored Siding: Collision Distribution Rear/Side	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty
	Percent Guilty			100%	0%	100%	0%
Both Trains TBE	Pass-Pass	0.8	0.2	0.568	0	0.142	0
	Pass-TBE Freight	0.7	0.3	0.203	0	0.087	0
	TBE Freight - TBE Freight	0.7	0.3	0	0	0	0
	Percent Guilty			50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	1	0	0	0	0	0
	Rear/Side, Pass into NE Frt	0	1	0	0	0	0
	Rear/Side NE Frt into Pass	0	1	0	0	0	0
	TBE Freight - NE Freight	0.7	0.3	0	0	0	0
	Percent Guilty			0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.7	0.3	0	0	0	0
	Total Probability (checking)		1	0.771	0	0.229	0

	Train Pairs in In Collision	CP Adjacent - Unmonitored Siding: Collision Distribution Head On	CP Adjacent - Unmonitored Siding: Collision Distribution Rear/Side	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
	Percent Guilty			100%	0%	100%	0%
Both Trains TBE	Pass-Pass	0.8	0.2	0.568	0	0.142	0
	Pass-TBE Freight	0.7	0.3	0.203	0	0.087	0
	TBE Freight - TBE Freight	0.7	0.3	0	0	0	0
	Percent Guilty			50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	1	0	0	0	0	0
	Rear/Side, Pass into NE Frt	0	1	0	0	0	0
	Rear/Side NE Frt into Pass	0	1	0	0	0	0
	TBE Freight - NE Freight	0.7	0.3	0	0	0	0
	Percent Guilty			0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.7	0.3	0	0	0	0
	Total Probability (checking)		1	0.771	0	0.229	0

	Train Pairs in In Collision	Plain Track: Collision Distribution Head On	Plain Track: Collision Distribution Rear/Side	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
	Percent Guilty			100%	0%	100%	0%
Both Trains TBE	Pass-Pass	0.70	0.30	0.497	0	0.213	0
	Pass-TBE Freight	0.40	0.60	0.116	0	0.174	0
	TBE Freight - TBE Freight	0.50	0.50	0	0	0	0
	Percent Guilty			50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	1.00	0.00	0	0	0	0
	Rear/Side, Pass into NE Frt	0.00	1.00	0	0	0	0
	Rear/Side NE Frt into Pass	0.00	1.00	0	0	0	0
	TBE Freight - NE Freight	0.50	0.50	0	0	0	0
	Percent Guilty			0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.50	0.50	0	0	0	0
	Total Probability (checking)		1	0.613	0	0.387	0

Table 2.1b: Collision Type Distribution - Diamonds

	Train Pairs in In Collision	Train Pair Type	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty
	Percent Guilty			
Both Trains TBE	Pass-Pass	Both Trains TBE		
	Pass-TBE Freight			
	TBE Freight - TBE Freight			
	Percent Guilty		50%	50%
One Train TBE	Pass - NE Freight, Head -On	One Train TBE	0	0
	Rear/Side, Pass into NE Frt		0.25	0.25
	Rear/Side NE Frt into Pass		0.05	0.05
	TBE Freight - NE Freight		0.1	0.1
	Percent Guilty			100%
Neither Train TBE	NE Freight - NE Freight	Neither Train TBE	0	0.2
	Total Probability (checking)		0.4	0.6

Note. The gray cells on these rows are set at zero, because in every case, the condition represented by the cell does not exist - either because there are no unequipped passenger trains, or because of the kind of collision defined for the row.

Quantity in cell C18 is for all collisions between a passenger train and an unequipped freight train

Table 2.2: Preventability Data For Unequipped train Guilty, One Train TBE

Segment Type	Not Prevented of Mitigated Freight	Not Prevented of Mitigated Pass	Not Prevented of Mitigated HS Pass	Mitigated Freight	Mitigated Pass	Mitigated HS Pass	Prevented Freight	Prevented Pass	Prevented HS Pass
Siding (M)	0.342	0.364	0.542	0.249	0.168	0.252	0.459	0.518	0.257
Siding (U)	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100
CP Adjacent (M)	0.269	0.342	0.526	0.230	0.187	0.296	0.550	0.521	0.229
CP Adjacent (U)	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.100	0.100
Plain Track	0.308	0.391	0.601	0.000	0.000	0.020	0.100	0.100	0.080
Diamonds	0.135	0.265	0.253	0.172	0.000	0.200	0.743	0.785	0.597

Mauve cells contain data imported from previous worksheet in a group of three worksheets covering one sub-corridor, season and operating state.

Table 2.3a: Collision Preventability Matrix (Percent Accidents Preventable Relative to CTC Reference Case)

	Train Pairs in In Collision	Preventability Equipped Train Guilty	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	85%	85%		85%		85%		85%	
	Pass-TBE Freight	85%	85%		85%		85%		85%	
	TBE Freight - TBE Freight	85%	85%		85%		85%		85%	
One TBE	Pass - NE Freight, Head -On	85%	85%	26%			85%	10%		
	Rear/Side, Pass into NE Frt	85%			85%	26%			85%	10%
	Rear/Side NE Frt into Pass	85%			85%	0%			85%	0%
	TBE Freight - NE Freight	85%	85%	46%	85%	0%	85%	10%	85%	0%
Neither TBE	NE Freight - NE Freight			0%		0%		0%		0%
Reference Case (CTC) Collision Accident Likelihood by Segment Type (collisions/million train miles)		0.030					0.040			

	Train Pairs in In Collision	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	85%		85%		85%		85%	
	Pass-TBE Freight	85%		85%		85%		85%	
	TBE Freight - TBE Freight	85%		85%		85%		85%	
One TBE	Pass - NE Freight, Head -On	85%	23%			85%	10%		
	Rear/Side, Pass into NE Frt			85%	23%			85%	10%
	Rear/Side NE Frt into Pass			85%	0%			85%	0%
	TBE Freight - NE Freight	85%	55%	85%	0%	85%	10%	85%	0%
Neither TBE	NE Freight - NE Freight		0%		0%		0%		0%
Reference Case (CTC) Collision Accident Likelihood by Segment Type (collisions/million train miles)		0.050				0.060			

	Train Pairs in In Collision	Plain Track: Collision Distribution Head On	Plain Track: Collision Distribution Rear/Side	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass			85%		85%	
	Pass-TBE Freight			85%		85%	
	TBE Freight - TBE Freight			85%		85%	
One TBE	Pass - NE Freight, Head -On			85%	8%		
	Rear/Side, Pass into NE Frt					85%	8%
	Rear/Side NE Frt into Pass					85%	0%
	TBE Freight - NE Freight			85%	10%	85%	0%
Neither TBE	NE Freight - NE Freight				0%		0%
Reference Case (CTC) Collision Accident Likelihood by Segment Type (collisions/million train miles)		0.006				Collisions/million diamond passes	

Table 2.3b: Collision Preventability Matrix - Diamonds

	Train Pairs in In Collision	Train Pair Type	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	Both TBE		
	Pass-TBE Freight			
	TBE Freight - TBE Freight			
One TBE	Pass - NE Freight, Head -On	One TBE		
	Rear/Side, Pass into NE Frt		85%	78.54%
	Rear/Side NE Frt into Pass		85%	78.54%
	TBE Freight - NE Freight		85%	74.29%
Neither TBE	NE Freight - NE Freight	Neither TBE		0.00%
Reference Case (CTC) Collision Accident Likelihood by Segment Type (collisions/million train miles)			0.1	

Table 2.4a: Passenger Trains in Train-to-Train Collisions (Trains in Collisions per Million Train-Miles)

	Train Pairs in In Collision	Passenger Trains in Collisions	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	2	0.0032		0.0032		0.0043		0.0043	
	Pass-TBE Freight	1	0.0007		0.0007		0.0009		0.0009	
	TBE Freight - TBE Freight	0								
One TBE	Pass - NE Freight, Head -On	1	0.0000	0.0000			0.0000	0.0000		
	Rear/Side, Pass into NE Frt	1			0.0000	0.0000			0.0000	0.0000
	Rear/Side NE Frt into Pass	1			0.0000	0.0000			0.0000	0.0000
	TBE Freight - NE Freight	0								
Neither TBE	NE Freight - NE Freight	0								
	Checking total		0.0038	0.0000	0.0038	0.0000	0.0051	0.0000	0.0051	0.0000
	Scenario Totals - Passenger	**Tots, P-UF**	**Totals**				**Totals**			
	Pass Loco Hits Loco	0.0000	0.0038	0.0038	0.0000		0.0000	0.0051	0.0051	0.0000
	Pass Loco Hits Pass Ca		0.0016			0.0016			0.0021	
	Pass Loco Hits Freight Ca	0.0000	0.0005			0.0005	0.0000	0.0007	0.0007	
	Pass Car Hit by Loco	0.0000	0.0017			0.0017	0.0000	0.0023	0.0023	0.0000
	Total		0.0077	0.0038	0.0000	0.0038	0.0000	0.0103	0.0051	0.0000

	Train Pairs in In Collision	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	0.0085		0.0021		0.0102		0.0026	
	Pass-TBE Freight	0.0015		0.0007		0.0018		0.0008	
	TBE Freight - TBE Freight								
One TBE	Pass - NE Freight, Head -On	0.0000	0.0000			0.0000	0.0000		
	Rear/Side, Pass into NE Frt			0.0000	0.0000			0.0000	0.0000
	Rear/Side NE Frt into Pass			0.0000	0.0000			0.0000	0.0000
	TBE Freight - NE Freight								
Neither TBE	NE Freight - NE Freight								
	Checking total	0.0100	0.0000	0.0028	0.0000	0.0121	0.0000	0.0033	0.0000
	Scenario Totals - Passenger	**Totals**				**Totals**			
	Pass Loco Hits Loco	0.0100	0.0000			0.0121	0.0000		
	Pass Loco Hits Pass Ca	0.0011				0.0013			
	Pass Loco Hits Freight Ca	0.0005				0.0006			
	Pass Car Hit by Loco	0.0012	0.0000			0.0015	0.0000		
	Total	0.0128	0.0100	0.0000	0.0028	0.0154	0.0121	0.0000	0.0033

	Train Pairs in In Collision	Plain Track: Collision Distribution Head On	Plain Track: Collision Distribution Rear/Side	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass			0.0009		0.0004	
	Pass-TBE Freight			0.0001		0.0002	
	TBE Freight - TBE Freight						
One TBE	Pass - NE Freight, Head -On			0.0000	0.0000		
	Rear/Side, Pass into NE Frt					0.0000	0.0000
	Rear/Side NE Frt into Pass					0.0000	0.0000
	TBE Freight - NE Freight						
Neither TBE	NE Freight - NE Freight				0.0000		
	Checking total	0.0000	0.0010	0.0000	0.0005	0.0000	
	Scenario Totals - Passenger	**Totals**					
	Pass Loco Hits Loco	0.0000	0.0010	0.0010	0.0000		
	Pass Loco Hits Pass Ca		0.0002			0.0002	
	Pass Loco Hits Freight Ca	0.0000	0.0001			0.0001	
	Pass Car Hit by Loco	0.0000	0.0002			0.0002	0.0000
	Total		0.0015	0.0010	0.0000	0.0005	0.0000

	Train Pairs in In Collision	Train Pair Type	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	Both TBE		
	Pass-TBE Freight			
	TBE Freight - TBE Freight			
One TBE	Pass - NE Freight, Head -On	One TBE		
	Rear/Side, Pass into NE Frt		0.003750	0.005366
	Rear/Side NE Frt into Pass		0.000750	0.001073
	TBE Freight - NE Freight		0.000000	0.000000
Neither TBE	NE Freight - NE Freight	Neither TBE		0.000000
	Checking total		0.00450	0.00644
	Scenario Totals - Passenger	**Totals**		
	Pass Loco Hits Loco			
	Pass Loco Hits Pass Ca			
	Pass Loco Hits Freight Ca	0.009116	0.003750	0.005366
	Pass Car Hit by Loco	0.001823	0.000750	0.001073
	Total	0.010938	0.004500	0.006439

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Table 2.5a: Freight trains in Train-to-Train Collisions (Trains in Collisions per Million Train-Miles)

	Train Pairs in In Collision	Freight Trains in Collisions	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	0								
	Pass-TBE Freight	1	0.0007		0.0007		0.0009		0.0009	
	TBE Freight - TBE Freight	2	0.0000		0.0000		0.0000		0.0000	
One TBE	Pass - NE Freight, Head -On	1	0.0000	0.0000			0.0000	0.0000		
	Rear/Side, Pass into NE Frt	1			0.0000	0.0000			0.0000	0.0000
	Rear/Side NE Frt into Pass	1			0.0000	0.0000			0.0000	0.0000
	TBE Freight - NE Freight	2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Neither TBE	NE Freight - NE Freight	2		0.0000		0.0000		0.0000		0.0000
	Checking total		0.0007	0.0000	0.0007	0.0000	0.0009	0.0000	0.0009	0.0000
	Scenario Totals - Freight		**Totals**				**Totals**			
	Freight Loco Hits Loco		0.0007	0.0007	0.0000		0.0009	0.0009	0.0000	
	Freight Loco Hits Car		0.0001			0.00013	0.0002			0.00017
	Freight Car Hit By Loco		0.0005			0.00052	0.0007			0.00070
	Total		0.0013	0.0007	0.0000	0.0007	0.0017	0.0009	0.0000	0.0009
	Freight Plus Passenger Totals (check)		0.0090				0.0120			

	Train Pairs in In Collision	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	0.0015		0.0007		0.0018		0.0008	
	Pass-TBE Freight	0.0000		0.0000		0.0000		0.0000	
	TBE Freight - TBE Freight								
One TBE	Pass - NE Freight, Head -On	0.0000	0.0000			0.0000	0.0000		
	Rear/Side, Pass into NE Frt			0.0000	0.0000			0.0000	0.0000
	Rear/Side NE Frt into Pass			0.0000	0.0000			0.0000	0.0000
	TBE Freight - NE Freight	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Neither TBE	NE Freight - NE Freight		0.0000		0.0000		0.0000		0.0000
	Checking total	0.0015	0.0000	0.0007	0.0000	0.0018	0.0000	0.0008	0.0000
	Scenario Totals - Freight	**Totals**				**Totals**			
	Freight Loco Hits Loco	0.0015	0.0015	0.0000		0.0018	0.0018	0.0000	
	Freight Loco Hits Car	0.0002			0.00016	0.0002			0.00020
	Freight Car Hit By Loco	0.0005			0.00049	0.0006			0.00059
	Total	0.0022	0.0015	0.0000	0.0007	0.0026	0.0018	0.0000	0.0008

	Train Pairs in In Collision	Plain Track: Collision Distribution Head On	Plain Track: Collision Distribution Rear/Side	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass			0.0009		0.0004	
	Pass-TBE Freight			0.0001		0.0002	
	TBE Freight - TBE Freight			0.0000		0.0000	
One TBE	Pass - NE Freight, Head -On			0.0000	0.0000		
	Rear/Side, Pass into NE Frt					0.0000	0.0000
	Rear/Side NE Frt into Pass					0.0000	0.0000
	TBE Freight - NE Freight			0.0000	0.0000	0.0000	0.0000
Neither TBE	NE Freight - NE Freight				0.0000		0.0000
	Checking total	0.0000	0.0001	0.0000	0.0000	0.0002	0.0000
	Scenario Totals - Freight	**Totals**					
	Freight Loco Hits Loco	0.0018	0.0001	0.0001	0.0000		
	Freight Loco Hits Car	0.0000				0.00003	0.00000
	Freight Car Hit By Loco	0.0001				0.00013	0.00000
	Total		0.0003	0.0001	0.0000	0.0002	0.0000

	Train Pairs in In Collision	Train Pair Type	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	Both TBE		
	Pass-TBE Freight			
	TBE Freight - TBE Freight			
One TBE	Pass - NE Freight, Head -On	One TBE		
	Rear/Side, Pass into NE Frt		0.003750	0.005366
	Rear/Side NE Frt into Pass		0.000750	0.001073
	TBE Freight - NE Freight		0.003000	0.005141
Neither TBE	NE Freight - NE Freight	Neither TBE		0.040000
	Checking total		0.00750	0.05158
	Scenario Totals - Freight	**Totals**		
	Freight Loco Hits Loco			
	Freight Loco Hits Car	0.028894	0.005250	0.023644
	Freight Car Hit By Loco	0.030187	0.002250	0.027937
	Total	0.059081	0.007500	0.051581

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

In rear-end/side collisions between like trains there is one loco hits car and one car hit by loco in each collision. In rear/side collisions between a passenger and freight trains, the ratio between passenger hits freight and freight loco hits passenger car are a function of the percentages given in Table IN-5b on the Inputs sheet. The values are given in the tables beneath the trains in collisions for each segment type.

