U.S. Department of Transportation

Federal Transit Administration

2022 FTA JOINT STATE SAFETY OVERSIGHT AND RAIL TRANSIT AGENCY HYBRID WORKSHOP

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Signal System Safety: Safety Advisory Overview

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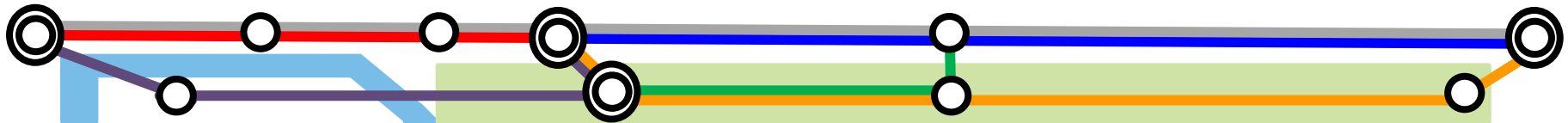


Meeting Purpose & Agenda

The purpose of this session is to provide State Safety Oversight Agencies (SSOA) and Rail Transit Agencies (RTA) with a summary of Safety Advisory 22-2 issued by the Federal Transit Administration (FTA) regarding signal system safety and to provide an overview of risk assessment best practices.

Meeting Agenda

- Overview of Safety Advisory 22-2
- Background
- Recommended Action
- Risk Assessment Best Practices
- Next Steps

Safety Advisory 22-2 Overview and Purpose

Safety Advisory Overview

- **Distribution**: Published in the Federal Register
- **Safety Advisory Number:** 22-2 (SA 22-2)
- **Audience**: SSOAs and RTAs
- **Purpose**: FTA recommends that SSOAs direct RTAs that operate Rail Fixed Guideway Public Transportation Systems in their jurisdictions to consider signal system safety and train control as part of their Safety Risk Management (SRM) processes required under the Public Transportation Agency Safety Plan regulation. In addition, FTA advises SSOAs to incorporate SA 22-2 into their oversight activities.

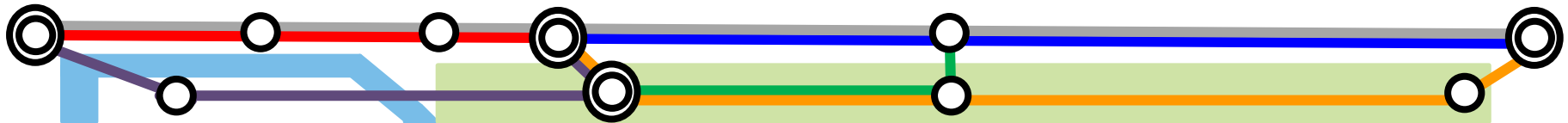
Signal Systems Background

Function of Signal Systems

- Control and monitor the movement of trains
- Locate and maintain safe separation between trains and can control train speeds and movements

Signal System Standards

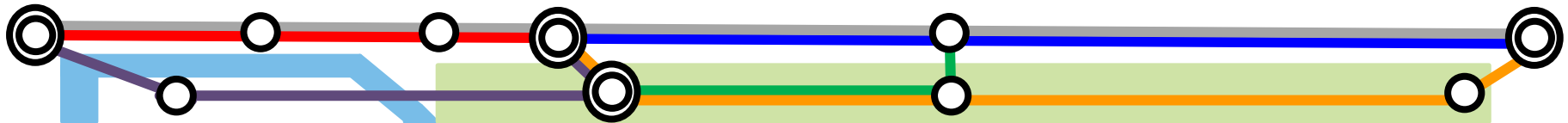
- FTA has not issued minimum safety standards governing the use of signal systems in the transit industry
- The American Public Transportation Association has created and issued a series of voluntary minimum signal safety standards
- RTAs deploy various designs and technologies based on system configurations, vehicle selection, available funding, and self-defined system performance requirements
    - Some RTAs do not use formal signal systems and others use sophisticated signal system technology that automatically controls trains



