QUINHAGAK STREET
Reconstruction

DRAFT DESIGN STUDY REPORT

MAY 2023

MOA PM&E Project No. 21-13

Prepared for:

Municipality of Anchorage
Project Management &
Engineering Department

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Executive Summary

I. Introduction

The Municipality of Anchorage Project Management and Engineering Department (MOA PM&E) has contracted with CRW Engineering Group, Inc. (CRW) to provide professional services to develop and evaluate alternatives to upgrade Quinhagak Street from E. Dowling Road to Askeland Drive (see FIGURE 1 for project location and vicinity map). The purpose of the project is to upgrade Quinhagak Street to meet current MOA Design Criteria for a local roadway. The roadway conditions are very poor and include significant rutting, cracking, and heaving along the pavement and curb and gutters. These conditions result in ponding in the roadway, bumpy driving conditions, and frequent maintenance.

Improvements are expected to include:

- Road structural section
- Asphalt pavement and curbs and gutters
- Storm drain system infrastructure
- Pedestrian facilities
- Street lighting
- Signage

The project is currently funded through the draft design study phase only. Additional funding will be necessary to complete design and construction of the project.

Stakeholder comments were solicited using the Context Sensitive Solutions (CSS) process through the following venues:

- Project Website and Interactive Project Map
- Direct Mailings (2) and Electronic Newsletters (4)
- Project Questionnaire
- Abbott Loop Community Council Meeting Presentation (1)
- Community Open House Meeting (1)
- Agency Coordination Meetings

The Design Study Report (DSR) evaluates existing and future conditions and a range of conceptual design alternatives. Preliminary recommended improvements are summarized below.

Figure 1- Project Location & Vicinity Map

II. Recommended Improvements

To achieve the project goals, meet the requirements of the DCM and AMC Title 21, and based on comments received from public, agency, and business stakeholders the recommended improvements for the project are as follows:

A. Roadway Cross Section

The preferred roadway cross section is Alternative 3 (see FIGURE 2) and includes two 11-foot wide travel lanes with 3.5-foot wide shoulders (33 feet total width from BOC), and a single 5-foot wide sidewalk with a 3-foot wide concrete buffer on the east side of the roadway. The buffer will be eliminated along Parcels 2 and 3 to improve sight distance of sidewalk users due to the fence with slats on property. Type 2 (rolled) curb and gutter is proposed on the west side and Type 1 (barrier) curb and gutter is proposed on the east side of the roadway. This alternative matches the existing curb type on the west side of the roadway, but barrier curb is proposed on the east side of the roadway where the sidewalk is proposed. Since the project is a local road, no roadway traffic markings are proposed along the project corridor.

