**Road/Rail Crossing Reduction Study in Fairbanks and North Pole, Alaska**

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## 1 Introduction and Background

Fairbanks Area Surface Transportation (FAST) Planning is a Metropolitan Planning Organization (MPO) located in the center of Alaska and includes the incorporated cities of Fairbanks and North Pole. Home to approximately 86,000 people, this area is the second most populous area in the State of Alaska. Fairbanks is a freight hub for Alaska's mineral extraction industry, with petroleum and coal products moving from extraction locations through Fairbanks to Alaska's ports, while heavy equipment and supplies head from the ports to the extraction locations, mainly the North Slope oil fields along the northern edge of Alaska. A portion of these goods travel by truck between Fairbanks and the North Slope, and by rail between Fairbanks and Anchorage. Moreover, the vast majority of consumer goods and fuel used by Fairbanksans is brought into the state at the Port of Alaska at Anchorage, 360 miles south of Fairbanks. The Alaska Railroad Corporation (ARRC) transports many of these goods; approximately 12 percent of the containers that enter the Port of Alaska are transported to Fairbanks by rail. ARRC also provides freight service to the area military bases and provides year-round passenger rail service between Anchorage and Fairbanks.

Given the size of the population, Fairbanks has a well-developed road network with good continuity and connectivity that fosters relatively low average annual daily traffic (AADT) volumes throughout the area. The highest volume segments on arterials entering and exiting the urban area carry around 25,000 vehicles per day.

Of specific concern to the FAST Planning area, the Fairbanks area has been designated a nonattainment area for $PM_{2.5}$ particulate matter. Improvements that reduce transportation-related emissions is one of the tools being used to reduce overall emissions in the area and one of the goals of the crossing reduction study is to reduce congestion and emissions at the at-grade crossings in the area. Approximately 16 percent of the rail/road crossings in Alaska are located within the FAST Planning boundary, including 5 grade separated crossings and 69 at-grade crossings. In addition, the railroad alignments traverse many sharp curves that necessitate slower train speeds, resulting in increased roadway traffic delays and emissions.

In 1985, the Fairbanks North Star Borough (FNSB) prepared the Fairbanks Railroad Industrial Area (FRIA) Relocation Report, which recommended the relocation of the railroad track, rail yard, and industrial customers outside of the Fairbanks urban core area. Several subsequent studies have looked at the relocation of the railroad track in more detail, and an environmental assessment has been prepared for Phase 1, which would relocate the track outside of the core area of North Pole. While the relocation project would decrease congestion and improve safety, the project would be very costly (at least $500 million) and is expected to take many years to complete.

The current planning effort, the Fairbanks Road/Rail Crossing Reduction/Realignment Plan (Plan), is a near term effort to enable FAST Planning and partnering agencies to implement an efficient and effective approach to address safety and operational concerns at at-grade rail/road and rail/pedestrian crossings (hereafter referred to as crossings) within the FAST Planning boundary. Figure 1 shows the FAST Planning boundary and the rail lines and branches included in the study. Note crossings within the Fort Wainwright Military Base boundary were excluded from the study because this study was funded by FHWA, and those funds are not eligible for use on planning efforts or projects on military bases.