Safety Advisory Background (1 of 2)

Summary of Source Inputs

- The following sources helped identify signal system safety as a top safety priority for FTA:
  - National Transit Database
  - State Safety Oversight Reporting Tool
  - Requests for information (RFIs)
  - National Transportation Safety Board (NTSB) investigation results
  - Reports from the Transit Advisory Committee for Safety (TRACS)
  - Subject matter expertise



Safety Advisory Background (2 of 2)

RFI

- On February 6, 2019, FTA issued an RFI to SSOAs to inventory hazards, incidents, and safety risks related to train control systems (TCS) in the rail transit industry
- Nationwide, 38 RTAs operate 42 rail transit lines with at least one form of TCS, including Automatic Train Control and Automatic Block System

NTSB

- NTSB has issued two recommendations to FTA related to signal system safety:
  - R-09-008
  - R-15-022 (*supersedes R-09-008*)
- Based on these recommendations, FTA selected signal system safety as a priority topic for assessment through its SRM process
- NTSB reiterated R-15-022 in its April 2022 accident investigation report on a 2019 collision between two Sacramento Regional Transit trains

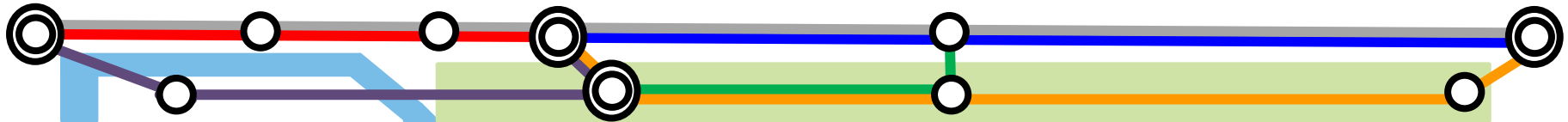
TRACS

- TRACS, FTA's Federal advisory committee on transit safety matters, highlighted the benefits of signal systems and TCS in its reports on roadway worker protection and trespass and suicide prevention
- TRACS also discussed the importance of signal system expertise for SSOAs to conduct sufficient oversight in its report on state safety oversight

Identified Hazards and Consequences (1 of 2)

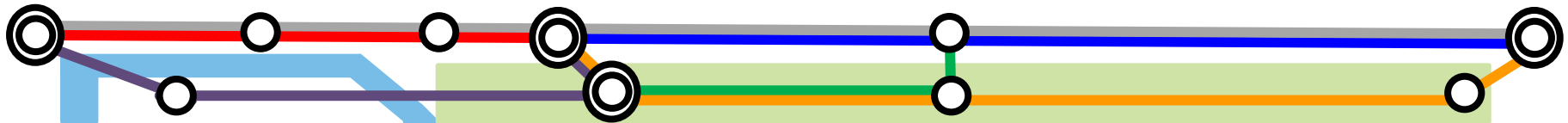
FTA identified the following hazards and consequences through its SRM analysis of signal system safety:

Hazard	Description	Potential Consequence
Wayside signal components insufficiently maintained	Signal components that are on the roadway or in signal rooms (wayside), such as relays, cables, or signal sources, are not maintained according to manufacturer or agency standards	Signal system fails to detect occupancy of track segment (false clear) as designed resulting in a train-to-train collision
		Signal system fails to properly route train through interlocking resulting in a train-to-train collision or derailment
		Signal system fails to control train movements as designed resulting in a train-to-train collision or derailment
Vehicle signal components insufficiently maintained	Signal components that are within a rail vehicle, such as receivers, relays, and cab signals, are not maintained according to manufacturer or agency standards	Signal system fails to control train movements as designed resulting in a train-to-train collision or derailment



Identified Hazards and Consequences (2 of 2)