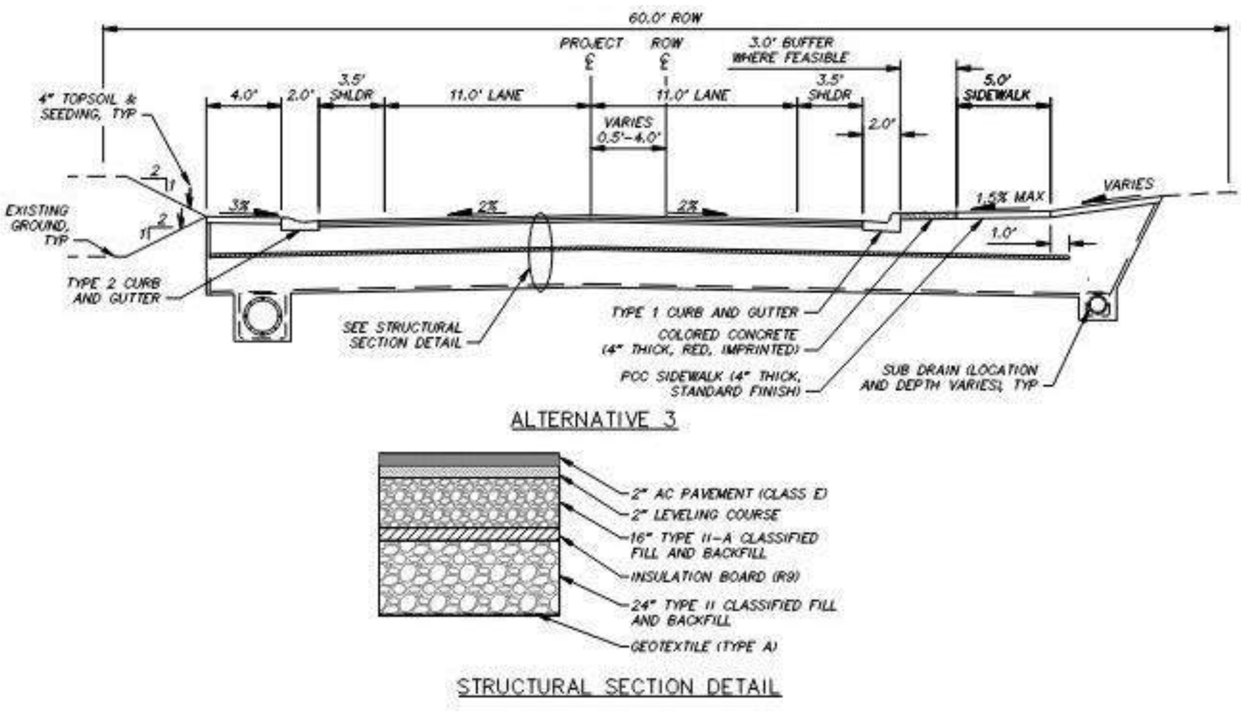

Figure 2 - Alternative A typical section

B. Design and Posted Speed Limit

It is proposed that the posted speed limit for Quinhagak Street remain at 25 mph. A Design speed of 30 mph is proposed.

C. Roadway Horizontal and Vertical Alignment

The proposed roadway cross section will be centered within the ROW from Askeland Drive to Station 19+25. To avoid the proposed curb and gutter conflicting with existing water valves along Quinhagak Street beginning at Station 19+25 the horizontal alignment will shift to the east by 3.5 feet and will continue along the same alignment until E. Dowling Road. The proposed profile for Quinhagak Street will generally match the existing grade but will force a high point south of E. Dowling Road and increase the grades in this area to a minimum of 0.65%.

D. Intersections:

The existing stop signs within the project limits are proposed to remain as currently installed with stop control on E. 63rd Avenue, E. 64th Avenue, on the east side of Askeland Drive and on Quinhagak Street at E. Dowling Road.

E. Traffic Calming

Based upon the 85th percentile speeds and in coordination with the MOA Traffic Engineering Department, no traffic calming features are proposed for this project.

F. Landscaping

Since Quinhagak Street is a local road no specific landscaping is proposed as part of the project improvements.

G. Drainage

The proposed drainage improvements consist of the following:

- Replace the aging Quinhagak Street & Askeland Drive storm drain system to align with the new roadway improvements.
- Install subdrains on both sides of Quinhagak Street to mitigate the effects of high groundwater.
- Install catch basins at roadway low points and other areas to alleviate ponding issues.
- Provide positive roadway drainage to minimize ponding.
- Provide water quality treatment for storm runoff.

H. Lighting

A continuous LED lighting system, consistent with current MOA standards will be installed along the roadway. Power for the new lighting system will come from an existing Type 1A Load Center on E. 63rd Ave, east of the intersection with Quinhagak Street.

I. Project Costs

Following is a summary of estimated project costs for the entire project for the Alternative 1 preferred alternative:

Table 1 - Summary of Estimated Project Costs

Category	Alternative 3 (preferred)
Design & Management Total (estimated)	$807,000
ROW Acquisition Total	$72,000
Utility Relocation (15% Contingency) Total	$969,000
A. Design, ROW Acquisition, Utility Relocation	***$1,848,000***
Construction Roadway Improvements	$2,051,000
Drainage Improvements	$969,000
Illumination Improvements	$216,000
Construction Subtotal	*$333,000*
Construction Contingency (15%)	$485,000
Construction Management / Inspection / Testing	$333,000
B. Total Estimated Construction Cost (rounded)	***$4,054,000***
C. Overhead / Grant Accounting	***$1,042,000***
Total Estimated Project Cost (A + B + C)	***$6,944,000***

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I. Introduction

The Municipality of Anchorage Project Management and Engineering Department (MOA PM&E) has contracted with CRW Engineering Group, Inc. (CRW) to provide professional services to develop and evaluate alternatives to upgrade Quinhagak Street from E. Dowling Road to Askeland Drive (see FIGURE 1 for project location and vicinity map). Alternatives developed for analysis will follow Complete Streets design methodologies to balance corridor improvements for all users, including motorists, bicyclists, pedestrians, and persons with disabilities, while minimizing impacts to existing residences and businesses in the project area.

In addition to CRW, the project team includes:

- Huddle AK (Public Involvement)

A. Project Purpose and Goals

Poor roadway conditions along Quinhagak Street require regular attention from MOA Street Maintenance

The purpose of the project is to upgrade Quinhagak Street from E. Dowling Road to Askeland Drive to meet current MOA Design Criteria for a local roadway. Quinhagak Street was constructed in 1983 and has reached the end of its useful life. The roadway conditions are very poor and include significant rutting, cracking, and heaving along the pavement and curb and gutters. These conditions result in ponding in the roadway, bumpy driving conditions, and frequent maintenance. The purpose of this project is to extend the life of the street by providing a stable roadway subgrade to correct the surface irregularities, improve drainage, and decrease maintenance.

