ENGSTROM ROAD TO TRUNK ROAD CONNECTOR

RECONNAISSANCE ENGINEERING REPORT

Prepared for:

MATANUSKA-SUSITNA BOROUGH

Prepared by:

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JULY 31, 2023

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ABBREVIATIONS

HDL .....HDL Engineering Consultants, LLC

1.0 PROJECT DESCRIPTION

Identified in the Matanuska-Susitna Borough's (MSB) 2035 Long Range Transportation Plan (LRTP), adopted December 2017, the goal of the Engstrom Road to Trunk Road Connector project is to reduce congestion on Engstrom Road and provide alternate access to Trunk Road. The project was approved by voters as part of the 2021 Transportation Infrastructure Projects (TIP21).

1.1 Scope of the Report

The purpose of this report is to present the results of a reconnaissance level study for route alternatives for a connector from Engstrom Road to Trunk Road. The study was performed to present the MSB with information to identify and compare two alternatives based on the following:

- Preliminary desktop geotechnical evaluation and preliminary geotechnical recommendations.
- Preliminary Hydrology and Hydraulics (H&H) evaluation for potential creek crossing locations and overall drainage patterns.
- Review of previously completed studies and plans within and around the project area, including:
    - Fishhook Area Collector Roads Traffic Study, 2017
    - Official Streets and Highways Plan (OSHP), adopted November 2022
    - 2035 LRTP, adopted December 2017
- Coordination with the Alaska Department of Transportation and Public Facilities (DOT&PF) on the impacts of the route alternatives to DOT&PF facilities.
- Rough order of magnitude cost estimate.

1.2 Project Location and Description

The MSB's Core Area has experienced continued rapid growth over the last several decades, resulting in an explosion in land development and a corresponding increase in local traffic. The purpose of this project is to evaluate route alternatives for a new road connecting Engstrom Road and Trunk Road. The MSB has asked HDL to evaluate the feasibility and impacts of the two route alternatives along the proposed corridor using collector road classification design criteria.

This proposed development would include right-of-way (ROW) acquisition, existing road upgrades and/or new road construction, intersection improvements, creek crossing(s), utility relocations, and signage and striping.

This project is located in Sections 22, 23, 26, and 27, Township 18 South, Range 1 East, of the Seward Meridian; Latitude 61°37'37.5", Longitude 149°14'15.1". See Figure 1 on the following page for the location and vicinity map.

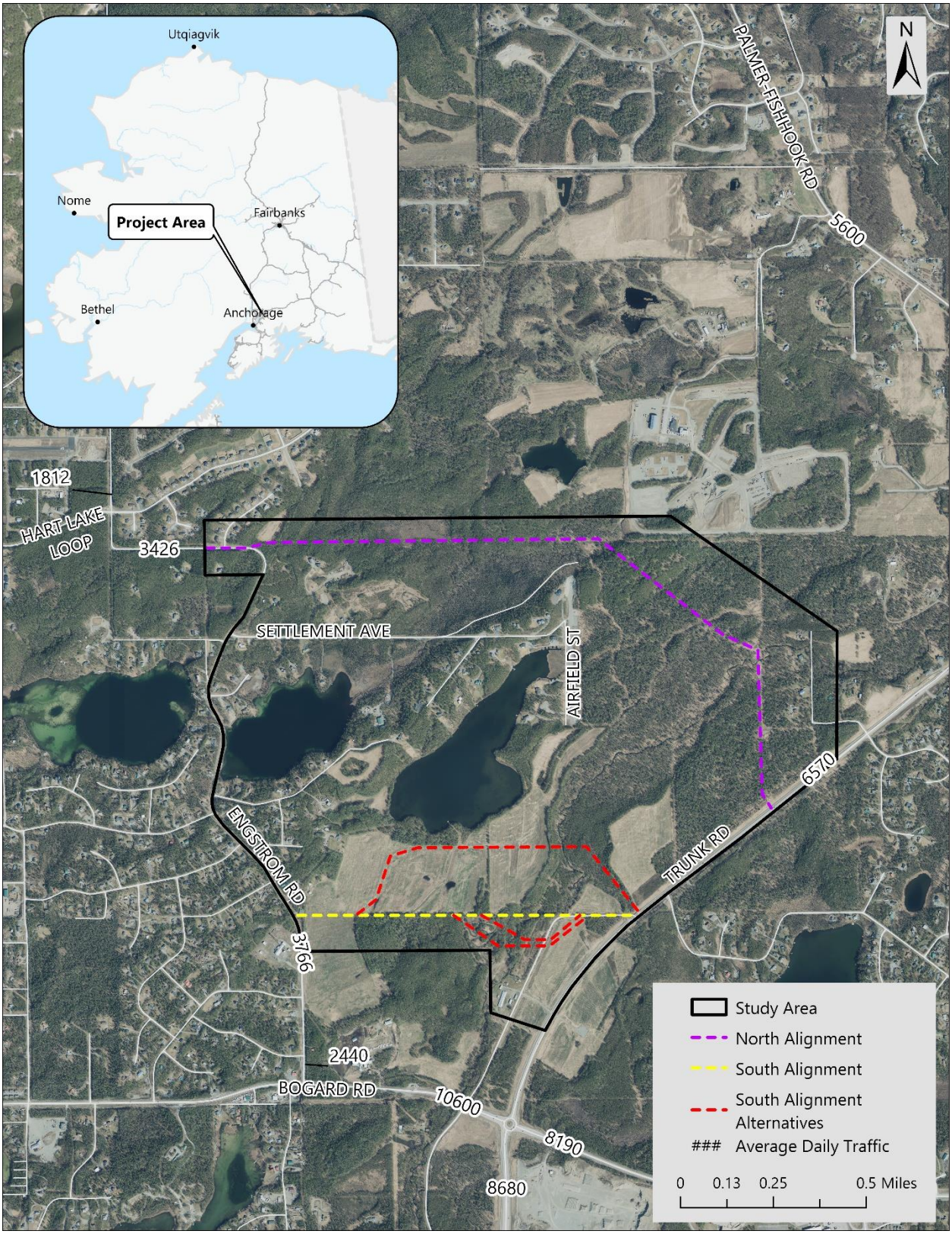


Figure 1 Location and Vicinity Map.

1.3 Existing Facilities and Land Use

There is no current direct connection between Engstrom Road and Trunk Road. Traffic traveling to and from Trunk Road and Engstrom Road must use Bogard Road and enter using the only collector intersection serving the study area. This has resulted in a high concentration of traffic at the Engstrom Road and Bogard Road intersection and notably left turning traffic from Engstrom Road onto Bogard Road that has limited sight distance, a crash rate that is higher than the statewide average for a similar intersection, and is heavily congested.

Adjacent land use largely consists of single-family and multi-family developments with some farms and industrial facilities. Moreover, the study area contains some of the only unsubdivided land in the immediate area; both alternatives pass through portions of unsubdivided land. The potential exists for future development including the extension of City of Palmer water service to the area.

1.4 Purpose and Need

Considerable steady population growth throughout the MSB has occurred over the last several decades, which has increased demand on the poorly connected network of local roads. The MSB's LRTP specifically identified congestion issues along Engstrom Road and a need to reduce congestion and provide an alternate access to Trunk Road and Palmer-Fishhook Road.

The purpose of this project is to improve safety and to increase the capacity of the road network in the Fishhook area by providing an alternate route between Engstrom Road and Trunk Road that has a minimum design life of 20 years.

The need of the project is to improve connectivity and reduce congestion to meet current and future traffic volumes, which are constricted by the Fishhook and North Lakes areas limited Collector level road network.

2.0 DESIGN STANDARDS AND GUIDELINES

Design standards and guidelines that apply to the Engstrom Road to Trunk Road Connector are contained in the following publications.

Standards:

- A Policy on Geometric Design of Highways and Streets (PGDHS), 8th Edition, AASHTO, 2018.
- Roadside Design Guide (RDG), 4th Edition, AASHTO, 2011.
- Alaska Highway Preconstruction Manual (HPCM), DOT&PF, 2022 as amended at the time of design approval.
- Alaska Highway Drainage Manual (AHDM), DOT&PF, 2006.
- The Alaska Traffic Manual (ATM), consisting of the Manual on Uniform Traffic Control Devices (MUTCD), 2009 as amended, U.S. DOT, FHWA, and the Alaska Traffic Manual Supplement (ATMS), DOT&PF, 2016.
- ADA Standards for Transportation Facilities, DOT, 2006.
- ADA Standards for Accessible Design, DOJ, 2010.
- Highway Capacity Manual (HCM), 5th Edition, TRB, 2010.
- Guidelines for Geometric Design of Very Low-Volume Local Roads (ADT ≤ 400), AASHTO, 2001.
- Subdivision Construction Manual (SCM), MSB, 2022.

3.0 DESIGN CRITERIA AND TYPICAL SECTION

Design criteria for the roadway corridor has been developed for a Major Collector Road as shown on the MSB's LRTP. The design and posted speed limit have yet to be determined, but for conceptual design purposes, 40 mph has been selected as the design speed. The design criteria used to develop the alternatives can be found in Appendix A.

The typical section for both route alternatives consists of two 11-foot lanes, 6-foot shoulders, 10-foot wide 4H:1V foreslopes, and 3H:1V backslopes. The recommended structural section is summarized below in the Geotechnical Evaluation.

Additional sections may be considered, including retaining walls, as the design progresses, in particular at creek crossing locations.

4.0 ALTERNATIVES

The MSB solicited proposals to design a connector from Engstrom Road to Trunk Road generally in-line with the existing N Old Homestead Road (South Alignment). Subsequently, the MSB has requested evaluation of an alternate route beginning approximately 1-mile to the north on Engstrom Road. The alternatives are described in further detail below.

4.1 No-Build Option

The No-Build option consists of maintaining the existing roadway network. No improvements or new connections would be made under this option. The existing level of service (LOS) would continue and decrease proportional to an increase in traffic volume. It can be anticipated that there would be an increased LOS at the intersection with Bogard Road due to the DOT&PF sponsored HSIP: Bogard Road at Engstrom Road/Green Forest Drive Intersection Improvements project currently in design.