Hazard	Description	Potential Consequence
Signal system design insufficiency	A signaling system that is not designed to accommodate the current level of service or technology in use	Signal system fails to detect occupancy of track segment (false clear) as designed resulting in a train-to-train collision
		Signal system is designed to permit trains to move in violation of speed commands resulting in a train-to-train collision or derailment
		Signal system does not provide adequate vehicle spacing and stopping distances resulting in a collision
		Train operators or controllers fail to respond to signal system information resulting in a train-to-train collision or derailment
Signal system not present	A signal system is not present. Instead, the agency relies on line-of-sight and standard traffic signals to operate	Train movement is not controlled by the RTA resulting in train-to-train collision or derailment

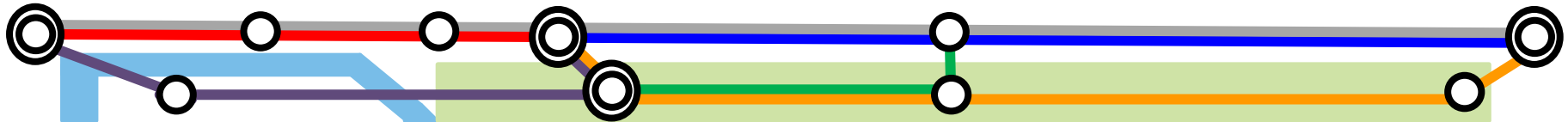


Recommended Actions

FTA recommends that SSOAs direct RTAs to, at a minimum, consider the hazards identified in SA 22-2 as a source of information in their safety risk assessments

At locations where signal systems are not presently installed, FTA recommends that RTAs consider whether safety hazards and risks exist in the absence of signal system installations and whether mitigations may be necessary

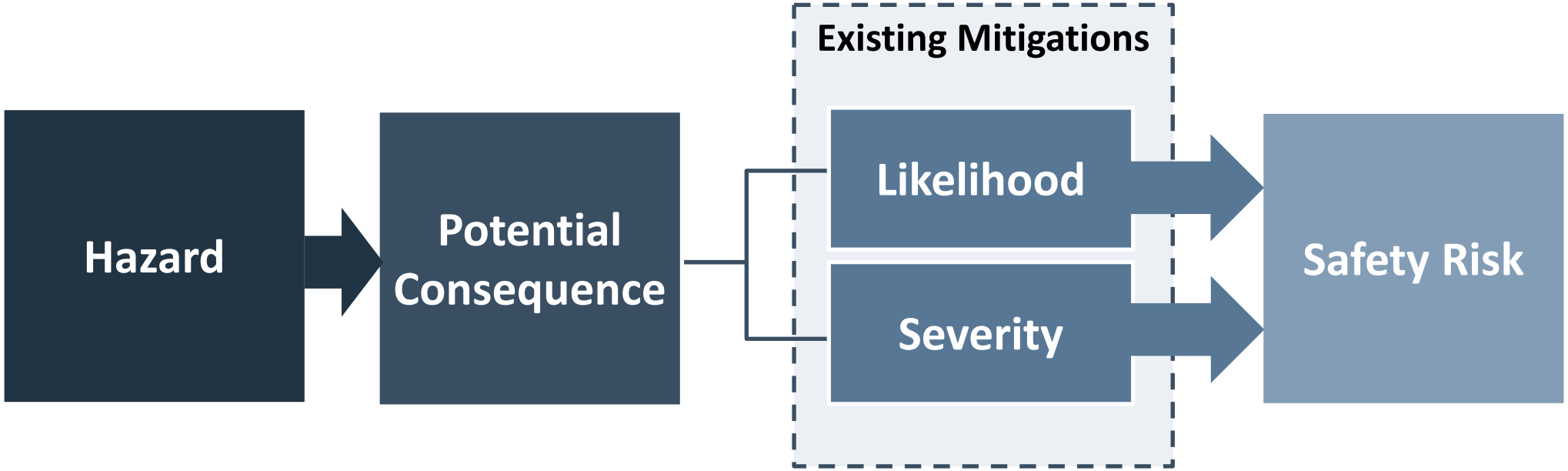
FTA recommends that SSOAs obtain completed risk assessments and any associated safety risk mitigations from RTAs within 180 days of issuance of SA 22-2