Improvements are expected to include the following new features:

- Roadway structural section
- Asphalt pavement and curbs and gutters
- Storm drain system infrastructure
- Pedestrian facilities
- Street lighting
- Signage

B. Project Approach

Prior to beginning this Design Study Report (DSR), the project team submitted a Technical Memorandum to MOA PM&E, Street Maintenance Department, Traffic Engineering Department which outlined the conceptual roadway design elements. The Technical Memorandum intended to gain concurrence from the MOA Departments on the design elements before presenting the concepts to the public.

A meeting was held on September 9, 2022 with PM&E, Traffic Engineering, and Street Maintenance to discuss the conceptual roadway design elements. The Draft Technical Memorandum was submitted for their review and comment on October 13, 2022. The Draft Technical Memorandum was updated based upon review comments received. In coordination with PM&E, an additional typical section (Alternative 3) was included in the Final Technical Memorandum. The MOA Departments were notified of this additional typical section Alternative 3 on November 14, 2022 and were asked to provide comments on it or provide any outstanding review comments on the Draft Technical Memorandum by November 18, 2022. No comments regarding the Alternative 3 typical section were received. See APPENDIX N for the Final Technical Memorandum.

Following the Technical Memorandum and concurrence on the conceptual roadway design elements, the project team organized multiple meetings with the public to identify and document issues and concerns that could potentially be addressed as part of this project. A survey questionnaire was also previously assembled and sent out to the public to gather feedback. Public survey questionnaire and meetings included (see SECTION XIV for a full summary of Stakeholder Coordination/Public Involvement):

- Survey Questionnaire (mailed/emailed in June 2022)
- Community Council Meeting #1 (October 20, 2022)
- Public Open House #1 (November 3, 2022)

Comments from these meetings were used to identify project issues and concerns with improvements along the corridor. Documents and figures presented to the public and input and comments received from stakeholders can be found in APPENDIX K.

C. Evaluation Factors

The Design Study Report will consider the following factors during the evaluation of improvements for the project corridor.

- Stakeholder input and needs
- Conditions of existing area
- Neighborhood connectivity
- Previous planning and design documents
- Traffic volumes and crash history
- Vehicle speeds and on-street parking
- Intersection and driveway sight distances
- Area drainage patterns and infrastructure
- Right-of-Way (ROW) restrictions
- Adjacent neighborhood and property owner impacts
- Utility relocation requirements
- Project costs

Figure 1 - Project Location & Vicinity Map

II. Existing Conditions

Quinhagak Street is a local road that spans from E. Dowling Road (north) to Askeland Drive (south). The existing roadway abuts 14 parcels consisting of primarily industrial/commerical parcels from E. Dowling Road to E. 64th Avenue. Residential parcels extend from E. 64th Avenue to Askeland Drive.

A. Previous Plans

1) Anchorage 2040 Land Use Plan (MOA - 2017)

The Anchorage 2040 Land Use Plan (2040 LUP) is a visual guide for growth and development in the Anchorage Bowl and is aligned with the visions and goals of the Anchorage 2020 Plan. The 2040 LUP incorporates the adopted neighborhood and district plans, public facility plans, and recent analysis into a land use amendment element of the Anchorage 2020 Plan. The 2040 LUP features policies and strategies and a land use plan map, which recommends future land development patterns and shows where land uses may occur within the Anchorage Bowl to accommodate future growth.

Map 1-2 in the 2040 Plan identifies the project area as an area of little growth. Specific policies from the 2040 Plan that are directly related to this project are listed below:

- Policy 6.2: Provide new or upgraded pedestrian and local/collector street connections in centers and commercial corridors to improve access to and from surrounding neighborhoods.
- Policy 6.3: Adopt and execute a Complete Streets policy to design streets to serve all users including pedestrians, transit riders, and bicyclists, and align the design and scale of streets to be compatible with compact, accessible, and walkable land use patterns.
- Policy 8.2: Provide new and improved trails, greenbelts, and other pedestrian facilities as alternative travel ways connecting open spaces, neighborhoods, and centers.

2) Little Campbell Creek Watershed Plan (MOA – 2007)

The Little Campbell Creek Watershed Plan was prepared to guide development in the Little Campbell Creek Watershed and recommends policies and objectives that are most beneficial to the whole watershed. General overall goals of the plan include improving water quality and managing the quantity of water discharged during storm events. No specific recommendations near/within the project area are included in the plan.

B. Planned Area Development

No planned area development adjacent to the project limits is known currently.

C. Project Area Context

1) Community Council

The project area is within the boundaries of the Abbott Loop Community Council (ALCC). The ALCC currently ranks the Quinhagak Street Reconstruction project as the fifth highest improvement project priority in their boundary limits.