The No-Build option does not satisfy the purpose and need of this project for the following reasons.

- No alternate route between Engstrom Road and Trunk Road. The MSB's LRTP specifically identifies the need for alternate access. This alternate access is needed to provide options for emergency services, detour options in cases of road closures due to weather or construction, and alternate routes to spread the existing and future traffic volumes across the road network.
- No safety improvements. Traffic volumes are expected to continue to increase and an increase in traffic volume beyond the existing design capacity greatly increases the likelihood of crashes and a reduction in safety.
- No congestion relief. Traffic volumes are expected to continue to increase and subsequently LOS decrease if no improvements are made. Providing no alternate route will continue to burden the Engstrom Road-Bogard Road intersection as the only Collector level connection, as well as continue to burden local roads with Collector level traffic volumes when alternate routes are needed.

4.2 South Alignment

The proposed South Alignment begins approximately 0.4-miles north of the Bogard Road-Engstrom Road intersection and extends east, merging into N Old Homestead Road. This is the alignment presented to voters as part of the TIP21. This proposed corridor is approximately 0.9-miles long and

would require construction of a new approach/intersection with Engstrom Road and make use of the existing approach of N Old Homestead Road to Trunk Road. Trunk Road is owned and maintained by DOT&PF and will require coordination with them on the connection.

During the preliminary H&H evaluation, it was determined that this proposed alignment is not ideal for crossing Wasilla Creek. The alternate alignments in red show proposed adjustments to the South Alignment that have more ideal crossing locations over Wasilla Creek. These alternatives are discussed further in the H&H Section.

While this is the alignment presented to voters as part of the TIP21, the close proximity to both the existing Trunk Road-Bogard Road roundabout and the proposed (currently in design) Bogard Road-Engstrom Road roundabout provides limited added benefit in reducing congestion (improving LOS) and increasing connectivity.

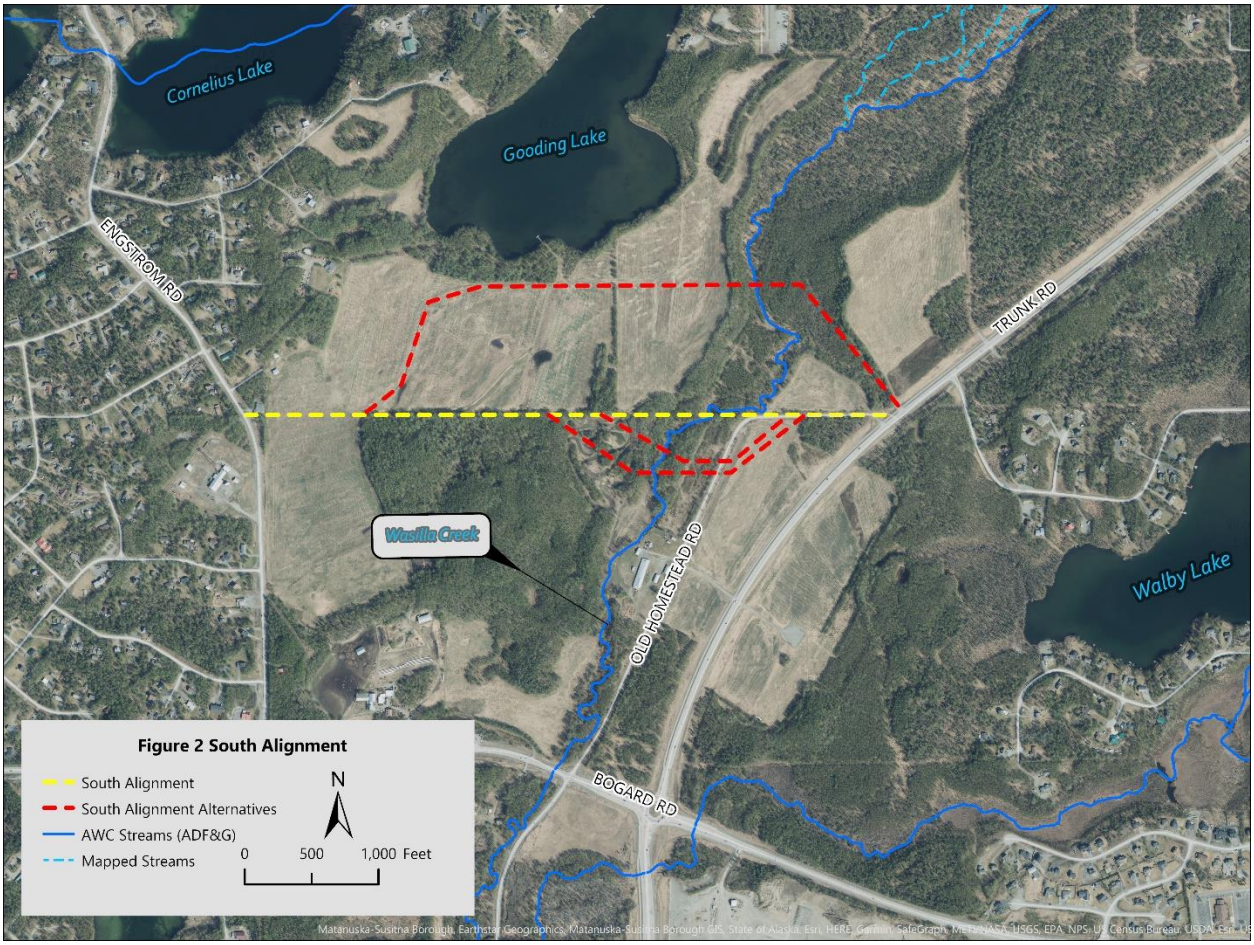


Figure 2: South Alignment

Key attributes of the south alignments are summarized below.

- Less than 1-mile long
- Uses existing approach at Trunk Road
- One anticipated creek crossing
- Less than 0.5-mile separation from Bogard Road roundabouts at Trunk Road and Engstrom Road (proposed)
- Five impacted properties

While this alternative makes use of the existing approach to Trunk Road, improvements would be required to, at minimum, widen the approach to match the assumed typical section and accommodate the existing multi-use pathway along Trunk Road. If this alternative were selected, further analysis would be required to determine the appropriate intersection configuration based on expected traffic volumes and appropriate crossing location of Wasilla Creek.

4.3 North Alignment

The proposed North Alignment begins approximately 1.6-miles north of the Bogard Road-Engstrom Road intersection, extends east along the ¼ Section line of Section 22 to Section 23, then turns southeast and then south where it connects to Trunk Road approximately 0.2-miles southwest of Heaton Road. The proposed corridor is approximately 1.9-miles long and would require a new intersection at both Engstrom Road and Trunk Road. Trunk Road is owned and maintained by DOT&PF and will require coordination with them on the connection and an appropriate intersection configuration. The proposed intersection location with Trunk Road aligns with a proposed future Collector Road north of Walby Lake, identified in the OSHP.

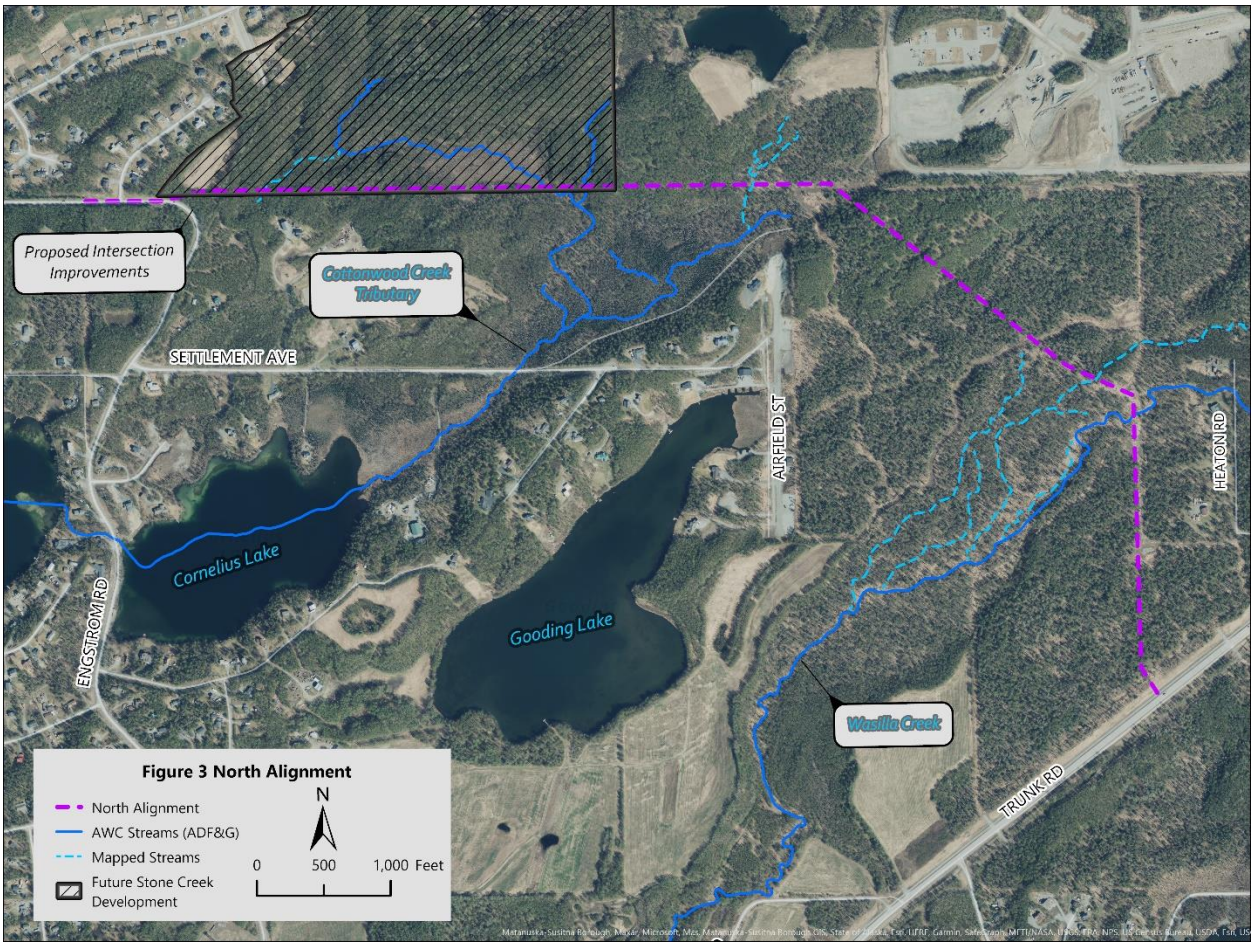


Figure 3: North Alignment

The MSB is currently entertaining an application for the development of the Stone Creek Phase 6 Tract Z residential subdivision, which is the property immediately north of the proposed alignment near the western end and extends approximately 3,200 feet east off of Engstrom Road. This alignment would help reduce traffic congestion at the Engstrom Road-Bogard Road intersection by moving the corridor further north and diverting a substantial amount of traffic to Trunk Road.