Safety Risk Assessment

Safety Risk Formula

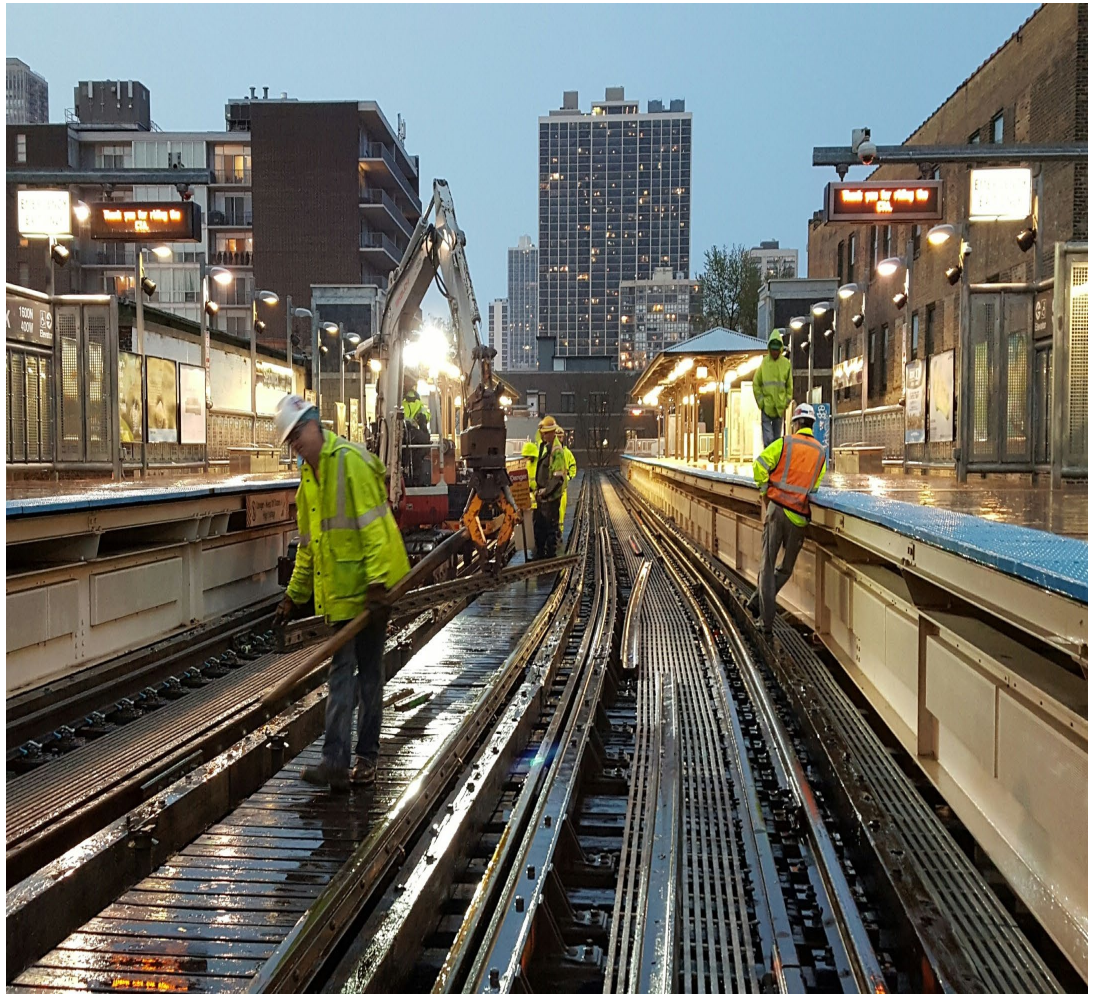
Safety Risk = Likelihood x *Severity*



Example: Hazard, Consequence Identification

Hazards and Consequences

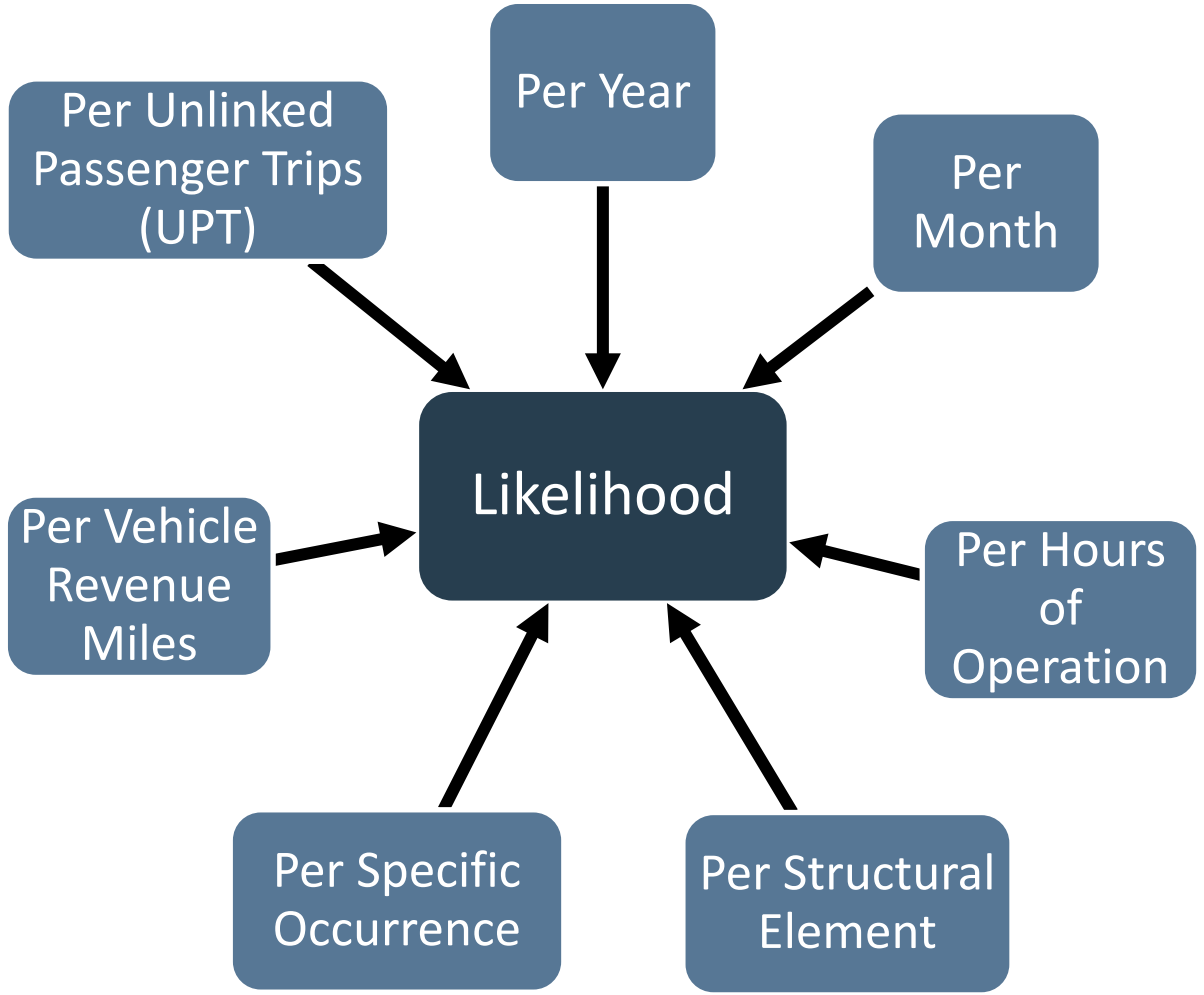
- **Hazards**
  - Intentional Trespass
  - Unintentional Trespass
- **Consequences**
  - Injury
  - Death
  - Property Damage
  - Operator Mental Distress
  - Public Relations Damage
  - Litigation