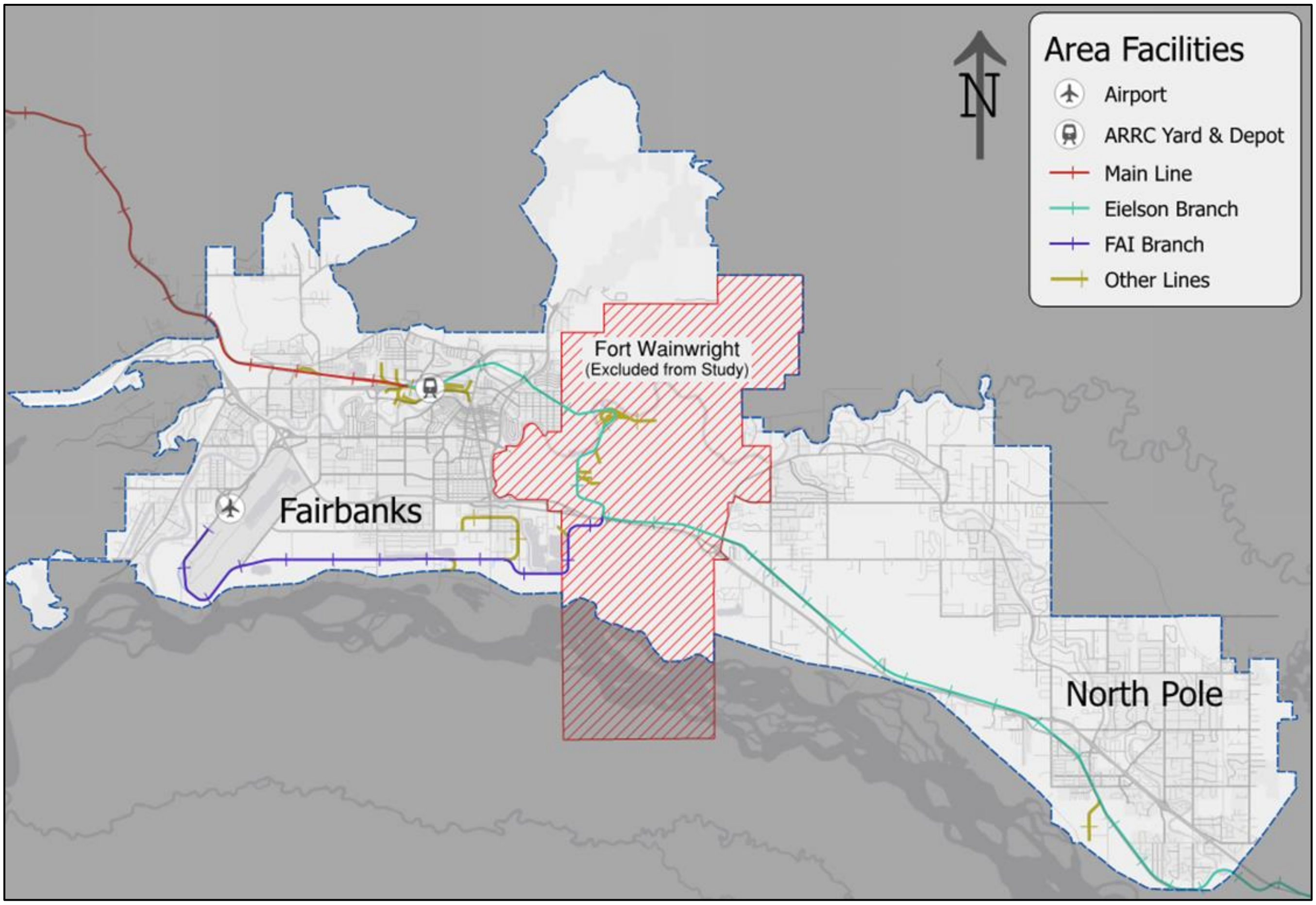

**Figure 1: Map of Rails within the FAST Planning Area**

## 2 Choosing Crossings to Focus On

The 5 separated grade crossing facilities are generally newer crossings with adequate designs and were therefore excluded from the study. Data was collected for the 69 existing at-grade crossings within the FAST Planning boundary. The data was either gathered from previously created GIS layers (obtained from the railroad, city, borough, or state agencies) or was manually added to the GIS database. Data gathered include roadway and rail traffic information and physical characteristics, crossing permittee, public facilities that may be impacted by the crossings, and the crossing's impact on the surface transportation system.

The at-grade crossings were screened for those most in need of safety and/or operational improvements using a two-level screening process. The screening process was performed under the advisement of a steering committee, composed of state and local transportation agencies, who provided local and technical perspective on recommendations and planning efforts. After each level of screening, the steering committee contributed helpful insight for the selected crossings, such as the public use patterns, programmed projects in the area, and other concerns they gathered from the community over time.

During the process, the team also looked for opportunities to reduce the density of crossings by eliminating or consolidating them. Most of the potential candidates for elimination or consolidation were ultimately ruled out due to a lack of roadway connectivity or the nature of the crossing agreements.

### 2.1 Level 1 Screening

#### *2.1.1 Evaluation Metrics*

Level 1 screening criteria included safety and operational assessment factors, crossing geometrics, and public comments. Safety and operational factors and public comments were the primary assessment metrics, and crossing geometrics were used as a secondary measure.

*Safety Metric - Accident Prediction Value (APV) and APV Capacity:* One of the safety metrics used for the screening process was Accident Prediction Value (APV), a calculated value intended to predict the likelihood of a crossing-related crash occurring over a given period of time. The team used direct comparison of the APVs at different crossing locations as one method to prioritize crossings.

Calculating the APV also allowed the team to look at how close a crossing is to needing increased traffic control protection. A set of threshold values published in the Alaska Policy on Railroad/Highway Crossings, indicate the minimum APV for which increased traffic control is required at a crossing, based on the crossing's existing traffic control devices. Because the existing traffic control devices are not the same at every crossing (some have automatic gates, some have flashing signals, and some have signs only), the threshold value is not the same for each location; therefore, using APV by itself does not address the need for improvements at the crossings.