2) Zoning and Land Use

Adjacent properties along Quinhagak Street from E. Dowling Road to E. 64th Avenue are zoned I-1 (Light Industrial). Adjacent industrial/commercial properties include a strip mall with multiple businesses, a church, a used car lot, fenced yards, and other businesses. There is one residential single-family parcel located mid-block along this segment, Parcel 15. Quinhagak Street from E. 64th Avenue to Askeland Drive is a local residential road, and the adjacent properties are zoned R-5 (Low-Density Residential). Adjacent properties have mobile homes on the parcels. See FIGURE 2 for area zoning.

- I-1 (Light Industrial) is intended primarily for public and private light and general manufacturing, processing, service, storage, wholesale, and distribution operations along with other uses that support and/or are compatible with industrial uses. Business-industrial parks and single-commodity bulk retail sales and building supply stores and services are allowed. Many commercial uses are also permitted and/or conditionally allowed, with some limitations on the more intensive customer retail, community service, and commercial employment establishments, to reduce land use and traffic conflicts, promote efficient use of industrial lands, and encourage the location of intensive commercial activities in commercial centers. This district is applied in areas designated as industrial/commercial by the comprehensive plan.
- R-5 (Mixed Residential) is intended primarily for single- and two-family residential areas with gross densities up to five dwelling units per acre. Mobile homes on individual lots are allowed in this district.

Future land use designations as outlined in the 2040 LUP along Quinhagak Street include “Light Industrial Commercial” from E. Dowling Road to E. 64th Avenue and “Single-Family and Two-Family” from E. 64th Avenue to Askeland Drive.

- Light Industrial Commercial - This area provides for multi-sector employment in an industrial setting. It gives priority to light industrial production distribution and repair (PDR) uses.
- Single-Family and Two-Family - This designation provides for a variety of low-density urban/suburban residential neighborhoods. Most areas have well-developed infrastructure, public water and sewer, and municipal services.

