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SUMMARY OF SIGNIFICANT CHANGES
EP-13 Light Rail Grade Crossings, Rev 1 – August 2025

- **Clarified process for diagnostics review of approved new and temporary at-grade crossings for Link alignment.**

- **Clarified roles and responsibilities for the DOR and other stakeholders.**

- **Clarified activities for design submissions.**

- **Exhibits**
  - Updated Diagnostics Review Worksheet.
  - Updated Pedestrian Sight Distance Example.
  - Updated Pedestrian Control Decision Tree.

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Approvals:	ENGINEERING DESIGN PROCEDURES	EP- 13 Rev: 1
Brian Holloway AO Chief Engineer Joanna Perez Director of Technical Standards & Requirements	**Light Rail Grade Crossings**	
	Original Issue Date: 2/2/16 Current Revision Date: 8/7/25	

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1.0 PURPOSE

This procedure establishes requirements for documenting rationale, engineering, and coordination of design decisions for new (permanent or temporary) light rail at-grade crossings. The goal is to achieve the following objectives for the new light rail at-grade crossings for Link:

- Define role and responsibilities of the DOR and the stakeholders.
- Provide diagnostic review requirements including design submission checklist for key activities.
- Ensure consistent application of warning and control devices.

2.0 APPLICABILITY

This document is applicable for the design of all new (permanent or temporary) at-grade crossings for Link.

3.0 SCOPE

This Engineering Procedure covers the use of the Grade Crossing Diagnostic Review Worksheet for new (permanent or temporary) at-grade crossings. This procedure applies to all Sound Transit staff, Designer of Record, and Authorities Having Jurisdiction (AHJ).

Prescriptive requirements for grade crossings can be found within the Sound Transit Requirements Manual (STRM) Set 120 At-Grade Crossings, Set 125 Link Train Control Block Design and the Manual on Uniform Traffic Control Devices (MUTCD). However, engineering judgement and experience is a significant factor when determining the use of a particular device or design approach. This Engineering Procedure will ensure the proper consideration, coordination and experience is applied to the grade crossing design.

Sound Transit light rail service provides fast, reliable, and frequent service connecting population centers that are typically in urban settings. These built-up environments have many considerations to ensure the highest practical level of safety including site distance, train speed, crossing usage, warning and control devices etc.

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4.0 REFERENCES

- Sound Transit Requirements Manual (STRM)
- Sound Transit Standard and Guidance Drawings
- Sound Transit Standard and Guidance Specifications
- Clark, R. (2008). *Pedestrian-Rail crossings in California*. California Public Utilities Commission. https://docs.cpuc.ca.gov/Published/Graphics/83568.pdf
- Federal Highway Administration. (2023). *Manual on uniform traffic control devices for streets and highways* (11th ed.). U.S. Department of Transportation. https://mutcd.fhwa.dot.gov
- Transportation Research Board. (2001). *TCRP Report 69: Certification of transit vehicle crashworthiness*. The National Academies Press. https://doi.org/10.17226/10141
- Transportation Research Board. (2015). *TCRP Report 175: Improving safety culture in public transportation*. The National Academies Press. https://doi.org/10.17226/22172
- U.S. Department of Transportation, Federal Railroad Administration, Office of Safety. (2008, January). *Compilation of pedestrian safety devices in use at grade crossings*. Washington, DC. Retrieved from https://www.fra.dot.gov/Elib/Document/1370
- U.S. Department of Transportation, Federal Railroad Administration. (2016, June). *Engineering design for pedestrian safety at highway-rail grade crossings* (Report No. DOT/FRA/ORD-16/24). Volpe National Transportation Systems Center. https://www.fra.dot.gov/elibrary/details/L18250

5.0 ACROYNMS

- AHJ – Authorities Having Jurisdictions
- AOD – Agency Oversight Department
- DOR – Designer of Record
- SME – Subject Matter Expert

6.0 DEFINITIONS

- AHJ – Authorities having jurisdictions (City, County, State, Fire Service etc) other than Sound Transit.
- AOD Information Services – Sound Transit Architectural, Engineering & Construction Technology team.
- AO Safety – Sound Transit Agency Oversight Transportation Safety & Security.
- Chief Engineer – Sound Transit Executive Director of Engineering Oversight (Chief Engineer).