Assessing Likelihood

Likelihood

- Likelihood is an estimation of how likely a potential consequence is to happen
- Likelihood can be estimated:
  - Using quantitative and qualitative data
  - Using lagging and leading indicators
- Likelihood risk is “scored” or normalized using established likelihood scales
  - Likelihood scales can use different denominators – such as time, service provided, or service consumed – to account for the type of consequence and available information

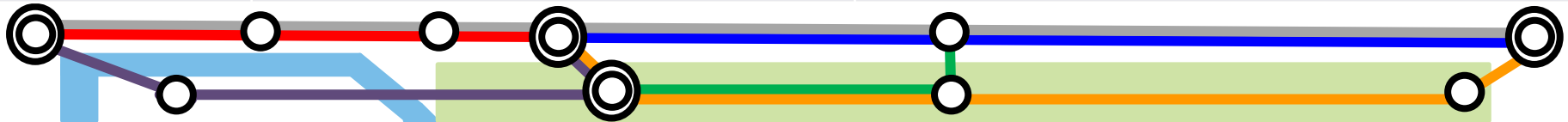


Example: Likelihood Assessment

Types of Considerations

- Lagging Indicators
- Leading Indicators
- External Conditions
- Existing Mitigations

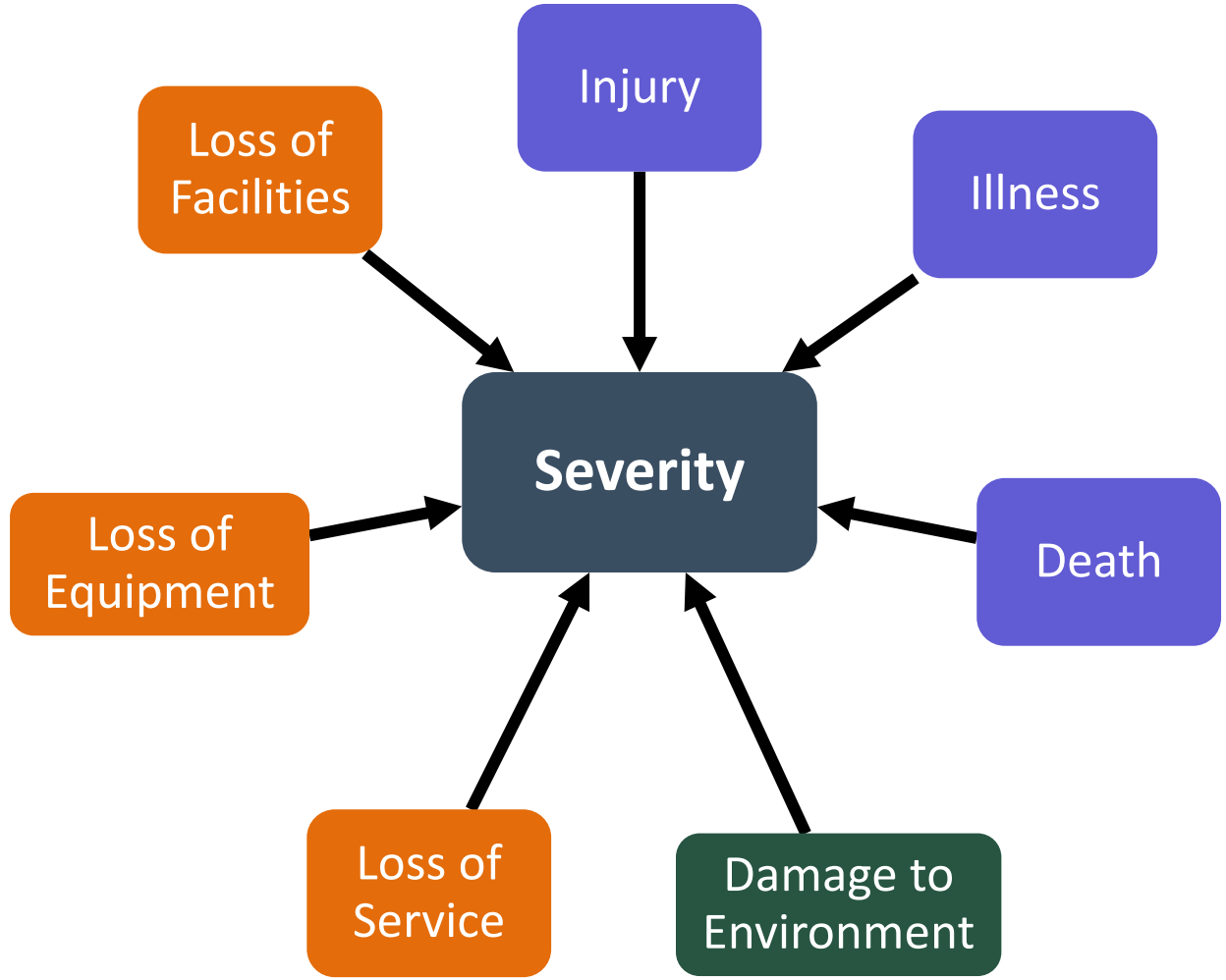
Sample Scale			
Rating	***Frequency***	***Per Year Example***	***Per UPT Example***
Frequent	Occurs regularly	Slips, trips, and falls	Slips, trips, and falls
Probable	Occurs sometimes	Collisions with privately owned vehicle	Injuries from wheelchair lifts/ramps
Moderate	Occurs occasionally	Suicides in the right of way	Station train-to-person collisions
Low	Occurs infrequently	500-year storm	Injuries from robbery in a station
Very Low	Improbable	Mass casualty incident	Injuries from flooding inside a rail station



