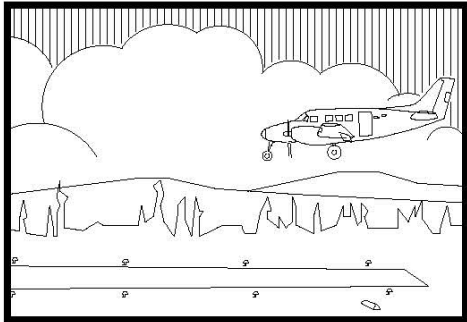


# DESIGN STUDY REPORT

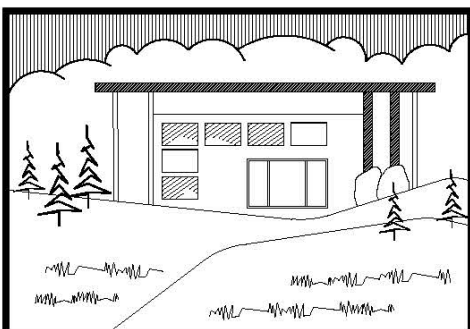
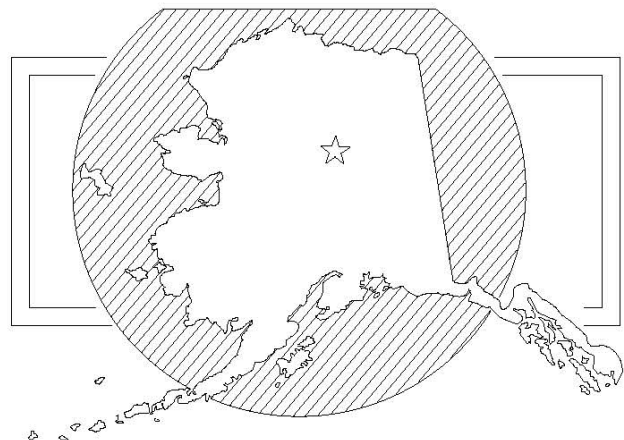
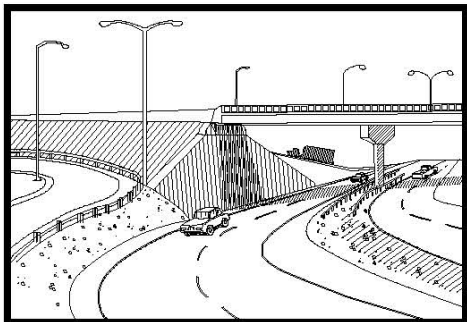
## Steese Expressway/Johansen Expressway Interchange

Z607320000/0002337



# STATE OF ALASKA

Department of Transportation  
and Public Facilities




*NORTHERN REGION*

*August 2022*

DESIGN APPROVAL

STEESE EXPRESSWAY/JOHANSEN EXPRESSWAY INTERCHANGE


PROJECT NO. Z607320000/0002337

Requested by:  8/0/2022

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Jennifer Wright, P.E.  
Engineering Manager  
Northern Region

Date

Design Approval  
Granted:  8/24/2022

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Sarah Schacher, P.E.  
Preconstruction Engineer  
Northern Region

Date

Distribution: NR Design Directive 20-01 Distribution

DESIGN STUDY REPORT  
FOR

STEESE EXPRESSWAY/JOHANSEN EXPRESSWAY INTERCHANGE

PROJECT NO. Z607320000/0002337

PREPARED BY: Kristen E. Keifer, P.E.



ALASKA DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES  
NORTHERN REGION DESIGN AND ENGINEERING SERVICES  
AUGUST 2022

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## INTRODUCTION/HISTORY

The Steese Expressway/Johansen Expressway (Steese-Jo) intersection has seen sustained growth due to rapid growth in the area over the last 20 years. Large tracts of property within and adjacent to the Bentley Trust commercial property have experienced a rapid increase in commercial and residential development. Multiple large and small retail stores, as well as service-oriented businesses and a residential neighborhood, have developed in this area dramatically increasing traffic volumes. Average annual traffic growth rates in this area vary, but in some cases are as high as 5.2 percent per year over the past 20 years. Future development plans will likely consist of business and residential land uses like those currently in the area. Although development may not continue at the pace experienced in the early 2000s, there is continued growth expected and traffic volumes are expected to continue to increase.