Thus, the team came up with a new metric, "APV capacity", which is calculated by dividing the APV at a specific location by the threshold APV for that location, given the existing traffic control. The APV capacity metric allowed prioritization of crossings based on how close they are to requiring the next level of traffic control protection. As an example, Table 1 presents 3 crossings with different levels of existing traffic control devices, so that they each have different APV thresholds. In the example, each crossing has the same calculated APV. The traffic control for Crossing A is signs only. Because the APV is above the threshold APV (APV capacity >100%), the crossing is in immediate need of improvements[1] (the next level of traffic control device). The existing devices for Crossing B, flashing signals, are appropriate as the minimum requirement[1], but the APV is nearing the threshold value (APV capacity >80%), which indicates a safety improvement may be needed in the near future. The calculated APV at Crossing C, with Automatic gates and flashing signal, is well below the threshold value (APV capacity <50%). Therefore, no safety improvement needs[1] are anticipated in the near future.

**Table 1: APV Capacity Comparison**

| Crossing | Existing Traffic Control Devices | Calculated APV | Threshold APV | APV Capacity | Minimum Required Traffic Control Devices (TCD)[1] |
|---|---|---|---|---|---|
| Crossing A | Signs Only | 0.16 | 0.12 | 133% | Install next level of TCD - Flashing Signals |
| Crossing B | Flashing Signals | | 0.18 | 89% | TCD is ok; but close to needing next level |
| Crossing C | Automatic Gates & Flashing Signals | | 1.98 | 8% | TCD is good; no need to install next level |

*Safety Metric – Hazard Index (HI):* The Hazard Index (HI) of each crossing was computed for the crossings and used as a safety metric. HI is a relative rating of safety at rail crossings, based on vehicle traffic, train traffic, and a traffic control factor. Alaska uses the New Hampshire Hazard Index, as presented in the FHWA Highway-Rail Crossing Handbook.

*Safety Metric – Crash History and Crash Sensitivity Analysis:* The safety assessment also considered the 5-year crash history between 2013 and 2019. Alaska's crash rate for rail crossings is very low; therefore, the team chose to evaluate any crossing with a recent crash history.

In addition, the team used a new metric called "crash sensitivity," which involved calculating the number of additional crossing-related crashes needed to increase the crossing APV to the point that the threshold value for needing additional crossing protection is reached. The crash sensitivity measure provides an additional method for prioritizing crossings that are closer to requiring enhanced traffic control devices.

*Operational Metric – Exposure Factor:* A crossing's exposure factor was used as an operational metric for prioritizing crossings. Exposure factor is calculated as the vehicle traffic volume multiplied by the train traffic volume and is a surrogate measure of the probability of conflicts and vehicle delay at a crossing.

[1] From an APV standpoint. There may be other factors which require crossing improvements.

*Crossing Geometric Metric – Sight Distance*

Geometric metrics were evaluated for each crossing, and those where a concern was identified were more likely to be included as a prioritized crossing. Sight distance triangles, unobstructed views from motorists to an approaching train, were reviewed for each crossing using aerial imagery both for stopped vehicles and for those approaching the crossing at speed. The required sight distance varies based on the maximum potential train speed and the posted roadway speed limit, as shown in Table 2.

**Table 2: Sight Distance Values at At-Grade Crossings**

| Train Speed (MPH) | Case B Departure from Stop | Case A Moving Vehicle | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Vehicle Speed (MPH) | | | | | | | |
| — | 0 | 10 | 20 | 34 | 40 | 50 | 60 | 70 | 80 |
| Distance Along Railroad Crossing from $d_T$ (ft) | | | | | | | | | |
| 10 | 255 | 155 | 110 | 102 | 102 | 106 | 112 | 119 | 127 |
| 20 | 509 | 310 | 220 | 203 | 205 | 213 | 225 | 239 | 254 |
| 30 | 794 | 465 | 331 | 305 | 307 | 319 | 337 | 358 | 381 |
| 40 | 1,019 | 619 | 441 | 407 | 409 | 426 | 450 | 478 | 508 |
| 50 | 1,273 | 774 | 551 | 509 | 511 | 532 | 562 | 597 | 635 |
| 60 | 1,528 | 929 | 661 | 610 | 614 | 639 | 675 | 717 | 763 |
| 70 | 1,783 | 1,084 | 771 | 712 | 716 | 745 | 787 | 836 | 890 |
| 80 | 2,037 | 1,239 | 882 | 814 | 818 | 852 | 899 | 956 | 1,017 |
| 90 | 2,292 | 1,394 | 992 | 915 | 920 | 958 | 1,012 | 1,075 | 1,144 |
| Distance Along Highway from Crossing, $d_H$ (ft) | | | | | | | | | |
| — | — | 69 | 135 | 220 | 324 | 447 | 589 | 751 | 931 |

*Source: FHWA Highway-Rail Crossing Handbook, Third Edition*

*Crossing Geometric Metric – Approach Skew:* Approach skew, the smallest angle between the roadway and the railroad track at an at-grade crossing, was also evaluated as a geometric metric. Ideally, roadway approaches should be perpendicular to tracks. Sharp skews at a crossing require drivers to twist their head and torso, sometimes uncomfortably for elderly or disabled drivers, making it difficult for a driver to see an oncoming train and assess whether or not it is safe to cross the tracks. In Alaska, the minimum skew angle for passive traffic control (signs only) is 75-degrees, otherwise, automatic gates and/or flashing signals should be present at the crossing. During Level 1 screening, aerial imagery was used to approximately estimate the approach skew.