Preliminary considerations for converting the 90-degree curve to an intersection include a tee-intersection and a roundabout. Based on traffic data collected by the MSB (2019) on Engstrom Road before and after Hart Lake Loop (see Figure 1), a significant amount of the traffic traveling on Engstrom Road to/from Bogard Road comes from or through the Wolf Lake area. Because of the disconnected road network in the Fishhook Triangle (see OSHP for further discussion), without additional traffic data, the trip origin and destinations are unclear and a preferred intersection configuration cannot be determined at this time. The list below outlines features for each configuration, including making the south leg of a tee-intersection stop controlled. It is assumed that minimal traffic would be making the movement between the south and east legs of the intersection and therefore the configuration making the west leg stop controlled was not considered.

- Roundabout
    - Provides continuous flow for all traffic movements
    - Provides better access control with the addition of the proposed Stone Creek subdivision
- Tee-Intersection (South Leg Stop Controlled)
    - Provides Major Collector level through movement to/from Trunk Road (Arterial)
- Tee-Intersection (East Leg Stop Controlled)
    - Maintains existing traffic movement of north/west and east/south

Key attributes of the north alignment are summarized below

- Approximately 2-miles long
- Proposed intersection with Trunk Road aligns with future Collector Road north of Walby Lake
- Approximately seven anticipated stream crossings
- Greater than 1.5-mile separation from Bogard Road roundabouts at Trunk Road and Engstrom Road (proposed)
- Ten impacted properties
- Reduces future traffic volume increase from Stone Creek Development on Engstrom Road
- Provides alternate Collector level route around annual road closure caused by snow drift south

While this alternative proposes an intersection with Trunk Road that aligns with a future Collector Road north of Walby Lake, the scope of this report is limited and does not include an analysis of anticipated traffic volumes and preferred intersection configuration. If this alternative were selected, further analysis would be required to determine the appropriate intersection configuration based on expected traffic volumes for both the Engstrom Road to Trunk Road Connector and the future [Walby Lake] Collector Road.

5.0 GEOTECHNICAL EVALUATION

HDL reviewed historical geotechnical reports, nearby well logs, topographic data, and aerial imagery along the proposed alignments to provide information regarding the anticipated subsurface

conditions. The results of the desktop evaluation were incorporated into preliminary structural section recommendations.

In general, we anticipate that subsurface conditions along the proposed alignments will largely consist of approximately 1 to 5 feet of silty organic soils underlain by gravel with varying amounts of sand, silt, and cobbles. In general, we anticipate groundwater to be encountered at elevations ranging between Wasilla Creek and the uphill Gooding and Cornelius Lakes. Portions along the alignment that may consist of differing soil conditions are noted in the following sections.

5.1 South Alignment

Several historic well logs located near the proposed Engstrom Road connection indicate gravelly clay and/or hard pan underlies the silty organic soils, which we interpret to be glacial till, and may be encountered as shallow as 5 feet below the existing ground surface (bgs).

5.2 North Alignment

Shallow groundwater and soft organic soils up to 15 feet thick are anticipated in the lowland area approximately 0.3 miles east of the proposed Engstrom Road tie-in.

5.3 Preliminary Geotechnical Recommendations

HDL recommends the proposed alignment be cleared and grubbed prior to the start of construction. If soft or unstable soils or other deleterious materials are encountered during construction, the materials should be removed and replaced with material meeting the DOT&PF Standard Specifications for Highway Construction (SSHC) requirements for Selected Material, Type B or better. We recommend that the exposed subgrade be proof-rolled to provide a level, firm, uniform surface prior to the placement of fill. If loose soils are encountered additional compaction effort may be required. Excavations should be dewatered and protected from adjacent runoff. Subgrade soils may be difficult to compact due to elevated in-situ moisture contents or if they are exposed to additional rainfall or runoff during excavation.

Fill placed outside of the structural section should be placed in lifts not to exceed 10 to 12 inches loose thickness, and compacted to a density of at least 90 percent of the maximum density as determined by the Modified Proctor compaction procedure (ASTM D1557). During fill placement, cobbles and boulders with dimensions in excess of 2/3 the lift thickness should be removed.

The minimum recommended structural section for the proposed road is as follows:

Table 1: Preliminary Structural Section Recommendations

Minimum Thickness (in.)	Material Type
4	HMA Type II, Class A
4	Base Course Gradation D-1
36	Selected Material, Type A
(As needed to meet grade)	Selected Material, Type B

The HMA Type II, Class A, Base Course Gradation D-1, and Selected Material should meet the requirements presented in the DOT&PF SSHC. The Base Course and Selected Material, Type A should be spread in thin, moisture conditioned layers and compacted to at least 95 percent of the maximum dry density as determined by ASTM D1557. All subgrades and final grades should be rolled to provide smooth, firm, and non-yielding surfaces.

The recommended structural section does not provide full frost protection and seasonal movement of the pavement should be expected; however, the recommended structural section is expected to provide a service life typical for Major Collector roads in the area. The life of the pavement can be increased by increasing the thickness of the structural section. We recommend the road and drainage ditches to be graded to and ditches constructed to carry surface water runoff away from the structural section.

Topography along the proposed alignments suggests several large cuts and fills may be required to achieve proposed grades. We recommend performing site specific geotechnical investigations near areas of large cuts to evaluate subsurface materials for reuse.

At least one bridge or large diameter culvert is anticipated where the proposed alignments cross Wasilla Creek. In addition, there may be additional culverts required to support construction of the proposed alignments. We recommend performing site specific geotechnical investigations near the proposed crossing(s) prior to final design.

6.0 HYDROLOGY AND HYDRAULICS

The Preliminary Hydrology and Hydraulics Overview (Appendix B) provides a summary of the floodplain management and fish passage design considerations within the project study area and outlines agency consultation that may be necessary to support the future development of a road connection between Engstrom Road and Trunk Road.

Both the north and south alignments are considered feasible with regards to fish passage and floodplain management requirements. Up to seven fish passage structures should be anticipated for the north alignment, compared to only one stream crossing for the south alignments. Because the hydraulic impacts to the Special Flood Hazard Area of Wasilla Creek are not anticipated to be significant, floodplain impacts should not be a critical deciding factor in alignment selection.

7.0 ENVIRONMENTAL COMMITMENTS AND CONSIDERATIONS

The Preliminary Environmental Overview (Appendix C) provides a summary of the environmental resources present within the project study area and outlines agency consultation and permitting requirements that may be necessary to support the future development of a road connection between Engstrom Road and Trunk Road. Development of any of the proposed alternatives will impact environmental resources. Table 2 provides a qualitative summary of potential environmental impacts associated with the proposed connection between Engstrom Road and Trunk Road.

Table 2: Preliminary Environmental Resources Present

Environmental Resource	North Alignment	South Alignment	South Alignment Alternative
Air Quality	Compliance with Ordinance 19-032.		
Anadromous Fish Streams and Essential Fish Habitat	Multiple Streams	Wasilla Creek crossing required.	Wasilla Creek crossing required.
Floodplain and Regulatory Floodway	Wasilla Creek floodzone present.		
Cultural Resources	5 properties impacted. Consultation with SHPO required.	6 properties impacted. Consultation with SHPO required.	6 properties impacted. Consultation with SHPO required.
Migratory Birds and Eagles' Nests	Vegetation clearing must occur during the USFWS recommended time period in Southcentral Alaska. Eagle nest survey must be complete prior to construction.		
Navigable Waters	USACE identified Wasilla Creek and the unnamed tributaries of Cottonwood Creek as navigable.	USACE identified Wasilla Creek as navigable.	USACE identified Wasilla Creek as navigable.
Noise	Compliance with MSB Chapter 8.52		
Right-of-Way	4 properties impacts	5 properties impacts	4 properties impacts
Right-of-Way	Multiple acquisitions required.		
Wetlands	Wetlands present.		

Agency consultation will be required for compliance with environmental laws and local ordinances. Permitting requirements for the project could include:

- U.S. Army Corp of Engineers Section 404 Permit
- Alaska Department of Fish & Game Title 16 Fish Habitat Permit

- Alaska Department of Natural Resources (ADNR) consultation with the State Historic Preservation Office
- ADNR Temporary Water Use Permit
- MSB Floodplain Permit

8.0 RIGHT-OF-WAY REQUIREMENTS

The extent of ROW requirements will vary depending on the selected alignment but impacts are significant regardless of the selected route alignment. The North Alignment has the benefit of existing Public Use Easements at the beginning of the route at Engstrom Road and along the ¼ Section line of Section 22. In addition, there are plans to develop Stone Creek Phase 6 Tract Z into a residential subdivision. The current plan is for the proposed subdivision to develop E Basalt Drive along the south property line and connecting to Engstrom Road at the southwest corner of the tract.

9.0 PEDESTRIAN AND BICYCLE FACILITIES

In the 2035 LRTP, the MSB identified transportation goals and developed strategies to reach them. One of the Goal Three: Improve Connectivity strategies presents the recommendation of establishing requirements for providing sidewalks or separated pathways on all MSB Core Area roads with a Major Collector or higher classification. The objective is to expand and connect gaps in the existing expansive multimodal network while concurrently increasing accessibility to transit facilities and improving pedestrian safety.