Assessing Severity

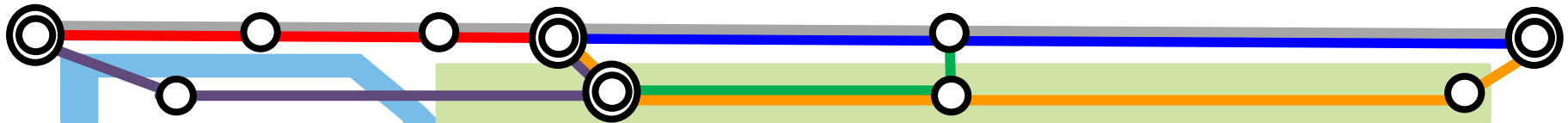
Severity

- Severity is the estimation of how serious the effects of a potential consequence may be
- Severity considers the impacts on **people**, the **system**, and the **environment**
  - Severity also considers the gravity of damage, duration of impact, and cost
- Examples:
  - The seriousness of injuries from a fall from the platform
  - The amount of time it takes for power restoration after an outage
  - The cost to replace equipment lost to storm surge



Example: Severity Assessment

Example Consequence: Outage		
Rating	***Outage***	***Outage Severity***
1	Negligible outage	Little or no noticeable impact on service
2	Minimal service outage	Service disrupted but minimal impact on customers
3	Significant service outage	Customer service interruptions of limited scope, duration and/or effect
4	Serious service outage	Limited-term disruptions in service impacting that may include threats to life safety, finances, property and/or reputation
5	Major service outage	Severe disruptions that will likely be of long-term duration that threaten life safety, finances, property and reputation.



Safety Risk Prioritization

Safety Risk Formula

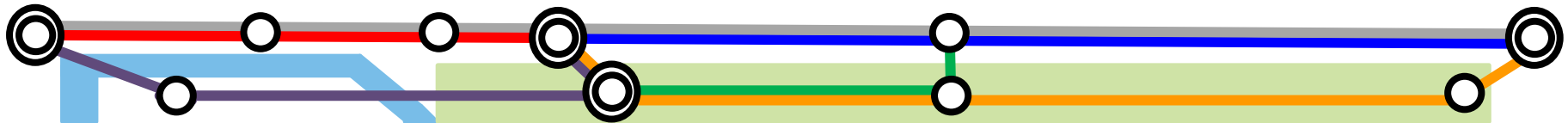
Safety Risk = Likelihood X Severity

Likelihood \ Severity	1	2	3	4
A	1A	2A	3A	4A
B	1B	2B	3B	4B
C	1C	2C	3C	4C
D	1D	2D	3D	4D
E	1E	2E	3E	4E