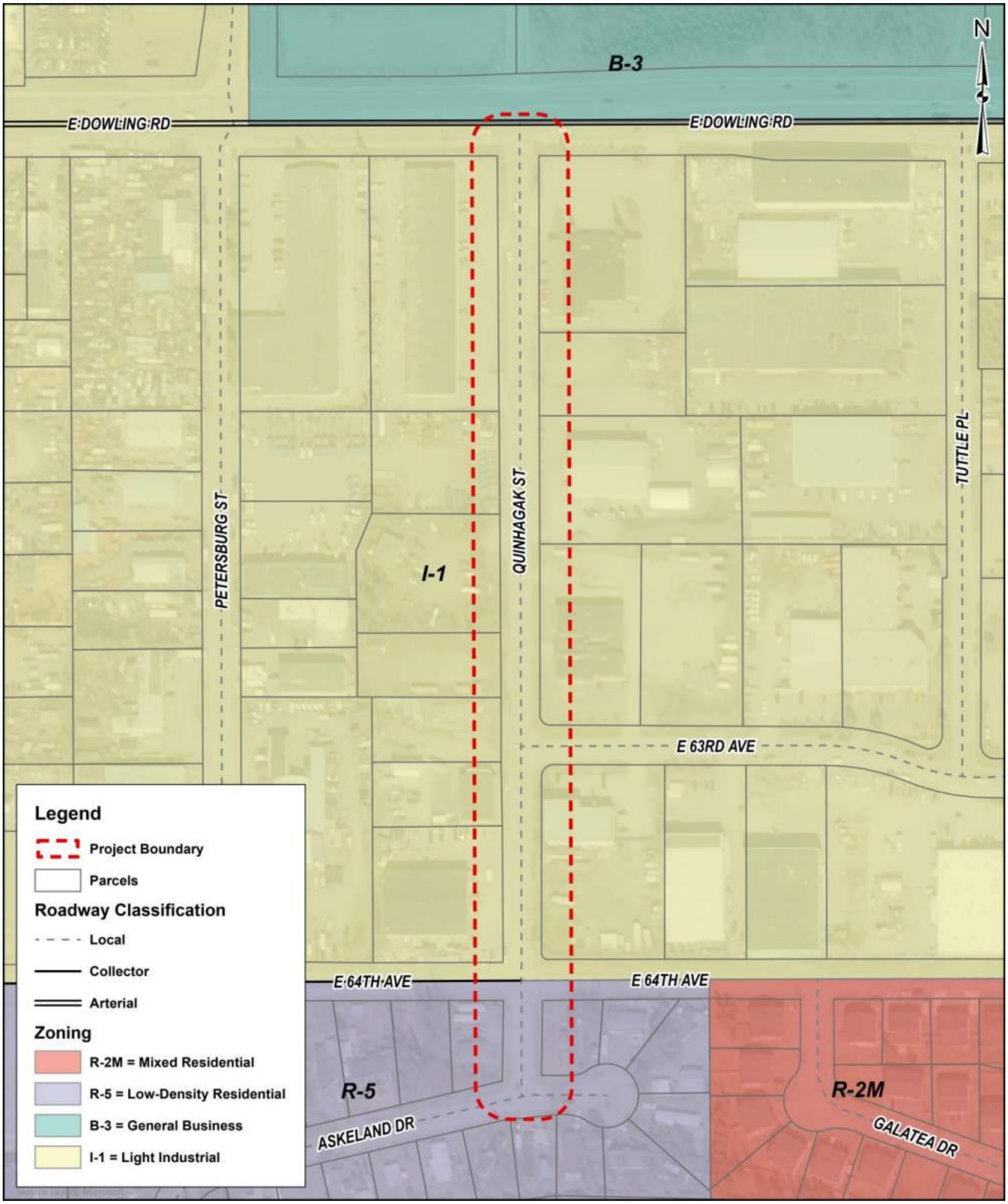


Figure 2 - Project Area Zoning

3) Schools

Project area students are within the following Anchorage School District (ASD) boundaries:

- Tudor Elementary School
- Wendler Middle School
- East High School

The following ASD alternative schools are within 0.35 miles of the project limits:

- Northern Lights ABC School K-8 is located at the southeast corner of the E. Dowling Road and Lake Otis Parkway intersection.
- Rilke Schule German Charter School of Arts & Sciences is located east of Meadow Street and south of E. 64th Avenue.
- Polaris K-12 School is located north of E. 64th Avenue at the far west end of E. 64th Avenue before the Seward Highway.

Transportation is typically provided by ASD for students who live more than 1.5 miles from their neighborhood school. Students who live within 1.5 miles of their neighborhood school are within the designated walking boundary; although, other factors also influence if a safe walking route to school can be established, such as street crossing requirements, presence of pedestrian facilities, maintenance of pedestrian facilities, lighting, etc.

The project area is outside of the designated walking boundary for all the non-alternative ASD schools listed above. No published walking routes are provided for the ASD alternative schools listed above. Based upon feedback from residents, many parents drop off/pick up their children at the Rilke Schule Charter School and at the Polaris K-12 School.

There are no ASD bus stops within the project limits.

4) Public and Religious Institutions

There are no public institutions within the project limits. Faith Presbyterian Church (Parcel 1) is located as the southeast quadrant of the Quinhagak Street and E. Dowling Road intersection.

5) Businesses

There are several businesses within the project limits. A list of businesses is included in APPENDIX M.

D. Roadway Characteristics and Function

1) Facility Description

Quinhagak Street is a local road that spans 1,470 feet from E. Dowling Road (north) to Askeland Drive (south). There are four side streets within the project corridor, inclusive of E. Dowling Road and Askeland Drive. Of these, three are three-way intersections (E. Dowling Road, E. 63rd Avenue, and Askeland Drive) and one is a four-way intersection (E. 64th Avenue). Stop signs are located on E. 63rd Avenue, on E. 64th Avenue, on the east side of Askeland Drive, and on Quinhagak Street at E. Dowling Road.

Quinhagak Street is approximately 36 feet wide measured to back of curb (32 feet of pavement). Type 2 (rolled) curb and gutter is installed along the entire length of the project limits except for a short section (approximately 90 feet) of Type 1 (barrier) curb & gutter is installed south of E. Dowling Road. On-street parking is allowed throughout the project limits even though space is limited in some locations due to some full frontage driveways. The posted road speed limit is 25 miles per hour (mph).

The existing roadway grades in the project area are moderate, between approximately 1%-4% except for just south of E. Dowling Road where the grades are very flat, between 0.1%-0.6%. The roadway is generally graded to drain from north to south but there is a forced low point located approximately 600 feet south of E. Dowling Road.

2) Roadway Functional Classification

The functional classification affects the basic design criteria including design speed, number of lanes, lane and shoulder width, right-of-way (ROW) width, distance between intersections, and alignment. The most current version of the Official Streets & Highways Plan (OS&HP) lists Quinhagak Street as a local road. Per the MOA Design Criteria Manual (DCM) Quinhagak Street is a secondary (local) industrial/commercial street from E. Dowling Road to E. 64th Avenue and a secondary (local) urban residential street from E. 64th Avenue to Askeland Drive.

3) Pedestrian and Bicyclist Facilities

There are no pedestrian or bicyclist facilities present along Quinhagak Street. There is an approximately 8.5-foot-wide asphalt pathway that runs east-west on the south side of E. Dowling Road that crosses Quinhagak Street.

4) Condition of Facilities

The existing conditions of the roadway pavement along the project alignment includes significant pavement degradation including transverse and longitudinal asphalt cracks and potholes. Pavement repairs are present in multiple locations along the alignment and the roadway requires routine maintenance. Many of the existing curbs are heaving which doesn't allow surface drainage to effectively drain, and during spring break up or large rain events these areas form large ponds in the roadway.