Additional operational and safety concerns identified for the area include:

- **Pedestrian and Bicycle Safety:** Two known pedestrian crashes occurred while pedestrians were crossing the Steese Expressway, one in 2007 resulting in major injury to the pedestrian and one in 2010 resulting in a fatality to one pedestrian and major injury to the other pedestrian. Residences on the east side of Steese Expressway and the commercial district on the west side create a high crossing demand.
- **Pedestrian Delay:** Pedestrians crossing the southbound right-turn lane during the AM peak hour may currently wait up to 45 seconds to find a gap to cross. Pedestrian delay for crossing at the signal is an average of 42 seconds or more, which equates to a level of service (LOS) of 'E'.
- **Proximity of Farmers Loop Road:** The proximity of the Farmers Loop Road intersection creates southbound weaving conflicts during the AM peak on Steese Expressway between merging Farmers Loop Road traffic and Steese Expressway traffic desiring to exit at the Johansen Expressway. In addition, eastbound left-turn vehicles at the Johansen Expressway often queue in the left-most left-turn lane, as travelers prepare to turn left onto Farmers Loop Road following a short northbound run on Steese Expressway, resulting in uneven use of the left-turn lanes and reduced signal capacity.
- **Vehicular Delay:** Currently, eastbound left-turn vehicles often wait through one signal cycle at the intersection with an average delay of over one minute per vehicle in the PM peak hour. The intersection LOS is expected to worsen below acceptable thresholds as the Fairbanks area grows, resulting in a LOS "E" by 2024.

The proposed project will address the peak hour congestion and pedestrian safety concerns through construction of an interchange for this critical node for commercial traffic heading to the North Slope from Canada, Valdez, and Anchorage.



Figure 1. Location Map.

## PROJECT DESCRIPTION

The proposed project will construct a diverging diamond interchange (DDI) at the intersection of the Steese and Johansen Expressways in Fairbanks, AK (see Figure 2). A temporary access road and bike path connection may be constructed between the Old Steese Highway and Farmers Loop Road to handle construction detour traffic and provide enhanced bike connectivity between the Johansen and Farmers Loop separated paths. The project will require closure of the City Lights Boulevard north of the Lazelle Road intersection terminating in a cul-de-sac at the Birch Hill Cemetery entrance. Noise walls will be constructed for eligible receptors. The adjacent



intersections of Farmers Loop/Steese and Old Steese/Johansen will receive minor optimizations to align with the new traffic pattern.

***Purpose and Need***

The purpose of the Steese-Jo project is to enhance motorized and non-motorized mobility and user safety at the Steese Expressway and Johansen Expressway intersection and within the influence area of the intersection. Traffic volumes within the project area are among the highest in the City of Fairbanks. The Johansen Expressway serves as a major thoroughfare for traffic moving east and west and provides a prominent link to developable lands, both north and south of the expressway. The Steese Expressway in the project area serves as a principal route for traffic moving north and south between residential and commercial developments. It is also the primary trucking route for access to the North Slope via the Dalton Highway.