Unacceptable under existing circumstances	
Acceptable, but monitoring is necessary	
Acceptable under existing circumstances	

Example: Prioritizing Risks

Hazard Description	Hazard Cause/Effect		Hazard Risk Index Assessment		
	Potential Cause	Consequences	Initial Risk Rating	Likelihood	Severity
Failure of radio system	Equipment/power failure	Loss of comms during regular or emergency situations, death, injury, property damage	IC	Occasional	High
Person struck by approaching/ departing vehicle	Design element; poor or incorrect signage, passenger or operator inattention	Personal injury, loss of life	IIC	Occasional	Moderate
Flooding	Human error (errant backhoe), infrastructure failure (water main break, sewer system failure)	Flooded roadways, damage to vehicles and infrastructure	IIIC	Occasional	Low



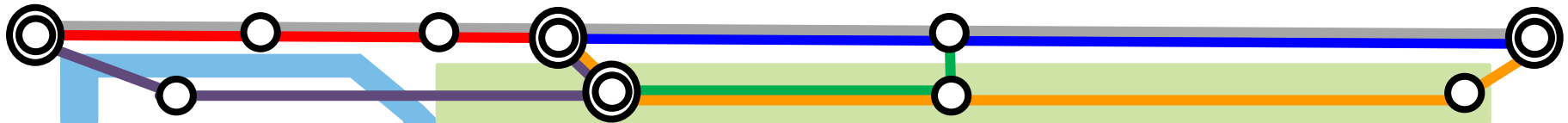
Safety Risk Mitigation

Mitigations

- The objective is to consider whether mitigations or strategies can:
  - Reduce risk by affecting the likelihood and/or severity risk, or
  - Eliminate the risk altogether, if possible
- Mitigations can be through design changes or operational in nature
- Agencies should consider potential cost/benefit of mitigations
- ***Agencies may accept risk and choose not to implement mitigations***

What will our safety risk mitigation achieve?

- Reduce ***Likelihood***
- Reduce ***Severity***
- Reduce ***Likelihood*** and ***Severity***
- Eliminate ***Risk***
- Accept ***Risk***



Example: Identifying Mitigations

Hazard Description	Hazard Cause/Effect		Hazard Risk Index Assessment			
	Potential Cause	Consequences	Initial Risk Rating	Likelihood	Severity	Possible Controlling
Failure of radio system	Equipment/power failure	Loss of comms during regular or emergency situations, death, injury, property damage	IC	Occasional	High	Peform propagation study perform radio coverage t supplemental repeaters, equipment.
Person struck by approaching/ departing vehicle	Design element; poor or incorrect signage, passenger or operator inattention	Personal injury, loss of life	IIC	Occasional	Moderate	Design pedestrian walkw MUTCD, ADA and other standards; install appropr markings or barriers; and procedures.
Flooding	Human error (errant backhoe), infrastructure failure (water main break, sewer system failure)	Flooded roadways, damage to vehicles and infrastructure	IIIC	Occasional	Low	Utilize reroute measures necessary.

Mitigations	
Possible Controlling Measures and Remarks	**Residual Risk Rating**
Peform propagation study for frequency range; perform radio coverage test of system; add supplemental repeaters, provide redundant equipment.	IID
Design pedestrian walkways in accordance with MUTCD, ADA and other relevant codes and standards; install appropriate signage, roadway markings or barriers; and enforce operator rules and procedures.	IID
Utilize reroute measures or suspend services as necessary.	IVC

Discussion & Next Steps

FTA Safety Advisory 22-2: Signal System Safety and Train Control
https://www.transit.dot.gov/regulations-and-programs/safety/fta-safety-advisory-22-2-signal-system-safety-and-train-control

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