As a proposed Major Collector, it is considered advantageous and consistent with the MSB's transportation goals to provide pedestrian and bicycle facilities along the proposed corridor. In consideration of the corridor passing through a rural area, limited access by public and private approaches, and the existing separated pathway along Trunk Road, it is recommended to include a separated pathway as part of the proposed road footprint. For consistency with current and recent improvement projects, such as the Bogard Road Extension and Seldon Road Extension Phase 1 and 2, a 10-foot paved separated pathway is included as part of the planning level cost estimate below.

10.0 UTILITY RELOCATION AND COORDINATION

Utility impacts were not analyzed as part of this study, but it is anticipated that some utility relocations may be required, particularly near the proposed intersections with Engstrom Road and Trunk Road. Utility companies with facilities in the project limits may include Matanuska Telephone Association, Matanuska Electric Association, Enstar Natural Gas Company, GCI, and Alaska Communications Services.

11.0 COST ESTIMATE

A planning level cost estimate has been prepared for each alternative and are summarized as follows:

11.1 South Alignment

	Wasilla Creek Crossing Type	
	Bridge	Culvert
Engineering Design	$ 738,000	$ 613,000
Right-of-Way Acquisition	$ 610,000	$ 610,000
Utility Relocation	$ 100,000	$ 100,000
Construction		
Roadway	$ 5,779,000	$ 5,779,000
Wasilla Creek Crossing	$ 1,600,000	$ 350,000
Construction Total	$ 7,379,000	$ 6,129,000
Construction Administration	$ 1,107,000	$ 920,000
Total	$ 9,934,000	$ 8,372,000

11.2 North Alignment

	Wasilla Creek Crossing Type	
	Bridge	Culvert
Engineering Design	$ 1,585,000	$ 1,460,000
Right-of-Way Acquisition	$ 768,000	$ 768,000
Utility Relocation	$ 100,000	$ 100,000
Construction		
Roadway	$ 13,022,000	$ 13,022,000
Wasilla Creek Crossing	$ 1,600,000	$ 350,000
Cottonwood Creek/Other Crossings	$ 1,225,000	$ 1,225,000
Construction Total	$ 15,847,000	$ 14,597,000
Construction Administration	$ 2,378,000	$ 2,190,000
Total	$ 20,678,000	$ 19,115,000

11.3 Trunk Road Intersection

The scope of this report is limited and further analysis is required to determine an appropriate intersection configuration at Trunk Road. Possible configurations and planning level cost for each are listed below. These costs should be added to the alignment costs listed in the above sections.

Intersection Configuration	*Additional Cost
Basic Stop Controlled – no alterations to Trunk Road	$100,000
Basic Stop Controlled – widening of Trunk Road for left turn lanes	$1,000,000
Roundabout	$12,000,000
Signalized Intersection	$10,000,000

*Additional costs are based on recent projects with similar scope; detailed analysis was not performed.

12.0 EXCEPTIONS TO DESIGN STANDARDS

There are no current exceptions to design standards for this project.

13.0 OTHER CONSIDERATIONS

13.1 Wind and Snow Drift

The majority of the Mat-Su Valley is impacted by strong winds throughout the year, especially in the Palmer area. The proposed project area is known for its windy conditions and snowdrifts, and there are known drifting issues near both proposed Engstrom Road intersections. Operations and Maintenance staff combat drifted snow piles that often close Engstrom Road at the curve south of Glade Court (beginning of the proposed south alignments) and the section near Cornelius Lake. It will be important to design this corridor to avoid snow drifting over the roadway.

13.2 DOT&PF Facilities

DOT&PF, in cooperation with the Federal Highway Administration (FHWA), is in the design phase of a proposed single lane roundabout at the intersection of Bogard Road with Engstrom Road and Green Forest Drive. The project is being developed and funded through the Highway Safety Improvement Program (HSIP), which specifically targets reducing fatalities and severe injury crashes on Alaska's roadways. The purpose of the HSIP: Bogard Road to Engstrom Road/Green Forest Drive Intersection Improvements project is to improve safety at the intersections of Green Forest Drive and Engstrom Road with Bogard Road. The accident rate for these intersections exceeds the statewide average for similar intersections. These two existing intersections are within 200 feet of each other, which creates overlapping influence areas that potentially increase the accident rate.

While the intersection improvements addresses both safety (crashes) and congestion, and it is included in the 2035 LRTP, alone it does not address the MSB's goal of improve connectivity. Alternate Collector level routes are still needed to provide access to and from subdivisions in the Fishhook triangle. As discussed earlier, Engstrom Road is consistently, albeit briefly, closed in the winter due to high winds and drifted snow; the intersection improvements with Bogard Road provide no solution for traffic in this situation.

Comments provided by DOT&PF staff concur that alternate access would provide more than just congestion relief and safety improvements along Engstrom Road by balancing the traffic volume load across Collector roads. An alternate Collector level road would provide additional route options for emergency services, school buses, detours for construction or emergencies (such as winter weather closures), and reducing volumes along residential roads that have previously been used as Collector level roads. Further, DOT&PF staff indicated the south alignment would not be a prudent option given its close proximity to Bogard Road.

APPENDIX A

Design Criteria

PROJECT DESIGN CRITERIA

Reconnaissance Engineering Report

Engstrom Road to Trunk Road Connector

ELEMENT	VALUE	SOURCE
Construction Classification	New Connection	MSB
Design Functional Classification	Major Collector	MSB 2035 Long Range Transportation Plan
Design Year	2043	Assumed
AADT	2500	Assumed
Design Hourly Volume (DHV)		
Peak Hour Factor (PHF)		
Directional Split (%D)		
Commercial (%CV) / RV's (%RV)		
Equiv. Single Axle Load (ESAL)		
Pavement Design Year		
Design Vehicle	AASHTO WB-65	MSB
Design Speed, Terrain	40 mph, Rolling	MSB
Stopping Sight Distance (SSD) Passing Sight Distance (PSD)	305 ft (on level roadways) 600 ft	PGDHS 2018, Table 3-1 PGDHS 2018, Table 3-4
Maximum Allowable Grade Minimum Allowable Grade	8.0% 0.5%	PGDHS 2018, Table 6-2 PGDHS 2018, pg. 3-130
Minimum Radius of Curvature	762 ft	PGDHS 2018, Table 3-13
Minimum K-Value for Vertical Curves	Crest:44 (SSD), 129 (PSD) Sag: 64	PGDHS 2018, Table 6-3 PGDHS 2018, Table 6-3
Number of Roadways	1 roadway – 2 travel lanes	MSB
Width of Traveled Way	11.0 ft per lane	PGDHS 2018, Table 6-5
Width of Shoulder	6.0 ft	PGDHS 2018, Table 6-5
Surface Treatment	Hot Mix Asphalt	MSB
Side Slope Ratios	Cut - Fore: 4H:1V; Back: 3H:1V Fill - Fore: 4H:1V; Back: 3H:1V	RDG, pg. 3-4
Clear Zone	16 ft for 4H:1V Foreslope	RDG Table 3-1
Degree of Access Control	Limited	Assumed
Median Treatment	None	Assumed
Illumination:	None	Assumed
Curb Usage and Type	None	Assumed
Bicycle Provisions	10 ft Multiuse Pathway	MSB
Pedestrian Provisions	10 ft Multiuse Pathway	MSB

Proposed By: _____ 5/2/23

Engineer Date

Recommended By: _____

MSB Project Manager Date

Accepted By: _____

MSB Public Works Director Date

APPENDIX B

Preliminary H&H Overview

HDL ENGINEERING Consultants LLC

MEMORANDUM

Date: February 1, 2023

To: Cole Branham, PE
Matanuska-Susitna Borough

From: Kyle Albert, PE, CFM

Subject: Preliminary H&H Overview
Engstrom to Trunk Road Connector

Civil Engineering

Geotechnical Engineering

Transportation Engineering

Aviation Engineering

W/WW Engineering

Environmental Services

Surveying & Mapping

Construction Administration

Material Testing

Executive Summary

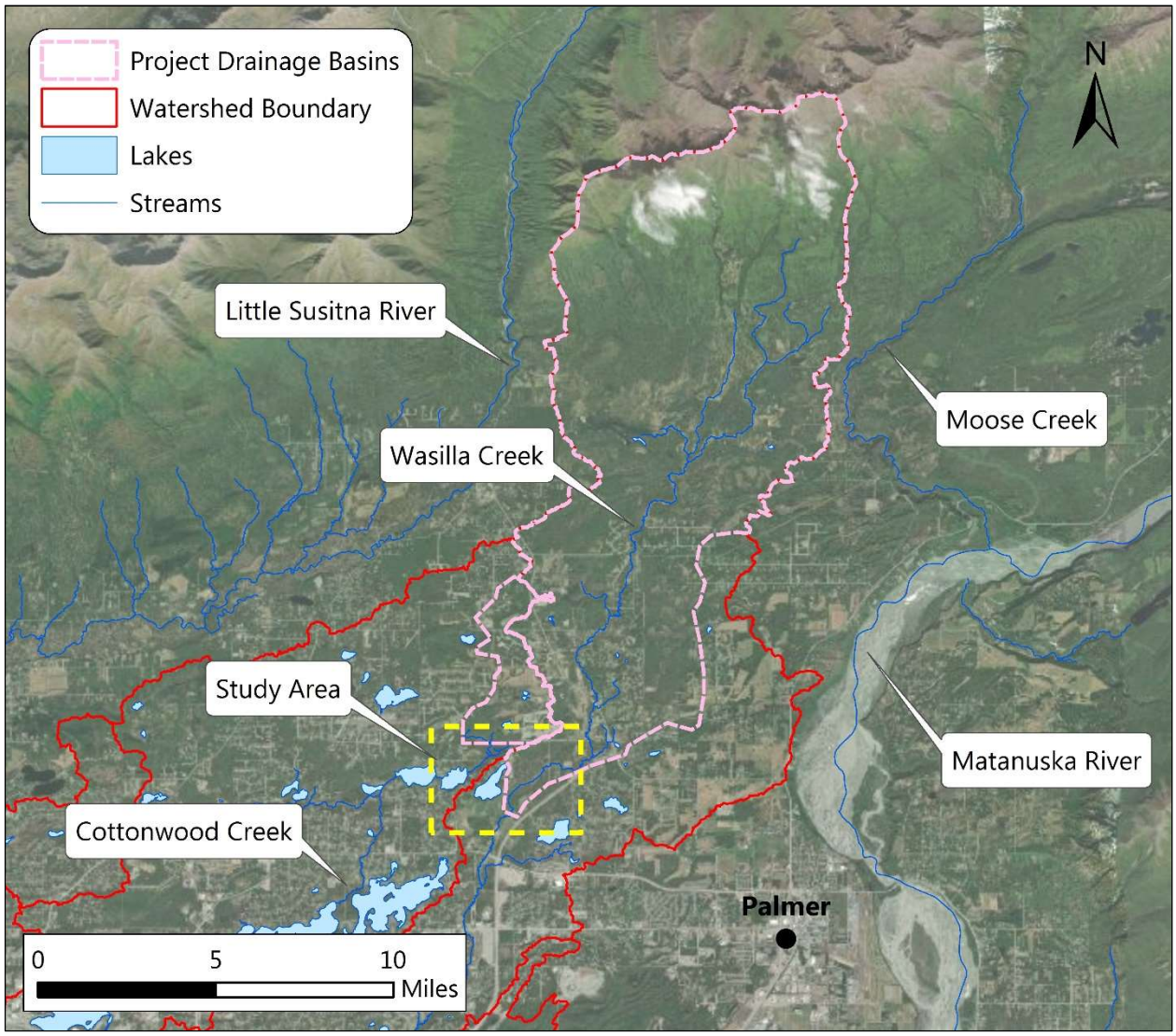
The Matanuska-Susitna Borough (MSB) is proposing to improve connectivity between Engstrom Road and Trunk Road. This Preliminary Hydrology and Hydraulics (H&H) Overview provides a summary of the floodplain management and fish passage design considerations within the project study area and outlines agency consultation that may be necessary to support the future development of a road connection between Engstrom Road and Trunk Road.