Siding - Monitored: Collision Type	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.8	0.2

Siding - Unmonitored: Collision Type	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.80	0.20

CP Adjacent - Monitored Siding: Collision Type	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.75	0.25

CP Adjacent - Unmonitored Siding: Collision Type	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.75	0.25

Plain Track: Collision Type	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.83	0.17

Table 2.5b: Freight Trains in Collisions at Diamonds

	Train Pairs in In Collision	Train Pair Type	Diamond Collisions Rear End/Side Equip Guilty	Diamond Collisions Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	Both TBE		
	Pass-TBE Freight			
	TBE Freight - TBE Freight			
One TBE	Pass - NE Freight, Head -On	One TBE		
	Rear/Side, Pass into NE Frt		0.003750	0.005366
	Rear/Side NE Frt into Pass		0.000750	0.001073
	TBE Freight - NE Freight		0.003000	0.005141
Neither TBE	NE Freight - NE Freight	Neither TBE		0.040000
	Checking total		0.00750	0.05158
	Scenario Totals - Freight	**Totals**		
	Freight Loco Hits Loco			
	Freight Loco Hits Car	0.028894	0.005250	0.023644
	Freight Car Hit By Loco	0.030187	0.002250	0.027937
	Total	0.059081	0.007500	0.051581

Worksheet 3 - B,N,S: - Risk Calculations - Base Case II: Northeast Corridor ATC, 85% Preventability with Severity reduction, Bloomington Sub-corridor, Summer

Table 3.1: Consequences Look-up Tables (Data Sources: Previous ICF Passenger Corridor Project (passenger), FRA Accident Data 2001-5 (freight)

Passenger Trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 40 mph			Representative Speed 60 mph			Representative Speed 79 mph			Representative Speed 105 mph		
			Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Pass Loco hits Loco	0.0664	0.0016	401600	0.1112	0.00392	913600	0.192	0.0068	1580800	0.34	0.0128	2796000
		Pass Loco hits Pass Car	0.0272	0.0008	200800	0.0448	0.00208	456800	0.0776	0.0036	790400	0.1368	0.0064	1397600
		Pass Loco hits Frt Car	0.0272	0.0008	200800	0.0448	0.00208	456800	0.0776	0.0036	790400	0.1368	0.0064	1397600
		Pass car hit by Loco	0.1328	0.004	804000	0.22	0.00952	1827200	0.3808	0.01648	3160800	0.6728	0.0256	5591200
	Intrusion Collision (rollout)	Pass Loco hits Car	0.00936	0.00036	81360	0.02232	0.000792	185040	0.03888	0.001368	320400	0.06912	0.002448	565920
	Intrusion Collision (other))	Pass Loco hits Car	0.02496	0.000864	216960	0.06048	0.002112	493440	0.10368	0.003648	853440	0.18336	0.006528	1510080
	Overspeed		0.044	0.0004	667000	0.14	0.00186	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Broken Rail		0.04268	0.000388	646990	0.1358	0.0018042	1455000	0.2037	0.0032786	2522000	0.2716	0.004365	4456180
	Work Zone Violation		0.083	0.0083	0	0.125	0.0125	0	0.164	0.0164	0	0.218	0.0218	0

Freight trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 25 mph			Representative Speed 40 mph			Representative Speed 50 mph		
			Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Frt Loco hits Loco	0.344	0.0344	84000	0.88	0.088	216000	1.36	0.136	337600
		Frt Loco hits Car	0.28	0.028	70400	0.72	0.072	180000	1.12	0.112	281600
		Frt car hit by Loco	0	0	35200	0	0	89600	0	0	140800
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.06336	0.00648	7920	0.162	0.01656	20160	0.252	0.0252	31680
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.06336	0.00648	7920	0.162	0.01656	20160	0.252	0.0252	31680
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.08448	0.00864	10560	0.216	0.02208	26880	0.336	0.0336	42240
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.08448	0.00864	10560	0.216	0.02208	26880	0.336	0.0336	42240
	Overspeed, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Overspeed, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Equip		0.05432	0.005432	145500	0.13968	0.013968	363750	0.3395	0.03395	568420
	Broken Rail, Unequip		0.05432	0.005432	145500	0.13968	0.013968	363750	0.3395	0.03395	568420
	Work Zone Viol'n, Equip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0
	Work Zone Viol'n, Unequip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0

Casualties and damage in Table 3.1 are per accident, except for Work Zone Violations which are per million train-miles

Table 3.2: Grade Crossing and Diamonds: Numbers by Rfepresentative Speed, and Accident Frequency and Consequences

Train Type	Representative Speed (mph)	Type of Grade-crossing	Number Crossings			Accident Frequency		Crossing Collision Consequences						Number Diamonds
			Passenger	HS Passenger	Freight	Per Million Crossing Passes		Pass. Occup't Casualty Prob/accident)			Freight Trains (per accident)			
						Passenger	Freight	Injuries	Fatalities	Cost $/Accid't	Injuries	Fatalities	Cost $	
Passenger	40	Public_gates_lights	7	7		0.350		0.0028	0.000047	50000				1
		Public_other	0	0		0.300								
		Private	0	0		0.100								
	60	Public_gates_lights	16	0		0.600		0.0068	0.000112	113000				0
		Public_other	0	0		0.500								
		Private	1	0		0.200								
	79	Public_gates_lights	16	16		0.800		0.0105	0.000156	196000				0
		Public_other	1	0		0.650								
		Private	6	1		0.300								
	105	Public_gates_lights	0	16		1.100		0.0186	0.000276	346000				0
		Public_other	0	1		0.800								
		Private	0	6		0.300								
Freight	25	Public_gates_lights			7		0.150				0.12	0.005	20000	0
		Public_other			0		0.120							
		Private			0		0.050							
	40	Public_gates_lights			16		0.300				0.25	0.013	50000	1
		Public_other			0		0.250							
		Private			1		0.100							
	50	Public_gates_lights			16		0.360				0.39	0.02	78000	0
		Public_other			1		0.300							
		Private			6		0.120							

Table 3.3a: Segment Data (for reference only, not used in calculations)

Segment Number	Start (Milepost)	End (Milepost)	Type	Length (miles)	Representative Speed (mph)			
					Freight	Pass	HS Pass (conseq)	HS Pass
14.0	88.35	90.55	Plain	2.20	50	79	79	105
15.0	90.55	92.47	CP Adjacent (M)	1.92	40	60	60	79
16.0	92.47	94.97	Siding (M)	2.50	50	79	79	105
17.0	94.97	96.81	CP Adjacent (M)	1.84	50	79	79	105
18.0	96.81	100.28	Plain	3.47	50	79	79	105
19.0	100.28	102.25	CP Adjacent (M)	1.97	40	60	60	79
20.0	102.25	102.25	Diamond	0.00	40	40	40	40
21.0	102.25	104.60	CP Adjacent (M)	2.35	40	60	60	79
22.0	104.60	106.43	CP Adjacent (M)	1.83	50	79	79	105
23.0	106.43	108.83	Siding (M)	2.40	50	79	79	105
24.0	108.83	111.36	CP Adjacent (M)	2.53	50	79	79	105
25.0	111.36	113.30	Plain	1.94	50	79	79	105
26.0	113.30	116.36	Plain	3.06	50	79	79	105
27.0	116.36	118.83	Plain	2.47	50	79	79	105
28.0	118.83	121.40	CP Adjacent (M)	2.57	50	79	79	105
29.0	121.40	123.57	Siding (M)	2.17	40	60	79	79
30.0	123.57	124.38	Siding (M)	0.81	25	40	40	40
31.0	124.38	124.86	Siding (M)	0.48	25	40	40	40
	Length Check	36.5		36.5				

Table 3.3b: Aggregate Segment Data: SegmentsTypes, Train Types, Speeds, and Lengths

Aggregate Segment Length by Type and Speed Band (from Seg Def and Preventability)

Segment Type	Train Type	Represent've Speed (mph)	Freight (miles)	Reg Pass (miles)	HS Pass Collision (mi)	HS Pass Other (mi)
Siding (mon)	Freight	25	1.29			
		40	2.17			
		50	4.9			
	Passenger	40		1.29	1.29	1.29
		60		2.17	0	0
		79		4.9	7.07	2.17
		105		0	0	4.9
Siding (unmon)	Freight	25	0			
		40	0			
		50	0			
	Passenger	40		0	0	0
		60		0	0	0
		79		0	0	0
		105		0	0	0
CP Adjacent (mon)	Freight	25	0			
		40	6.24			
		50	8.77			
	Passenger	40		0	0	0
		60		6.24	6.24	0
		79		8.77	8.77	6.24
		105		0	0	8.77
CP Adjacent (unmon)	Freight	25	0			
		40	0			
		50	0			
	Passenger	40		0	0	0
		60		0	0	0
		79		0	0	0
		105		0	0	0
Plain Track	Freight	25	0			
		40	0			
		50	13.14			
	Passenger	40		0	0	0
		60		0	0	0
		79		13.14	13.14	0
		105		0	0	13.14
Totals All Types	Freight	25	1.29			
		40	8.41			
		50	26.81			
	Passenger	40		1.29	1.29	1.29
		60		8.41	6.24	0
		79		26.81	28.98	8.41
		105		0	0	26.81
	Checking Totals		36.51	36.51	36.51	36.51

Table 3.4a: Traffic Inputs to Risk Calculation

Trips/Day		
Train Type	Summer	Rest of Year
Passenger	6.00	6.00
Equipped Freight	1.43	2.28
Unequipped Freight	0.00	0.00
Operating Days	91.00	274.00

Percent Train-Miles in	
Timeout (secs)	0.00
Normal Operating Mode	95.00
Timeout Mode	0.00
Fallback Mode	5.00

Passenger Train Occupancy	
Seats	320.00
Occupancy Factor	0.60

Table 3.4: Collision Frequencies by Segment Type and Collision Scenario (From Coll Matrix)

Scenarios	Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain	Diamond
Pass Loco Hits Loco	0.0038	0.0051	0.0100	0.0121	0.0010	0.000000
Pass Loco Hits Pass Car	0.0016	0.0021	0.0011	0.0013	0.0002	0.000000
Pass Loco Hits Freight Car	0.0005	0.0007	0.0005	0.0006	0.0001	0.009116
Pass Car Hit by Loco	0.0017	0.0023	0.0012	0.0015	0.0002	0.001823
Freight Loco Hits Loco	0.0007	0.0009	0.0015	0.0018	0.0001	0.000000
Freight Loco Hits Car	0.0001	0.0002	0.0002	0.0002	0.0000	0.028894
Freight Car Hit By Loco	0.0005	0.0007	0.0005	0.0006	0.0001	0.030187

Weighted Collision Accident Frequencies by Representative Speed (mph)

Scenarios	Freight			Passenger			
	25	40	50	40	60	79	105
Pass Loco Hits Loco				0.0038	0.0000	0.0084	0.0045
Pass Loco Hits Pass Car				0.0016	0.0000	0.0012	0.0007
Pass Loco Hits Freight Car				0.0005	0.0000	0.0005	0.0003
Pass Car Hit by Loco				0.0017	0.0000	0.0014	0.0008
Freight Loco Hits Loco	0.0007	0.0013	0.0007				
Freight Loco Hits Car	0.0001	0.0002	0.0001				
Freight Car Hit By Loco	0.0005	0.0005	0.0003				

Collision Frequencies for Passenger + Unequipped Freight Train

Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain
0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000

Mauve cells contain data imported from previous worksheet in a group of three worksheets covering one sub-corridor, season and operating state.

All train-to-train collision frequencies are in units of **trains in collisions per million train-miles operated in the sub-corridor by all train types.**

Table 3.5a: Risk Calculation - Passenger Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Table 3.5b: Risk Calculation - Collisions at Diamonds - Passenger

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Freq'y (per million tm)	Preventability	Adjusted Frequency	Trips/day	Trips per 10 years	Length of Track (miles)	Train-miles per 10 years	Accidents per 10 years	Number seats per train	Occupancy Factor	Passengers per train	Injuries per 10 years	Fatalities per 10 years	Damage $ per 10 years
40	Train-Train Collision	Pass Loco hits Loco	0.00384	Incl	0.00384	7.43	6423	1.29	8286	0.00003	320	0.6	192	0.0004	0.00001	0
		Pass Loco hits Pass Car	0.00160	Incl	0.00160	7.43	6423	1.29	8286	0.00001	320	0.6	192	0.0001	0.00000	0
		Pass Loco hits Frt Car	0.00052	Incl	0.00052	7.43	6423	1.29	8286	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00173	Incl	0.00173	7.43	6423	1.29	8286	0.00001	320	0.6	192	0.0004	0.00001	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	5187	1.29	6691	0.00003	320	0.6	192	0.0001	0.00000	0
	Intrusion Collision (other))	Pass Loco hits intruder	0.01440	0.12	0.01267	6.00	5187	1.29	6691	0.00008	320	0.6	192	0.0004	0.00001	0
	Overspeed		0.01100	0.00	0.01100	6.00	5187	1.29	6691	0.00007	320	0.6	192	0.0006	0.00001	0
	Broken Rail		0.01670	0.08	0.01536	6.00	5187	1.29	6691	0.00010	320	0.6	192	0.0008	0.00001	0
	Work Zone Violation			0.00		6.00	5187	1.29	6691					0.0000	0.00006	0
										0.00036				**0.00280**	**0.00011**	**0**
60	Train-Train Collision	Pass Loco hits Loco	0.00000	Incl	0.00000	7.43	6423	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Pass Car	0.00000	Incl	0.00000	7.43	6423	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Frt Car	0.00000	Incl	0.00000	7.43	6423	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00000	Incl	0.00000	7.43	6423	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	5187	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.12	0.01267	6.00	5187	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Overspeed		0.01100	0.00	0.01100	6.00	5187	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Broken Rail		0.01670	0.08	0.01536	6.00	5187	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Work Zone Violation			0.00		6.00	5187	0	0					0.0000	0.00000	0
										0.00000				**0.00000**	**0.00000**	**0**
79	Train-Train Collision	Pass Loco hits Loco	0.00844	Incl	0.00844	7.43	6423	8.41	54019	0.00046	320	0.6	192	0.017	0.0006	721
		Pass Loco hits Pass Car	0.00120	Incl	0.00120	7.43	6423	8.41	54019	0.00006	320	0.6	192	0.001	0.0000	51
		Pass Loco hits Frt Car	0.00050	Incl	0.00050	7.43	6423	8.41	54019	0.00003	320	0.6	192	0.000	0.0000	21
		Pass car hit by Loco	0.00136	Incl	0.00136	7.43	6423	8.41	54019	0.00007	320	0.6	192	0.005	0.0002	232
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	5187	8.41	43623	0.00021	320	0.6	192	0.002	0.0001	69
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.12	0.01267	6.00	5187	8.41	43623	0.00055	320	0.6	192	0.011	0.0004	472
	Overspeed		0.01100	0.00	0.01100	6.00	5187	8.41	43623	0.00048	320	0.6	192	0.019	0.0003	1248
	Broken Rail		0.01670	0.08	0.01536	6.00	5187	8.41	43623	0.00067	320	0.6	192	0.026	0.0004	1690
	Work Zone Violation			0.00		6.00	5187	8.41	43623					0.007	0.0007	0
										0.00254				**0.08886**	**0.00278**	**4503**
105	Train-Train Collision	Pass Loco hits Loco	0.00448	Incl	0.00448	7.43	6423	26.81	172207	0.00077	320	0.6	192	0.050	0.0019	2156
		Pass Loco hits Pass Car	0.00073	Incl	0.00073	7.43	6423	26.81	172207	0.00013	320	0.6	192	0.003	0.0002	177
		Pass Loco hits Frt Car	0.00032	Incl	0.00032	7.43	6423	26.81	172207	0.00006	320	0.6	192	0.001	0.0001	77
		Pass car hit by Loco	0.00082	Incl	0.00082	7.43	6423	26.81	172207	0.00014	320	0.6	192	0.018	0.0007	794
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	5187	26.81	139063	0.00068	320	0.6	192	0.009	0.0003	386
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.12	0.01267	6.00	5187	26.81	139063	0.00176	320	0.6	192	0.062	0.0022	2661
	Overspeed		0.01100	0.00	0.01100	6.00	5187	26.81	139063	0.00153	320	0.6	192	0.082	0.0013	7027
	Broken Rail		0.01670	0.08	0.01536	6.00	5187	26.81	139063	0.00214	320	0.6	192	0.111	0.0018	9521
	Work Zone Violation			0.00		6.00	5187	26.81	139063					0.030	0.0030	0
	Total									**0.00720**				**0.36849**	**0.01149**	**22798**
	Overall Totals									**0.01010**				**0.46015**	**0.01438**	**27302**
	Totals All Speeds	**Train-train Collisions**								**0.00178**				**0.09784**	**0.00373**	**4229**
		Intrusion Collisions								**0.00333**				**0.08415**	**0.00299**	**3587**
		Overspeed								**0.00208**				**0.10221**	**0.00164**	**8275**
		Broken Rail								**0.00291**				**0.13847**	**0.00222**	**11211**
		Work Zone Violation								**0.00000**				**0.03748**	**0.00380**	**0**

Number Diamonds	Freq'y per mill passes	Collisions (millions)	Injuries	Fatalities	Damage
1	0.000000	0.000000	0.000000	0.000000	0.00
1	0.000000	0.000000	0.000000	0.000000	0.00
1	0.009116	0.000059	0.000306	0.000009	11.76
1	0.001823	0.000012	0.000299	0.000009	9.42
		0.000070	**0.000604**	**0.000018**	**21.17**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.009116	0.000000	0.000000	0.000000	0.00
0	0.001823	0.000000	0.000000	0.000000	0.00
		0.000000	**0.00000**	**0.00000**	**0.00**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.009116	0.000000	0.000000	0.000000	0.00
0	0.001823	0.000000	0.000000	0.000000	0.00
		0.000000	**0.00000**	**0.00000**	**0.00**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.009116	0.000000	0.000000	0.000000	0.00
0	0.001823	0.000000	0.000000	0.000000	0.00
		0.000000	**0.00000**	**0.00000**	**0.00**
		0.000070	**0.000604**	**0.000018**	**21**