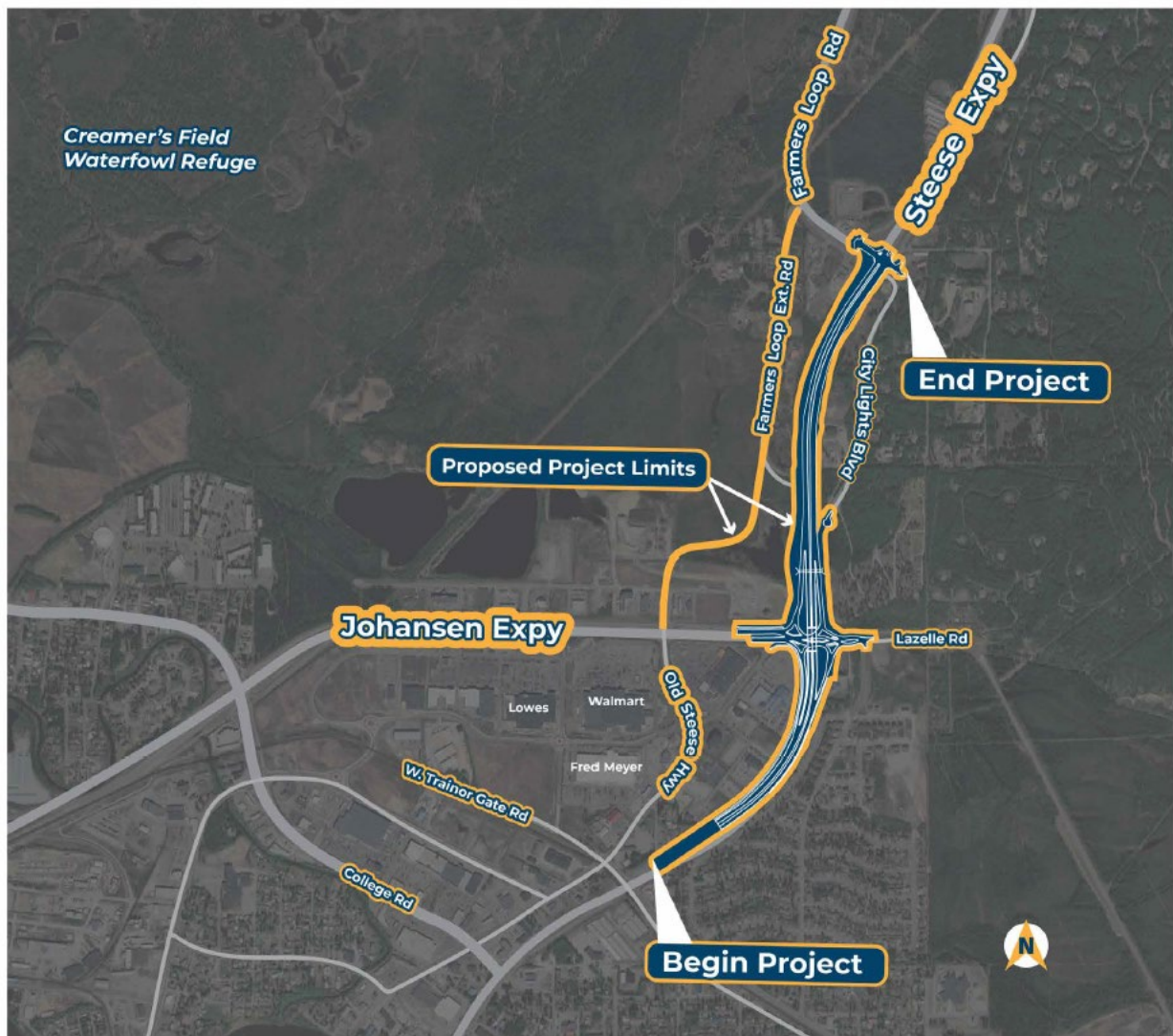


Figure 2. Project Limits.

## ***Existing Conditions***

The existing infrastructure in the Steese-Jo project area is modern with recent pavement and signalization projects (within last 10 years). Congestion relief and pedestrian safety are the primary project drivers.

## **DESIGN STANDARDS**

This project is being designed in accordance with the following standards and guidelines:

### ***Standards & Guidelines***

- Highway Preconstruction Manual (PCM), Alaska Department of Transportation & Public Facilities (DOT&PF)
- Highway Drainage Manual (HDM), DOT&PF, 2006
- Alaska Traffic Manual (ATM), 2016
- A Policy on the Geometric Design of Highways and Streets (Green Book), 6<sup>th</sup> Edition, American Association of State Highway and Transportation Officials (AASHTO), 2011
- Roadside Design Guide (RDG), 4<sup>th</sup> Edition, AASHTO, 2011
- Highway Capacity Manual (HCM), 5<sup>th</sup> Edition, Transportation Research Board, 2010
- ADA Standards for Transportation Facilities, U.S. Department of Transportation, 2006
- ADA Standards for Accessible Design, U.S. Department of Justice, 2010
- Alaska Bridges and Structures Manual
- Guide for the Development of Bicycle Facilities, 4<sup>th</sup> Edition, AASHTO, 2012
- Recommended Practice for Roadway Lighting (RP-8-14), American National Standards Institute/Illumination Engineering Society, 2014

### ***DDI Standards & Guidelines***

- Green Book, 7<sup>th</sup> Edition, AASHTO, 2018, Section 10.9.3.5
- National Cooperative Highway Research Program (NCHRP) Research Report 959, Diverging Diamond Interchange Informational Guide, 2<sup>nd</sup> Edition, 2021

The project design criteria and design designation are provided in Appendix A.

## **DESIGN EXCEPTIONS AND DESIGN WAIVERS**

There are no design exceptions or design waivers.

## **DESIGN ALTERNATIVES**

There are no new alternatives since the environmental document was approved. Optimizations were evaluated to better address long term system resiliency of the interchange during peak traffic. Geometric enhancements include:

- Increased radii at crossover intersections
- Longer tangent lengths through the crossover intersections
- Maintaining tangent-on-tangent through crossover intersections
- Increased intersection spacing between the northbound and southbound ramp terminal



- Reduced impacts to Birch Hill Cemetery
- Maintaining full access to/from D Street

See Appendix C, “Steese-Johansen Diverging Diamond Interchange Design Optimizations”, January 28, 2022 for a full discussion of the enhancements considered.

### PREFERRED DESIGN ALTERNATIVE

The Enhanced DDI Alternative 3 was selected for its improvements to the traffic flow through the diverging diamond, reduction of site impacts, and traffic resiliency. The preferred diverging diamond layout is shown below in Figure 3.