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- DOR – This position can be either Sound Transit Engineering design team lead or consultants' design lead who will be responsible for all diagnostics site visit(s), design tasks and issuing bid packages.
- Engineering SME(s) – Lead Sound Transit Engineer(s) to review the design tasks.
- EIC – Employee in Charge assigned from King County Metro Rail ensuring safe workplaces for all the staff working within Sound Transit right-of-way.
- Fatal Flaw – A fatal flaw(s) is a critical and irreversible condition that prevents a project from proceeding, renders the design or concept unfeasible or leads to failure to meet Agency or AHJ standards. Some examples of fatal flaws for at-grade crossing project are inadequate sight distance, insufficient warning systems, improper geometric design, non-compliance with Sound Transit or AHJ requirements, right-of-way conflict, conflict with future development.
- New Crossing – Approved new crossing for Link Light Rail. It can be permanent or temporary.
- Project Design Manager – Sound Transit Project Manager assigned to manage the at-grade crossing project(s).
- Preemption - A traffic control strategy where normal traffic signal operations are temporarily interrupted to give priority to specific vehicles such as trains or emergency vehicles.
- Pre-Signal - A traffic signal installed upstream of a main signal, usually near a railroad grade crossing to control the flow of vehicles into a critical area, such as a railroad track or intersection, and prevent vehicles from stopping on the tracks or entering an unsafe zone.
- Priority - A traffic signal system or control feature that modifies signal timing to favor certain vehicles, such as transit, emergency vehicles, or freight, without fully interrupting the normal operation of the traffic signal (unlike preemption).
- Queue Cutter Signal - A special type of midblock traffic signal used to interrupt traffic flow temporarily on a major road so that vehicles from a minor side street or driveway often a bus, truck, or emergency vehicle can safely enter or cross the road when queues from nearby intersections block access.

7.0 RESPONSIBILITIES

7.1 DIAGNOSTICS REVIEW

For new at-grade crossings, the diagnostic review team will be comprised of Sound Transit Project Manager, Engineering SME, DOR and AHJs.

- Project Design Manager will be responsible for communication with Chief Engineer, Engineering SME, DOR and AHJs. Project Manager is also responsible for coordinating the site visit and EIC support for diagnostics review.
- Chief Engineer will assign the Engineering SME(s) to act as Sound Transit engineering lead for design tasks and review coordination with the DOR.

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- Engineering SME(s) in collaboration with AO Safety will attend the diagnostics site visit and will review the design tasks and will ensure the submittals are compliant with design scope and requirements.
- AO Safety will collaborate with Engineering SME for diagnostics site visit and design reviews.
- AOD Information Services will be responsible for providing guidance on CAD standards and auditing the design files for Sound Transit CAD requirements' compliance.
- The DOR of the design team leads the diagnostic review effort. This DOR must have a Professional Engineering License from Washington State to stamp and seal the designed crossing. It is the responsibility of the DOR to ensure the design reflects the agreements within the scope of work in concurrence with the Engineering SME(s) and the diagnostic review worksheet. The DOR will be responsible for developing a memo for diagnostic review and will submit it to Engineering SME(s) for review.

8.0 QUALITY

Each design submittal must follow quality procedures as detailed in the ST Quality approved project-specific Quality Management Plan (QMP) inclusive of visible, traceable, and verifiable design quality checking procedures with resultant Check Prints for design submittal documents (e.g. drawings, specifications, calculations, technical reports, technical memos, etc.).

9.0 PROCEDURES

For the approved new at-grade crossings, the DOR will collaborate with the Project Design Manager, Engineering SME(s) and AHJ(s) to advance the design from the conceptual to the final phase. The DOR must comply with the following procedures:

- Coordinate with the Project Design Manager to schedule site visits for diagnostics.
- Conduct diagnostics site visit with the Project Design Manager, Engineering SME(s), AO Safety and AHJ(s).
- Complete the Diagnostics Review Worksheet (refer to attached EP-13-02).
- Collaborate with the Engineering SME(s) and AO Safety to determine the required treatments for the proposed at-grade crossing (refer to attached EP-13-02, Section 3).
- Ensure the design is in compliance with the STRM and AHJ requirements.
- Complete the core design activities listed in the design submittals' checklist (refer to attached EP-13-01).
- Conduct comment resolution meeting(s) with the Sound Transit Project Design Manager and Reviewers for each design phase. The DOR can invite additional designers who are working on the design. Project Design Manager and Engineering SME(s) may direct that the Comment Resolution Meeting also include representatives from AHJs.