Table 3.6a: Risk Calculation - Freight Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Freq'y (per million tm)	Preventability	Adjusted Frequency	Trips/day	Trips per 10 years	Length of Track (miles)	Per 10 years: Train-miles	Accidents	Injuries	Fatalities	Damage $
25	Train-Train Collision	Frt Loco hits Loco	0.000651995	Incl	0.00065	7.43	6423	1.29	8286	0.00001	0.00000	0.000000	$0
		Frt Loco hits Car	0.000130399	Incl	0.00013	7.43	6423	1.29	8286	0.00000	0.00000	0.000000	$0
		Frt car hit by Loco	0.000521596	Incl	0.00052	7.43	6423	1.29	8286	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.43	0.00821	1.43	1236	1.29	1595	0.00001	0.00000	0.000000	$0
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.12	0.00757	1.43	1236	1.29	1595	0.00001	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.00	0	1.29	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.00	0	1.29	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.00	0.01600	1.43	1236	1.29	1595	0.00003	0.00000	0.000000	$4
	Overspeed, Unequip		0.016	0.00	0.01600	0.00	0	1.29	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.08	0.05115	1.43	1236	1.29	1595	0.00008	0.00000	0.000000	$12
	Broken Rail, Unequip		0.056	0.00	0.05560	0.00	0	1.29	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.00		1.43	1236	1.29	1595		0.00007	0.000007	$0
	Work Zone Viol'n, Unequip			0.00		0.00	0	1.29	0		0.00000	0.000000	$0
	Totals									**0.0001**	**0.0001**	**0.00001**	**$17**
40	Train-Train Collision	Frt Loco hits Loco	0.0013	Incl	0.00130	7.43	6423	8.41	54019	0.00007	0.00006	0.000006	$15
		Frt Loco hits Car	0.0002	Incl	0.00015	7.43	6423	8.41	54019	0.00001	0.00001	0.000001	$2
		Frt car hit by Loco	0.0005	Incl	0.00050	7.43	6423	8.41	54019	0.00003	0.00000	0.000000	$2
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.43	0.00821	1.43	1236	8.41	10397	0.00009	0.00001	0.000001	$2
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.12	0.00757	1.43	1236	8.41	10397	0.00008	0.00001	0.000001	$2
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.00	0	8.41	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.00	0	8.41	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.00	0.01600	1.43	1236	8.41	10397	0.00017	0.00002	0.000002	$62
	Overspeed, Unequip		0.016	0.00	0.01600	0.00	0	8.41	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.08	0.05115	1.43	1236	8.41	10397	0.00053	0.00007	0.000007	$193
	Broken Rail, Unequip		0.056	0.00	0.05560	0.00	0	8.41	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.00		1.43	1236	8.41	10397		0.00069	0.000069	$0
	Work Zone Viol'n, Unequip			0.00		0.00	0	8.41	0		0.00000	0.000000	$0
	Totals									**0.00097**	**0.0009**	**0.00009**	**$278**
50	Train-Train Collision	Frt Loco hits Loco	0.0007	Incl	0.00067	7.43	6423	26.81	172207	0.00012	0.00016	0.000016	$39
		Frt Loco hits Car	0.0001	Incl	0.00009	7.43	6423	26.81	172207	0.00002	0.00002	0.000002	$4
		Frt car hit by Loco	0.0003	Incl	0.00032	7.43	6423	26.81	172207	0.00006	0.00000	0.000000	$8
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.43	0.00821	1.43	1236	26.81	33143	0.00027	0.00007	0.000007	$9
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.12	0.00757	1.43	1236	26.81	33143	0.00025	0.00006	0.000006	$8
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.00	0	26.81	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.00	0	26.81	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.00	0.01600	1.43	1236	26.81	33143	0.00053	0.00019	0.000019	$311
	Overspeed, Unequip		0.016	0.00	0.01600	0.00	0	26.81	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.08	0.05115	1.43	1236	26.81	33143	0.00170	0.00058	0.000058	$964
	Broken Rail, Unequip		0.056	0.00	0.05560	0.00	0	26.81	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.00		1.43	1236	26.81	33143		0.00275	0.000275	$0
	Work Zone Viol'n, Unequip			0.00		0.00	0	26.81	0		0.00000	0.000000	$0
	Totals									**0.00293**	**0.0038**	**0.00038**	**$1,342**
	Overall Totals									**0.00404**	**0.0048**	**0.0005**	**$1,637**
Totals All Speeds	**Train-Train Collisions**									**0.00030**	**0.00024**	**0.00002**	**71**
	Intrusion Collisions									**0.00071**	**0.00016**	**0.00002**	**20**
	Diamond Collisions									**0.00038**	**0.00013**	**0.00001**	**51**
	Overspeed									**0.00072**	**0.00021**	**0.00002**	**377**
	Broken Rail									**0.00231**	**0.00065**	**0.00007**	**1169**
	Work Zone Violation									**0.00000**	**0.00350**	**0.00035**	**0**
	Grade Crossing Collisions												

Table 3.6b: Risk Calculation - Collisions at Diamonds - Freight

Number Diamonds	Freq'y per mill passes	Collisions (millions)	Injuries	Fatalities	Damage
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.028894	0.000000	0.000000	0.000000	0.00
0	0.030187	0.000000	0.000000	0.000000	0.00
		0.000000	**0.000000**	**0.000000**	**0.00**
1	0.000000	0.000000	0.000000	0.000000	0.00
1	0.028894	0.000186	0.000134	0.000013	33.41
1	0.030187	0.000194	0.000000	0.000000	17.37
		0.000379	**0.000134**	**0.000013**	**50.78**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.028894	0.000000	0.000000	0.000000	0.00
0	0.030187	0.000000	0.000000	0.000000	0.00
		0.000379	**0.000134**	**0.000013**	**$51**

Table 3.7: Risk Calculations: Passenger and Freight Trains; Grade Crossings

Train Type	Representative Speed (mph)	Type of Grade-crossing	Base Collision Frequency	Preventability Factor	Adjusted Collision Frequency	Trips per Day	Crossing Passes per Trip	Crossing Passes per 10 Years	Collisions per 10 Years	Seats per Train (Passenger)	Occupancy Factor	Passengers per Train	Passenger/ Crew Injuries per 10 Years	Passenger/ Crew Fatalities per 10 Years	Damage per 10 Years ($)
Passenger	40	Public_gates_lights	0.35	0%	0.350	6.00	7	36309	0.013	320	0.60	192	0.0068	0.0001	635
		Public_other	0.30	0%	0.300	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Private	0.10	0%	0.100	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
	60	Public_gates_lights	0.60	0%	0.600	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Public_other	0.50	0%	0.500	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Private	0.20	0%	0.200	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
	79	Public_gates_lights	0.80	0%	0.800	6.00	16	82992	0.066	320	0.60	192	0.1338	0.0020	13013
		Public_other	0.65	0%	0.650	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Private	0.30	0%	0.300	6.00	1	5187	0.002	320	0.60	192	0.0031	0.0000	305
	105	Public_gates_lights	1.10	0%	1.100	6.00	16	82992	0.091	320	0.60	192	0.3260	0.0048	31587
		Public_other	0.80	0%	0.800	6.00	1	5187	0.004	320	0.60	192	0.0148	0.0002	1436
		Private	0.30	0%	0.300	6.00	6	31122	0.009	320	0.60	192	0.0333	0.0005	3230
Freight	25	Public_gates_lights	0.15	0%	0.150	1.43	7	8654	0.001				0.00016	0.00001	26
Equipped		Public_other	0.12	0%	0.120	1.43	0	0	0.000				0.00000	0.00000	0
		Private	0.05	0%	0.050	1.43	0	0	0.000				0.00000	0.00000	0
	40	Public_gates_lights	0.30	0%	0.300	1.43	16	19780	0.006				0.00148	0.00008	297
		Public_other	0.25	0%	0.250	1.43	0	0	0.000				0.00000	0.00000	0
		Private	0.10	0%	0.100	1.43	1	1236	0.000				0.00003	0.00000	6
	50	Public_gates_lights	0.36	0%	0.360	1.43	16	19780	0.007				0.00278	0.00014	555
		Public_other	0.30	0%	0.300	1.43	1	1236	0.000				0.00014	0.00001	29
		Private	0.12	0%	0.120	1.43	6	7417	0.001				0.00035	0.00002	69
Freight	25	Public_gates_lights	0.15	0%	0.150	0.00	7	0	0.000				0.00000	0.00000	0
Unequipped		Public_other	0.12	0%	0.120	0.00	0	0	0.000				0.00000	0.00000	0
		Private	0.05	0%	0.050	0.00	0	0	0.000				0.00000	0.00000	0
	40	Public_gates_lights	0.30	0%	0.300	0.00	16	0	0.000				0.00000	0.00000	0
		Public_other	0.25	0%	0.250	0.00	0	0	0.000				0.00000	0.00000	0
		Private	0.10	0%	0.100	0.00	1	0	0.000				0.00000	0.00000	0
	50	Public_gates_lights	0.36	0%	0.360	0.00	16	0	0.000				0.00000	0.00000	0
		Public_other	0.30	0%	0.300	0.00	1	0	0.000				0.00000	0.00000	0
		Private	0.12	0%	0.120	0.00	6	0	0.000				0.00000	0.00000	0
								Total - Passenger	**0.185**				**0.518**	**0.008**	**50207**
Risk Calculations: Passenger and Freight Trains; Diamonds								**Total - Freight**	**0.016**				**0.005**	**0.000**	**983**
Train Type								**Totals - All Speeds**	**0.201**				**0.52**	**0.01**	**51189**

Table 3.8: Summary - All Risks

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00178	0.09784	0.00373	4229	25203
	Intrusion Collisions	0.00333	0.08415	0.00299	3587	20969
	Diamond Collisions	0.000070	0.00060	0.00002	21	136
	Overspeed	0.00208	0.10221	0.00164	8275	23412
	Broken Rail	0.00291	0.13847	0.00222	11211	31719
	Work Zone Violation	0.00000	0.03748	0.00380	0	15156
	Grade Crossing Collisions	0.18544	0.51800	0.00770	50207	125113
	Total, All Scenarios	0.19561	0.97876	0.02210	77530	241707
Freight	Train-Train Collisions	0.00030	0.00024	0.00002	71	168
	Intrusion Collisions	0.00071	0.00016	0.00002	20	84
	Diamond Collisions	0.00038	0.00013	0.00001	51	104
	Overspeed	0.00072	0.00021	0.00002	377	461
	Broken Rail	0.00231	0.00065	0.00007	1169	1431
	Work Zone Violation	0.00000	0.00350	0.00035	0	1402
	Grade Crossing Collisions	0.01574	0.00494	0.00025	983	2235
	Total, All Scenarios	0.02016	0.00985	0.00074	2670	5885
Total Passenger + Freight		**0.21577**	**0.98860**	**0.02284**	**80200**	**247592**
	Unit Costs ($/Casualty)		100000	3000000		

Data exported to the Results Summary worksheet

Worksheet 1-Sp,N: IDOT Risk Model: Braking Distances and Collision Zone Calculations, Base Case II: Northeast Corridor ATC, 85% Preventability with Severity Reduction, Springfield Sub-corridor

Table 1.1: Stopping Distance Parameters and Calculations, Including Timeout and ACS Response Delay

Braking Formula Inputs		
Train/System Type	Parameter	Value
Freight	Coefficient P	0.035
	App'n Time (sec)	13.8
	Train Weight (lb)	37600000
	Brake Force (lb)	779683
Passenger	Coefficient A	0.666
	Coefficient B	0
	Safety Factor	1.25
Train Control	Latency/T-out (sec)	3
	ACS Response (sec)	0
Guilty Train Speed (mph)		15

Braking Distance Calculations (including free running in TO) (ft)						
Train Type	Speeds (mph)	To Stop	Reduction to RedCon*	RedCon* to Stop	Deceleration (ft/sec²)	
Freight	25	1671	1671	0	0.668	
	40	3686	1619	2068	0.668	
	50	5452	3384	2068	0.668	
Passenger	40	1452	1452	0	1.293	
	60	3177	3177	0	1.293	
	79	5433	3035	2398	1.293	
	105	9493	7096	2398	1.293	
Fct RedYd Consp	35	1125	NA	NA	1.293	

Note: RedCon refers to the speed at which collision consequences will be significantly reduced
60 mph for passenger trains and 35 mph for freight trains
If train speed is lower that this speed, then there are no reduced consequences and Zone A2 has zero length

Braking Duration (secs)		Guilty Train Distance (ft)		Total Zone Lengths (ft)		
Reduction to RedCon*	RedCon* to Stop	Reduction to RedCon*	RedCon* to Stop	Reduction to RedCon*	RedCon* to Stop	Full Speed to Stop
58	0	1275	0	2946	0	2946
14	77	308	1692	1927	3760	5686
36	77	791	1692	4176	3760	7935
48	0	1065	0	2517	0	2517
71	0	1565	0	4742	0	4742
25	68	541	1499	3576	3896	7472
54	68	1190	1499	8286	3896	12182

Blue cells contain data imported from the Inputs worksheet

Sight Distance (ft): 2500

Table 1.2: Segment Definitions: Springfield Sub-Corridor, MP 124.9 (Bloomington) - MP 181.0 (Ridgely)

Segment Number	Start (milepost	End (milepost)	Type	Variant	Length Miles	Length Feet	Posted Speed (mph) Freight	Posted Speed (mph) Pass	Posted Speed (mph) HS Pass	Representative Speed (mph) Freight	Representative Speed (mph) Pass	Representative Speed (mph) HS Pass (Consq*)	Representative Speed (mph) HS Pass (Other)	Industry Siding Number	Industry Siding Name	Passenger Stops
1	32.0	124.9	126.5	CP Adjacent (M)	1.6	8659.2	25.0	40.0	40.0	25.0	40.0	40.0	40.0		Bloom Yard	
2	33.0	126.5	126.5	Diamond	0.0	0.0	25.0	40.0	40.0	25.0	40.0	40.0	40.0			
3	34.0	126.5	128.8	CP Adjacent (M)	2.3	11932.8	30.0	50.0	50.0	25.0	60.0	60.0	79.0			
4	35.0	128.8	131.0	Plain	2.2	11616.0	60.0	79.0	90.0	50.0	79.0	79.0	79.0			
5	36.0	131.0	131.7	Plain	2.8	14572.8	60.0	79.0	110.0	50.0	79.0	60.0	105.0			
6	37.0	133.7	136.9	Plain	3.2	16790.4	60.0	79.0	110.0	50.0	79.0	79.0	105.0			
7	38.0	136.9	138.6	CP Adjacent (M)	1.7	9134.4	60.0	79.0	110.0	50.0	79.0	79.0	105.0			
8	39.0	138.6	141.3	Siding (M)	2.7	14097.6	60.0	79.0	110.0	50.0	79.0	79.0	105.0	1.0	McLean	
9	40.0	141.3	143.4	CP Adjacent (M)	2.0	10824.0	60.0	79.0	110.0	50.0	79.0	79.0	105.0			
10	41.0	143.4	148.3	Plain	5.0	26136.0	60.0	79.0	110.0	50.0	60.0	79.0	79.0	2.0	Fertilizer, Atlanta	
11	42.0	148.3	151.0	Plain	2.7	14044.8	60.0	79.0	110.0	50.0	79.0	79.0	105.0	1.0	Lincoln Grain	
12	43.0	151.0	153.6	CP Adjacent (U)	2.6	13728.0	60.0	79.0	110.0	50.0	79.0	79.0	105.0	1.0	Kruger	
13	44.0	153.6	155.6	Siding (U)	2.0	10612.8	60.0	79.0	110.0	50.0	60.0	60.0	79.0			
14	45.0	155.6	155.6	Diamond	0.0	0.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0			
15	46.0	155.6	157.3	CP Adjacent (U)	1.7	8923.2	50.0	70.0	70.0	50.0	60.0	60.0	79.0	1.0	Havana Ind	Lincoln
16	47.0	157.3	160.1	Plain	2.8	14731.2	60.0	79.0	90.0	50.0	79.0	79.0	79.0			
17	48.0	160.1	162.1	Plain	2.1	10876.8	60.0	79.0	110.0	50.0	79.0	79.0	105.0			
18	49.0	162.1	164.0	Plain	1.9	10180.4	60.0	79.0	110.0	50.0	79.0	79.0	105.0			
19	50.0	164.0	166.2	Plain	2.1	11193.6	60.0	79.0	110.0	50.0	79.0	79.0	105.0			
20	51.0	166.2	168.3	CP Adjacent (U)	2.2	11510.4	60.0	79.0	110.0	50.0	79.0	79.0	105.0	1.0	Elkhart Grain	
21	52.0	168.3	170.4	Siding (U)	2.1	10876.8	60.0	79.0	110.0	50.0	79.0	79.0	105.0			
22	53.0	170.4	172.3	CP Adjacent (U)	1.9	10243.2	60.0	79.0	110.0	50.0	79.0	79.0	105.0			
23	54.0	172.3	175.8	Plain	3.5	18480.0	60.0	79.0	110.0	50.0	79.0	79.0	105.0			
24	55.0	175.8	179.5	Plain	3.7	19272.0	60.0	79.0	110.0	50.0	79.0	79.0	79.0			
25	56.0	179.5	181.0	CP Adjacent (M)	1.5	7920.0	60.0	79.0	110.0	50.0	79.0	79.0	79.0			

Check Total: 56.1

Table 1.3: Mitigation and Prevention Zones - All Segments - Lengths in Feet

Zone A1: Limited Speed Reduction No Prevention or Mitigation			Zone A2: Reduced Speed to Stop Severity Mitigation			Zone B: Able to Stop Full Prevention			Overlap of Stopping Distance into Zone C			Distance in Timeout in Zone C			Overlap of Zone A1 into Zone C			Overlap of Zone A1 into Zone C within Sight Distance			Overlap of Zone A2 into Zone C within Sight Distance		
Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass	Freight	Pass	HS Pass
2946	2517	2517	0	0	0	5713	6142	6142	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2946	4742	3576	0	0	3896	8987	7191	4461	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	3576	3896	3896	3896	3544	4144	4144	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	8286	3896	3896	3896	6501	7101	2391	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	8286	3760	3896	3896	8855	9319	4609	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	8286	3896	3896	849	1063	1663	0	0	0	3047	0	0	462	0	0	0	0	0	2500	0	0	0
4176	3576	8286	3896	3896	3896	6026	6626	1916	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	8286	3896	3896	2538	2752	3352	0	0	0	1358	0	0	462	0	0	0	0	0	1358	0	0	0
4176	4742	3576	0	0	3896	21960	21394	18564	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	8286	3896	3896	3896	5973	6573	1863	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	8286	3896	3896	3896	5656	6256	1546	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	4742	3576	0	0	3896	6437	5871	3141	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	4742	3576	3760	0	3896	988	4182	1452	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	3576	3760	3896	3896	6796	7260	7260	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	8286	3760	3896	2591	2942	3405	0	0	0	1305	0	0	462	0	0	0	0	0	1305	0	0	0
4176	3576	8286	3760	3896	1905	2255	2719	0	0	0	1991	0	0	462	0	0	0	0	0	1991	0	0	0
4176	3576	8286	3760	3896	2908	3258	3722	0	0	0	988	0	0	462	0	0	0	0	0	988	0	0	0
4176	3576	8286	3760	3896	3225	3575	4039	0	0	0	671	0	0	462	0	0	0	0	0	671	0	0	0
4176	3576	8286	3760	3896	2591	2942	3405	0	0	0	1305	0	0	462	0	0	0	0	0	1305	0	0	0
4176	3576	8286	3760	3896	1958	2308	2772	0	0	0	1939	0	0	462	0	0	0	0	0	1939	0	0	0
4176	3576	8286	3760	3896	3896	10545	11008	6298	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	3576	3760	3896	3896	11337	11800	11800	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4176	3576	3576	3744	3896	3896	0	448	448	15	0	0	15	0	0	0	0	0	0	0	0	15	0	0

Table 1.4: Breakdown of Segments Lengths by Representative Speed (miles)