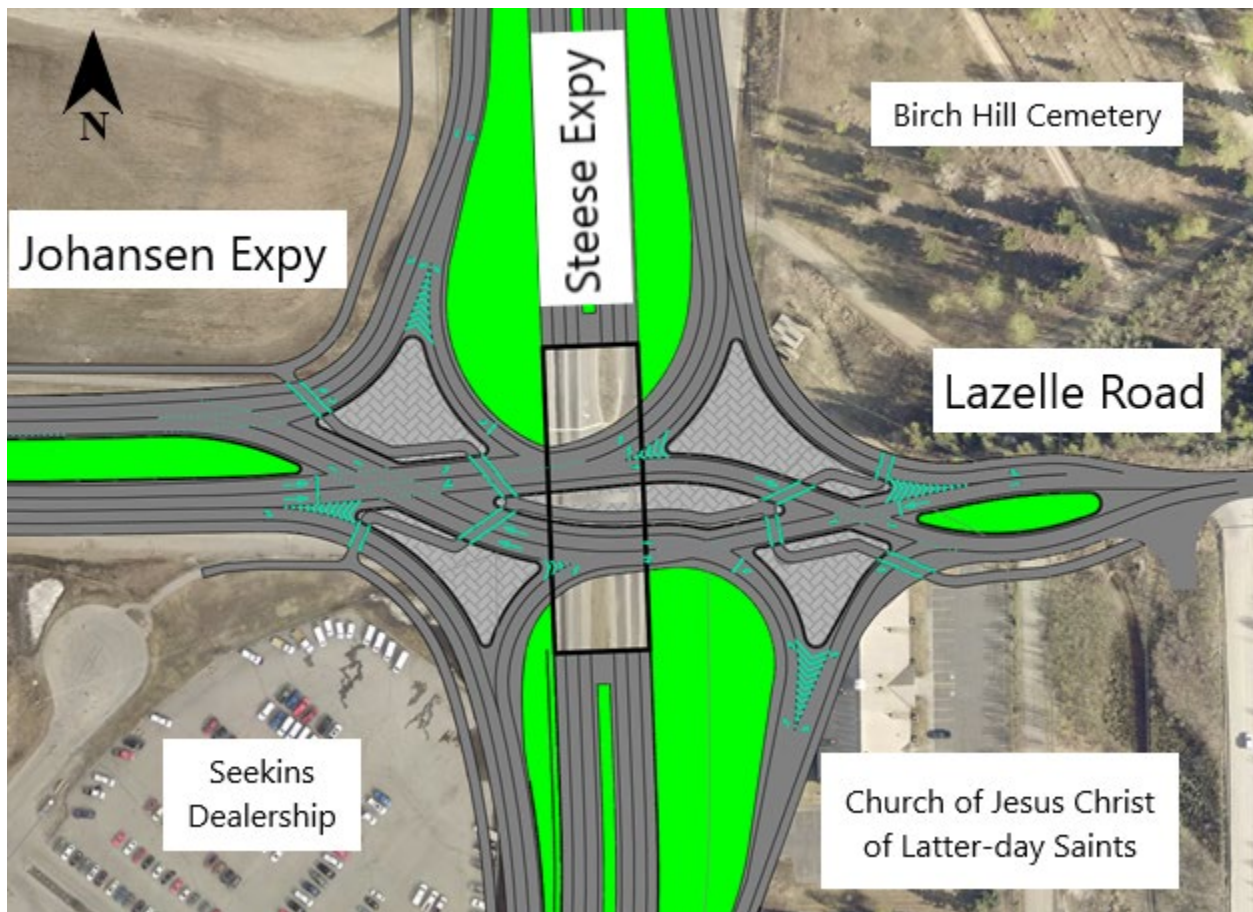


Figure 3. Enhanced DDI Alternative 3.

The following are key geometric enhancements for Alternative 3:

- Eastbound left turn radius increased to 155 feet
  - Reduces the speed differential between approach speeds and turning speeds at the northbound entrance ramp.
  - Reduces potential of shockwave to develop between ramp terminals
  - Improves mobility of heavy trucks
- East crossover intersection shifted southeast
  - Significantly reduces impacts to Birch Hill Cemetery

- Increases intersection spacing between ramp terminals which improves long term system capacity
- Improves northbound exit ramp geometry to better accommodate large vehicles
- Increases impact to the Church of Jesus Christ of Latter-day Saints
- Longer tangents maintained through the crossover intersections
  - Improves driver comfort through crossover intersections by removing point-of-curvature from the crossover intersections, allowing drivers to traverse without changing direction of their steering wheel
  - Improves adherence to lane assignment

Improvements will also be made at the intersection of Farmer's Loop and the Steese Expressway. The existing free-flow eastbound right turn from Farmers Loop Road creates a weaving conflict between southbound Steese Expressway traffic bound for Johansen Expressway and Farmers Loop traffic wanting to stay on Steese Expressway. Today, the total weave distance is approximately 3,000 feet. With the proposed DDI interchange, the southbound off-ramp and the modifications to the Steese Expressway vertical profile to grade separate over Johansen Expressway will reduce the effective weave length by 600 feet, leaving 2,400 feet to complete the necessary lane changes. Today, the existing weave operation results in reduced travel speeds, congestion, reduced reliability, and safety concerns, especially during the AM peak period. With the projected forecasted volumes and reduced weave length, maintaining the weave conflict will result in an increased potential for rear-end and side-swipe collisions and result in degradation of operational performance along southbound Steese Expressway and the southbound exit ramp. Removing the free right improves operations and reduces safety concerns.