Flat grades & heaved curbs result in ponding at the Quinhagak Street & E. 63rd Avenue intersection

Significant pavement degradation with recent repairs along Quinhagak Street

E. Environmental Constraints

1) Wetlands/Creeks/Flood Plain

There are no mapped wetlands, creeks, flood plains or other water bodies along the project corridor based on MOA Watershed Management Services (WMS) Wetland Mapping data.

2) Contaminated Sites

According to the Alaska Department of Environmental Conservation (ADEC) Contaminated Sites Program Database, there are no active contaminated sites within 500 feet of the project area. The nearest active contaminated site is located at the northeast quadrant of the E. Dowling Road and Lake Otis Parkway intersection and is approximately 1,000 feet from the project area.

F. Lighting

The only two MOA-owned roadway lights near Quinhagak Street are on the east side at the intersections of E. 64th Avenue and Askeland Drive but there are no roadways lights directly on Quinhagak Street. The Alaska Department of Transportation (ADOT) owns roadway lights on the north side of E. Dowling Road.

G. Landscaping

The landscaping along Quinhagak Street generally consists of owner maintained lawn areas and natural mature trees. A privately owned landscaping bed west of Parcel 1 and some boulders west of Parcel 6 extend into the right-of-way (ROW). Multiple parcels (Parcels 4, 5, and 12) have landscaping beds and trees that are installed up to the ROW and a few of the landscaping beds slightly extend into the ROW.

H. Utilities

Existing utilities within the project area include water, sanitary sewer, storm drain, electric, telephone, cable television, fiber optic, and natural gas (See APPENDIX A for the layout, size, and type of existing utilities in the project area). The location of utilities in the project planning documents and drawings are based on utility company facility maps and utility company locates.

1) Water

The project area is primarily served by a public piped water system owned and operated by Anchorage Water & Wastewater Utility (AWWU). The water main along Quinhagak Street is 12 inches in diameter, ductile iron (DI) pipe from Askeland Drive to E. 63rd Avenue. An 8-inch DI water main extends from the E. 64th Avenue & Quinhagak Street intersection to E. Dowling Road. Water mains are present at all the side streets and T-intersections within the project area. The depth of the burial of the water mains on Quinhagak Street are generally 8-10 feet below ground surface. Water service lines, hydrants, valves, key boxes, and other water appurtenances are located throughout the project area. AWWU has not indicated any water improvement plans within the project area.

The only parcel served by a private well is Parcel 15.

2) Sanitary Sewer

The project area is also served by a public piped sanitary sewer system owned and operated by AWWU. The gravity sanitary sewer main along Quinhagak Street is 8 inches in diameter and made of DI pipe. It extends from Askeland Drive to approximately 130 feet south of E. Dowling Road. Sanitary sewer mains are present at all the side streets and T-intersections within the project area. Sanitary sewer service lines, manholes, and other appurtenances are present throughout the project area. AWWU has not indicated any sewer improvement plans within the project area.

3) Storm Drain

See SECTION III: EXISTING DRAINAGE Conditions & Analysis for summary of the existing storm drain facilities in the project area.

4) Electric

Chugach Electric Association (CEA) owns and operates overhead (OH) and underground (UG) electric lines, junction boxes, padmount transformers, and utility poles in the project area. An OH 3-phase electric line crosses Quinhagak Street on the south side of E. 64th Avenue. An UG 3-phase 4 wire primary conductor is located on the east side of Quinhagak Street from the north side of Parcel 4 to just south of E. Dowling Road where it crosses Quinhagak Street and extends to the west. A padmount transformer along this UG segment is located south of Parcel 1. Transmission OH lines cross Quinhagak Street on the south side of E. Dowling Road. CEA has not indicated any future extension or improvement plans within the project area.

5) Telephone

Alaska Communications (ACS) owns and operates OH and UG telephone and fiber optic lines in the project area. ACS has an OH telephone line crossing Quinhagak Steet on the south side of E. 64th Avenue and an UG telephone line crossing on the north side of E. 64th Avenue. ACS has UG telephone and fiber optic lines that cross Quinhagak Street on the south side of E. Dowling Road. ACS serves most properties along Quinhagak Street from OH and UG lines along the back side of the properties. ACS has not indicated any future extension or improvement plans within the project area. ACS has not indicated any future extension or improvement plans within the project area.

6) Cable Television

General Communications, Inc. (GCI) owns and operates UG and OH cable television (cable) and fiber optic lines, underground vaults and pedestals within the project area. An UG cable line is installed on the east side of Quinhagak Street from Askeland Drive to E. 63rd Avenue. Multiple UG cable lines are installed on the west side of Quinhagak Street from E. 64th Avenue to E. Dowling Road. GCI's lines cross Quinhagak Street as follows: UG & OH cable crossing on the south side of E. 64th Avenue and OH cable/fiber optic crossing on the south side of E. Dowling Road. GCI serves some properties along Quinhagak Street along the back side of the properties. GCI has not indicated any future extension or improvement plans within the project area.