Segment Number	Freight Speeds (mph) 25	40	50	Convent'l Pass Speeds (mph) 40	60	79	HS Pass. Speeds - Coll'n Conseq. (mph) 40	60	79	105	HS Pass. Speeds - Other (mph) 40	60	79	105
1	32.0	1.64	0	0	1.64	0	0	1.64	0	0	0	1.64	0	0	0
2	34.0	2.26	0	0	0	2.26	0	0	2.26	0	0	0	2.26	0	0
3	35.0	0	0	2.2	0	0	2.2	0	0	2.2	0	0	0	2.2	0
4	36.0	0	0	2.76	0	0	2.76	0	2.76	0	0	0	0	0	2.76
5	37.0	0	0	3.18	0	0	3.18	0	0	3.18	0	0	0	0	3.18
6	38.0	0	0	1.73	0	0	1.73	0	0	1.73	0	0	0	0	1.73
7	39.0	0	0	2.67	0	0	2.67	0	0	2.67	0	0	0	0	2.67
8	40.0	0	0	2.05	0	0	2.05	0	0	2.05	0	0	0	0	2.05
9	41.0	0	0	4.95	0	0	4.95	0	0	4.95	0	0	0	0	4.95
10	42.0	0	0	2.66	0	0	2.66	0	0	2.66	0	0	0	0	2.66
11	43.0	0	0	2.6	0	0	2.6	0	0	2.6	0	0	0	0	2.6
12	44.0	0	0	2.01	0	2.01	0	0	2.01	0	0	0	0	2.01	0
13	46.0	0	0	1.69	0	1.69	0	0	1.69	0	0	0	0	1.69	0
14	47.0	0	0	2.79	0	0	2.79	0	0	2.79	0	0	0	0	2.79
15	48.0	0	0	2.06	0	0	2.06	0	0	2.06	0	0	0	0	2.06
16	49.0	0	0	1.93	0	0	1.93	0	0	1.93	0	0	0	0	1.93
17	50.0	0	0	2.12	0	0	2.12	0	0	2.12	0	0	0	0	2.12
18	51.0	0	0	2.18	0	0	2.18	0	0	2.18	0	0	0	0	2.18
19	52.0	0	0	2.06	0	0	2.06	0	0	2.06	0	0	0	0	2.06
20	53.0	0	0	1.94	0	0	1.94	0	0	1.94	0	0	0	0	1.94
21	54.0	0	0	3.5	0	0	3.5	0	0	3.5	0	0	0	0	3.5
22	55.0	0	0	3.65	0	0	3.65	0	0	3.65	0	0	0	0	3.65
23	56.0	0	0	1.5	0	0	1.5	0	0	1.5	0	0	0	0	1.5

Table 1.5: Aggregate Segment Length by Segment Type and Speed

Segment Type	Train Type	Representative Speed (mph)	Aggregate Length of Segments by Train and Segment Types: Freight Miles	Freight Feet	Conv passenger Miles	Conv passenger Feet	High Speed Passenger Collision Consq* Miles	High Speed Passenger Collision Consq* Feet	High Speed Passenger Other Miles	High Speed Passenger Other Feet
Siding (mon)	Freight	25	0.0	0						
		40	0.0	0						
		50	2.7	14097.6						
	Passenger	40			0.0	0	0.0	0	0.0	0
		60			0.0	0	0.0	0	0.0	0
		79			2.7	14097.6	2.7	14097.6	0.0	0
		105					0.0	0	2.7	14097.6
Siding (unmon)	Freight	25	0.0	0						
		40	0.0	0						
		50	4.1	21489.6						
	Passenger	40			0.0	0	0.0	0	0.0	0
		60			2.0	10612.8	2.0	10612.8	0.0	0
		79			2.1	10876.8	2.1	10876.8	2.0	10612.8
		105					0.0	0	2.1	10876.8
CP Adjacent (mon)	Freight	25	3.9	20592						
		40	0.0	0						
		50	5.3	27878.4						
	Passenger	40			1.6	8659.2	1.6	8659.2	1.6	8659.2
		60			2.3	11932.8	2.3	11932.8	0.0	0
		79			5.3	27878.4	5.3	27878.4	3.8	19852.8
		105					0.0	0	3.8	19958.4
CP Adjacent (unmon)	Freight	25	0.0	0						
		40	0.0	0						
		50	8.4	44404.8						
	Passenger	40			0.0	0	0.0	0	0.0	0
		60			1.7	8923.2	1.7	8923.2	0.0	0
		79			6.7	35481.6	6.7	35481.6	1.7	8923.2
		105					0.0	0	6.7	35481.6
Plain Track	Freight	25	0.0	0						
		40	0.0	0						
		50	31.8	167904						
	Passenger	40			0.0	0	0.0	0	0.0	0
		60			5.0	26136	2.8	14572.8	0.0	0
		79			26.9	141768	29.0	153331.2	13.6	71755.2
		105					0.0	0	18.2	96148.8
Check Total			56.1		56.1		56.1		56.1	

*This speed is used to calculate collision consequences in collisions between an equipped and an unequipped train ONLY, reflecting the IDOT PTC speed restriction when an equipped train nears an unequipped train

Yellow cells contain data exported to the next sectsheet in the sequence of three sheets that perform the calculations for one sub-corridor, season and operating state

Table 1.6a: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for Siding (M) Segments

Lengths in Zone C	A1	A2	B
Total Length, Siding (M) Segments (ft)	14097.6		
Number Siding (M) Segments	1		
Average distance in Zone C (ft) Freight	0	0	2500
Passenger	0	0	2500
HS Pass	0	0	2500

	Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass
Sum Zone Lengths A1, A2, B (ft)	4176	3576	8286	3896	3896	3896	6026	6626	1916
Fraction of total length in zone	0.296	0.254	0.588	0.276	0.276	0.276	0.427	0.470	0.136
Collision Accident Mitigation Probabilities: Combined All Zones.	0.281	0.241	0.558	0.263	0.263	0.263	0.506	0.547	0.229

Values transferred to Collision Matrix

Distribution of train location at time of	In Block	0.95
violation in Reference Case accidents	Previous Block	0.05
PTC Risk Increment in Zone C		2
Potential danger length in Zone C (ft)		2500

Table 1.6b: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for Siding (U) Segments

Lengths in Zone C	A1	A2	B
Total Length, Siding (U) Segments (ft)	21489.6		
Number Siding (M) Segments	2		
Average distance in Zone C (ft) Freight	0	0	2500
Passenger	0	0	2500
HS Pass	0	652	1848

	Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass
Zone lengths A1, A2, B (ft)	8351	8317	11861	3760	3896	6487	9379	9276	3141
Fraction of total length in zone	0.389	0.387	0.552	0.175	0.181	0.302	0.436	0.432	0.146
Collision Accident Mitigation Probabilities: Combined All Zones.	0.369	0.368	0.524	0.166	0.172	0.313	0.515	0.510	0.213

Values transferred to Collision Matrix

Distribution of train location at time of	In Block	0.95
violation in Reference Case accidents	Previous Block	0.05
PTC Risk Increment in Zone C		2
Potential danger length in Zone C (ft)		2500

Table 1.6c: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for CP Adjacent (M) Segments

Lengths in Zone C	A1	A2	B
Total Length, CP Adjacent (M) Segments (ft)	48470.4		
Number CP Adjacent Segments	5		
Average distance in Zone C FT0 Freight	0	3	2497
Passenger	0	0	2500
HS Pass	0	772	1728

	Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass
Zone lengths A1, A2, B (ft)	18418	17985	26239	11537	11688	11179	18516	18797	11052
Fraction of total length in zone	0.380	0.371	0.541	0.238	0.241	0.231	0.382	0.388	0.228
Collision Accident Mitigation Probabilities: Combined All Zones.	0.361	0.353	0.514	0.226	0.229	0.250	0.463	0.468	0.286

Values transferred to Collision Matrix

Distribution of train location at time of	In Block	0.95
violation in Reference Case accidents	Previous Block	0.05
PTC Risk Increment in Zone C		2
Potential danger length in Zone C (ft)		2500

Table 1.6d: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for CP Adjacent (U)Segments

Lengths in Zone C	A1	A2	B
Total Length, CP Adjacent (U) Segments (ft)	44404.8		
Number CP Adjacent Segments	4		
Average distance in Zone C (ft) Freight	0	0	2500
Passenger	0	0	2500
HS Pass	0	652	1848

	Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass
Zone lengths A1, A2, B (ft)	16702	15468	28432	15175	11688	12975	12527	17248	2998
Fraction of total length in zone	0.376	0.348	0.640	0.342	0.263	0.292	0.282	0.388	0.068
Collision Accident Mitigation Probabilities: Combined All Zones.	0.357	0.331	0.608	0.325	0.250	0.304	0.368	0.469	0.138

Values transferred to Collision Matrix

Distribution of train location at time of	In Block	0.95
violation in Reference Case accidents	Previous Block	0.05
PTC Risk Increment in Zone C		2
Potential danger length in Zone C (ft)		2500

Table 1.6e: Distribution of Equipped Train Locations by Collision Preventability Zones - Aggregate Values for Plain Track Segments

Lengths in Zone C	A1	A2	B
Total Length, Plain Track Segments (ft)	167904		
Number CP Adjacent Segments	11		

	Zone A1 Totals Freight	Pass	HS Pass	Zone A2 Totals Freight	Pass	HS Pass	Zone B Totals Freight	Pass	HS Pass

| | | |

Worksheet 2 - Sp,N,R: Collision Frequencies Calculation - Base Case II: Northeast Corridor ATC, 85% Preventability with Severity Reduction, Springfield Sub-corridor, Rest of Year

Table 2.1a: Collision Distribution Matrix (Fraction Accidents by Train Pair and Collision Type). Collisions Between Trains Operating on the IDOT Test Corridor Only (not diamonds and intrusions)

	Train Pairs in In Collision	Collision Scenario Prob (Top Level)	Siding - Monitored: Collision Distribution Head On	Siding - Monitored: Collision Distribution Rear/Side	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty
	Percent Guilty				100%	0%	100%	0%
Both Trains TBE (Note 3)	Pass-Pass	0.62	0.50	0.50	0.31	0	0.31	0
	Pass-TBE Freight	0.30	0.50	0.50	0.15	0	0.15	0
	TBE Freight - TBE Freight	0.08	0.50	0.50	0.04	0	0.04	0
	Percent Guilty				50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	0.00	1	0	0	0	0	0
	Rear/Side, Pass into NE Frt		0	1	0	0	0	0
	Rear/Side NE Frt into Pass		0	1	0	0	0	0
	TBE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0
	Percent Guilty				0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0
	Total Probability (checking)	1		1	0.5	0	0.5	0

	Siding - Unmonitored: Collision Distribution Head On	Siding - Unmonitored: Collision Distribution Rear/Side	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
			100%	0%	100%	0%
	0.5	0.5	0.31	0	0.31	0
	0.5	0.5	0.15	0	0.15	0
	0.5	0.5	0.04	0	0.04	0
			50%	50%	50%	50%
	1	0	0	0	0	0
	0	1	0	0	0	0
	0	1	0	0	0	0
	0.5	0.5	0	0	0	0
			0%	100%	0%	100%
	0.5	0.5	0	0	0	0
		1	0.5	0	0.5	0

	CP Adjacent - Monitored Siding: Collision Distribution Head On	CP Adjacent - Monitored Siding: Collision Distribution Rear/Side	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty
			100%	0%	100%	0%
0.8	0.2	0.496	0	0.124	0	
0.7	0.3	0.21	0	0.09	0	
0.7	0.3	0.056	0	0.024	0	
		50%	50%	50%	50%	
1	0	0	0	0	0	
0	1	0	0	0	0	
0	1	0	0	0	0	
0.7	0.3	0	0	0	0	
		0%	100%	0%	100%	
0.7	0.3	0	0	0	0	
	1	0.762	0	0.238	0	

	CP Adjacent - Unmonitored Siding: Collision Distribution Head On	CP Adjacent - Unmonitored Siding: Collision Distribution Rear/Side	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
			100%	0%	100%	0%
0.8	0.2	0.496	0	0.124	0	
0.7	0.3	0.21	0	0.09	0	
0.7	0.3	0.056	0	0.024	0	
		50%	50%	50%	50%	
1	0	0	0	0	0	
0	1	0	0	0	0	
0	1	0	0	0	0	
0.7	0.3	0	0	0	0	
		0%	100%	0%	100%	
0.7	0.3	0	0	0	0	
	1	0.762	0	0.238	0	

	Plain Track: Collision Distribution Head On	Plain Track: Collision Distribution Rear/Side	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
			100%	0%	100%	0%
0.70	0.30	0.434	0	0.186	0	
0.40	0.60	0.12	0	0.18	0	
0.50	0.50	0.04	0	0.04	0	
		50%	50%	50%	50%	
1.00	0.00	0	0	0	0	
0.00	1.00	0	0	0	0	
0.00	1.00	0	0	0	0	
0.50	0.50	0	0	0	0	
		0%	100%	0%	100%	
0.50	0.50	0	0	0	0	
		0.12	0	0.18	0	

Table 2.1b: Collision Type Distribution - Diamonds

Diamond Collisions: Rear End/Side Equip Guilty	Diamond Collisions: Rear End/Side Unequip Guilty	Train Pairs in In Collision	Train Pair Type
		Percent Guilty	
		Pass-Pass	Both Trains TBE
		Pass-TBE Freight	
		TBE Freight - TBE Freight	
50%	50%	**Percent Guilty**	One Train TBE
0	0	Pass - NE Freight, Head -On	
0.25	0.25	Rear/Side, Pass into NE Frt	
0.05	0.05	Rear/Side NE Frt into Pass	
0.1	0.1	TBE Freight - NE Freight	
	100%	**Percent Guilty**	
0	0.2	NE Freight - NE Freight	Neither Train TBE
0.4	0.6	Total Probability (checking)	

Note. The gray cells on these rows are set at zero, because in every case, the condition represented by the cell does not exist - either because there are no unequipped passenger trains, or because of the kind of collision defined for the row.

Quantity in cell C18 is for all collisions between a passenger train and an unequipped freight train

Table 2.2: Preventability Data For Unequipped train Guilty, One Train TBE

Segment Type	Not Prevented of Mitigated: Freight	Not Prevented of Mitigated: Pass	Not Prevented of Mitigated: HS Pass	Mitigated: Freight	Mitigated: Pass	Mitigated: HS Pass	Prevented: Freight	Prevented: Pass	Prevented: HS Pass
Siding (M)	0.281	0.241	0.558	0.263	0.263	0.263	0.506	0.547	0.229
Siding (U)	0.369	0.368	0.524	0.166	0.172	0.313	0.515	0.510	0.213
CP Adjacent (M)	0.361	0.353	0.514	0.226	0.229	0.250	0.463	0.468	0.286
CP Adjacent (U)	0.357	0.331	0.608	0.325	0.250	0.304	0.368	0.469	0.138
Plain Track	0.104	0.102	0.148	0.000	0.000	0.016	0.100	0.100	0.084
Diamonds	0.239	0.260	0.250	0.098	0.000	0.170	0.713	0.790	0.630

Mauve cells contain data imported from previous worksheet in a group of three worksheets covering one sub-corridor, season and operating plan.

Table 2.3a: Collision Preventability Matrix (Percent Accidents Preventable Relative to CTC Reference Case)

	Train Pairs in Collision	Preventability Equipped Train Guilty	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	85%	85%		85%	
	Pass-TBE Freight	85%	85%		85%	
	TBE Freight - TBE Freight	85%	85%		70%	
One TBE	Pass - NE Freight, Head -On	85%	85%	23%		
	Rear/Side, Pass into NE Frt	85%			85%	23%
	Rear/Side NE Frt into Pass	85%			85%	0%
	TBE Freight - NE Freight	85%	85%	51%	85%	0%
Neither TBE	NE Freight - NE Freight			0%		0%
Reference Case (CTC) Collision Accident Likelihood by Segment Type (collisions/million train miles)		0.030				

	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
	85%		85%	
	85%		85%	
	85%		85%	
	85%	21%		
			85%	21%
			85%	0%
	85%	51%	85%	0%
		0%		0%
0.040				

	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty
	85%		85%	
	85%		85%	
	85%		85%	
	85%	29%		
			85%	29%
			85%	0%
	85%	46%	85%	0%
		0%		0%
0.050				

	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
	85%		85%	
	85%		85%	
	85%		85%	
	85%	14%		
			85%	14%
			85%	0%
	85%	37%	85%	0%
		0%		0%
0.060				

	Plain Track: Collision Distribution Head On	Plain Track: Collision Distribution Rear/Side	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
			85%		85%	
			85%		85%	
			85%		85%	
			85%	8%		
					85%	8%
					85%	0%
			85%	10%	85%	0%
				0%		0%
0.006						

Collisions/million diamond passes: 0.1

Table 2.3b: Collision Preventability Matrix - Diamonds

Diamond Collisions: Rear End/Side Equip Guilty	Diamond Collisions: Rear End/Side Unequip Guilty	Train Pairs in In Collision	Train Pair Type
		Pass-Pass	Both TBE
		Pass-TBE Freight	
		TBE Freight - TBE Freight	
		Pass - NE Freight, Head -On	One TBE
85%	79.00%	Rear/Side, Pass into NE Frt	
85%	79.00%	Rear/Side NE Frt into Pass	
85%	71.27%	TBE Freight - NE Freight	
	0.00%	NE Freight - NE Freight	Neither TBE

Table 2.4a: Passenger Trains in Train-to-Train Collisions (Trains in Collisions per Million Train-Miles)

	Train Pairs in Collision	Passenger Trains in Collisions	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	2	0.0028		0.0028	
	Pass-TBE Freight	1	0.0007		0.0007	
	TBE Freight - TBE Freight	0				
One TBE	Pass - NE Freight, Head -On	1	0.0000	0.0000		
	Rear/Side, Pass into NE Frt	1			0.0000	0.0000
	Rear/Side NE Frt into Pass	1			0.0000	0.0000
	TBE Freight - NE Freight	0				
Neither TBE	NE Freight - NE Freight	0				
	Checking total		0.0035	0.0000	0.0035	0.0000
	Scenario Totals - Passenger	**Tots, P-UF**	**Totals**			
	Pass Loco Hits Loco	0.0000	0.0035	0.0035	0.0000	
	Pass Loco Hits Pass Car		0.0014		0.0014	
	Pass Loco Hits Freight Car	0.0000	0.0005		0.0005	
	Pass Car Hit by Loco	0.0000	0.0015		0.0015	0.0000
	Total		0.0069	0.0035	0.0035	0.0000

	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
	0.0037		0.0037	
	0.0009		0.0009	
	0.0000	0.0000		
			0.0000	0.0000
			0.0000	0.0000
	0.0046	0.0000	0.0046	0.0000
Totals				
0.0000	0.0046	0.0000		
	0.0019		0.0019	
0.0000	0.0007		0.0007	
0.0000	0.0020	0.0000	0.0020	0.0000
	0.0092	0.0046	0.0000	0.0046	0.0000

	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty
	0.0074		0.0019	
	0.0016		0.0007	
	0.0000	0.0000		
			0.0000	0.0000
			0.0000	0.0000
	0.0090	0.0000	0.0025	0.0000
Totals				
0.0000	0.0090	0.0000		
	0.0009		0.0009	
	0.0005		0.0005	
0.0000	0.0011	0.0000	0.0011	0.0000
	0.0116	0.0090	0.0000	0.0025	0.0000