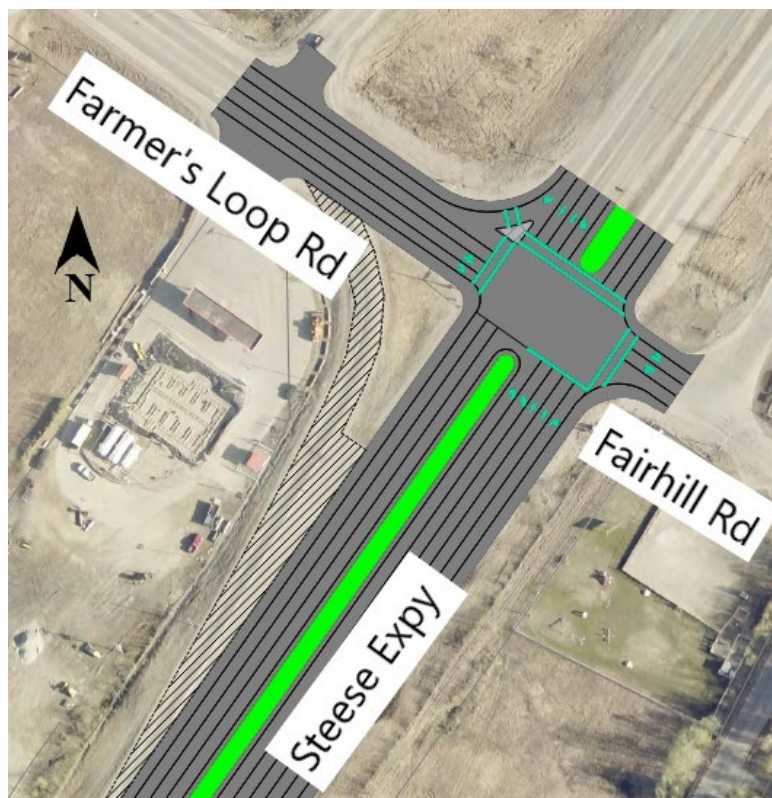


Figure 4. Farmers Loop Intersection Alternative 3.

### 3R ANALYSIS

Not applicable. This is a reconstruction project.

### TRAFFIC ANALYSIS

Traffic and safety analyses were completed for the environmental document phase and further refined to optimize final DDI geometry. See Appendix C for detailed traffic analyses. Crash rates are below statewide critical rates.

The Enhanced DDI geometry was developed to address the potential shockwave and operational challenges in the design year. Table 1 below shows the operational results for the original DDI and the Enhanced DDI.

Table 1: Microsimulation Results of DDI and Enhanced DDI

Intersection	DDI		Enhanced DDI
	AM – Avg. Delay/LOS (Seconds)	PM – Avg. Delay/LOS (Seconds)	PM – Avg. Delay/LOS (Seconds)
Northbound Ramp	3.8/A	9.8/A	6.3/A
Southbound Ramp	7.0/A	50.9/D	24.3/C

### HORIZONTAL/VERTICAL ALIGNMENT

Johansen Expressway grades remain very flat, with all grades less than 2%. Steese Expressway mainline grades generally match existing except for the overpass location, varying from very flat south of the interchange to approximately 3% north of the interchange. Overpass grades vary 1% to 4%. Ramp grades vary from 0-4%, See Appendix F for preliminary plan and profile sheets.

### TYPICAL SECTION(S)

Multiple typical sections are needed to complete the project improvements. See Appendix F for graphics of proposed typical sections.

### PAVEMENT DESIGN

The selected pavement design was generated using the Alaska Flexible Pavement Manual and associated software. The design life of the pavement is 15 years. The pavement design was analyzed using the mechanistic design method. Design calculations and design approval is documented in Appendix D. The pavement design from the 3<sup>rd</sup> Street Widening project was used a basis for this project to promote pavement uniformity within the Steese corridor. It was also decided to be used for the Johansen Expressway leg of this project. The Lazelle road leg has a

different structure due to the fact that the ESALs are less than 100,000 and more than 2.7 million smaller than the next smallest leg.

The preliminary preferred pavement section for the Steese and Johansen will consist of:

- 5 inches of Asphalt Concrete
- 4 inches of Base Course Grading D1
- 34 inches of Selected Material Type A

The preliminary preferred pavement section for Lazelle will consist of:

- 2 inches of Asphalt Concrete
- 6 inches of Base Course Grading D1

## **PRELIMINARY BRIDGE LAYOUT**

This project proposes to construct an overpass bridge along the Steese Expressway that is 301-ft long, 2-span, precast, pre-stressed concrete girder bridge. The proposed bridge carries the same road typical as the Steese Expressway for a total width of 92-ft 6-in including a 14-ft median for snow storage and safety.

Due to the grade raise and right-of-way constraints at the bridge, the preliminary bridge design incorporates retaining walls at the four corners of the bridge. The walls will confine the fill footprint to minimize impacts to multiple commercial and residential properties.

See Appendix G for preliminary bridge plans.

## **RIGHT-OF-WAY REQUIREMENTS**

Right-of-way (ROW) acquisition will be required on all quadrants of the intersection as well as for the Farmers Loop Extension bike path and temporary road. ROW acquisition will be predominantly fee simple, with a drainage easement or fee simple for the stormwater retention basin.

One business relocation (Church of Jesus Christ of Latter-Day Saints) will be required. Impacts to other developed properties in the area are not anticipated to trigger zoning, setback or parking study requirements as the acquisitions are relatively small existing road frontage strips.