*Crossing Geometric Metric – Vehicle Storage:* Vehicle storage, the distance between the tracks and a downstream-nearby roadway intersection, was looked at as a geometric metric. When there is not enough room for vehicles to queue between the intersection and the tracks, drivers may spillback and stop on the tracks, which could contribute to crashes between trains and stopped vehicles and/or between vehicles. The minimum vehicle storage length should be at least equal to the length of the longest vehicle expected to frequently use the crossing; however, it is desirable to be able to store the entire vehicle queue. During Level 1 screening, aerial imagery was used to determine crossings that potentially had a vehicle storage issue.

*Public Comment:* During the Level 1 screening process, the public had an opportunity to comment on issues and concerns for specific crossings. Any crossing that received a public comment that indicated a concern was identified for further review.

### *2.1.2 Level 1 Screening Results*

At the level 1 screening, the intent was to identify approximately 30 crossings most in need of improvements. Crossings that were noted to be further evaluated included those with the following metrics:

- Highest Safety Assessment, which included crossings meeting all of the following 3 criteria:
    a. ranking in the 30 highest for APV capacity
    b. having collision sensitivity analysis resulting in the least number of crashes required to meet the next APV threshold for crossing protection
    c. ranking in the 30 highest for HI
- History of prior collisions
- Highest exposure factor
- Recent crash history
- Any applicable public comment

Crossings meeting one of criteria noted above were individually reviewed for geometric concerns.

From the Level 1 screening, 29 of the 69 existing at-grade crossings were advanced to Level 2 screening. Of these, 27 crossings were selected based on the safety, operational, or geometric assessments. Two additional crossings were added based on public comments only.

## 2.2 Level 2 Screening

### *2.2.1 Evaluation Metrics*

The 29 crossings selected under the first screening process were reviewed with the steering committee. Based on steering committee input, crossings that had programmed projects were excluded and the remaining crossings were further screened using two general categories: safety issues and maintenance issues. Reviewing crossings for maintenance issues allowed lower volume crossings with potentially low cost improvements that would otherwise be overshadowed by the higher safety-centric measures to be included in the analysis.

*Safety Issue Category:* The safety issue metrics were again applied to the crossings selected from Level 1. This category included assessment of the Hazard Index; APV Capacity; Crash Sensitivity; safety-related crossing geometrics, including sight distance, vehicle storage, and approach skew; and safety-related public comments.

All the metrics were normalized based on the maximum values or maximum number of occurrences per individual crossing when computing the safety score. A summation of the metrics was taken for a total safety issue score per crossing. Equation 1 describes the normalized computation.

$$\text{Safety Issue Score} = \sum \frac{X_n - X_{min}}{X_{max} - X_{min}}$$

Where, $X$ is one of $n$ assessment factors

**Equation 1: Safety Issue Score**

*Maintenance Issue Category:* Crossings identified as having possible maintenance issues were evaluated separately from the whole. These included crossings with public comments noting poor crossing condition as well as any crossing identified during the Level 1 screening as having possible sight distance issues due to overgrowth of vegetation. These crossings were then ranked relative to each other based on the safety issues category.

### *2.2.2 Field Review*

The top 10 crossings under both categories were compiled and individually reviewed for duplication and consideration of public comments such as noise complaints. In total, 11 crossings were selected for further evaluation due to safety or maintenance concerns. These crossings were reviewed in the field by the study team, accompanied by representatives of ARRC. The existing sight distance and vehicle storage were measured; the existing signage, striping, and signal controls, if applicable, were inventoried; and traffic operations were observed. In addition, approach grade was assessed. Per ARRC Technical Standards, a 50-foot-long level area is required at the crossing to prevent low, long trailers from damaging or getting stuck on the tracks. Each crossing was discussed by the team and possible elements for improvement were identified.

### *2.2.3 Level 2 Screening Results*

As a result of the field review, 1 additional crossing was added to the crossings for which alternatives were developed, so it could be reviewed as a system with other crossings. In total, 12 crossings were advanced to the alternative development stage.