10.0 EXHIBITS

- EP-13-01 Design Submittals
- EP-13-02 Light Rail Grade Crossing Diagnostic Review Worksheet
- EP-13-03 Pedestrian Sight Distance Example
- EP-13-04 Pedestrian Controls Decision Tree
- EP-13-05 Pedestrian and LRV Crossing Equations

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EP-13-01 DESIGN SUBMITTALS

Note: This list identifies the core submissions and is not a comprehensive Design Submission Checklist. See EP-03 Design Checklist for complete design submissions' requirements.		
Project Phase	**Description**	**Key Activities**
Pre-Diagnostics	After the project kick-off meeting, the DOR collaborates with the Engineering SME to assess the existing conditions of the crossing.	-Develop site distance exhibits using Google Maps as background. -Evaluate sight distances and assess existing infrastructure. -Participate in a site visit with Project Manager, Engineering SME and AO Safety to analyze conditions. -Revise and update exhibits to reflect recommended safety enhancements based on virtual meetings and field observations.
Conceptual Engineering (5-10%)	Completed to support the definition, comparison, and assessment of alternatives developed during the pre-diagnostics phase.	-Analyze and eliminate the alternatives with fatal Flaws. -Conduct cost comparisons for all viable alternatives. -Develop appropriate mitigation measures. -Identify and assess right-of-way requirements. -Prepare baseline comparative data to support alternatives' evaluations. -Ensure compliance with environmental regulations. -Identify the preferred alternative based on evaluation criteria. -Conduct comment resolution meeting with Project Manager, Engineering SME(s) and AO Safety.
Preliminary Engineering (30%)	Advanced design of the preferred alternative to refine project costs and implement mitigation requirements identified during environmental review.	-Refine project cost estimated including appropriate contingencies. -Implement required mitigation measures. -Coordinate with AHJs. -Include sight triangle and sight distance diagrams for pedestrians analysis. -Develop the Concept of Operations and create VISSIM models/simulations. -Request traffic control information from relevant AHJs. -Conduct comment resolution meeting with Project Manager, Engineering SME(s) and AO Safety.

Note: This list identifies the core submissions and is not a comprehensive Design Submission Checklist. See EP-03 Design Checklist for complete design submissions' requirements.		
Project Phase	**Description**	**Key Activities**
60% Design (60%)	Identification of key technical elements and coordination between design disciplines, incorporating comments from previous submittals.	-Address comments received from previous submittals. -Coordinate closely with all relevant design disciplines. -Obtain early input from Engineering SME(s), AO Safety and AHJs. -Refine and update the design from preliminary engineering. -Incorporate sight line and nominal braking distance into the design. -Conduct comment resolution meeting with Project Manager, Engineering SME(s) and AO Safety.
Final Design (100%)	Design completion and submission for final review.	-Finalize the design, prepare a list of lessons learned and all associated documentations. -Complete and finalize Diagnostic Review Worksheet (see attached Exhibit EP-13-02).

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EP-13-02 LIGHT RAIL GRADE CROSSING DIAGNOSTIC REVIEW WORKSHEET

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LINK LIGHT RAIL GRADE CROSSING

DIAGNOSTIC REVIEW WORKSHEET

MM/DD/YYYY

At-Grade Crossing Design
Assume "Year of Opening" for use of this form.

Prepared by _____

Date _____ Scheduled "year of opening" _____

Location (attach a site vicinity map to show the north arrow, proposed crossing location, surrounding streets, adjacent signalized intersections, and any pedestrian generators)

Pedestrian-only crossing _____ Vehicle-only crossing _____ Both Ped & Vehicle crossing _____

Street/Intersection name _____ Crossing (Permanent/Temporary) _____

Authority Having Jurisdiction _____

Section 1 - Site Specific Information

1.1 Pedestrian and Bike related Information

1	Where do bicyclists cross the tracks? (Vehicular Lane/ Pedestrian Path/ Bike Lane)		
2	Expected pedestrian/bicyclists is greater than 50 (AM or PM weekday or weekend peak hour)	Yes	No
3	Is there a large pedestrian generator adjacent to the crossing? Example: bus stop, hospital, school, stadium etc.	Yes	No

Additional Information:

_____
_____
_____

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1.2 Roadway related Information