	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
	0.0089		0.0022	
	0.0019		0.0008	
	0.0000	0.0000		
			0.0000	0.0000
			0.0000	0.0000
	0.0108	0.0000	0.0030	0.0000
Totals				
0.0000	0.0108	0.0000		
	0.0011		0.0002	
	0.0006		0.0001	
0.0000	0.0013	0.0000	0.0002	
	0.0139	0.0108	0.0000	0.0030	0.0000

	Plain Track: Collision Distribution Head On	Plain Track: Collision Distribution Rear/Side	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
			0.0008		0.0003	
			0.0001		0.0002	
			0.0000	0.0000		
					0.0000	0.0000
					0.0000	0.0000
			0.0009	0.0000	0.0005	0.0000
Totals						
0.0000	0.0001	0.0000				
	0.0002		0.0002			
	0.0001		0.0001			
	0.0002	0.0000	0.0002	0.0000		
	0.0014	0.0009	0.0000	0.0005	0.0000

Diamond Collisions: Rear End/Side Equip Guilty	Diamond Collisions: Rear End/Side Unequip Guilty	Train Pairs in In Collision	Train Pair Type
		Pass-Pass	Both TBE
		Pass-TBE Freight	
		TBE Freight - TBE Freight	
		Pass - NE Freight, Head -On	One TBE
0.003750	0.005250	Rear/Side, Pass into NE Frt	
0.000750	0.001050	Rear/Side NE Frt into Pass	
0.000000	0.000000	TBE Freight - NE Freight	
	0.000000	NE Freight - NE Freight	Neither TBE
0.00450	0.00630		
Totals		**Scenario Totals - Passenger**	
		Pass Loco Hits Loco	
		Pass Loco Hits Pass Car	
0.003750	0.005250	0.009000	Pass Loco Hits Freight Car
0.000750	0.001050	0.001800	Pass Car Hit by Loco
0.004500	0.006300	0.010800	Total

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Table 2.5a: Freight trains in Train-to-Train Collisions (Trains in Collisions per Million Train-Miles)

	Train Pairs in Collision	Freight Trains in Collisions	Siding - Monitored: Head On Equip Guilty	Siding - Monitored: Head On Unequip Guilty	Siding - Monitored: Rear End/Side Equip Guilty	Siding - Monitored: Rear End/Side Unequip Guilty
Both TBE	Pass-Pass	0				
	Pass-TBE Freight	1	0.0007		0.0007	
	TBE Freight - TBE Freight	2	0.0004		0.0007	
One TBE	Pass - NE Freight, Head -On	1	0.0000	0.0000		
	Rear/Side, Pass into NE Frt	1			0.0000	0.0000
	Rear/Side NE Frt into Pass	1			0.0000	0.0000
	TBE Freight - NE Freight	2	0.0000	0.0000	0.0000	0.0000
Neither TBE	NE Freight - NE Freight	2		0.0000		0.0000
	Checking total		0.0010	0.0000	0.0014	0.0000
	Scenario Totals - Freight		**Totals**			
	Freight Loco Hits Loco		0.0000	0.0010	0.0010	0.0000
	Freight Loco Hits Car		0.0000	0.0005		0.00050	0.00000
	Freight Car Hit By Loco		0.0000	0.0009	b		0.00090	0.00000
	Total			0.0024	0.0010	0.0000	0.0014	0.0000

	Siding - Unmonitored: Head On Equip Guilty	Siding - Unmonitored: Head On Unequip Guilty	Siding - Unmonitored: Rear End/Side Equip Guilty	Siding - Unmonitored: Rear End/Side Unequip Guilty
	0.0009		0.0009	
	0.0005		0.0005	
	0.0000	0.0000		
			0.0000	0.0000
			0.0000	0.0000
	0.0014	0.0000	0.0014	0.0000
Totals				
0.0014	0.0014	0.0000		
0.0004			0.0042	0.00000
0.0010			0.00096	0.00000
	0.0028	0.0014	0.0000	0.0014	0.0000

	CP Adjacent - Monitored Siding: Head On Equip Guilty	CP Adjacent - Monitored Siding: Head On Unequip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Monitored Siding: Rear End/Side Unequip Guilty
	0.0016		0.0007	
	0.0008		0.0004	
	0.0000	0.0000		
			0.0000	0.0000
			0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000
		0.0000		0.0000
	0.0024	0.0000	0.0010	0.0000
Totals				
0.0024	0.0024	0.0000		
0.0003			0.00035	0.00000
0.0007			0.00069	0.00000
	0.0024	0.0000	0.0010	0.0000

	CP Adjacent - Unmonitored Siding: Head On Equip Guilty	CP Adjacent - Unmonitored Siding: Head On Unequip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Equip Guilty	CP Adjacent - Unmonitored Siding: Rear End/Side Unequip Guilty
	0.0019		0.0008	
	0.0010		0.0004	
	0.0000	0.0000		
			0.0000	0.0000
			0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000
		0.0000		0.0000
	0.0029	0.0000	0.0012	0.0000
Totals				
0.0029	0.0029	0.0000		
0.0004			0.00042	0.00000
0.0008			0.00082	0.00000
	0.0041	0.0029	0.0000	0.0012	0.0000

	Plain Track: Collision Distribution Head On	Plain Track: Collision Distribution Rear/Side	Plain Track: Head On Equip Guilty	Plain Track: Head On Unequip Guilty	Plain Track: Rear End/Side Equip Guilty	Plain Track: Rear End/Side Unequip Guilty
			0.0001		0.0002	
			0.0001		0.0001	
			0.0000	0.0000		
					0.0000	0.0000
					0.0000	0.0000
			0.0000	0.0000	0.0000	0.0000
				0.0000		0.0000
			0.0002	0.0000	0.0002	0.0000
Totals						
0.0002	0.0002	0.0000				
0.0001			0.00006	0.00000
0.0000			0.00017	0.00000
	0.0004	0.0002	0.0000	0.0002	0.0000

Diamond Collisions: Rear End/Side Equip Guilty	Diamond Collisions: Rear End/Side Unequip Guilty	Train Pairs in In Collision	Train Pair Type
		Pass-Pass	Both TBE
		Pass-TBE Freight	
		TBE Freight - TBE Freight	
		Pass - NE Freight, Head -On	One TBE
0.003750	0.005250	Rear/Side, Pass into NE Frt	
0.000750	0.001050	Rear/Side NE Frt into Pass	
0.003000	0.005745	TBE Freight - NE Freight	
	0.040000	NE Freight - NE Freight	Neither TBE
0.00750	0.05205		
Totals		**Scenario Totals - Freight**	
		Freight Loco Hits Loco	
0.005250	0.023923	0.029173	Freight Loco Hits Car
0.002250	0.028123	0.030373	Freight Car Hit By Loco
0.007500	0.052046	0.059546	Total

Cells highlighted in yellow are inputs to the risk calculations on sheet 3

Freight Plus Passenger Totals (check): 0.0600 0.0094 | 0.0800 0.0120 | 0.1000 0.0150 | 0.1200 0.0180 | 0.0018

In rear-end/side collisions between like trains there is one loco hits car and one car hit by loco in each collision. In rear/side collisions between a passenger and freight trains, the ratio between passenger hits freight and freight loco hits passenger car are a function of the percentages given in Table IN-5b on the Inputs sheet. The values are given in the tables beneath the trains in collisions for each segment type.

Collision Ratios: Collision Type	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.8	0.2

Collision Ratios: Collision Type	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.80	0.20

Collision Ratios: Collision Type	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.75	0.25

Collision Ratios: Collision Type	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.75	0.25

Collision Ratios: Collision Type	Like Trains: Loco hits car	Like Trains: car hit by loco	Unlike Trains: P loco hits F car	Unlike Trains: F loco hits P car
Freight to Freight	0.50	0.50		
Passenger to Passenger	0.50	0.50		
Passenger to Freight			0.83	0.17

Table 2.5b: Freight Trains in Collisions at Diamonds

Diamond Collisions: Rear End/Side Equip Guilty	Diamond Collisions: Rear End/Side Unequip Guilty	Train Pairs in In Collision	Train Pair Type
		Pass-Pass	Both TBE
		Pass-TBE Freight	
		TBE Freight - TBE Freight	
		Pass - NE Freight, Head -On	One TBE
0.003750	0.005250	Rear/Side, Pass into NE Frt	
0.000750	0.001050	Rear/Side NE Frt into Pass	
0.000000	0.000000	TBE Freight - NE Freight	
	0.000000	NE Freight - NE Freight	Neither TBE
0.00000	0.00000		
Totals		**Scenario Totals - Freight**	
		Freight Loco Hits Loco	
0.000000	0.000000	0.000000	Freight Loco Hits Car
0.000000	0.000000	0.000000	Freight Car Hit By Loco
0.000000	0.000000	0.000000	Total

Worksheet 3 - Sp,N,R: - Risk Calculations - Base Case II: Northeast Corridor ATC, 85% Preventability with Severity Reduction, Springfield Subcorridor, Rest of Year

Table 3.1: Consequences Look-up Tables (Data Sources: Previous ICF Passenger Corridor Project (passenger), FRA Accident Data 2001-5 (freight)

Passenger Trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 40 mph			Representative Speed 60 mph			Representative Speed 79 mph			Representative Speed 105 mph		
			Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Pass Loco hits Loco	0.0664	0.0016	401600	0.1112	0.00392	913600	0.192	0.0068	1580800	0.34	0.0128	2796000
		Pass Loco hits Pass Car	0.0272	0.0008	200800	0.0448	0.00208	456800	0.0776	0.0036	790400	0.1368	0.0064	1397600
		Pass Loco hits Frt Car	0.0272	0.0008	200800	0.0448	0.00208	456800	0.0776	0.0036	790400	0.1368	0.0064	1397600
		Pass car hit by Loco	0.1328	0.004	804000	0.22	0.00952	1827200	0.3808	0.01648	3160800	0.6728	0.0256	5591200
	Intrusion Collision (rollout)	Pass Loco hits Car	0.00936	0.00036	81360	0.02232	0.000792	185040	0.03888	0.001368	320400	0.06912	0.002448	565920
	Intrusion Collision (other))	Pass Loco hits Car	0.02496	0.000864	216960	0.06048	0.002112	493440	0.10368	0.003648	853440	0.18336	0.006528	1510080
	Overspeed		0.044	0.0004	667000	0.14	0.00186	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Broken Rail		0.04268	0.000388	646990	0.1358	0.0018042	1455000	0.2037	0.0032786	2522000	0.2716	0.004365	4456180
	Work Zone Violation		0.083	0.0083	0	0.125	0.0125	0	0.164	0.0164	0	0.218	0.0218	0

Freight trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 25 mph			Representative Speed 40 mph			Representative Speed 50 mph		
			Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Frt Loco hits Loco	0.344	0.0344	84000	0.88	0.088	216000	1.36	0.136	337600
		Frt Loco hits Car	0.28	0.028	70400	0.72	0.072	180000	1.12	0.112	281600
		Frt car hit by Loco	0	0	35200	0	0	89600	0	0	140800
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.06336	0.00648	7920	0.162	0.01656	20160	0.252	0.0252	31680
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.06336	0.00648	7920	0.162	0.01656	20160	0.252	0.0252	31680
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.08448	0.00864	10560	0.216	0.02208	26880	0.336	0.0336	42240
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.08448	0.00864	10560	0.216	0.02208	26880	0.336	0.0336	42240
	Overspeed, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Overspeed, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Equip		0.05432	0.005432	145500	0.13968	0.013968	363750	0.3395	0.03395	568420
	Broken Rail, Unequip		0.05432	0.005432	145500	0.13968	0.013968	363750	0.3395	0.03395	568420
	Work Zone Viol'n, Equip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0
	Work Zone Viol'n, Unequip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0

Casualties and damage in Table 3.1 are per accident, except for Work Zone Violations which are per million train-miles

Table 3.2: Grade Crossing and Diamonds: Numbers by Representative Speed, and Accident Frequency and Consequences

Train Type	Representative Speed (mph)	Type of Grade-crossing	Number Crossings			Accident Frequency		Crossing Collision Consequences						Number Diamonds
			Passenger	HS Passenger	Freight	Per Million Crossing Passes		Pass. Occup't Casualty Prob/accident)			Freight Trains (per accident)			
						Passenger	Freight	Injuries	Fatalities	Cost $/Accid't	Injuries	Fatalities	Cost $	
Passenger	40	Public_gates_lights	0	0		0.350		0.0028	0.000047	50000				2
		Public_other	0	0		0.300								
		Private	0	0		0.100								
	60	Public_gates_lights	14	0		0.600		0.0068	0.000112	113000				0
		Public_other	0	0		0.500								
		Private	0	0		0.200								
	79	Public_gates_lights	15	16		0.800		0.0105	0.000156	196000				0
		Public_other	5	1		0.650								
		Private	5	1		0.300								
	105	Public_gates_lights	0	13		1.100		0.0186	0.000276	346000				0
		Public_other	0	4		0.800								
		Private	0	4		0.300								
Freight	25	Public_gates_lights			3		0.150				0.12	0.005	20000	0
		Public_other			0		0.120							
		Private			0		0.050							
	40	Public_gates_lights			0		0.300				0.25	0.013	50000	2
		Public_other			0		0.250							
		Private			0		0.100							
	50	Public_gates_lights			26		0.360				0.39	0.02	78000	0
		Public_other			5		0.300							
		Private			5		0.120							

Table 3.3a: Segment Data (for reference only, not used in calculations)

Segment Number	Start (Milepost)	End (Milepost)	Type	Length (miles)	Representative Speed (mph)			
					Freight	Pass	HS Pass	HS Pass
32	$124.86	$126.50	CP Adjacent (M)	1.64	25	40	40	40
33	$126.50	$126.50	Diamond	0.00	25	40	40	40
34	$126.50	$128.76	CP Adjacent (M)	2.26	25	60	60	79
35	$128.76	$130.96	Plain	2.20	50	79	79	79
36	$130.96	$133.72	Plain	2.76	50	79	60	105
37	$133.72	$136.90	Plain	3.18	50	79	79	105
38	$136.90	$138.63	CP Adjacent (M)	1.73	50	79	79	105
39	$138.63	$141.30	Siding (M)	2.67	50	79	79	105
40	$141.30	$143.35	CP Adjacent (M)	2.05	50	79	79	105
41	$143.35	$148.30	Plain	4.95	50	60	79	79
42	$148.30	$150.96	Plain	2.66	50	79	79	105
43	$150.96	$153.56	CP Adjacent (U)	2.60	50	79	79	105
44	$153.56	$155.57	Siding (U)	2.01	50	60	60	79
45	$155.57	$155.57	Diamond	0.00	40	40	40	40
46	$155.57	$157.26	CP Adjacent (U)	1.69	50	60	60	79
47	$157.26	$160.05	Plain	2.79	50	79	79	79
48	$160.05	$162.11	Plain	2.06	50	79	79	105
49	$162.11	$164.04	Plain	1.93	50	79	79	105
50	$164.04	$166.16	Plain	2.12	50	79	79	105
51	$166.16	$168.34	CP Adjacent (U)	2.18	50	79	79	105
52	$168.34	$170.40	Siding (U)	2.06	50	79	79	105
53	$170.40	$172.34	CP Adjacent (U)	1.94	50	79	79	105
54	$172.34	$175.84	Plain	3.50	50	79	79	105
55	$175.84	$179.49	Plain	3.65	50	79	79	79
56	$179.49	$180.99	CP Adjacent (M)	1.50	50	79	79	79

Table 3.3b: Aggregate Segment Data: SegmentsTypes, Train Types, Speeds, and Lengths

Aggregate Segment Length by Type and Speed Band (from Seg Def and Preventability)

Segment Type	Train Type	Represent've Speed (mph)	Freight (miles)	Reg Pass (miles)	HS Pass Collision (mi)	HS Pass Other (mi)
Siding (mon)	Freight	25	0			
		40	0			
		50	2.67			
	Passenger	40		0	0	0
		60		0	0	0
		79		2.67	2.67	0
		105		0	0	2.67
Siding (unmon)	Freight	25	0			
		40	0			
		50	4.07			
	Passenger	40		0	0	0
		60		2.01	2.01	0
		79		2.06	2.06	2.01
		105		0	0	2.06
CP Adjacent (mon)	Freight	25	3.9			
		40	0			
		50	5.28			
	Passenger	40		1.64	1.64	1.64
		60		2.26	2.26	0
		79		5.28	5.28	3.76
		105		0	0	3.78
CP Adjacent (unmon)	Freight	25	0			
		40	0			
		50	8.41			
	Passenger	40		0	0	0
		60		1.69	1.69	0
		79		6.72	6.72	1.69
		105		0	0	6.72
Plain Track	Freight	25	0			
		40	0			
		50	31.8			
	Passenger	40		0	0	0
		60		4.95	2.76	0
		79		26.85	29.04	13.59
		105		0	0	18.21
Totals All Types	Freight	25	3.9			
		40	0			
		50	52.23			
	Passenger	40		1.64	1.64	1.64
		60		10.91	8.72	0
		79		43.58	45.77	21.05
		105		0	0	33.44
		Check Totals		56.13	56.13	56.13	56.13

Table 3.4a: Traffic Inputs to Risk Calculation

Train Type	Trips/Day Summer	Rest of Year
Passenger	6.00	6.00
Equipped Freight	1.73	3.16
Unequipped Freight	0.00	0.00
Operating Days	91	274

Percent Train-Miles in	
Timeout (secs)	0
Normal Operating Mode	95.00
Timeout Mode	0.00
Fallback Mode	5

Passenger Train Occupancy	
Seats	320
Occupancy Factor	0.60

Table 3.4: Collision Frequencies by Segment Type and Collision Scenario (From Coll Matrix)

Scenarios	Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain	Diamond
Pass Loco Hits Loco	0.0035	0.0046	0.0090	0.0108	0.0009	0.000000
Pass Loco Hits Pass Car	0.0014	0.0019	0.0009	0.0011	0.0002	0.000000
Pass Loco Hits Freight Car	0.0005	0.0007	0.0005	0.0006	0.0001	0.009000
Pass Car Hit by Loco	0.0015	0.0020	0.0011	0.0013	0.0002	0.001800
Freight Loco Hits Loco	0.0010	0.0014	0.0024	0.0029	0.0002	0.000000
Freight Loco Hits Car	0.0005	0.0004	0.0003	0.0004	0.0001	0.029173
Freight Car Hit By Loco	0.0009	0.0010	0.0007	0.0008	0.0002	0.030373

Collision Frequencies for Passenger + Unequipped Freight Train

Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain
0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000

Mauve cells contain data imported from previous worksheet in a group of three worksheets covering one sub-corridor, season and operating state.