### 2.3 Alternative Development

After the field review and consideration of possible improvements, alternatives were recommended for 12 crossings. The alternatives were reviewed with the Steering Committee and final recommended improvements, along with accompanying priorities, were established. The alternatives were also evaluated to determine the benefits provided. Benefits evaluated include:

- Reduction in vehicle delay
- Reduction in vehicle emissions
- Safety improvement (reduction in likelihood of crashes)
- Reduction in train noise where noise was identified as a concern
- Reduction in crossing maintenance efforts
- Meeting current standards

## 3 Plan Summary

The team, in coordination with the Steering Committee, developed the draft Plan, which will be presented for public comment in May 2021 and finalized in September 2021. The Plan outlines the screening process and presents the recommended improvements. In summary, the Plan proposes the following types of improvements:

*Update Crossing Equipment to Current Standards:* Two crossings propose adding pedestrian automatic gates and/or signals. In these locations, the non-motorized facilities lack traffic control devices for the crossings. In order to be in compliant with ARRC standards, non-motorized facilities require the same crossing protection as the adjacent roadway. This will enhance safety, especially for bicyclists who often are traveling at a higher speed and may not have as much time to react to train activity.

For two other crossings, mitigations are recommended to address geometric concerns, such as approach grade or approach skew. These improvements will improve sight distance, increasing safety for the motorists, and could also reduce the maintenance burden at the crossings.

The Plan also recommends area-wide train signal control cabinet improvements. During the field review, ARRC noted many of the existing crossing signal cabinets, including the equipment contained within them, are out of date or obsolete and do not provide the controlled environment that is required for modern crossing signal electrical equipment. Updating the cabinets and included equipment will increase safety for railroad maintenance personnel and decrease the likelihood of faulty signal function, which increases motorist safety.

*Quiet zone study:* One recommended improvement involves initiating a quiet zone study. The crossings included in this improvement are within a residential neighborhood and received many public comments concerning train noise. Establishing a quiet zone in this area will enhance the quality of life for the residents.

*School crossing:* One pedestrian crossing is adjacent to and on a walking route for a middle school. Enhanced traffic control devices are recommended at this crossing. Adding visual and physical devices at this crossing will alert pedestrians (including school children) of train activity. The improvements are proposed to be included with pedestrian crossing improvements for a nearby collector street, to further improve the safety for the school route. Proposed turning lane improvements could additionally reduce delay for vehicles when a train is in the crossing, incrementally improving air quality.

*Intelligent Transportation Systems (ITS):* Flashing advance warning signs are recommended at a crossing on a high speed, high volume highway with an extremely skewed crossing. This crossing is associated with the highest number of crashes of all the crossings within the study area. Installation of flashing advance warning signs will alert motorists ahead of time that the crossing is active, to prepare them to stop. Flashing advance warning signs have been successful in alerting drivers of an active train crossing in Anchorage, Alaska.

*Conversion from Manual Switch to Automatic Switch:* Currently, the train yard has a manual switch, which affects one of the highest used crossings (in terms of train traffic, as well as vehicle traffic) in the study area. The trains coming up to Fairbanks from Anchorage are typically long enough that the train must stop in the crossing while an operator steps off the train to manually activate the switch. These train movements often coincide with morning rush hour traffic. Replacing the manual switch with an automatic switch that could be activated without stopping the train would greatly reduce vehicle and train delay and emissions at this location. Of particular interest, this recommendation has a high benefit/cost ratio.

*Elimination/Consolidation/Improvement:* A system evaluation of 3 crossings recommended improving 2 and eliminating 1. The three crossings are located in an area with low traffic volumes, and all serve the same neighborhood. The crossing that is proposed for elimination is unpermitted and therefore lacks maintenance. Eliminating the crossing will reduce the maintenance burden without significant effects to roadway connectivity, congestion, or delay.

*Grade Separation:* Grade separation alternatives were considered for several of the crossings. In many instances, grade separation is not practical due to nearby driveways and streets requiring the roadway grade to remain the same, high water tables, and nearby sidings requiring the railway track to remain at the same grade. One segment of the railroad was recommended for elevation, which would eliminate 6 at-grade crossings, grade separating 5 crossings with higher traffic volumes and closing 1 lower volume crossing. This would increase safety by removing the vehicle-train conflict points and it would significantly reduce vehicle delay and improve emissions.

# 4 Case Study for Old Steese Highway/Steese Expressway Crossings

The Steese Expressway is a four-lane, divided highway with access control that serves as a major north-south route through Fairbanks. Upon leaving Fairbanks, the Steese Expressway is the route for all truck traffic heading to the North Slope oil fields. A planning and environmental linkages (PEL) study that was completed in 2015 concluded that grade separation is desirable for the Steese Expressway intersections within Fairbanks.

The Old Steese Highway is a three-lane highway with a center two-way left turn lane that runs parallel to the Steese Expressway for about a mile, traveling through a major commercial corridor. The Alaska Department of Transportation and Public Facilities (DOT&PF) is currently designing a reconstruction project for the Old Steese Highway, which is expected to expand the road to a four-lane highway with two-way left turn lane.

The two roadways cross the Eielson Branch of the Alaska Railroad and a cross street, Trainor Gate Road, at the location where the distance between the two roads is narrowest, as shown in Figure 2.