1	Is crossing at a vehicular signalized intersection?	Yes	No
2	Are any signalized or stop-controlled intersections/driveways located within 500 feet of the crossing?	Yes	No
3	Number of travel lanes in each direction of the roadway approaching the crossing (exclude left-turn pockets)		
4	Average Daily Traffic (ADT)		
5	Vehicular Speed Limit (mph)		
6	Are left turns allowed, from a parallel street, across the tracks?	Yes	No

Additional Information:

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Section 2 - Sight Distance, Obstructions, and Remedy

2.1 - Related to Pedestrians

1	Pedestrian sight distance to an approaching train and include exhibits *Refer to EP-13-03 for sight triangle example*	From _____ approach to track(s) looking left _____ right_____ From _____ approach to track(s) looking left _____ right_____ From _____ approach to track(s) looking left _____ right_____ From _____ approach to track(s) looking left _____ right_____	
2	List any crossing angles, grades, curvature or obstructions that limit the view of advancing trains		
3	Pedestrian crossing distance *Refer to EP-13-03 for sight triangle example*	_____ feet	
4	Pedestrian Crossing Time *Refer to EP-13-05 for equations for calculation*	_____ seconds	
5	Train travel distance when pedestrian is crossing *Refer to EP-13-05 for equations for calculation*	_____ feet	
6	Is Sight distance < Train Travel Distance?	Yes	No
	If yes, what changes can be made to improve sight triangle?		

Note: Provide additional sight distance calculations (use the same worksheet) and exhibits (refer to EP-13-03) for reverse train operations.

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2.2 - Related to Light Rail Vehicle

1	Distance between the face of the train to the crossing with an unobstructed sight line (account for both direction of travel NB/SB or EB/WB); include exhibits *Refer to EP-13-03 for sight triangle example*	_____ feet	
2	Nominal braking distance for the train (account for both direction of travel NB/SB or EB/WB) *Refer to EP-13-05 for equations for calculation*	_____feet	
3	Is Nominal braking distance > unobstructed sight line? Nominal braking distance can not be greater than the unobstructed sight line. If greater, automatic ped gates must be required. *Refer to EP-13-05 for equations for calculation*	Yes	No

Note: Provide additional sight distance calculations (use the same worksheet) and exhibits (refer to EP-13-03) for reverse train operations.

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Section 3 - Designed Warning and Control Devices (check all that apply)

Based on the information documented in Sections 1-3 and the Sound Transit Requirements Manual for At-Grade Crossings (Set 120), select and design the appropriate treatments from the list below.

Traffic	Crossing Treatment	Yes/No
Vehicle	Warning Bell	
	Two-Quadrant Vehicular Automatic Gates with Vehicle Loops	
	Post-Mounted Flashing Lights	
	Cantilever-Mounted Flashing Lights	
	Four-Quadrant Vehicular Automatic Gates	
	Advance Warning Sign (W10-1)	
	Crossbucks Sign (R15-1)	
	No of Tracks Sign (R15-2P)	
	DO NOT STOP ON TRACKS Sign (R8-8)	
	STOP HERE WHEN FLASHING Sign (R8-10)	
	No Left Turn/Train Coming Dynamic Sign	
	Another Train Coming Sign	
	Emergency Notification Sign (I-13)	
	Railroad Pavement (RXR) Markings	
	Raised Median	
	Preemption	
	Priority	
	Pre-Signals	
	Queue-Cutter Signals	
Pedestrian	Flashing Lights with Bell	
	Low-Mounted Flashers	
	LOOK BOTH WAYS Sign (R15-8)	
	Another Train Coming with Arrows Flashing Dynamic Message Sign	
	Another Train Coming Sign (Text Only)	
	Crossbucks Sign (R15-1)	
	No of Tracks Sign (R15-2P)	
	Four-Quadrant Pedestrian Automatic Gates	
	Swing Gate (identify the crossing approach)	
	Tactile Warning Strip	
	Stop Here Pavement Marking	
	Dynamic Message Sign at an Adjacent Traffic Signal	

Active warning devices require track detection in order to activate a response, such as flashing lights, signal preemption, priority, pre-signals, queue cutter signals etc. Which active warning device, if any, will be used and therefore require track detection?