ROW acquisition from the Birch Hill Cemetery will require adjustment of their internal access road and relocation of the winter storage facility.

Temporary construction permits and easements are anticipated for construction workspace and tying back into built environment grades.

## **MAINTENANCE CONSIDERATIONS**

The proposed interchange will result in increased M&O costs due to increased lane miles and additional signals. Additional elements that may require inspection or maintenance include new



retaining walls and noise barrier. Snow removal and other M&O considerations have been coordinated throughout the design of the project.

Improvements to ditches and swales, and installation of a new storm drain system are anticipated to reduce maintenance in the near term. However, new manholes and catch basins will require additional cleanout efforts in the long term.

	Pre-Construction	Post-Construction
Road Lane Miles	7.01	9.43
Path Lane Miles	0.88	0.97

## **MATERIAL SOURCES**

Material sources will be Contractor furnished due the presence of numerous Contractor owned sites in the project area.

## **UTILITY RELOCATION & COORDINATION**

There are numerous utilities within the corridor limits, both crossing and paralleling the Steese Expressway, the Johansen Expressway and adjacent roads. These utilities include:

- Golden Valley Electric Association (GVEA): Electric power
- Alaska Communications Systems (ACS): Telephone and fiber optic
- General Communications Inc. (GCI): Fiber optics and cable TV
- AT&T /Alascom (AT&T): fiber optic
- Golden Heart Utilities: Water

AT&T, GCI and ACS will likely need to relocate buried communications. Anticipated grade separation will require GVEA to relocate an overhead 12.5kV crossing. Overhead and underground power and communication will likely be completed in advance of construction by the utility companies. Water relocation will likely be included with the road construction. The project will be expanding access control limits which may result in additional relocations beyond those inside the new toe of slope. Several relocation alternatives are very close to the ROW and/or geographic constraints which may limit options.

## **ACCESS CONTROL FEATURES**

The Steese and Johansen Expressways are both access controlled facilities within the project limits. No changes to access control on the Steese or Johansen Expressways are proposed with this project. Access control will need to be extended along Lazelle Road within the limits of the interchange.

## **PEDESTRIAN/BICYCLE (ADA) PROVISIONS**

The project will reconstruct existing and add new pedestrian and bicycle facilities within the project limits. Existing facilities have not been evaluated for full compliance with ADA requirements but are anticipated to be out of compliance for cross-slope and ramp standards based on the year they were constructed. New facilities will be constructed to current ADA standards and no exceptions are anticipated at this time.

Pedestrian/bicycle facilities include a new bike path connecting the existing Johansen and Farmers Loop separated bike paths, sidewalks through the interchange, and connecting to the Old Steese Highway sidewalks.

## **SAFETY IMPROVEMENTS**

The proposed project will shorten pedestrian and bicycle crossing distances as well as signaling the majority of non-motorized crossing locations, improving safety for non-motorized users. The grade separation will eliminate stopping and crossing conflicts for high-speed traffic.

## **INTELLIGENT TRANSPORTATION SYSTEM FEATURES**

This project will include fiber optic interconnect along the Steese Highway from the Trainer Gate intersection to the Farmers Loop intersection. Continuous Count Stations will also be installed as a part of the project.

## **DRAINAGE**

Surface water in the project area flows primarily from the northeast, southeast, and southwest quadrants towards the northwest corner. Existing drainage facilities include curb, gutter, drainage ditches and culverts which drain the surrounding three quadrants towards the northwest. Minimal grade difference in the location of the interchange and heavy development surrounding the location result in annual flooding of the ditches surrounding the intersection. There is a ditch along the Steese on the west side conveying runoff from the north near Farmers Loop towards the Johansen Expy. The proposed interchange will utilize new culverts and storm drain to carry water from the ditches to a storm water retention pond located in the northwest corner. This area is currently being developed as a gravel pit. This will alleviate the seasonal flooding.





Figure 5. Existing Drainage patterns.

The Farmers Loop bike path connection is currently predominantly flat gradient wetlands. The bike path will be built up above the surrounding terrain to reduce the risk of ponding on the facility.

## SOIL CONDITIONS

Soil conditions in the project area consist of a mix of alluvial sands and gravels overlain by silt. In the northwest quadrant peat overburden is anticipated due to the adjacent peat mining operation and visual observations. Permafrost and seasonal frozen ground conditions are anticipated, and pile foundations are expected for the bridge structures.