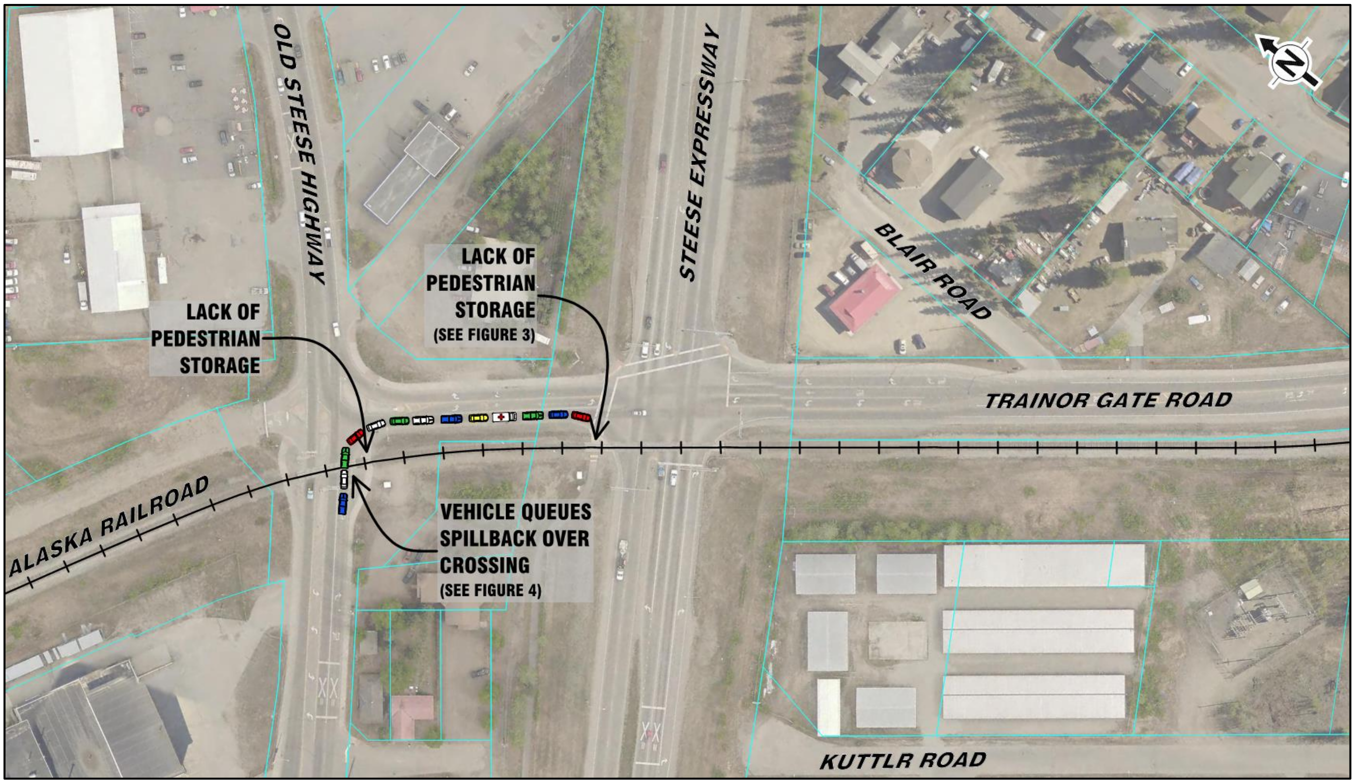


**Figure 2: Aerial View of At-Grade Crossings and Issues of Alaska Railroad at Old Steese Highway and Steese Expressway near Trainor Gate Road**

The at-grade rail/road crossings of the Old Steese Highway and Steese Expressway ranked 5th and 1st in the initial plan screening and were considered a top priority by the steering committee. The close proximity between the railroad track and Trainor Gate Road, as well as the short distance between the Old Steese Highway and Steese Expressway have led to a number of concerns, which were identified during the field review:

- A history of 5 incidents from 2013 through 2019 in which drivers turned onto the tracks, thinking they were turning onto Trainor Gate Road, four of which occurred at the Old Steese Highway crossing. None of these incidents were in the DOT&PF crash database; they were all provided by ARRC from the ARRC security and police records.
- Limited storage space for pedestrians/bicyclists between the train tracks and Trainor Gate Road as identified in Figure 2 and shown in Figure 3.
- Queues for eastbound vehicles traveling from Old Steese Highway to Steese Expressway sometimes queue back to Old Steese Highway, resulting in vehicles occasionally queueing across the railroad tracks as identified in Figure 2 and shown in Figure 4.

**Figure 3: Lack of Pedestrian Storage Space**

**Figure 4: Vehicle Queue across the Old Steese Highway Crossing**

In addition to these crossing-related concerns, there are roadway operational concerns, for example queues for westbound vehicles traveling from Steese Expressway to Old Steese Highway sometimes extend back onto the Steese Expressway, blocking lanes on the highway. This occurs even though the westbound traffic is limited to a yield-controlled right turn only at the Old Steese Highway.