_____

Additional Recommendations/Action Items

_____
_____
_____
_____
_____
_____

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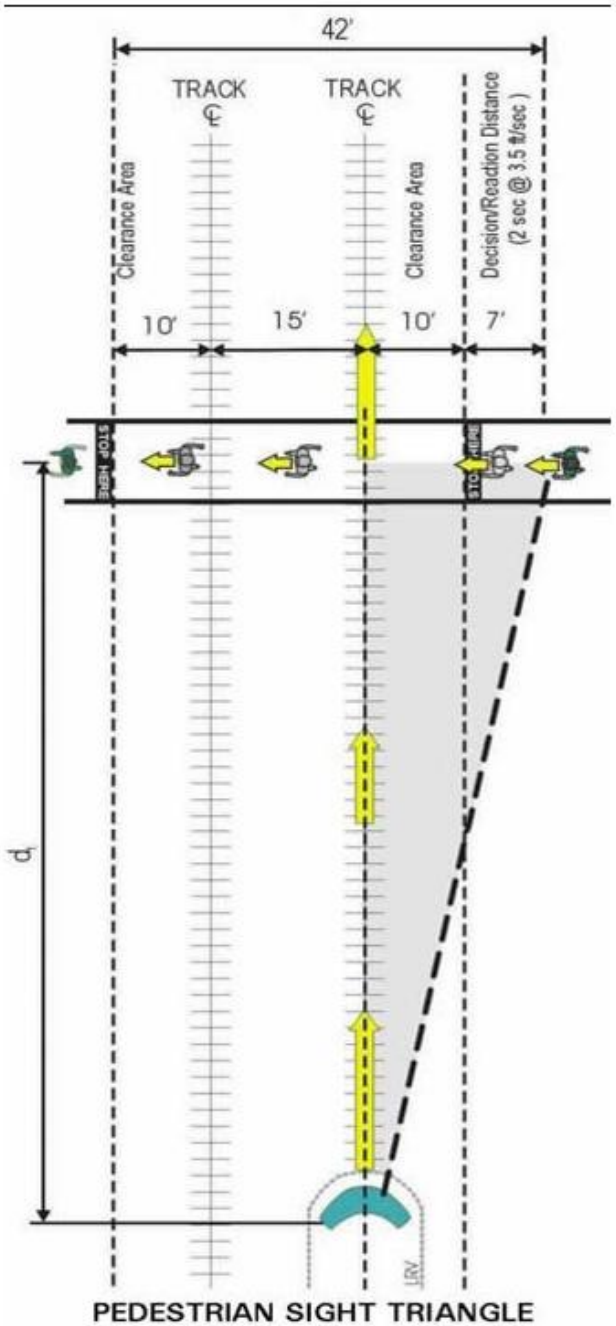
EP-13-03 PEDESTRIAN SIGHT DISTANCE EXAMPLE