Hydrology

The study area is located in the MSB approximately 4 miles west of Palmer. The south roadway alignments are wholly within the Wasilla Creek watershed, and a portion of the north alignment crosses into the upper fringes of the Cottonwood Creek watershed. A vicinity map of the study area and drainage basins is shown in Figure 1.

The upstream drainage areas of Wasilla Creek and Cottonwood Creek are approximately 25 and 1.5 square miles, respectively. Wasilla Creek crosses both the north and south alignments, and has an ordinary high water (OHW) width of 20 to 30 feet in the study area. The 100-year flood discharge of Wasilla Creek is 1006 cfs, according to the current FEMA Flood Insurance Study (FIS) for the MSB. A preliminary regression analysis found that the maximum 100-year flood discharge of any stream crossing in the Cottonwood Creek watershed is 111 cfs.

Figure 1. Vicinity Map



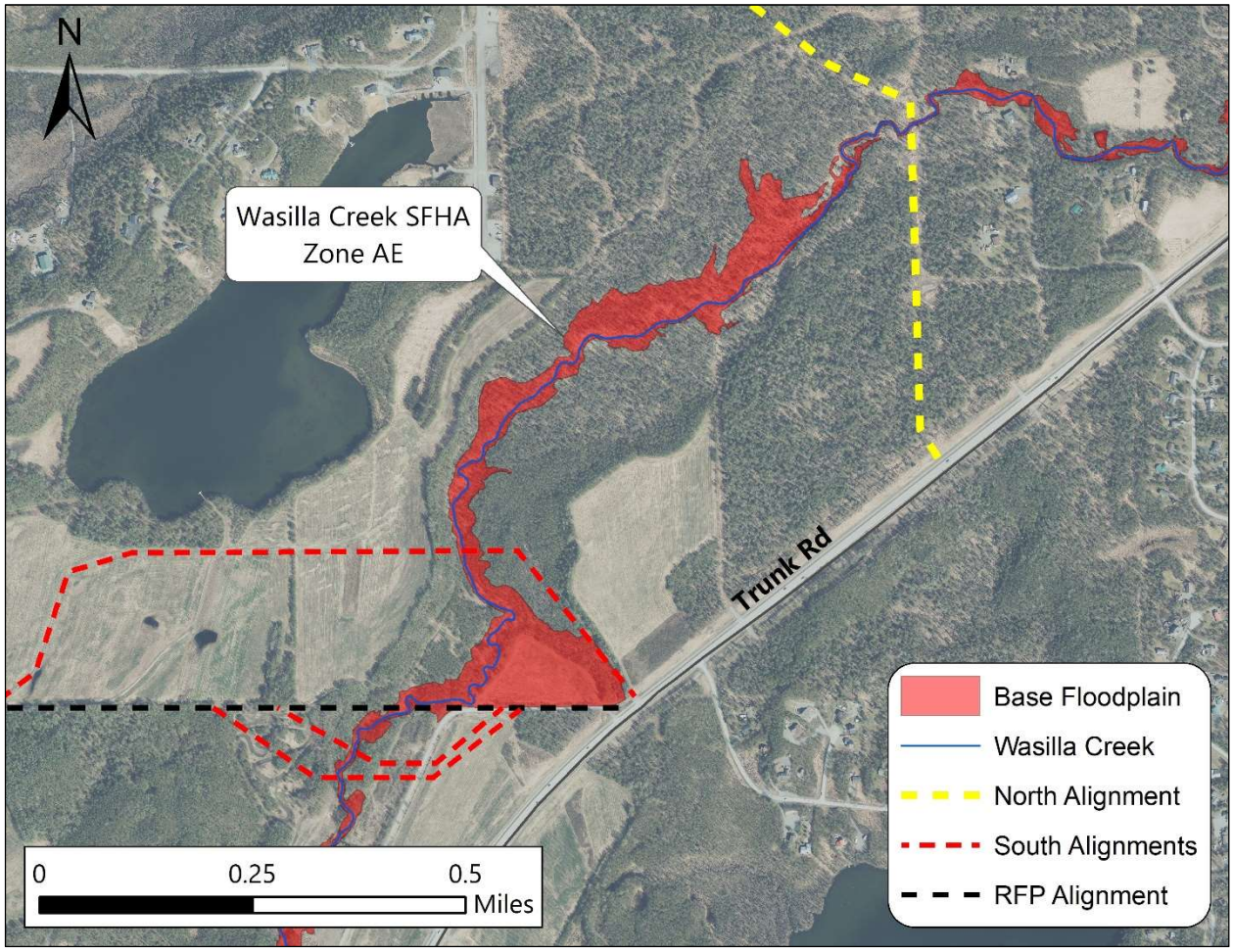
Floodplains

Wasilla Creek was included in the FEMA Flood Insurance Study (FIS) for the MSB, current as of September 27, 2019. The FIS defines the limits of the Special Flood Hazard Area (SFHA) of Wasilla Creek. The SFHA is defined by FEMA as:

> *"The 1% annual chance flood, also known as the base flood or 100-year flood, has a 1% chance of happening or being exceeded each year. Special Flood Hazard Areas are subject to flooding by the 1% annual chance flood. The Base Flood Elevation is the water surface elevation of the 1% annual chance flood. The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights."* (FEMA FIS 02170CV001B)

From 0.3 miles upstream of N. Palmer-Fishhook Road to E. Nelson Road downstream, the SFHA of Wasilla Creek is categorized as Zone AE, which is a 100-year flood zone for which base flood elevations have been determined. A regulatory floodway has not been determined for this SFHA. The north and south alignment crossing locations are shown in Figure 2.

Figure 2. Wasilla Creek SFHA



MSB is a participant in the National Flood Insurance Program (NFIP). In exchange for making flood insurance available, the federal government requires local communities to enforce floodplain management regulations to reduce future flood risks to new construction and substantially improved structures in SFHAs.

MSB's floodplain management regulations are described in Chapter 17 of MSB Code. As stated in MSB Code 17.29.100, a Floodplain Development Permit must be acquired before any construction or development begins in a SFHA, which includes dredging, filling, grading, paving, or excavation operations. Therefore, this project will require preparation of a Floodplain Development Permit application.

In circumstances where development is planned for areas of SFHAs that are defined as regulatory floodways, MSB Code prohibits development unless:

> *"…certification by a registered professional engineer is provided demonstrating through hydrologic and hydraulic analyses performed in accordance with standard engineering practice that the encroachments shall not result in any increase in flood levels during the occurrence of the base flood discharge."* (MSB 17.29.180)

Since a regulatory floodway is not defined in the Zone AE SFHA impacted by this project, H&H analysis and "no-rise" certification is not required.

If the project improvements will alter the base flood elevations and SFHA limits of Wasilla Creek, MSB is responsible for requesting from FEMA a Conditional Letter of Map Revision (CLOMR) in the project planning stage, and a Letter of Map Revision (LOMR) following construction. This ensures that FEMA can update the Flood Insurance Rate Maps (FIRMs) accordingly. Therefore, an H&H analysis may still be required in support of CLOMR or LOMR requests.

As this project pertains to MSB's participation in the NFIP, selection of the preferred roadway alignment should seek to mitigate impacts to the Wasilla Creek SFHA by limiting encroachment of the base floodplain. This may achieved by identifying locations where the floodplain is naturally constricted and/or designing culverts and bridges to have surplus hydraulic capacity.

Figure 2 illustrates why the preliminary alignment described in the Request For Proposal (RFP) is poorly suited for the floodplain. Because Wasilla Creek flows approximately parallel, significant stream realignment and channel improvements would be required to accommodate construction of the roadway and stream crossing.

The north alignment is the preferred alternative for limiting floodplain impacts, since it crosses the Wasilla Creek SFHA where it is most constricted. However, this does not exclude the south alignments from consideration. According to the MSB Parcel Viewer there are no structures located in the immediate vicinity of the south alignment crossings as of 2022. Therefore, any relative increase in the base flood elevation upstream of the south alignments is not anticipated to result in adverse impacts to surrounding properties.