After the field review, the study team prepared a concept design for an alternative to move Trainor Gate Road away from the tracks at these two intersections and to install an eastbound right turn lane on Trainor Gate Road, for the turn onto the Steese Expressway, as a means of addressing the crossing-related pedestrian and vehicle storage concerns. In addition, pedestrian crossing traffic control devices were proposed to meet the ARRC standards. The concept design is presented in Figure 5.

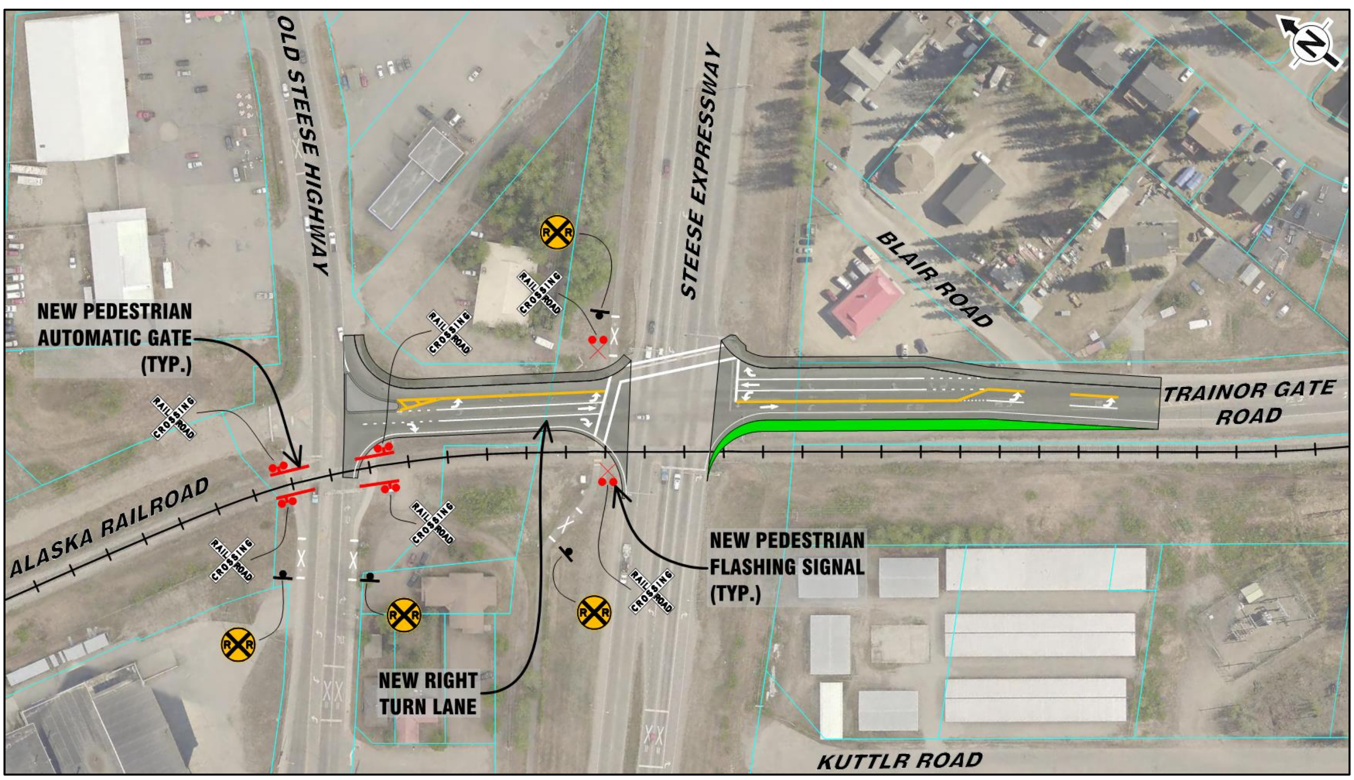


**Figure 5: Old Steese Highway and Steese Expressway Concept Design**

As mentioned previously, DOT&PF has a reconstruction project currently in design for the Old Steese Highway that will expand the roadway to two lanes in each direction, with a center two-way-left-turn lane. The study team worked closely with DOT&PF to vet the team's alternative concept. After internal discussions, DOT&PF concluded that they would convert Trainor Gate Road to one-way westbound, as shown in Figure 6. This will effectively move Trainor Gate Road away from the tracks without requiring any right-of-way acquisition, and will also eliminate the problem of eastbound vehicles queuing across the tracks. DOT&PF proposes to address the problem of westbound vehicles queueing back to the Steese Expressway by installing a free right turn from Trainor Gate Road onto the Old Steese Highway. Capacity improvements elsewhere in the street network are expected to accommodate the displaced eastbound traffic from Trainor Gate Road.