Weighted Collision Accident Frequencies by Representative Speed (mph)

Scenarios	Freight			Passenger			
	25	40	50	40	60	79	105
Pass Loco Hits Loco				0.0090	0.0000	0.0035	0.0042
Pass Loco Hits Pass Car				0.0009	0.0000	0.0005	0.0006
Pass Loco Hits Freight Car				0.0005	0.0000	0.0003	0.0003
Pass Car Hit by Loco				0.0011	0.0000	0.0006	0.0007
Freight Loco Hits Loco	0.0024	0.0000	0.0010				
Freight Loco Hits Car	0.0003	0.0000	0.0002				
Freight Car Hit By Loco	0.0007	0.0000	0.0004				

All train-to-train collision frequencies are in units of **trains in collisions per million train-miles operated in the sub-corridor by all train types.**

Table 3.5a: Risk Calculation - Passenger Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Table 3.5b: Risk Calculation - Collisions at Diamonds - Passenger

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Freq'y (per million tm)	Preventability	Adjusted Frequency	Trips/day	Trips per 10 years	Length of Track (miles)	Train-miles per 10 years	Accidents per 10 years	Number seats per train	Occupancy Factor	Passengers per train	Injuries per 10 years	Fatalities per 10 years	Damage $ per 10 years
40	Train-Train Collision	Pass Loco hits Loco	0.00901	Incl	0.00901	9.16	23843	1.64	39103	0.00035	320	0.6	192	0.0045	0.00011	0
		Pass Loco hits Pass Car	0.00093	Incl	0.00093	9.16	23843	1.64	39103	0.00004	320	0.6	192	0.0002	0.00001	0
		Pass Loco hits Frt Car	0.00051	Incl	0.00051	9.16	23843	1.64	39103	0.00002	320	0.6	192	0.0001	0.00000	0
		Pass car hit by Loco	0.00110	Incl	0.00110	9.16	23843	1.64	39103	0.00004	320	0.6	192	0.0011	0.00003	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	15618	1.64	25614	0.00013	320	0.6	192	0.0002	0.00001	0
	Intrusion Collision (other))	Pass Loco hits intruder	0.01440	0.12	0.01267	6.00	15618	1.64	25614	0.00032	320	0.6	192	0.0016	0.00005	0
	Overspeed		0.01100	0.00	0.01100	6.00	15618	1.64	25614	0.00028	320	0.6	192	0.0024	0.00002	0
	Broken Rail		0.01670	0.08	0.01536	6.00	15618	1.64	25614	0.00039	320	0.6	192	0.0032	0.00003	0
	Work Zone Violation			0.00		6.00	15618	1.64	25614					0.0021	0.00021	0
										0.00158				**0.01539**	**0.00048**	**1**
60	Train-Train Collision	Pass Loco hits Loco	0.00000	Incl	0.00000	9.16	23843	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Pass Car	0.00000	Incl	0.00000	9.16	23843	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Frt Car	0.00000	Incl	0.00000	9.16	23843	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00000	Incl	0.00000	9.16	23843	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	15618	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.12	0.01267	6.00	15618	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Overspeed		0.01100	0.00	0.01100	6.00	15618	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Broken Rail		0.01670	0.08	0.01536	6.00	15618	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Work Zone Violation			0.00		6.00	15618	0	0					0.0000	0.00000	0
										0.00000				**0.00000**	**0.00000**	**0**
79	Train-Train Collision	Pass Loco hits Loco	0.00349	Incl	0.00349	9.16	23843	21.05	501905	0.00175	320	0.6	192	0.065	0.0023	2772
		Pass Loco hits Pass Car	0.00054	Incl	0.00054	9.16	23843	21.05	501905	0.00027	320	0.6	192	0.004	0.0002	215
		Pass Loco hits Frt Car	0.00030	Incl	0.00030	9.16	23843	21.05	501905	0.00015	320	0.6	192	0.002	0.0001	117
		Pass car hit by Loco	0.00062	Incl	0.00062	9.16	23843	21.05	501905	0.00031	320	0.6	192	0.023	0.0010	987
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	15618	21.05	328759	0.00161	320	0.6	192	0.012	0.0004	516
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.12	0.01267	6.00	15618	21.05	328759	0.00417	320	0.6	192	0.083	0.0029	3555
	Overspeed		0.01100	0.00	0.01100	6.00	15618	21.05	328759	0.00362	320	0.6	192	0.146	0.0023	9403
	Broken Rail		0.01670	0.08	0.01536	6.00	15618	21.05	328759	0.00505	320	0.6	192	0.198	0.0032	12739
	Work Zone Violation			0.00		6.00	15618	21.05	328759					0.054	0.0054	0
										0.01693				**0.58598**	**0.01783**	**30304**
105	Train-Train Collision	Pass Loco hits Loco	0.00424	Incl	0.00424	9.16	23843	33.44	797326	0.00338	320	0.6	192	0.221	0.0083	9449
		Pass Loco hits Pass Car	0.00065	Incl	0.00065	9.16	23843	33.44	797326	0.00052	320	0.6	192	0.014	0.0006	720
		Pass Loco hits Frt Car	0.00034	Incl	0.00034	9.16	23843	33.44	797326	0.00027	320	0.6	192	0.007	0.0003	379
		Pass car hit by Loco	0.00074	Incl	0.00074	9.16	23843	33.44	797326	0.00059	320	0.6	192	0.077	0.0029	3312
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	15618	33.44	522266	0.00256	320	0.6	192	0.034	0.0012	1449
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.12	0.01267	6.00	15618	33.44	522266	0.00662	320	0.6	192	0.233	0.0083	9994
	Overspeed		0.01100	0.00	0.01100	6.00	15618	33.44	522266	0.00574	320	0.6	192	0.309	0.0050	26392
	Broken Rail		0.01670	0.08	0.01536	6.00	15618	33.44	522266	0.00802	320	0.6	192	0.418	0.0067	35757
	Work Zone Violation			0.00		6.00	15618	33.44	522266					0.114	0.0114	0
	Total									**0.02771**				**1.42588**	**0.04476**	**87452**
	Overall Totals									**0.04621**				**2.02725**	**0.06306**	**117757**
	Totals All Speeds	**Train-train Collisions**								**0.00770**				**0.41740**	**0.01590**	**17951**
		Intrusion Collisions								**0.01541**				**0.36371**	**0.01290**	**15515**
		Overspeed								**0.00964**				**0.45704**	**0.00733**	**35795**
		Broken Rail								**0.01347**				**0.61921**	**0.00993**	**48496**
		Work Zone Violation								**0.00000**				**0.16990**	**0.01699**	**0**

Table 3.6a: Risk Calculation - Freight Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Freq'y (per million tm)	Preventability	Adjusted Frequency	Trips/day	Trips per 10 years	Length of Track (miles)	Per 10 years: Train-miles	Accidents	Injuries	Fatalities	Damage $
25	Train-Train Collision	Frt Loco hits Loco	0.002414381	Incl	0.00241	9.16	23843	3.9	92990	0.00022	0.00008	0.000008	$19
		Frt Loco hits Car	0.000348661	Incl	0.00035	9.16	23843	3.9	92990	0.00003	0.00001	0.000001	$2
		Frt car hit by Loco	0.000686074	Incl	0.00069	9.16	23843	3.9	92990	0.00006	0.00000	0.000000	$2
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.43	0.00821	3.16	8225	3.9	32079	0.00026	0.00002	0.000002	$2
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.12	0.00757	3.16	8225	3.9	32079	0.00024	0.00002	0.000002	$2
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.00	0	3.9	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.00	0	3.9	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.00	0.01600	3.16	8225	3.9	32079	0.00051	0.00003	0.000003	$77
	Overspeed, Unequip		0.016	0.00	0.01600	0.00	0	3.9	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.08	0.05115	3.16	8225	3.9	32079	0.00164	0.00009	0.000009	$239
	Broken Rail, Unequip		0.056	0.00	0.05560	0.00	0	3.9	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.00		3.16	8225	3.9	32079		0.00135	0.000135	$0
	Work Zone Viol'n, Unequip			0.00		0.00	0	3.9	0		0.00000	0.000000	$0
	Totals									**0.0030**	**0.0016**	**0.00016**	**$343**
40	Train-Train Collision	Frt Loco hits Loco	0.0000	Incl	0.00000	9.16	23843	0	0	0.00000	0.00000	0.000000	$0
		Frt Loco hits Car	0.0000	Incl	0.00000	9.16	23843	0	0	0.00000	0.00000	0.000000	$0
		Frt car hit by Loco	0.0000	Incl	0.00000	9.16	23843	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.43	0.00821	3.16	8225	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.12	0.00757	3.16	8225	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.00	0	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.00	0	0	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.00	0.01600	3.16	8225	0	0	0.00000	0.00000	0.000000	$0
	Overspeed, Unequip		0.016	0.00	0.01600	0.00	0	0	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.08	0.05115	3.16	8225	0	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Unequip		0.056	0.00	0.05560	0.00	0	0	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.00	0.00000	3.16	8225	0	0		0.00000	0.000000	$0
	Work Zone Viol'n, Unequip			0.00		0.00	0	0	0		0.00000	0.000000	$0
	Totals									**0.0000**	**0.0000**	**0.00000**	**$0**
50	Train-Train Collision	Frt Loco hits Loco	0.0010	Incl	0.00098	9.16	23843	52.23	1245345	0.00122	0.00166	0.000166	$412
		Frt Loco hits Car	0.0002	Incl	0.00020	9.16	23843	52.23	1245345	0.00025	0.00028	0.000028	$70
		Frt car hit by Loco	0.0004	Incl	0.00043	9.16	23843	52.23	1245345	0.00053	0.00000	0.000000	$75
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.43	0.00821	3.16	8225	52.23	429617	0.00353	0.00089	0.000089	$112
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.12	0.00757	3.16	8225	52.23	429617	0.00325	0.00082	0.000082	$103
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.00	0	52.23	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.00	0	52.23	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.00	0.01600	3.16	8225	52.23	429617	0.00687	0.00241	0.000241	$4,028
	Overspeed, Unequip		0.016	0.00	0.01600	0.00	0	52.23	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.08	0.05115	3.16	8225	52.23	429617	0.02198	0.00746	0.000746	$12,491
	Broken Rail, Unequip		0.056	0.00	0.05560	0.00	0	52.23	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.00		3.16	8225	52.23	429617		0.03566	0.003566	$0
	Work Zone Viol'n, Unequip			0.00		0.00	0	52.23	0		0.00000	0.000000	$0
	Totals									**0.03763**	**0.0492**	**0.00492**	**$17,291**
	Overall Totals									**0.04061**	**0.0508**	**0.0051**	**$17,634**
Totals All Speeds	**Train-Train Collisions**									**0.00232**	**0.00203**	**0.00020**	**580**
	Intrusion Collisions									**0.00728**	**0.00174**	**0.00017**	**219**
	Diamond Collisions									**0.00284**	**0.00100**	**0.00010**	**380**
	Overspeed									**0.00739**	**0.00243**	**0.00024**	**4105**
	Broken Rail									**0.02362**	**0.00755**	**0.00075**	**12730**
	Work Zone Violation									**0.00000**	**0.03701**	**0.00370**	**0**
	Grade Crossing Collisions												

Table 3.6b: Risk Calculation - Collisions at Diamonds - Freight

Number Diamonds	Freq'y per mill passes	Collisions (millions)	Injuries	Fatalities	Damage
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.030373	0.000000	0.000000	0.000000	0.00
2	0.000000	0.000000	0.000000	0.000000	0.00
2	0.000000	0.000000	0.000000	0.000000	0.00
2	0.009000	0.000429	0.002241	0.000066	86.18
2	0.001800	0.000086	0.002189	0.000066	69.02
		0.000515	**0.004430**	**0.000132**	**155.20**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.009000	0.000000	0.000000	0.000000	0.00
0	0.001800	0.000000	0.000000	0.000000	0.00
		0.000000	**0.00000**	**0.00000**	**0.00**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.009000	0.000000	0.000000	0.000000	0.00
0	0.001800	0.000000	0.000000	0.000000	0.00
		0.000000	**0.00000**	**0.00000**	**0.00**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.009000	0.000000	0.000000	0.000000	0.00
0	0.001800	0.000000	0.000000	0.000000	0.00
		0.000515	**0.004430**	**0.000132**	**155**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.029173	0.000000	0.000000	0.000000	0.00
0	0.030373	0.000000	0.000000	0.000000	0.00
2	0.000000	0.000000	0.000000	0.000000	0.00
2	0.029173	0.001391	0.001002	0.000100	250.41
2	0.030373	0.001448	0.000000	0.000000	129.78
		0.002840	**0.001002**	**0.000100**	**380.18**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.029173	0.000000	0.000000	0.000000	0.00
0	0.030373	0.000000	0.000000	0.000000	0.00
		0.000000	**0.000000**	**0.000000**	**0.00**
		0.002840	**0.001002**	**0.000100**	**$380**

Table 3.7: Risk Calculations: Passenger and Freight Trains; Grade Crossings

Train Type	Representative Speed (mph)	Type of Grade-crossing	Base Collision Frequency	Preventability Factor	Adjusted Collision Frequency	Trips per Day	Crossing Passes per Trip	Crossing Passes per 10 Years	Collisions per 10 Years	Seats per Train (Passenger)	Occupancy Factor	Passengers per Train	Passenger/ Crew Injuries per 10 Years	Passenger/ Crew Fatalities per 10 Years	Damage per 10 Years ($)
Passenger	40	Public_gates_lights	0.35	0%	0.350	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Public_other	0.30	0%	0.300	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Private	0.10	0%	0.100	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
	60	Public_gates_lights	0.60	0%	0.600	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Public_other	0.50	0%	0.500	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Private	0.20	0%	0.200	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
	79	Public_gates_lights	0.80	0%	0.800	6.00	16	249888	0.200	320	0.60	192	0.4030	0.0060	39182
		Public_other	0.65	0%	0.650	6.00	1	15618	0.010	320	0.60	192	0.0205	0.0003	1990
		Private	0.30	0%	0.300	6.00	1	15618	0.005	320	0.60	192	0.0094	0.0001	918
	105	Public_gates_lights	1.10	0%	1.100	6.00	13	203034	0.223	320	0.60	192	0.7976	0.0118	77275
		Public_other	0.80	0%	0.800	6.00	4	62472	0.050	320	0.60	192	0.1785	0.0026	17292
		Private	0.30	0%	0.300	6.00	4	62472	0.019	320	0.60	192	0.0669	0.0010	6485
Freight	25	Public_gates_lights	0.15	0%	0.150	3.16	3	24676	0.004				0.00044	0.00002	74
Equipped		Public_other	0.12	0%	0.120	3.16	0	0	0.000				0.00000	0.00000	0
		Private	0.05	0%	0.050	3.16	0	0	0.000				0.00000	0.00000	0
	40	Public_gates_lights	0.30	0%	0.300	3.16	0	0	0.000				0.00000	0.00000	0
		Public_other	0.25	0%	0.250	3.16	0	0	0.000				0.00000	0.00000	0
		Private	0.10	0%	0.100	3.16	0	0	0.000				0.00000	0.00000	0
	50	Public_gates_lights	0.36	0%	0.360	3.16	26	213862	0.077				0.03003	0.00154	6005
		Public_other	0.30	0%	0.300	3.16	5	41127	0.012				0.00481	0.00025	962
		Private	0.12	0%	0.120	3.16	5	41127	0.005				0.00192	0.00010	385
Freight	25	Public_gates_lights	0.15	0%	0.150	0.00	3	0	0.000				0.00000	0.00000	0
Unequipped		Public_other	0.12	0%	0.120	0.00	0	0	0.000				0.00000	0.00000	0
		Private	0.05	0%	0.050	0.00	0	0	0.000				0.00000	0.00000	0
	40	Public_gates_lights	0.30	0%	0.300	0.00	0	0	0.000				0.00000	0.00000	0
		Public_other	0.25	0%	0.250	0.00	0	0	0.000				0.00000	0.00000	0
		Private	0.10	0%	0.100	0.00	0	0	0.000				0.00000	0.00000	0
	50	Public_gates_lights	0.36	0%	0.360	0.00	26	0	0.000				0.00000	0.00000	0
		Public_other	0.30	0%	0.300	0.00	5	0	0.000				0.00000	0.00000	0
		Private	0.12	0%	0.120	0.00	5	0	0.000				0.00000	0.00000	0
								Total - Passenger	**0.507**				**1.476**	**0.022**	**143142**
Risk Calculations: Passenger and Freight Trains; Diamonds								**Total - Freight**	**0.098**				**0.037**	**0.002**	**7427**
Train Type								**Totals - All Speeds**	**0.605**				**1.51**	**0.02**	**150569**

Table 3.8: Summary - All Risks

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00770	0.41740	0.01590	17951	107394
	Intrusion Collisions	0.01541	0.36371	0.01290	15515	90592
	Diamond Collisions	0.000515	0.00443	0.00013	155	994
	Overspeed	0.00964	0.45704	0.00733	35795	103495
	Broken Rail	0.01347	0.61921	0.00993	48496	140218
	Work Zone Violation	0.00000	0.16990	0.01699	0	67959
	Grade Crossing Collisions	0.50680	1.47592	0.02191	143142	356461
	Total, All Scenarios	0.55353	3.50760	0.08510	261054	867112
Freight	Train-Train Collisions	0.00232	0.00203	0.00020	580	1390
	Intrusion Collisions	0.00728	0.00174	0.00017	219	915
	Diamond Collisions	0.00284	0.00100	0.00010	380	781
	Overspeed	0.00739	0.00243	0.00024	4105	5079
	Broken Rail	0.02362	0.00755	0.00075	12730	15750
	Work Zone Violation	0.00000	0.03701	0.00370	0	14802
	Grade Crossing Collisions	0.09797	0.03721	0.00190	7427	16859
	Total, All Scenarios	0.14141	0.08896	0.00708	25441	55576
Total Passenger + Freight		**0.69495**	**3.59657**	**0.09218**	**286495**	**922688**
	Unit Costs ($/Casualty)		100000	3000000		

Data exported to the Results Summary worksheet

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Worksheet 2 - Sp,N,S: Collision Frequencies Calculation - Base Case II: Northeast Corridor ATC, 85% Preventability with Severity Reduction, Springfield Sub-corridor, Summer