Fish Passage

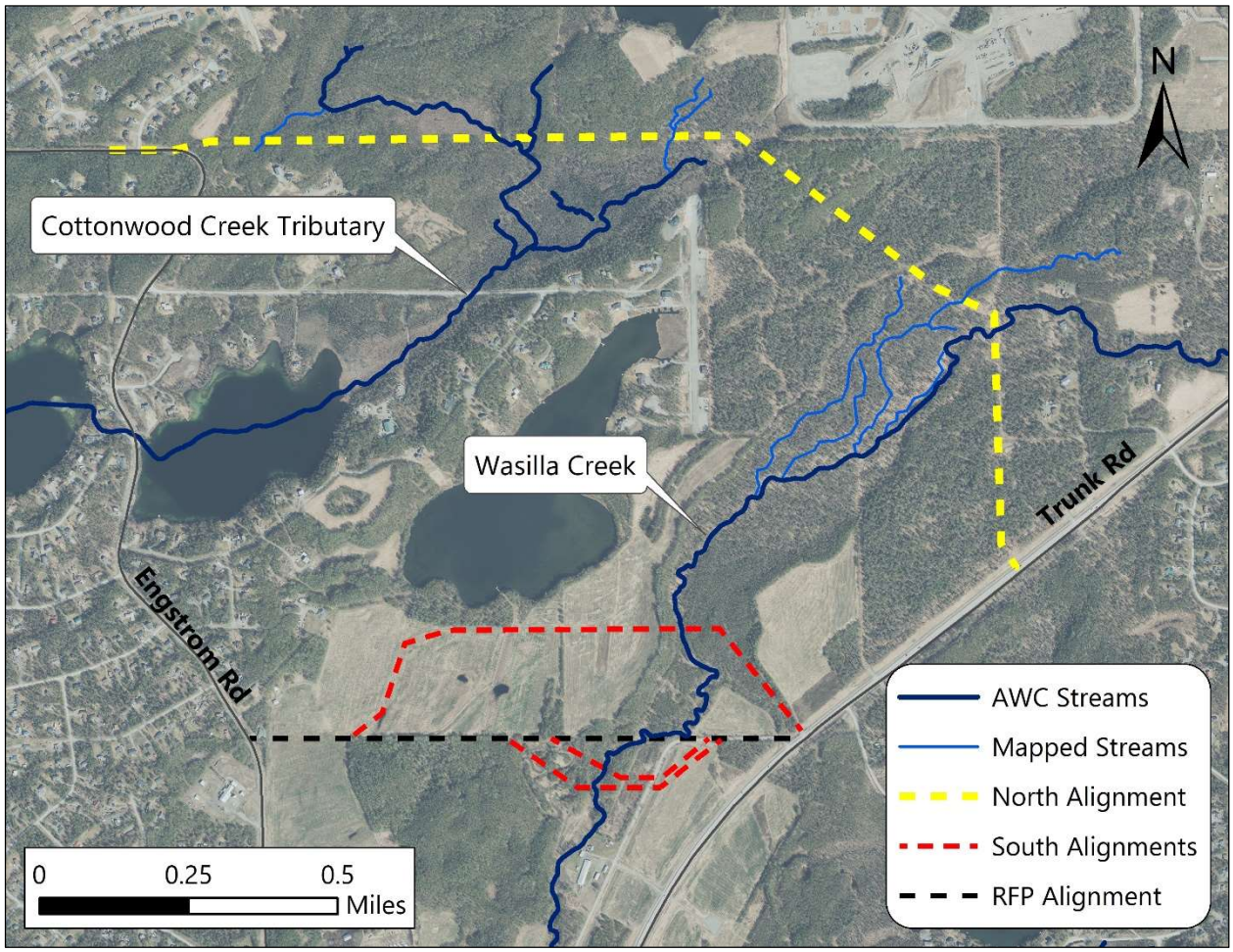
Roadway improvements performed under this project will require one or more crossings of streams that are categorized as anadromous water bodies by the Alaska Department of Fish and Game (ADF&G). ADF&G has regulatory responsibility for protection of freshwater anadromous fish habitat and a Title 16 Fish Habitat Permit will be required for all anadromous stream crossings.

Since this project involves new roadway construction with impacts to previously undisturbed fish habitat, it should be anticipated that, at a minimum, proposed anadromous stream crossings comply with Tier 1

fish passage design criteria outlined in the *Memorandum of Agreement between ADF&G and Alaska Department of Transportation and Public Facilities for the Design, Permitting, and Construction of Culverts for Fish Passage* (MOA 2001). Tier 1 design involves methods of Stream Simulation, where natural stream conditions are replicated inside the culvert. Culverts are sized to span no less than 90% of the ordinary high water (OHW) width of the natural stream channel and are embedded in streambed material. Furthermore, the MSB Subdivision Construction Manual (SCM) requires that culvert crossings of fish-bearing streams be designed with Stream Simulation methods.

Review of the ADF&G Anadromous Waters Catalog (AWC) indicated the presence of anadromous fish streams within the study area, including Wasilla Creek and multiple tributaries of Cottonwood Creek (ADF&G 2022). Wasilla Creek provides spawning and rearing habitat for chum, coho, and king salmon, and sockeye salmon have been observed. Cottonwood Creek provides spawning and rearing habitat for coho salmon.

Figure 3. Anadromous stream crossings



Future consultation with ADF&G and field investigations may reveal that additional anadromous streams are present in the study area. Uncatalogued streams may be determined to be anadromous if they are found to be hydraulically connected to AWC streams. For this Preliminary H&H Overview, a watershed analysis was performed with ArcGIS to map flow paths having high potential for anadromous designation. Locations of anadromous streams in relation to the roadway alignment alternatives are shown in Figure 3.

Anadromous streams that are listed in the AWC are shown as thick navy lines. This spatial data was obtained directly from ADF&G and is current for 2022. Thinner blue lines represent the tributary streams that were generated from the watershed analysis, and verified by visual inspection of aerial imagery.

Mapping of anadromous streams in the study area indicates that the south alignment alternatives would include one major anadromous stream crossing at the main channel of Wasilla Creek. Based on channel widths measured from aerial imagery, it should be anticipated that either a bridge or a 20-foot span pipe arch culvert will be required for the stream crossing.

The north alignment would involve a substantially greater fish passage design scope. This alternative would include a minimum of 4 anadromous stream crossings, and potentially as many as 7 crossings. A bridge or large-span pipe arch culvert will be required for the Wasilla Creek crossing.

Conclusion

Based on the findings of this desktop H&H investigation, both the north and south alignments are considered feasible with regards to fish passage and floodplain management requirements. Up to 7 fish passage structures should be anticipated for the north alignment, compared to only one stream crossing for the south alignments. The south alignments have a clearly defined fish passage design scope and lower habitat impact. As fish passage culverts require considerably greater effort for analysis, design, and construction than conventional hydraulically designed culverts, the north alignment will have a significantly greater design and construction cost compared with the south alignments.

Because a "no-rise" certification is not required for this project, route selection is flexible with regards to compliance with floodplain management regulations. Although the north alignment minimizes impacts to the base floodplain, the south alignments' hydraulic impact to the Wasilla Creek SFHA is not anticipated to be significant, and should not be a critical deciding factor.

Sincerely,

HDL Engineering Consultants, LLC

Kyle Albert

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APPENDIX C

Preliminary Environmental Overview

Preliminary Environmental Overview

Engstrom Road to Trunk Road Corridor

Proposed Project

The Matanuska-Susitna Borough is proposing to improve connectivity between Engstrom Road and Trunk Road. This Preliminary Environmental Overview provides a summary of the environmental resources present with the project study area and outlines agency consultation and permitting requirements that may be necessary to support the future development of a road connection between Engstrom Road and Trunk Road. The study area is located in Section 22, 23, 26, and 27 of Township 18N, Range 1W, of the Seward Meridian, and on U.S. Geological Survey Quadrangle Anchorage C-6 & C-7; and Latitude 61.628655° North, Longitude 149.233243° West (study area center) (Figures 1 & 2).

Air Quality

Pursuant to the Clean Air Act, the U.S. Environmental Protection Agency (EPA) has established National Ambient Air Quality Standards (NAAQS) for six "criteria" air pollutants: carbon monoxide (CO); lead (Pb); nitrogen dioxide (NO_2); ozone (O_3); particulate matter (PM) for both PM_{10} and $PM_{2.5}$; and sulfur dioxide (SO2). The State of Alaska has designated areas that are in attainment (areas that meet the NAAQS), nonattainment (areas where concentration of one or more of the criteria air pollutants is higher than the NAAQS), or maintenance (an area previously designated as nonattainment and re-designated as a maintenance area because of an improvement in air quality) for each of the criteria pollutants.

Review of the Alaska Department of Environmental Conservation (ADEC) Air Non-Point Mobile Sources and the EPA Non-Attainment Areas for Criteria Pollutants (Green Book) websites indicate that the Matanuska-Susitna Valley is designated as a nonattainment area for particulate matter ($PM_{2.5}$ and PM_{10}) (ADEC 2022). In March 2019, the MSB approved Ordinance 19-032, to minimize health impacts and possible federal regulatory issues from exceeding national air quality standards for fine particulate matter ($PM_{2.5}$). Ordinance 19-032 implements an air quality management plan and identifies the Greater Butte Area Air Quality District (Butte Community Council Boundaries) as the area that consistently exceeds the NAAQS for $PM_{2.5}$.

The proposed project is within an area susceptible to windblown dust events. Construction of a new road alignment will temporarily increase airborne dust. Consultation with the MSB Code Compliance Office prior to construction is encouraged to ensure that appropriate best management practices are incorporated into the project throughout construction to reduce localized impacts to air quality.