7) Natural Gas

ENSTAR Natural Gas (ENSTAR) owns and operates natural gas facilities within the project area. Natural gas mains along Quinhagak Street include 2-inch diameter plastic mains extending from Askeland Drive to E. 64th Avenue on the west side and from E. 63rd Avenue to E. Dowling Road on the east side. Numerous services cross Quinhagak Street providing natural gas service to parcels along the project area. A 12-inch diameter pressurized transmission gas main crosses Quinhagak Street on the north side of E. 64th Avenue. ENSTAR has not indicated any future extension or improvement plans within the project area.

I. Right-of-Way (ROW) and Easements

The existing ROW for Quinhagak Street is 60 feet wide. Existing easements on private properties vary in width and include: telephone and electric, visual enhancement, aerial telecommunication and electric, anchor, and utility.

J. Nonconformities

MOA Code of Ordinances Title 21.13 defines "nonconformities" as legal uses, structures, lots, or signs established prior to the effective date of the current title, or future amendments to the current title, that don't conform to the requirements of the current title. The acknowledgement and relief granted to existing property, land uses, and structures are intended to minimize negative economic effects on development that was lawfully established prior to the current title. In all cases, the burden of establishing the existence of a legal nonconformity is solely the responsibility of the owner of the nonconformity. Verification of nonconforming status can be requested by the owner or on behalf of the owner by submitting a Nonconforming Determination application along with supporting documentation to the MOA Planning Department for a determination.

Improvements made to the structure or lot that require a permit from MOA Building Safety may require dedicating a portion of the construction cost to bring the affected areas towards compliance with current codes. However, if improvements do not require a permit, the area is not subject to upgrading to current standards. For example, per current code, improvements to lots that place fills (including pavement) less than 1 foot in depth, on natural terrain with a slope flatter than 5H:1V, and do not obstruct drainage courses do not require a building safety permit.

One parcel along the project corridor has previously established nonconforming status. TABLE 1 below provides a summary of the parcel and the relevant nonconformities (see FIGURE 1 for the location of the parcel). This parcel and potentially other parcels along the project limits may have additional nonconforming features associated with the lots that have not yet established nonconforming status, including:

- Driveway widths exceed two-fifths of the frontage of the lot.
- Parking and maneuvering not entirely located on property.
- Vehicles not able to enter abutting street in forward.

Depending on the preferred design, these additional nonconformities may need to be established to construct the proposed project improvements and not negatively impact current development. Since the MOA is making improvements to the ROW with this project, the project team will work with the owners of the lots to gain approval from them to submit a Nonconforming Determination application on their part if required. The MOA Planning Department will review the application and determine whether a property has valid nonconformities. Once the nonconforming uses have been established, the design team will work with the MOA Traffic Engineering Department to provide the safest possible roadway design.

Table 1 - Summary of Nonconforming Uses

Parcel No.	Year of Nonconforming Status Determination	Nonconformity
11	2019	• The driveway entrance at Quinhagak Street is in excess of 40% of the lot's frontage is considered conforming. • The lack of parking lot perimeter and site enhancement landscaping is considered conforming.

III. Existing Drainage Conditions & Analysis

Quinhagak Street is paved with typical industrial/commercial roadway features such as curb and gutter and stormwater infrastructure to help convey surface runoff. While storm drain systems do exist along the project corridor, many drainage features are ineffective due to the poor condition of the road, grades, and curb and gutter. High groundwater levels and seasonal freezing have also created several roadway issues within the project area including widespread cracking, ponding, and potholes resulting in deteriorating roadway surfaces. Additionally, the majority of the piped systems in place were installed in the 1980s and are nearing the end of their design life. One of the primary goals of this project is to improve subsurface drainage along the entire project corridor to alleviate the high groundwater issues. These improvements, along with upgrades to improve surface drainage, will extend the life of the proposed road and pedestrian improvements.

There are two (piped) storm drain subsystems located within the project limits; the Quinhagak Street system, which is a part of the E. 64th Avenue system and the Askeland Drive system, all of which are part of the greater Meadow Street Park System that outfalls into North Fork Little Campbell Creek in Meadow Street Park. These two systems convey stormwater runoff from the project corridor and surrounding areas and will be discussed in further detail below.

Widespread ponding & ineffective catch basin at the Quinhagak Street and E. 64th Avenue intersection

To properly evaluate the infrastructure currently in place, an assessment of the existing storm drain piping was conducted for specific pipe runs in the project area to determine its overall condition. Additionally, a hydrologic and hydraulic (drainage) analysis was performed to determine if the existing piping is adequately sized to meet MOA design criteria.

The information gathered from the condition assessment and the existing condition drainage analysis will be used to develop the proposed storm drain system. The proposed drainage improvements are discussed in SECTION IX.