Geotechnical investigations have not been completed for the project to date, but will consist of centerline investigations in locations of widening, realignments, and the Farmers Loop bike path connection. Foundation investigations for the bridge and retaining walls will be completed once the structure locations have been finalized. Historic geotechnical information is available from the following prior DOT&PF investigations:

- Engineering Geology & Soils Report, Gaffney to Farmers Loop Road, Prepared by Engineering Geology Section, Alaska Department of Highways, 1972
- Reconnaissance Study, Trainer Gate Road to Fox, Prepared by State of Alaska Department of Highways, 1970
- Engineering Geology & Soils Report, Steese Expressway Resurfacing, Trainer Gate to Fox, Prepared by Northern Region Design and Construction, AKDOT&PF, 1988

## **EROSION AND SEDIMENT CONTROL**

The proposed project will require a Stormwater Pollution Prevention Plan (SWPPP) developed by the Contractor and based on the project's Erosion Sediment Control Plan (ESCP). Permanent BMP's include grass or rock lined slopes, ditches, and swales and a stormwater retention pond in the northwest quadrant of the intersection. Temporary BMP's are anticipated to consist of perimeter controls and inlet/outlet controls at drainage structures. Given the tall slopes anticipated for the overpass embankment velocity controls may be required while waiting for permanent stabilization (grass) to establish.

The project is located in the MS4 boundary. Receiving waters will be adjacent wetlands and the stormwater retention pond.

## **ENVIRONMENTAL COMMITMENTS**

The following environmental commitments are from the approved environmental document.

- Should unanticipated contaminated soil or groundwater be encountered during construction activities (including dewatering, if needed), DOT&PF's Contractor will coordinate with DOT&PF and ADEC to determine an appropriate course of action before proceeding with excavation, transfer, or other manipulation of contaminated or potentially contaminated soils or groundwater. The Contractor will be required to get the appropriate permits from ADEC for de-watering in areas of known contamination.
- The DOT&PF Contractor will comply with ADEC requirements for working in areas of contamination or handling contamination, including the unlikely possibility of relocating or removing PCB-containing electrical transformers or material.
- To minimize fragmentation, the Farmers Loop Connection will be a temporary construction road. The driving surface will be removed following completion of construction at the main intersection, and the area will be seeded with native species. The multi-use pathway will remain, with minimal potential to affect habitat.
- To prevent or reduce the risk of invasive species propagation, the DOT&PF Contractor will seed side slopes with an approved seed mix containing no invasive species. Use of local topsoil and grubbing will be investigated during detailed design to ensure seed mix grows dense enough to crowd out future invasive intrusion. These measures will minimize the risk of invasive species spread.
- The Contractor will follow the vegetation clearing guidelines provided by the USFWS as a means of minimizing or preventing impacts to migratory birds and their nests. Per USFWS guidelines, should bald or golden eagles or their nests be found within 660 feet of the project area, DOT&PF will consult with USFWS on construction activities and eagle avoidance measures prior to proceeding with construction.
- The Contractor will minimize construction-related emissions to the extent feasible through implementation of best management practices (BMPs) to reduce emissions and control fugitive dust. Such BMPs may include measures such as site watering to reduce dust and minimizing idling of heavy machinery.

- Noise barriers will be constructed where indicated in the project Traffic Noise Analysis Report provided the property owners desire the barrier(s) in accordance with the Department's Noise Policy.
- Noise generating construction activities would be limited to the hours of 7 am to 10 pm, in compliance with the City of Fairbanks ordinances regarding noise, unless a noise variance is granted.
- The Farmers Loop Connection enhancement has incorporated design features, such as tight side slopes, to minimize the amount of fill in wetlands. The road itself will be a temporary feature to provide construction routing that avoids the Steese-Jo intersection and will be removed once complete, leaving only the pedestrian and bicycle path as a permanent feature on this alignment. Furthermore, the roadbed will be designed to promote hydrologic connectivity between the wetlands on the east and west sides of the alignment, using permeable materials, geotextile wrap, equalizer culverts, or other design features that allow cross-connectivity. The ends of the alignment may be capped with a non-permeable material to prevent use of the Farmers Loop Connection alignment as a preferential flow path for subsurface hydrology, thereby preventing dewatering of the surrounding wetland.
- Should construction activities, most notably excavation, encounter evidence of a previously unknown cultural resource, construction activities would stop in that area. The DOT&PF Cultural Resources team would be consulted on how to proceed.

## **WORK ZONE TRAFFIC CONTROL**

This project is considered significant for traffic control in accordance with P&P 05.05.015. There is potential to fully close the Steese and Johansen Expressways for more than one hour at a time. There are practical alternate routes for the Johansen Expressway however the nearest parallel corridor for the Steese Expressway is Peger Road which is a significant detour. In accordance with the PCM a Transportation Management Plan (TMP) will be developed prior to construction. The TMP will be developed in partnership with the Construction Manager/General Contractor (CMGC) selected for the project.

Construction traffic management was evaluated during the environmental document stage. Preliminary analysis indicates mitigations may include:

- Construction of temporary road connection between Northside Boulevard and Farmers Loop Extension.
- Construction of a temporary traffic signal at Farmers Loop Rd and Farmers Loop Extension.
- Signal timing adjustments and lane reassignments to various intersections in the impact area.

The Johansen and Steese Expressway are primary freight routes. Alternatively, Goldstream Road will be used to bypass the intersection during construction.

Lazelle Road traffic will be routed to Trainor Gate Road for the duration of construction. City Lights Boulevard is proposed to be closed with the project due to proximity to the intersection. The traffic that accessed City Lights from Steese/Jo will utilize the Farmers Loop/Steese Expressway intersection.