Anadromous Fish Streams and Essential Fish Habitat

Review of the Alaska Department of Fish and Game (ADF&G) Atlas to the Catalog of Waters Important to the Spawning, Rearing or Migration of Anadromous Fishes indicated the presence of anadromous fish streams and waterbodies within the study area, including Wasilla Creek, five unnamed anadromous tributaries of Cottonwood Creek (ADF&G 2022), and Cornelius Lake:

- Wasilla Creek (Anadromous Waters Catalog [AWC] code 247-50-10260-2019)
    - Spawning and rearing habitat for Chum (*Oncorhynchus Keta*), Coho (*O. kisutch*), King (*O. tshawyscha*) salmon
    - Presence of Sockeye salmon (*O. Nerka*) (ADF&G 2022)
- Five Unnamed Tributaries of Cottonwood Creek (AWCs 247-50-10300-2054, 247-50-10300-2054-3039, 247-50-10300-2054-3041, 247-50-10300-2054-3041-4040, 247-50-10300-2054-3047)
    - All five of these tributaries support the presence, spawning, and/or rearing habitat for Coho salmon (*O. kisutch*)
    - The presence of Sockeye salmon (*O. Nerka*) is also noted in the main unnamed stream (AWC 247-50-10300-2054) that connects all these tributaries and discharges into Cornelius Lake.
- Cornelius Lake (AWC 247-50-10300-2054-0030)
    - Spawning and rearing habitat for Coho (*O. kisutch*) and Sockeye (*O. Nerka*) salmon

The ADF&G has regulatory responsibility for protection of freshwater anadromous fish habitat. Consultation with ADF&G early in the development of the project will be necessary for the design of any alignment crossing an anadromous waterbody. A Title 16 Fish Habitat Permit will be required for crossing anadromous waters to ensure the design minimizes impacts to anadromous species. Construction project which involve potential impacts to anadromous waters are required to be conducted during the fish window (May 15 to July 15) to minimize potential impacts to fish species.

Floodplain and Regulatory Floodway

Review of the Federal Emergency Management Agency (FEMA) flood maps indicate that floodplains exist in the study area and are associated with Wasilla Creek. The project is located on FEMA flood insurance rate maps 02170C7245E, 02170C8110F, 02170C7265F, and 02170C8130F. Wasilla Creek shown on the latter two map panels, is designated as Zone AE and has defined base flood elevations (FEMA 2022).

A hydraulic and hydrologic study will be completed once a preferred alignment is selected.

Hazardous Waste

A search of ADEC's Contaminated Sites Program database did not identify any known contaminated sites within the study area or within the immediate vicinity (within 0.10-mile). Consultation with ADEC is recommended, should the project encounter an area within the study area that presents recognized environmental conditions that warrant concern regarding environmental contamination.

Historic Properties, Archaeological and Cultural Resources

In accordance with Alaska's State Historic Preservation Act, the MSB will be required to consult with the Alaska Department of Natural Resources, Office of History and Archaeology regarding potential impacts to cultural and historic resources. The MSB will be required to develop an Area of Potential Effect associated with the proposed development of a connector alignment and coordinate with consulting parties (including Certified Local Governments, Tribes, and other interested parties) regarding knowledge of past uses of the area that could be culturally significant.

Northern Land Use Research Alaska, LLC researched the Alaska Department of Natural Resources (ADNR) Alaska Heritage Resource Survey Integrated Business Suite (AHRS IBS) online database on October 19, 2022, to ascertain the presence of cultural and historic resources within or adjacent to the proposed project area.

The AHRS IBS identified eleven sites within the Cultural Resource Study Area buffer. Four of those sites are within or partially overlapping the preliminary Area of Potential Effect (APE). NLURA also reviewed the MSB tax/property information which indicates there are a total of 105 parcels located within the Cultural Resource Study Area buffer. Of those, 7 have the potential to contain historic buildings/structures (or historic building/structure remains and associated features or artifacts) which may be directly or indirectly (visually) impacted by the proposed project (Figure 1).

Based on the information presented in NLURA's desktop assessment, NLURA recommends the following cultural resources investigations be completed for the proposed project:

- Conduct a Cultural Resource Phase I/II survey along the routes within the final APE.
- Conduct a condition assessment of the AHRS sites to identify the site boundary of the historic property and its essential physical features (i.e. structures, features, artifacts, etc.) relative to the final APE and reassess its NRHP eligibility status.

Due to the sensitive nature of cultural resources, a copy of NLURA's Cultural Resources Desktop Analysis Report was provided to the MSB as a separate attachment.

Invasive Species

Review of the University of Alaska Anchorage Exotic Plants Information Clearinghouse Invasive Plants Mapper indicated there are no non-native species infestations within the study area. However, non-native species infestations have been identified in the vicinity of the study area. The project is anticipated to involve vegetation loss in association with proposed construction of a connector road. Executive Order 13112 (Invasive Species) requires the MSB to ensure that ground disturbing activities are minimized to the extent practicable, and disturbed areas are re-vegetated with seed recommended for the region by ADNR's A Revegetation Manual for Alaska.

Migratory Birds and Eagles' Nests

Several migratory bird species travel through the proposed project area and may be disturbed by vegetation clearing operations and displaced by the loss of habitat. Birds are most sensitive during breeding and nesting, when vegetation clearing, ground disturbance, and other site construction activities can destroy active bird nests, eggs, or nestlings. The most effective way to protect nesting birds is to conduct these activities before or after the breeding season. Vegetation clearing associated with the project is expected to follow United States Fish and Wildlife Service (USFWS) recommended time periods for avoiding clearing in Southcentral Alaska, except as allowed by state, federal, and local laws, and as approved by the Project Engineer (USFWS 2022 & 2022a) are listed below:

- Forest/Woodland: May 1st- July 15th (*a, b, c)
- Shrub/Open: May 1st- July 15th(*a, b, c)
- Seabird Colonies: May 10th – September 15
- Eagles March 1st – August 31st (*e)

(*a) Raptors may nest 2+ months earlier than other birds
(*b) Canada geese and swans begin nesting April 20
(*c) Black scoter are known to nest through August 10
(*e) Eagles and eagle nests have additional protections under the Bald and Golden Eagle Protection Act, and a permit maybe required to conduct activities near an eagle nest.

Suitable eagle nesting habitat exists in the general project vicinity. Prior to construction, an eagle's nest survey will be completed to identify whether eagles or eagle nests are sighted within 660 feet of proposed project development. If eagles or eagle nests are present consultation with the USFWS on how to proceed with the project will be required (USFWS 2022b).

Navigable Waters

Various state and federal agencies define and determine navigability of water in the study area. State and federal determinations may differ, and sometimes conflict. The USACE defines navigable waters of the U.S., Code of Federal Regulations 33 CFR 329, as those waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce while the waterway is in its ordinary condition (USACE 2022). Section 10 of the Rivers and Harbors Act of 1899 (33. U.S.C. 403) prohibits the unauthorized obstruction of a navigable water of the U.S.

The Clean Water Act (CWA) also uses the terms "navigable waters," "waters of the U.S.," and "navigability" to define its applicability. Waters of the U.S. include not only navigable waters, but also waters with "a significant connection to navigable waters" (USACE & EPA 2015). Wasilla Creek as well as the unnamed tributaries within the study area discharge directly into the Knik Arm of the Cook Inlet, a navigable waterbody.

The U. S. Coast Guard (USCG) has permit authority for navigable waters of the U.S., as defined in 33 CFR 329. Under Section 9 of the Rivers and Harbors Act of 1899, a USCG Bridge Permit would be required to construct any bridge or causeway over any navigable river or navigable water of the U.S. USCG's a list of waters, last updated in March 2012, indicates that navigable waters under USCG jurisdiction for navigability are not present in the project area.

The Alaska Department of Natural Resources defines navigable waters as water that at the time the state achieved statehood, was used, or was used, or was susceptible of being used, in its ordinary condition as a highway for commerce over which trade and travel were or could have been conducted in the customary modes of trade and travel on water, the use or potential use dues not need to have been without difficulty, extensive, or long and continuous (Alaska Statue [AS] 38.04.062(g)(1)). For those waters identified as navigable by the State of Alaska, a person may not obstruct or interfere with the free passage or use by a person of any navigable water unless the obstruction or interference is (AS 38.05.128):

- Authorized by a federal or state agency
- Authorized under a federal or state law or permit
- Exempt under 33 U.S.C. 1344(f) (Clean Water Act)
- Caused by normal operation of freight barging that is otherwise consistent with law
- Authorized by the commissioner after reasonable public notice

Review of ADNR's Navigable Waters mapper did not identify Wasilla Creek or the other unnamed tributaries within the study area as navigable waterways. After selection of a preferred connector alignment the MSB will be required to consult with USACE regarding potential impacts, mitigation, and permitting for proposed crossing of waterbodies within the study area. The MSB may also be required to consult with the USCG and ADNR regarding any additional navigability determinations in the project area.

Noise

The State of Alaska has a Noise Policy that applies to all Federal or Federal Aid Highway Projects authorized under Title 23, U.S.C. that applies to highway and multimodal projects that:
Requires Federal Highway Administration approval regardless of funding sources, or
Is funded with Federal Aid highway funds. This includes Federal or Federal-aid projects that are administered by Local Public Agencies as well as Alaska Department of Transportation and Public Facilities. The MSB will be required to examine the funding source for construction of the proposed Engstrom Road to Trunk Road Connector and determine if the State of Alaska Noise Policy is applicable to the project. Should the project require a noise analysis an evaluation of traffic noise impacts to residents and businesses in the area of the proposed road alignment will be required.

The MSB has a noise ordinance that prohibits amplified sounds louder than 50 decibels between 10 p.m. and 7 a.m. weeknights and 60 decibels all other times. Should construction activity be necessary prior to 7 a.m. and after 10 p.m. a noise permit from the MSB may be required for the project.

Right-of-Way

Review of the MSB's tax parcel viewer identified many private properties within the study area. The MSB will have to acquire additional right-of-way property in order to construct a new road connection between Engstrom Road and Trunk Road (MSB 2022).

State Parks, National Parks, National Forests, Wild and Scenic Rivers

A review of the National Park Service (NPS) and U.S. Forest Service (USFS) indicate there are no national parks, monuments, preserves, national forests, or wild and scenic rivers are located within or adjacent to the proposed project area (NPS 2022, USFS 2022).

A review of ADNR's Division of Parks and Outdoor Recreation website indicates no state parks or recreation areas are located in or adjacent to the study area. Finger Lake State Recreation Site is located approximately 0.35 miles southwest of the study area (ADNR 2022).

State Refuges, National Wildlife Refuges, Critical Habitat Areas and Sanctuaries

According to the ADF&G online listing of State of Alaska Refuges, Critical Habitat Areas, and Sanctuaries (2022a) and the USFWS National Wildlife Refuge System (2022c) webpages there are no state refuges, sanctuaries, or national wildlife refuges are present within or in the vicinity of the project study area.