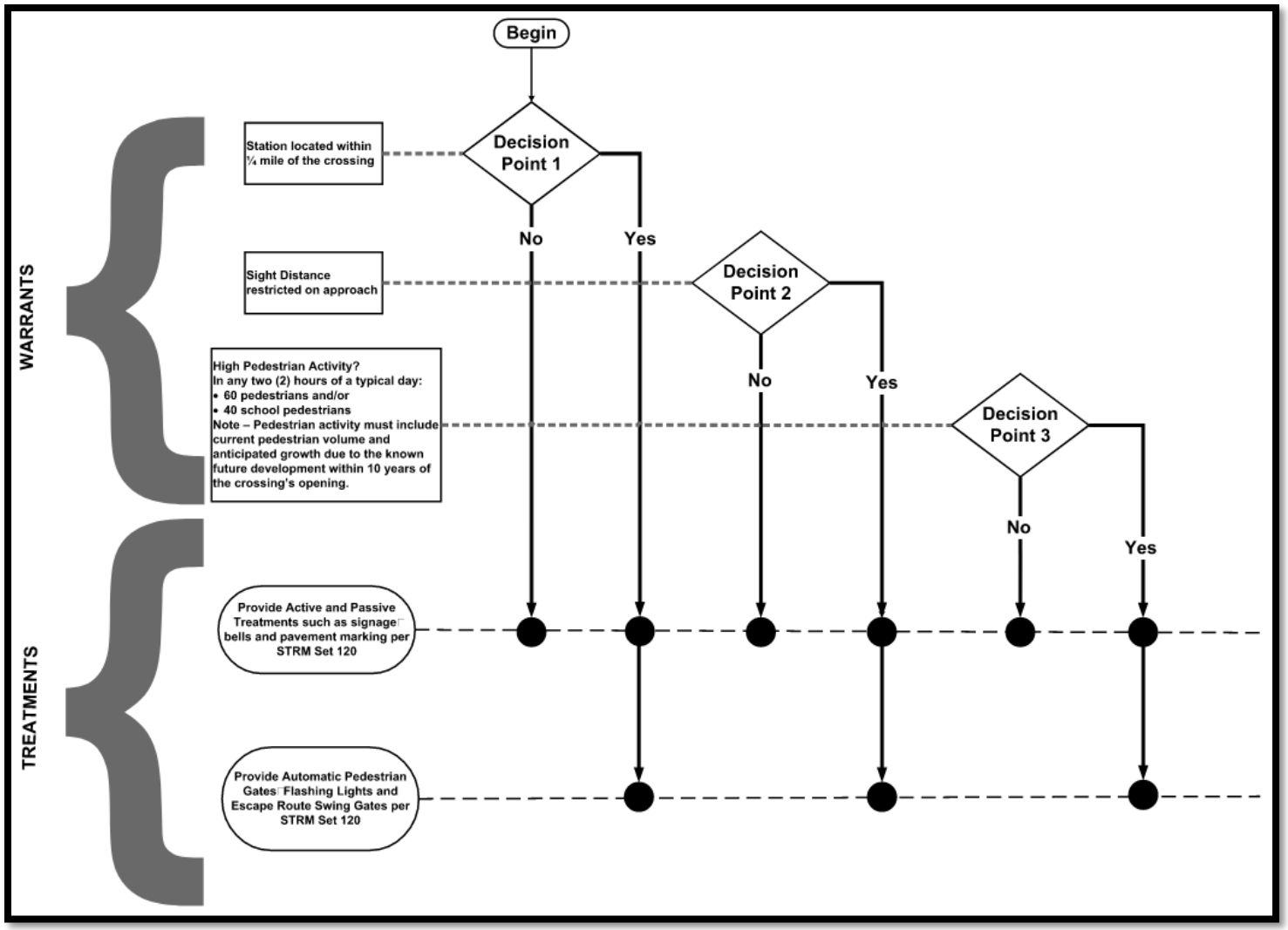
Train Speed (MPH)	Pedestrian Clearing Sight Distance (feet) *
10	180
20	355
25	440
30	530
40	705
50	880
60	1060
70	1235
80	1410
90	1585

*Based on walking speed of 3.5 fps



PEDESTRIAN SIGHT TRIANGLE

EP-13-04 PEDESTRIAN CONTROLS DECISION TREE



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EP-13-05 PEDESTRIAN AND LRV CROSSING EQUATIONS

1. Pedestrian Crossing Time

$$\text{PT (s)} = \frac{RT(s) * PV\left(\frac{ft}{s}\right) + \text{D (ft)}}{PV\left(\frac{ft}{s}\right)}$$

Where:
PT = Pedestrian Crossing Time, seconds (s)
RT = Pedestrian Decision Reaction Time, seconds (s) = 2
PV = Pedestrian Walking Speed, ft/s = 3.5 ft/s (if AHJ does not have a recommended value)
D = Pedestrian Crossing Distance, feet, this is the dynamic envelope plus a 2.5' buffer

2. LRV Traveled Distance

$$DT\ (ft) = PT(\text{s}) * V\left(\frac{miles}{hour}\right) * \left(\frac{hour}{3600s}\right) * \left(5280\frac{ft}{miles}\right)$$

Where:
DT = Distance Traveled, feet
PT = Pedestrian Crossing Time, seconds (S)
V = LRV Speed, miles/hour

LRV Nominal Braking Distance (Verify the equation and the parameters with the latest revision of the Sound Transit Requirements Manual (STRM)

$$BD = (V_{es} * RT_{nom} * 1.467) + [(V_{es}^2 - V_f^2) * (\frac{0.7333}{0.22G+BRnom})]$$

Where:
BD = Nominal Braking Distance, feet
V_{es} = LRV Speed, miles/hour
RT_{nom} = sum of nominal reaction times, seconds = 3.5
V_f = Final Target Speed, miles/hour
G = Grade, %
BR_{nom} = de-rated Brake Rate, mi/hr/s = 2.1 mphps
1.467 & 0.7333 are conversion factors from mph to fps
0.22 is braking correction factor