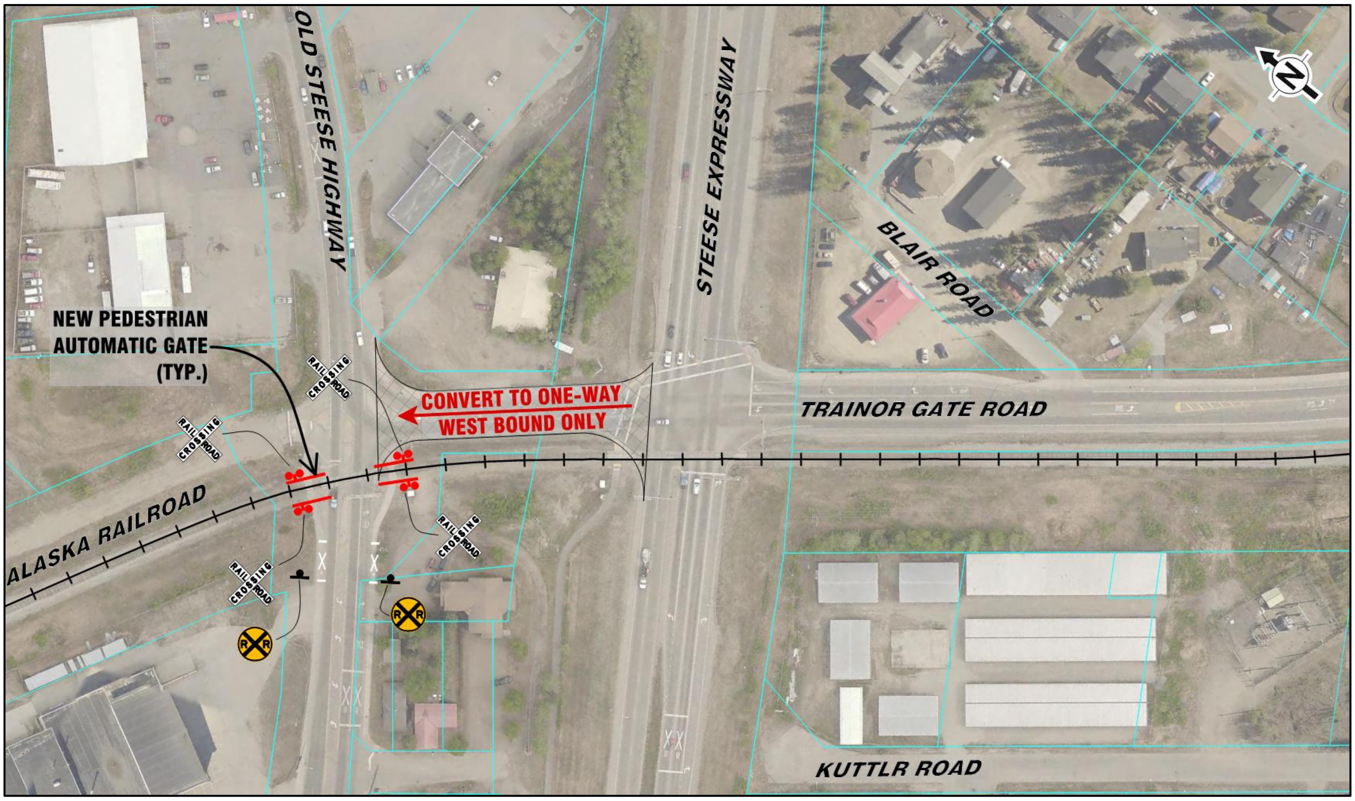


**Figure 6: Old Steese Highway and Steese Expressway DOT&PF Solution**

As a result of this process, the Fairbanks Road/Rail Crossing Reduction/Realignment Plan will succeed in achieving immediately implementable improvements that will significantly benefit nonmotorized and vehicular traffic traveling across these two crossings.

## 5 Lessons Learned

The study team identified the following lessons learned:

- The railroad security and police records were not easily available (the ARRC steering committee member had to manually compile the incident record); however, they provided important insight into safety concerns at these crossings that would not have been understood only by reviewing the DOT&PF crash database.
- By checking in with the steering committee members frequently throughout the plan development process, the study team was able to keep apprised of other pertinent projects, ensuring that the plan remained up-to-date and could be implemented immediately.

## 6 References


- *Fairbanks Railroad Industrial Area (FRIA) Relocation Report*, FNSB, 1985
- *Alaska Policy on Railroad/Highway Crossings*, ADOT&PF and ARRC, September 1988
- *Railroad-Highway Grade Crossing Handbook*, U.S. Department of Transportation Federal Highway Administration (FHWA), July 2019, Third Edition
- *Technical Standards for Roadway, Trail, and Utility Facilities in the ARRC Right-of-Way,* Alaska Railroad, January 2014