Threatened and Endangered Species

The USFWS' Information for Planning and Consultation (IPaC) website (2022a) and the ADF&G threatened and endangered species website (2022b) were reviewed to determine if any threatened or

endangered species or their habitats are located within or adjacent to the proposed project. Both websites indicated that there are no threatened or endangered species or their critical habitats within the vicinity of the study area.

Water Quality

Majority of the study area is comprised of a mixture of land use including agriculture, residential, and businesses. Land within the study area consists of developed and undeveloped areas. The project is located within the Matanuska watershed, which ultimately drains to the Knik Arm of Cook Inlet. Per Alaska's Final 2018 Integrated Water Quality Monitoring and Assessment Report (approved June 2020), does not identify 303-listed waterbodies in the vicinity of the project (ADEC 2022b).

An ADEC Alaska Pollution Discharge Elimination System approved SWPPP will be required for the project.

Wetlands and Other Waters of the U.S.

A review of the MSB Wetlands mapper (2022a), the Cook Inlet Wetlands (Gracz n.d.), and the National Wetlands Inventory (NWI) (2022) databases identify several wetland complexes within and immediately adjacent to the proposed project area. A wetland delineation will be necessary to ground truth identified wetland boundaries, inform design to support avoidance and minimization of impacts to wetlands, and to evaluate impacts where necessary. Should the project involve dredge and/or fill within wetlands and/or waters of the U.S. authorization under USACE Section 404 permit and ADEC Section 401 will be required.

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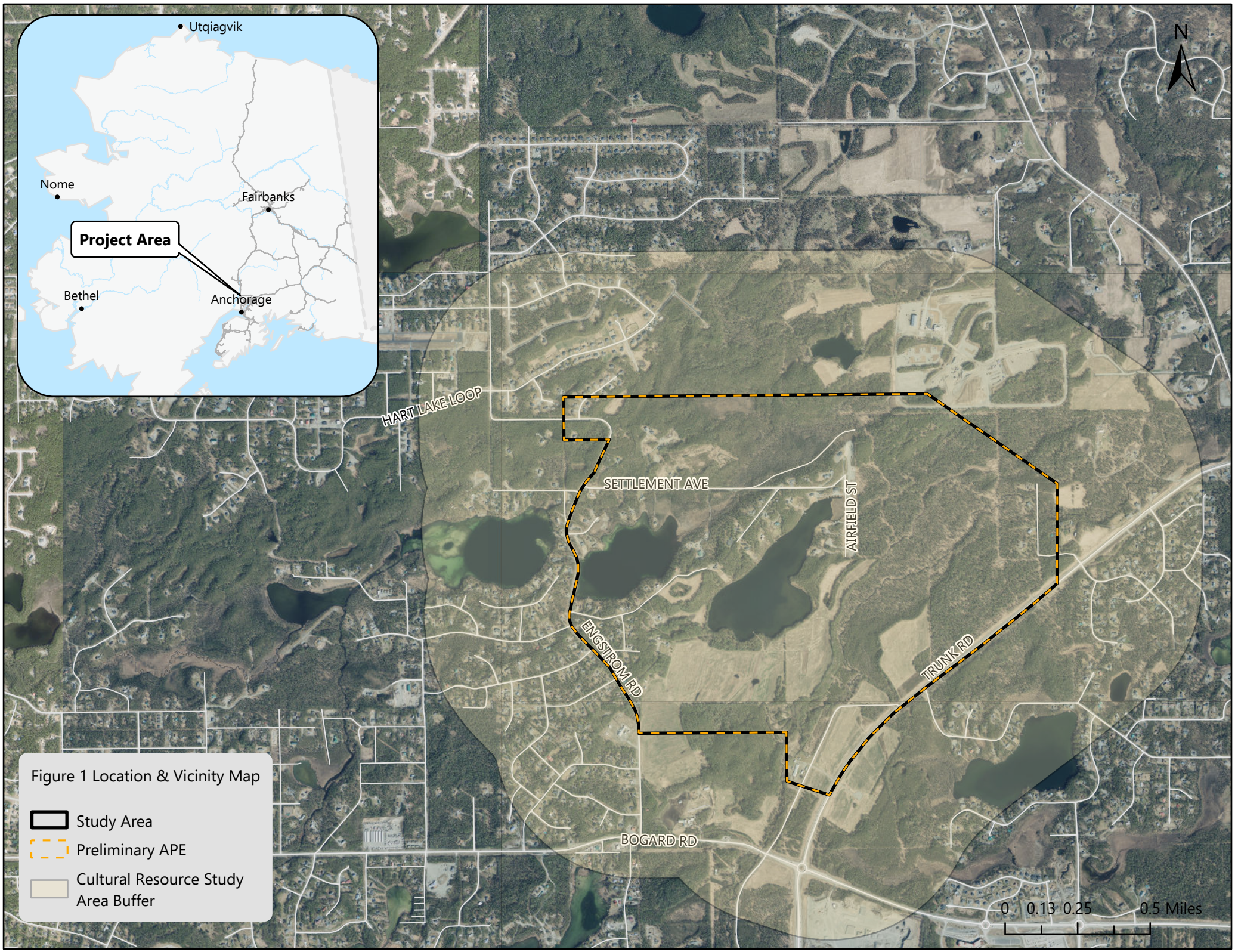
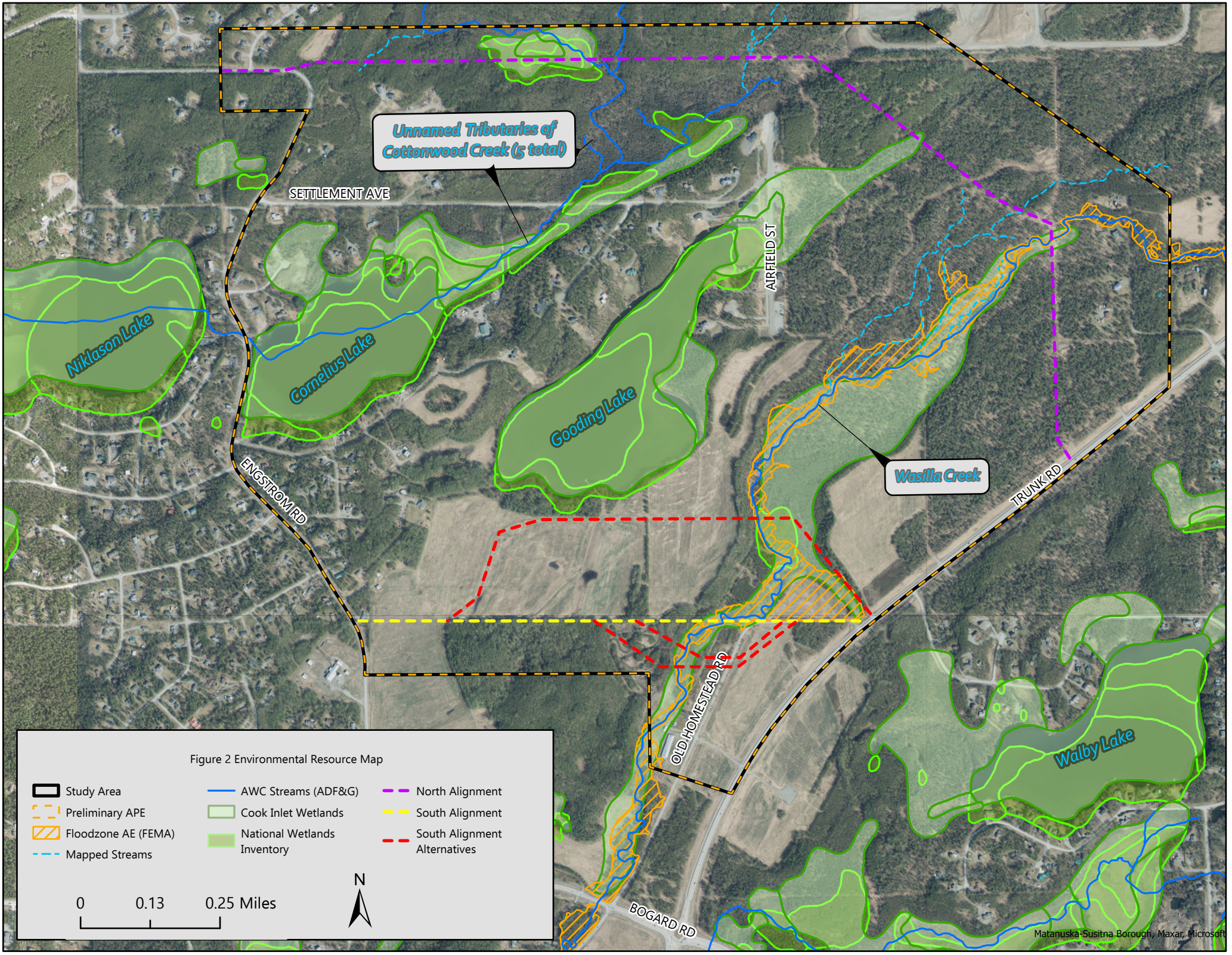

Utqiagvik
Nome
Fairbanks
Project Area
Bethel
Anchorage
N
HART LAKE LOOP
SETTLEMENT AVE
AIRFIELD ST
ENGSTROM RD
TRUNK RD
BOGARD RD
0 0.13 0.25 0.5 Miles
Figure 1 Location & Vicinity Map
Study Area
Preliminary APE
Cultural Resource Study Area Buffer


Unnamed Tributaries of Cottonwood Creek (5 total)
SETTLEMENT AVE
AIRFIELD ST
Niklason Lake
Cornelius Lake
Gooding Lake
Wasilla Creek
ENGSTROM RD
TRUNK RD
OLD HOMESTEAD RD
Walby Lake
BOGARD RD
Matanuska-Susitna Borough, Maxar, Microsoft
Figure 2 Environmental Resource Map
Study Area
Preliminary APE
Floodzone AE (FEMA)
Mapped Streams
AWC Streams (ADF&G)
Cook Inlet Wetlands
National Wetlands Inventory
North Alignment
South Alignment
South Alignment Alternatives
0
0.13
0.25 Miles
N