The proposed construction sequence would construct the temporary Farmers Loop Extension roadway and permanent pathway ahead of the main interchange construction to handle the impacted facility traffic while the interchange is constructed. Pedestrians are prohibited within the access controlled sections of the Steese and Johansen Expressways except to cross at the existing signalized intersection. Pedestrian crossing of the Johansen Expressway will likely be maintained at the Old Steese intersection while the interchange is constructed.

A general schematic of anticipated detour routes and closures is shown below.

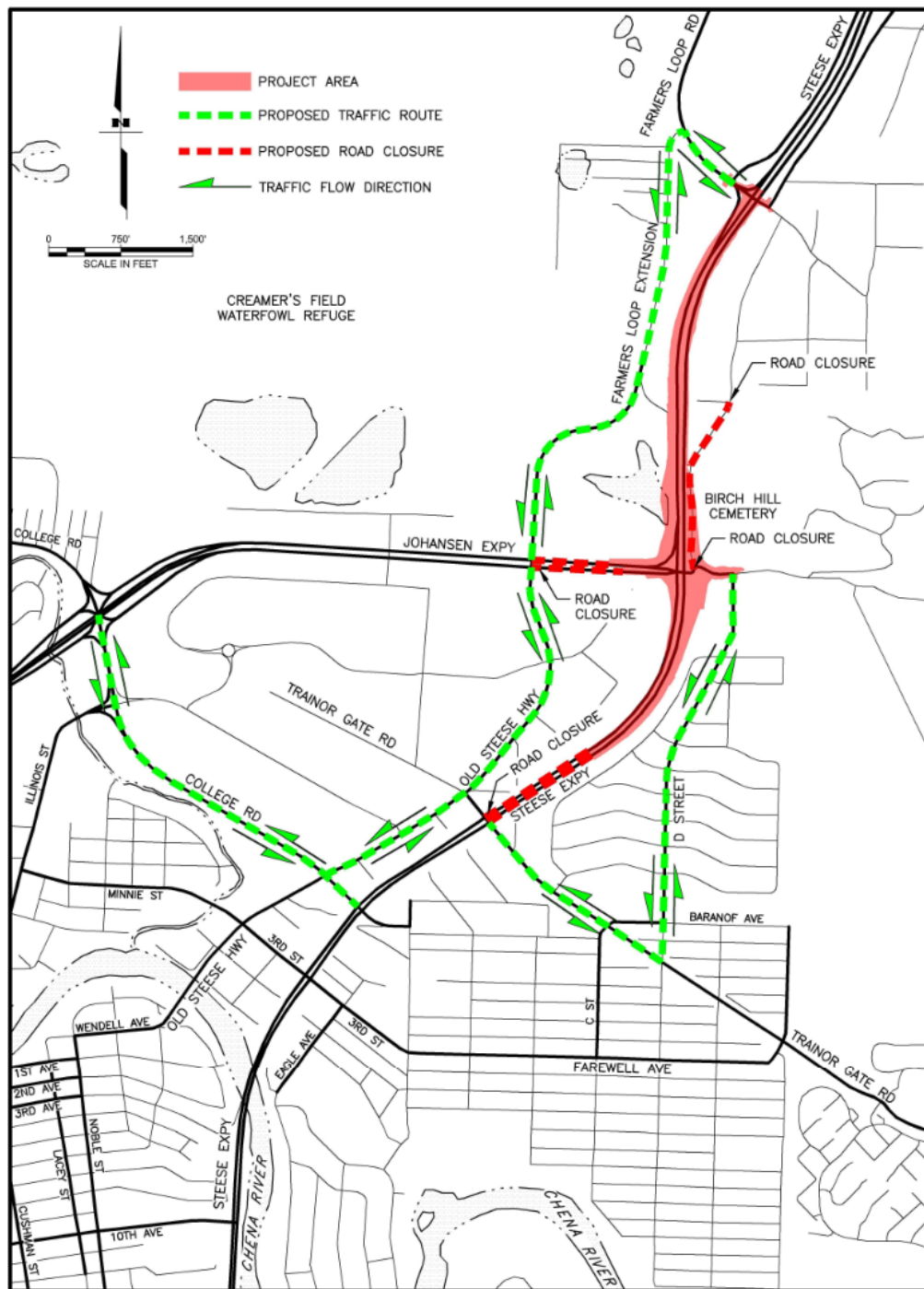


Figure 6. General work zone traffic management scheme.

## VALUE ENGINEERING

A Value Engineering Study was completed. In addition, CMGC will be used to deliver the project to maximize value and best manage impacts to the traveling public during construction.

## COST ESTIMATE

The estimated costs for this project are as follows:

Design	\$6,000,000.00
Utilities	\$2,000,000.00
Right of Way	\$3,000,000.00
Construction (Includes 14% Engineering)	\$70,000,000.00
	<hr/>
Total Cost of Project	\$81,000,000.00