Table 2.1a: Collision Distribution Matrix (Fraction Accidents by Train Pair and Collision Type). Collisions Between Trains Operating on the IDOT Test Corridor Only (not diamonds and intrusions)

		Train Pairs in In Collision	Collision Scenario Prob (Top Level)	Siding - Monitored: Collision Distribution		Siding - Monitored: Head On		Siding - Monitored: Rear End/Side	
				Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty
	Percent Guilty					100%	0%	100%	0%
Both Trains TBE		Pass-Pass	0.80	0.50	0.50	0.4	0	0.4	0
		Pass-TBE Freight	0.20	0.50	0.50	0.1	0	0.1	0
(Note 3)		TBE Freight - TBE Freight	0.00	0.50	0.50	0	0	0	0
	Percent Guilty					50%	50%	50%	50%
One Train TBE		Pass - NE Freight, Head -On	0.00	1	0	0	0	0	0
		Rear/Side, Pass into NE Frt		0	1	0	0	0	0
		Rear/Side NE Frt into Pass		0	1	0	0	0	0
		TBE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0
	Percent Guilty					0%	100%	0%	100%
Neither Train TBE		NE Freight - NE Freight	0.00	0.5	0.5	0	0	0	0
		Total Probability (checking)	1		1	0.5	0	0.5	0

		Siding - Unmonitored: Collision Distribution		Siding - Unmonitored: Head On		Siding - Unmonitored: Rear End/Side	
		Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty
	Percent Guilty			100%	0%	100%	0%
Both Trains TBE	Pass-Pass	0.8	0.2	0.64	0	0.16	0
	Pass-TBE Freight	0.7	0.3	0.14	0	0.06	0
(Note 3)	TBE Freight - TBE Freight	0.7	0.3	0	0	0	0
	Percent Guilty			50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	1	0	0	0	0	0
	Rear/Side, Pass into NE Frt	0	1	0	0	0	0
	Rear/Side NE Frt into Pass	0	1	0	0	0	0
	TBE Freight - NE Freight	0.7	0.3	0	0	0	0
	Percent Guilty			0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.7	0.3	0	0	0	0
	Total Probability (checking)		1	0.78	0	0.22	0

		CP Adjacent - Monitored Siding: Collision Distribution		CP Adjacent - Monitored Siding: Head On		CP Adjacent - Monitored Siding: Rear End/Side	
		Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty
	Percent Guilty			100%	0%	100%	0%
Both Trains TBE	Pass-Pass	0.8	0.2	0.64	0	0.16	0
	Pass-TBE Freight	0.7	0.3	0.14	0	0.06	0
(Note 3)	TBE Freight - TBE Freight	0.7	0.3	0	0	0	0
	Percent Guilty			50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	1	0	0	0	0	0
	Rear/Side, Pass into NE Frt	0	1	0	0	0	0
	Rear/Side NE Frt into Pass	0	1	0	0	0	0
	TBE Freight - NE Freight	0.7	0.3	0	0	0	0
	Percent Guilty			0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.7	0.3	0	0	0	0
	Total Probability (checking)		1	0.78	0	0.22	0

		CP Adjacent - Unmonitored Siding: Collision Distribution		CP Adjacent - Unmonitored Siding: Head On		CP Adjacent - Unmonitored Siding: Rear End/Side	
		Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty
	Percent Guilty			100%	0%	100%	0%
Both Trains TBE	Pass-Pass	0.8	0.2	0.64	0	0.16	0
	Pass-TBE Freight	0.7	0.3	0.14	0	0.06	0
(Note 3)	TBE Freight - TBE Freight	0.7	0.3	0	0	0	0
	Percent Guilty			50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	1	0	0	0	0	0
	Rear/Side, Pass into NE Frt	0	1	0	0	0	0
	Rear/Side NE Frt into Pass	0	1	0	0	0	0
	TBE Freight - NE Freight	0.7	0.3	0	0	0	0
	Percent Guilty			0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.7	0.3	0	0	0	0
	Total Probability (checking)		1	0.78	0	0.22	0

		Plain Track: Collision Distribution		Plain Track: Head On		Plain Track: Rear End/Side	
		Head On	Rear/Side	Equip Guilty	Unequip Guilty	Equip Guilty	Unequip Guilty
	Percent Guilty			100%	0%	100%	0%
Both Trains TBE	Pass-Pass	0.70	0.30	0.56	0	0.24	0
	Pass-TBE Freight	0.40	0.60	0.08	0	0.12	0
(Note 3)	TBE Freight - TBE Freight	0.50	0.50	0	0	0	0
	Percent Guilty			50%	50%	50%	50%
One Train TBE	Pass - NE Freight, Head -On	1.00	0.00	0	0	0	0
	Rear/Side, Pass into NE Frt	0.00	1.00	0	0	0	0
	Rear/Side NE Frt into Pass	0.00	1.00	0	0	0	0
	TBE Freight - NE Freight	0.50	0.50	0	0	0	0
	Percent Guilty			0%	100%	0%	100%
Neither Train TBE	NE Freight - NE Freight	0.50	0.50	0	0	0	0
	Total Probability (checking)		1	0.64	0	0.36	0

Table 2.1b: Collision Type Distribution - Diamonds

Diamond Collisions: Rear End/Side Equip Guilty	Diamond Collisions: Rear End/Side Unequip Guilty	Train Pairs in In Collision	Train Pair Type
		Percent Guilty	
		Pass-Pass	Both Trains TBE
		Pass-TBE Freight	
		TBE Freight - TBE Freight	
50%	50%	**Percent Guilty**	One Train TBE
0	0	Pass - NE Freight, Head -On	
0.25	0.25	Rear/Side, Pass into NE Frt	
0.05	0.05	Rear/Side NE Frt into Pass	
0.1	0.1	TBE Freight - NE Freight	
	100%	**Percent Guilty**	
0	0.2	NE Freight - NE Freight	Neither Train TBE

Note. The gray cells on these rows are set at zero, because in every case, the condition represented by the cell does not exist - either because there are no unequipped passenger trains, or because of the kind of collision defined for the row.

Quantity in cell C18 is for all collisions between a passenger train and an unequipped freight train

Table 2.2: Preventability Data For Unequipped train Guilty, One Train TBE

Segment Type	Not Prevented of Mitigated: Freight	Not Prevented of Mitigated: Pass	Not Prevented of Mitigated: HS Pass	Mitigated: Freight	Mitigated: Pass	Mitigated: HS Pass	Prevented: Freight	Prevented: Pass	Prevented: HS Pass
Siding (M)	0.281	0.241	0.558	0.263	0.263	0.263	0.506	0.547	0.229
Siding (U)	0.369	0.368	0.524	0.166	0.172	0.313	0.515	0.510	0.213
CP Adjacent (M)	0.361	0.353	0.514	0.226	0.229	0.250	0.463	0.468	0.286
CP Adjacent (U)	0.357	0.331	0.608	0.325	0.250	0.304	0.368	0.469	0.138
Plain Track	0.104	0.102	0.148	0.000	0.000	0.016	0.100	0.100	0.084
Diamonds	0.239	0.260	0.250	0.098	0.000	0.170	0.713	0.790	0.630

Mauve cells contain data imported from Worksheet 1 in this group of three worksheets covering this sub-corridor, season and operating state.

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Worksheet 3 - Sp,N,R: - Risk Calculations - Base Case II: Northeast Corridor ATC, 85% Preventability with Severity Reduction, Springfield Subcorridor, Summer

Table 3.1: Consequences Look-up Tables (Data Sources: Previous ICF Passenger Corridor Project (passenger), FRA Accident Data 2001-5 (freight)

Passenger Trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 40 mph			Representative Speed 60 mph			Representative Speed 79 mph			Representative Speed 105 mph		
			Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Pass Loco hits Loco	0.0664	0.0016	401600	0.1112	0.00392	913600	0.192	0.0068	1580800	0.34	0.0128	2796000
		Pass Loco hits Pass Car	0.0272	0.0008	200800	0.0448	0.00208	456800	0.0776	0.0036	790400	0.1368	0.0064	1397600
		Pass Loco hits Frt Car	0.0272	0.0008	200800	0.0448	0.00208	456800	0.0776	0.0036	790400	0.1368	0.0064	1397600
		Pass car hit by Loco	0.1328	0.004	804000	0.22	0.00952	1827200	0.3808	0.01648	3160800	0.6728	0.0256	5591200
	Intrusion Collision (rollout)	Pass Loco hits Car	0.00936	0.00036	81360	0.02232	0.000792	185040	0.03888	0.001368	320400	0.06912	0.002448	565920
	Intrusion Collision (other))	Pass Loco hits Car	0.02496	0.000864	216960	0.06048	0.002112	493440	0.10368	0.003648	853440	0.18336	0.006528	1510080
	Overspeed		0.044	0.0004	667000	0.14	0.00186	1500000	0.21	0.00338	2600000	0.28	0.0045	4594000
	Broken Rail		0.04268	0.000388	646990	0.1358	0.0018042	1455000	0.2037	0.0032786	2522000	0.2716	0.004365	4456180
	Work Zone Violation		0.083	0.0083	0	0.125	0.0125	0	0.164	0.0164	0	0.218	0.0218	0

Freight trains	Accident Scenario	Accident Sub-scenarios	Representative Speed 25 mph			Representative Speed 40 mph			Representative Speed 50 mph		
			Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $	Injuries	Fatalities	Damage $
	Train-Train Collision	Frt Loco hits Loco	0.344	0.0344	84000	0.88	0.088	216000	1.36	0.136	337600
		Frt Loco hits Car	0.28	0.028	70400	0.72	0.072	180000	1.12	0.112	281600
		Frt car hit by Loco	0	0	35200	0	0	89600	0	0	140800
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.06336	0.00648	7920	0.162	0.01656	20160	0.252	0.0252	31680
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.06336	0.00648	7920	0.162	0.01656	20160	0.252	0.0252	31680
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.08448	0.00864	10560	0.216	0.02208	26880	0.336	0.0336	42240
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.08448	0.00864	10560	0.216	0.02208	26880	0.336	0.0336	42240
	Overspeed, Equip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Overspeed, Unequip		0.056	0.0056	150000	0.144	0.0144	375000	0.35	0.035	586000
	Broken Rail, Equip		0.05432	0.005432	145500	0.13968	0.013968	363750	0.3395	0.03395	568420
	Broken Rail, Unequip		0.05432	0.005432	145500	0.13968	0.013968	363750	0.3395	0.03395	568420
	Work Zone Viol'n, Equip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0
	Work Zone Viol'n, Unequip		0.042	0.0042	0	0.066	0.0066	0	0.083	0.0083	0

Casualties and damage in Table 3.1 are per accident, except for Work Zone Violations which are per million train-miles

Table 3.2: Grade Crossing and Diamonds: Numbers by Representative Speed, and Accident Frequency and Consequences

Train Type	Representative Speed (mph)	Type of Grade-crossing	Number Crossings			Accident Frequency		Crossing Collision Consequences						Number Diamonds
			Passenger	HS Passenger	Freight	Per Million Crossing Passes		Pass. Occup't Casualty Prob/accident)			Freight Trains (per accident)			
						Passenger	Freight	Injuries	Fatalities	Cost $/Accid't	Injuries	Fatalities	Cost $	
Passenger	40	Public_gates_lights	0	0		0.350		0.0028	0.000047	50000				2
		Public_other	0	0		0.300								
		Private	0	0		0.100								
	60	Public_gates_lights	14	0		0.600		0.0068	0.000112	113000				0
		Public_other	0	0		0.500								
		Private	0	0		0.200								
	79	Public_gates_lights	15	16		0.800		0.0105	0.000156	196000				0
		Public_other	5	1		0.650								
		Private	5	1		0.300								
	105	Public_gates_lights	0	13		1.100		0.0186	0.000276	346000				0
		Public_other	0	4		0.800								
		Private	0	4		0.300								
Freight	25	Public_gates_lights			3		0.150				0.12	0.005	20000	0
		Public_other			0		0.120							
		Private			0		0.050							
	40	Public_gates_lights			0		0.300				0.25	0.013	50000	2
		Public_other			0		0.250							
		Private			0		0.100							
	50	Public_gates_lights			26		0.360				0.39	0.02	78000	0
		Public_other			5		0.300							
		Private			5		0.120							
		Check Totals	39	39	39									

Table 3.3a: Segment Data (for reference only, not used in calculations)

Segment Number	Start (Milepost)	End (Milepost)	Type	Length (miles)	Representative Speed (mph)			
					Freight	Pass	HS Pass	HS Pass
32	$124.86	$126.50	CP Adjacent (M	1.64	25	40	40	40
33	$126.50	$126.50	Diamond	0.00	25	40	40	40
34	$126.50	$128.76	CP Adjacent (M	2.26	25	60	60	79
35	$128.76	$130.96	Plain	2.20	50	79	79	79
36	$130.96	$133.72	Plain	2.76	50	79	60	105
37	$133.72	$136.90	Plain	3.18	50	79	79	105
38	$136.90	$138.63	CP Adjacent (M	1.73	50	79	79	105
39	$138.63	$141.30	Siding (M)	2.67	50	79	79	105
40	$141.30	$143.35	CP Adjacent (M	2.05	50	79	79	105
41	$143.35	$148.30	Plain	4.95	50	60	79	79
42	$148.30	$150.96	Plain	2.66	50	79	79	105
43	$150.96	$153.56	CP Adjacent (U	2.60	50	79	79	105
44	$153.56	$155.57	Siding (U)	2.01	50	60	60	79
45	$155.57	$155.57	Diamond	0.00	40	40	40	40
46	$155.57	$157.26	CP Adjacent (U	1.69	50	60	60	79
47	$157.26	$160.05	Plain	2.79	50	79	79	79
48	$160.05	$162.11	Plain	2.06	50	79	79	105
49	$162.11	$164.04	Plain	1.93	50	79	79	105
50	$164.04	$166.16	Plain	2.12	50	79	79	105
51	$166.16	$168.34	CP Adjacent (U	2.18	50	79	79	105
52	$168.34	$170.40	Siding (U)	2.06	50	79	79	105
53	$170.40	$172.34	CP Adjacent (U	1.94	50	79	79	105
54	$172.34	$175.84	Plain	3.50	50	79	79	105
55	$175.84	$179.49	Plain	3.65	50	79	79	79
56	$179.49	$180.99	CP Adjacent (M	1.50	50	79	79	79

Table 3.4a: Traffic Inputs to Risk Calculation

Train Type	Trips/Day Summer	Trips/Day Rest of Year
Passenger	6.00	6.00
Equipped Freight	1.73	3.16
Unequipped Freight	0.00	0.00
Operating Days	91	274

Percent Train-Miles in	
Timeout (secs)	0
Normal Operating Mode	95.00
Timeout Mode	0.00
Fallback Mode	5

Passenger Train Occupancy	
Seats	320
Occupancy Factor	0.60

Table 3.3b: Aggregate Segment Data: SegmentsTypes, Train Types, Speeds, and Lengths

Aggregate Segment Length by Type and Speed Band (from Seg Def and Preventability)

Segment Type	Train Type	Represent've Speed (mph)	Freight (miles)	Reg Pass (miles)	HS Pass Collision (mi)	HS Pass Other (mi)
Siding (mon)	Freight	25	0			
		40	0			
		50	2.67			
	Passenger	40		0	0	0
		60		0	0	0
		79		2.67	2.67	0
		105		0	0	2.67
Siding (unmon)	Freight	25	0			
		40	0			
		50	4.07			
	Passenger	40		0	0	0
		60		2.01	2.01	0
		79		2.06	2.06	2.01
		105		0	0	2.06
CP Adjacent (mon)	Freight	25	3.9			
		40	0			
		50	5.28			
	Passenger	40		1.64	1.64	1.64
		60		2.26	2.26	0
		79		5.28	5.28	3.76
		105		0	0	3.78
CP Adjacent (unmon)	Freight	25	0			
		40	0			
		50	8.41			
	Passenger	40		0	0	0
		60		1.69	1.69	0
		79		6.72	6.72	1.69
		105		0	0	6.72
Plain Track	Freight	25	0			
		40	0			
		50	31.8			
	Passenger	40		0	0	0
		60		4.95	2.76	0
		79		26.85	29.04	13.59
		105		0	0	18.21
Totals All Types	Freight	25	3.9			
		40	0			
		50	52.23			
	Passenger	40		1.64	1.64	1.64
		60		10.91	8.72	0
		79		43.58	45.77	21.05
		105		0	0	33.44
	Check Totals		56.13	56.13	56.13	56.13

Table 3.4: Collision Frequencies by Segment Type and Collision Scenario (From Coll Matrix)

Scenarios	Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain	Diamond
Pass Loco Hits Loco	0.0041	0.0054	0.0107	0.0128	0.0011	0.000000
Pass Loco Hits Pass Car	0.0018	0.0024	0.0012	0.0014	0.0002	0.000000
Pass Loco Hits Freight Car	0.0004	0.0005	0.0003	0.0004	0.0001	0.009000
Pass Car Hit by Loco	0.0019	0.0025	0.0013	0.0016	0.0002	0.001800
Freight Loco Hits Loco	0.0005	0.0006	0.0011	0.0013	0.0001	0.000000
Freight Loco Hits Car	0.0001	0.0001	0.0001	0.0001	0.0000	0.029173
Freight Car Hit By Loco	0.0004	0.0005	0.0003	0.0004	0.0001	0.030373

Collision Frequencies for Passenger + Unequipped Freight Train

Siding (M)	Siding (U)	CP Adj (M)	CP Adj (U)	Plain
0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000

Mauve cells contain data imported from Worksheet 2 in this group of three worksheets covering this sub-corridor, season and operating state.

Weighted Collision Accident Frequencies by Representative Speed (mph)

Scenarios	Freight 25	Freight 40	Freight 50	Passenger 40	Passenger 60	Passenger 79	Passenger 105
Pass Loco Hits Loco				0.0106	0.0000	0.0041	0.0050
Pass Loco Hits Pass Car				0.0012	0.0000	0.0007	0.0008
Pass Loco Hits Freight Car				0.0003	0.0000	0.0002	0.0002
Pass Car Hit by Loco				0.0013	0.0000	0.0008	0.0009
Freight Loco Hits Loco	0.0010	0.0000	0.0004				
Freight Loco Hits Car	0.0001	0.0000	0.0001				
Freight Car Hit By Loco	0.0003	0.0000	0.0002				

All train-to-train collision frequencies are in units of **trains in collisions per million train-miles operated in the sub-corridor by all train types.**

Table 3.5a: Risk Calculation - Passenger Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Table 3.5b: Risk Calculation - Collisions at Diamonds - Passenger

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Freq'y (per million tm)	Preventability	Adjusted Frequency	Trips/day	Trips per 10 years	Length of Track (miles)	Train-miles per 10 years	Accidents per 10 years	Number seats per train	Occupancy Factor	Passengers per train	Injuries per 10 years	Fatalities per 10 years	Damage $ per 10 years
40	Train-Train Collision	Pass Loco hits Loco	0.01064	Incl	0.01064	7.73	6683	1.64	10959	0.00012	320	0.6	192	0.0015	0.00004	0
		Pass Loco hits Pass Car	0.00120	Incl	0.00120	7.73	6683	1.64	10959	0.00001	320	0.6	192	0.0001	0.00000	0
		Pass Loco hits Frt Car	0.00034	Incl	0.00034	7.73	6683	1.64	10959	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00131	Incl	0.00131	7.73	6683	1.64	10959	0.00001	320	0.6	192	0.0004	0.00001	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	5187	1.64	8507	0.00004	320	0.6	192	0.0001	0.00000	0
	Intrusion Collision (other))	Pass Loco hits intruder	0.01440	0.12	0.01267	6.00	5187	1.64	8507	0.00011	320	0.6	192	0.0005	0.00002	0
	Overspeed		0.01100	0.00	0.01100	6.00	5187	1.64	8507	0.00009	320	0.6	192	0.0008	0.00001	0
	Broken Rail		0.01670	0.08	0.01536	6.00	5187	1.64	8507	0.00013	320	0.6	192	0.0011	0.00001	0
	Work Zone Violation			0.00		6.00	5187	1.64	8507					0.0007	0.00007	0
										0.00052				**0.00510**	**0.00016**	**0**
60	Train-Train Collision	Pass Loco hits Loco	0.00000	Incl	0.00000	7.73	6683	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Pass Car	0.00000	Incl	0.00000	7.73	6683	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass Loco hits Frt Car	0.00000	Incl	0.00000	7.73	6683	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
		Pass car hit by Loco	0.00000	Incl	0.00000	7.73	6683	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	5187	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.12	0.01267	6.00	5187	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Overspeed		0.01100	0.00	0.01100	6.00	5187	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Broken Rail		0.01670	0.08	0.01536	6.00	5187	0	0	0.00000	320	0.6	192	0.0000	0.00000	0
	Work Zone Violation			0.00		6.00	5187	0	0					0.0000	0.00000	0
										0.00000				**0.00000**	**0.00000**	**0**
79	Train-Train Collision	Pass Loco hits Loco	0.00414	Incl	0.00414	7.73	6683	21.05	140668	0.00058	320	0.6	192	0.021	0.0008	921
		Pass Loco hits Pass Car	0.00070	Incl	0.00070	7.73	6683	21.05	140668	0.00010	320	0.6	192	0.001	0.0001	78
		Pass Loco hits Frt Car	0.00020	Incl	0.00020	7.73	6683	21.05	140668	0.00003	320	0.6	192	0.000	0.0000	22
		Pass car hit by Loco	0.00075	Incl	0.00075	7.73	6683	21.05	140668	0.00011	320	0.6	192	0.008	0.0003	335
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	5187	21.05	109186	0.00054	320	0.6	192	0.004	0.0001	171
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.12	0.01267	6.00	5187	21.05	109186	0.00138	320	0.6	192	0.028	0.0010	1181
	Overspeed		0.01100	0.00	0.01100	6.00	5187	21.05	109186	0.00120	320	0.6	192	0.048	0.0008	3123
	Broken Rail		0.01670	0.08	0.01536	6.00	5187	21.05	109186	0.00168	320	0.6	192	0.066	0.0011	4231
	Work Zone Violation			0.00		6.00	5187	21.05	109186					0.018	0.0018	0
										0.00561				**0.19457**	**0.00592**	**10061**
105	Train-Train Collision	Pass Loco hits Loco	0.00502	Incl	0.00502	7.73	6683	33.44	223466	0.00112	320	0.6	192	0.073	0.0028	3134
		Pass Loco hits Pass Car	0.00083	Incl	0.00083	7.73	6683	33.44	223466	0.00019	320	0.6	192	0.005	0.0002	261
		Pass Loco hits Frt Car	0.00023	Incl	0.00023	7.73	6683	33.44	223466	0.00005	320	0.6	192	0.001	0.0001	71
		Pass car hit by Loco	0.00090	Incl	0.00090	7.73	6683	33.44	223466	0.00020	320	0.6	192	0.026	0.0010	1123
	Intrusion Collision (rollout)	Pass Loco hits car	0.00860	0.43	0.00490	6.00	5187	33.44	173453	0.00085	320	0.6	192	0.011	0.0004	481
	Intrusion Collision (other))	Pass Loco hits car	0.01440	0.12	0.01267	6.00	5187	33.44	173453	0.00220	320	0.6	192	0.077	0.0028	3319
	Overspeed		0.01100	0.00	0.01100	6.00	5187	33.44	173453	0.00191	320	0.6	192	0.103	0.0016	8765
	Broken Rail		0.01670	0.08	0.01536	6.00	5187	33.44	173453	0.00266	320	0.6	192	0.139	0.0022	11875
	Work Zone Violation			0.00		6.00	5187	33.44	173453					0.038	0.0038	0
	Total									**0.00918**				**0.47336**	**0.01485**	**29029**
	Overall Totals									**0.01531**				**0.67303**	**0.02093**	**39090**
	Totals All Speeds	**Train-train Collisions**								**0.00252**				**0.13837**	**0.00526**	**5943**
		Intrusion Collisions								**0.00512**				**0.12079**	**0.00429**	**5153**
		Overspeed								**0.00320**				**0.15179**	**0.00244**	**11888**
		Broken Rail								**0.00447**				**0.20565**	**0.00330**	**16106**
		Work Zone Violation								**0.00000**				**0.05643**	**0.00564**	**0**

Number Diamonds	Freq'y per mill passes	Collisions (millions)	Injuries	Fatalities	Damage
2	0.000000	0.000000	0.000000	0.000000	0.00
2	0.000000	0.000000	0.000000	0.000000	0.00
2	0.009000	0.000120	0.000628	0.000018	24.15
2	0.001800	0.000024	0.000613	0.000018	19.34
		0.000144	**0.001242**	**0.000037**	**43.50**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.009000	0.000000	0.000000	0.000000	0.00
0	0.001800	0.000000	0.000000	0.000000	0.00
		0.000000	**0.00000**	**0.00000**	**0.00**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.009000	0.000000	0.000000	0.000000	0.00
0	0.001800	0.000000	0.000000	0.000000	0.00
		0.000000	**0.00000**	**0.00000**	**0.00**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.009000	0.000000	0.000000	0.000000	0.00
0	0.001800	0.000000	0.000000	0.000000	0.00
		0.000000	**0.00000**	**0.00000**	**0.00**
		0.000144	**0.001242**	**0.000037**	**43**

Table 3.6a: Risk Calculation - Freight Trains (Collisions, Broken Rail Derailments, Overspeed, Work Zones)

Representative Speed (mph)	Accident Scenario	Accident Sub-scenarios	Base Freq'y (per million tm)	Preventability	Adjusted Frequency	Trips/day	Trips per 10 years	Length of Track (miles)	Per 10 years Train-miles	Accidents	Injuries	Fatalities	Damage $
25	Train-Train Collision	Frt Loco hits Loco	0.001049731	Incl	0.00105	7.73	6683	3.9	26062	0.00003	0.00001	0.000001	$2
		Frt Loco hits Car	0.000112471	Incl	0.00011	7.73	6683	3.9	26062	0.00000	0.00000	0.000000	$0
		Frt car hit by Loco	0.000337413	Incl	0.00034	7.73	6683	3.9	26062	0.00001	0.00000	0.000000	$0
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.43	0.00821	1.73	1496	3.9	5833	0.00005	0.00000	0.000000	$0
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.12	0.00757	1.73	1496	3.9	5833	0.00004	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.00	0	3.9	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.00	0	3.9	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.00	0.01600	1.73	1496	3.9	5833	0.00009	0.00001	0.000001	$14
	Overspeed, Unequip		0.016	0.00	0.01600	0.00	0	3.9	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.08	0.05115	1.73	1496	3.9	5833	0.00030	0.00002	0.000002	$43
	Broken Rail, Unequip		0.056	0.00	0.05560	0.00	0	3.9	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.00		1.73	1496	3.9	5833		0.00024	0.000024	$0
	Work Zone Viol'n, Unequip			0.00		0.00	0	3.9	0		0.00000	0.000000	$0
	Totals									**0.0005**	**0.0003**	**0.00003**	**$61**
40	Train-Train Collision	Frt Loco hits Loco	0.0000	Incl	0.00000	7.73	6683	0	0	0.00000	0.00000	0.000000	$0
		Frt Loco hits Car	0.0000	Incl	0.00000	7.73	6683	0	0	0.00000	0.00000	0.000000	$0
		Frt car hit by Loco	0.0000	Incl	0.00000	7.73	6683	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.43	0.00821	1.73	1496	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.12	0.00757	1.73	1496	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.00	0	0	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.00	0	0	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.00	0.01600	1.73	1496	0	0	0.00000	0.00000	0.000000	$0
	Overspeed, Unequip		0.016	0.00	0.01600	0.00	0	0	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.08	0.05115	1.73	1496	0	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Unequip		0.056	0.00	0.05560	0.00	0	0	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.00		1.73	1496	0	0		0.00000	0.000000	$0
	Work Zone Viol'n, Unequip			0.00		0.00	0	0	0		0.00000	0.000000	$0
	Totals									**0.00000**	**0.0000**	**0.00000**	**$0**
50	Train-Train Collision	Frt Loco hits Loco	0.0004	Incl	0.00042	7.73	6683	52.23	349031	0.00015	0.00020	0.000020	$50
		Frt Loco hits Car	0.0001	Incl	0.00006	7.73	6683	52.23	349031	0.00002	0.00002	0.000002	$6
		Frt car hit by Loco	0.0002	Incl	0.00021	7.73	6683	52.23	349031	0.00007	0.00000	0.000000	$10
	Intrusion Coll'n equip (rollout)	Frt Loco hits Car	0.014	0.43	0.00821	1.73	1496	52.23	78114	0.00064	0.00016	0.000016	$20
	Intrusion Coll'n equip (other)	Frt Loco hits Car	0.009	0.12	0.00757	1.73	1496	52.23	78114	0.00059	0.00015	0.000015	$19
	Intrusion Coll'n Unequip (rollout)	Frt Loco hits Car	0.014	0.00	0.01440	0.00	0	52.23	0	0.00000	0.00000	0.000000	$0
	Intrusion Coll'n Unequip (other)	Frt Loco hits Car	0.009	0.00	0.00860	0.00	0	52.23	0	0.00000	0.00000	0.000000	$0
	Overspeed, Equip		0.016	0.00	0.01600	1.73	1496	52.23	78114	0.00125	0.00044	0.000044	$732
	Overspeed, Unequip		0.016	0.00	0.01600	0.00	0	52.23	0	0.00000	0.00000	0.000000	$0
	Broken Rail, Equip		0.056	0.08	0.05115	1.73	1496	52.23	78114	0.00400	0.00136	0.000136	$2,271
	Broken Rail, Unequip		0.056	0.00	0.05560	0.00	0	52.23	0	0.00000	0.00000	0.000000	$0
	Work Zone Viol'n, Equip			0.00		1.73	1496	52.23	78114		0.00648	0.000648	$0
	Work Zone Viol'n, Unequip			0.00		0.00	0	52.23	0		0.00000	0.000000	$0
	Totals									**0.00672**	**0.0088**	**0.00088**	**$3,108**
	Overall Totals									**0.00724**	**0.0091**	**0.0009**	**$3,169**
Totals All Speeds	**Train-Train Collisions**									**0.00028**	**0.00023**	**0.00002**	**69**
	Intrusion Collisions									**0.00132**	**0.00032**	**0.00003**	**40**
	Diamond Collisions									**0.00080**	**0.00028**	**0.00003**	**107**
	Overspeed									**0.00134**	**0.00044**	**0.00004**	**746**
	Broken Rail									**0.00429**	**0.00137**	**0.00014**	**2315**
	Work Zone Violation									**0.00000**	**0.00673**	**0.00067**	**0**
	Grade Crossing Collisions												

Table 3.6b: Risk Calculation - Collisions at Diamonds - Freight

Number Diamonds	Freq'y per mill passes	Collisions (millions)	Injuries	Fatalities	Damage
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.029173	0.000000	0.000000	0.000000	0.00
0	0.030373	0.000000	0.000000	0.000000	0.00
		0.000000	**0.000000**	**0.000000**	**0.00**
2	0.000000	0.000000	0.000000	0.000000	0.00
2	0.029173	0.000390	0.000281	0.000028	70.18
2	0.030373	0.000406	0.000000	0.000000	36.37
		0.000796	**0.000281**	**0.000028**	**106.55**
0	0.000000	0.000000	0.000000	0.000000	0.00
0	0.029173	0.000000	0.000000	0.000000	0.00
0	0.030373	0.000000	0.000000	0.000000	0.00
		0.000796	**0.000281**	**0.000028**	**$107**

Table 3.7: Risk Calculations: Passenger and Freight Trains; Grade Crossings

Train Type	Representative Speed (mph)	Type of Grade-crossing	Base Collision Frequency	Preventability Factor	Adjusted Collision Frequency	Trips per Day	Crossing Passes per Trip	Crossing Passes per 10 Years	Collisions per 10 Years	Seats per Train (Passenger)	Occupancy Factor	Passengers per Train	Passenger/ Crew Injuries per 10 Years	Passenger/ Crew Fatalities per 10 Years	Damage per 10 Years ($)
Passenger	40	Public_gates_lights	0.35	0%	0.350	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Public_other	0.30	0%	0.300	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Private	0.10	0%	0.100	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
	60	Public_gates_lights	0.60	0%	0.600	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Public_other	0.50	0%	0.500	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
		Private	0.20	0%	0.200	6.00	0	0	0.000	320	0.60	192	0.0000	0.0000	0
	79	Public_gates_lights	0.80	0%	0.800	6.00	16	82992	0.066	320	0.60	192	0.1338	0.0020	13013
		Public_other	0.65	0%	0.650	6.00	1	5187	0.003	320	0.60	192	0.0068	0.0001	661
		Private	0.30	0%	0.300	6.00	1	5187	0.002	320	0.60	192	0.0031	0.0000	305
	105	Public_gates_lights	1.10	0%	1.100	6.00	13	67431	0.074	320	0.60	192	0.2649	0.0039	25664
		Public_other	0.80	0%	0.800	6.00	4	20748	0.017	320	0.60	192	0.0593	0.0009	5743
		Private	0.30	0%	0.300	6.00	4	20748	0.006	320	0.60	192	0.0222	0.0003	2154
Freight	25	Public_gates_lights	0.15	0%	0.150	1.73	3	4487	0.001				0.00008	0.00000	13
Equipped		Public_other	0.12	0%	0.120	1.73	0	0	0.000				0.00000	0.00000	0
		Private	0.05	0%	0.050	1.73	0	0	0.000				0.00000	0.00000	0
	40	Public_gates_lights	0.30	0%	0.300	1.73	0	0	0.000				0.00000	0.00000	0
		Public_other	0.25	0%	0.250	1.73	0	0	0.000				0.00000	0.00000	0
		Private	0.10	0%	0.100	1.73	0	0	0.000				0.00000	0.00000	0
	50	Public_gates_lights	0.36	0%	0.360	1.73	26	38885	0.014				0.00546	0.00028	1092
		Public_other	0.30	0%	0.300	1.73	5	7478	0.002				0.00087	0.00004	175
		Private	0.12	0%	0.120	1.73	5	7478	0.001				0.00035	0.00002	70
Freight	25	Public_gates_lights	0.15	0%	0.150	0.00	3	0	0.000				0.00000	0.00000	0
Unequipped		Public_other	0.12	0%	0.120	0.00	0	0	0.000				0.00000	0.00000	0
		Private	0.05	0%	0.050	0.00	0	0	0.000				0.00000	0.00000	0
	40	Public_gates_lights	0.30	0%	0.300	0.00	0	0	0.000				0.00000	0.00000	0
		Public_other	0.25	0%	0.250	0.00	0	0	0.000				0.00000	0.00000	0
		Private	0.10	0%	0.100	0.00	0	0	0.000				0.00000	0.00000	0
	50	Public_gates_lights	0.36	0%	0.360	0.00	26	0	0.000				0.00000	0.00000	0
		Public_other	0.30	0%	0.300	0.00	5	0	0.000				0.00000	0.00000	0
		Private	0.12	0%	0.120	0.00	5	0	0.000				0.00000	0.00000	0
								Total - Passenger	**0.168**				**0.490**	**0.007**	**47540**
Risk Calculations: Passenger and Freight Trains; Diamonds								**Total - Freight**	**0.018**				**0.007**	**0.000**	**1350**
Train Type								**Totals - All Speeds**	**0.186**				**0.50**	**0.01**	**48890**

Table 3.8: Summary - All Risks

Train Type	Accident Scenario	Accidents	Injuries	Fatalities	Damage ($)	Financial Totals ($)
Passenger	Train-Train Collisions	0.00252	0.13837	0.00526	5943	35575
	Intrusion Collisions	0.00512	0.12079	0.00429	5153	30087
	Diamond Collisions	0.000144	0.00124	0.00004	43	279
	Overspeed	0.00320	0.15179	0.00244	11888	34372
	Broken Rail	0.00447	0.20565	0.00330	16106	46569
	Work Zone Violation	0.00000	0.05643	0.00564	0	22570
	Grade Crossing Collisions	0.16832	0.49018	0.00728	47540	118387
	Total, All Scenarios	0.18378	1.16445	0.02824	86673	287838
Freight	Train-Train Collisions	0.00028	0.00023	0.00002	69	162
	Intrusion Collisions	0.00132	0.00032	0.00003	40	166
	Diamond Collisions	0.00080	0.00028	0.00003	107	219
	Overspeed	0.00134	0.00044	0.00004	746	923
	Broken Rail	0.00429	0.00137	0.00014	2315	2864
	Work Zone Violation	0.00000	0.00673	0.00067	0	2691
	Grade Crossing Collisions	0.01781	0.00677	0.00035	1350	3065
	Total, All Scenarios	0.02585	0.01614	0.00128	4626	10091
Total Passenger + Freight		**0.20963**	**1.18059**	**0.02952**	**91300**	**297929**
	Unit Costs ($/Casualty)		100000	3000000		

Data exported to the Results Summary worksheet