A. Existing Conditions

1) Contributing Drainage Areas

The drainage basins (catchments) that contribute stormwater runoff to the project area were delineated using several methods, including topographical mapping, aerial photography, parcel boundaries, and MOA Watershed Management's hydrography geodatabase (HGDB). Based on HGDB data, the project is contained within the Lower North Fork Little Campbell Creek sub-watershed boundary. Refer to FIGURE 1, APPENDIX E which illustrates the project location and watershed boundaries within the Anchorage area.

The larger scale sub-watershed identified from HGDB mapping was refined into individual drainage catchments near the project area to more accurately represent the surface drainage and hydraulic properties anticipated within the project corridor. Sixteen catchments were delineated within the sub-watershed for the existing conditions assessment of the E. 64th Avenue and Askeland Drive systems. See FIGURE 4, APPENDIX E for the refined catchment areas.

The contributing catchments are characterized primarily by light industrial/commercial properties along Quinhagak Street with low density residential south of E. 64th Avenue (approximately ¼ acre lots). The industrial/commercial areas increase the impervious surface area (roofs, driveways and parking lots) throughout the project area, resulting in increased runoff. The majority of stormwater runoff from these catchments is generally directed toward the adjacent roadways, where it is conveyed by predominantly Type 2 (rolled) curb and gutter to piped systems. These conveyance systems are described in more detail below.

2) Conveyance Systems

The following provides a description of the existing storm drain conveyance systems within the project area and systems adjacent to the project area that influence drainage. The drainage systems described below are owned and maintained by MOA or the Alaska Department of Transportation and Public Facilities (DOT&PF). All drainage systems described below south of E. Dowling Road are owned by the MOA. See FIGURE 3 below for an Existing Storm Drain System Map.

a) Quinhagak Street System

The Quinhagak Street branch of the E. 64th Avenue storm drain system (described below) extends north from the E. 64th Avenue/Quinhagak Street intersection and terminates approximately 375 feet south of E. Dowling Road. Surface runoff from the properties adjacent to Quinhagak Street, E. 63rd Avenue, Tuttle Place, and a short segment of Lake Otis Parkway are all conveyed through the Quinhagak Street storm drain and into the E. 64th Avenue system. The Quinhagak Street storm drain was installed in 1983 and consists of a 12-inch corrugated metal pipe (CMP) main line, with 10-inch CMP catch basin leads. A newer section of storm drain was installed along E. 63rd Avenue that extends approximately 350 feet east of the Quinhagak Street/E. 63rd Avenue intersection (installation date unknown). The E. 63rd Avenue storm drain consists of an 18-inch corrugated polyethylene pipe (CPEP) main line with a 12-inch CPEP connection that appears to serve a private property to the north. Other private storm drain systems connect to storm drain structures on Quinhagak Street.

Surface flow is generally conveyed by curb and gutter (predominantly Type 2) from north to south along Quinhagak Street and east to west along E. 63rd Avenue. Catch basin inlets are located within the curb and gutter to intercept the stormwater runoff and direct it into the piped systems described above. The furthest extents of surface runoff captured within the

Quinhagak Street system are from the north end of Tuttle Place and Lake Otis Parkway north of E. 63rd Avenue.

b) Askeland Drive System

The project corridor includes the (furthest) upstream end of the Askeland Drive storm drain system. The existing storm drain network within the project area collects flows from Quinhagak Street south of E. 64th Avenue and the adjacent residential homes. Runoff is collected via curb and gutter and directs flow southwest towards the system outfall. There is a Type I storm drain manhole in the center of the Quinhagak Street/Askeland Drive intersection that is connected to two 10-inch CMP catch basin leads and an 18-inch CMP main line that extends west along Askeland Drive. There is also an existing 10-inch CMP subdrain and cleanout installed in the cul-de-sac east of the project that is connected to the same manhole.

c) E. 64th Avenue System

The E. 64th Avenue storm drain system is extensive and located entirely outside of the project corridor except for the infrastructure at the intersection of Quinhagak Street. It was constructed in the late 1980s and extends underground from its confluence with the Askeland Drive system north of Meadow Street Park (25 feet upstream of the OGS inlet) to the north to E. 64th Avenue. From there it continues east along E. 64th Avenue to Lake Otis Parkway, collecting flows from E. 64th Avenue, Burlwood Street (with connecting systems from E. Dowling Road, Dow Place, E. 59th Avenue, and Petersburg Street north of E. Dowling Road), Petersburg Street south of E. Dowling Road, and Quinhagak Street. Once the system reaches Lake Otis Parkway, it splits north and south, extending approximately 3,700 feet to the north and 900 feet to the south along Lake Otis Parkway with several connecting sub-systems.

Upstream of Quinhagak Street, the primary trunk lines are constructed of 36- and 42-inch CMP. Downstream of Quinhagak Street, the trunk line is constructed of 57-inch (span) by 38-inch (rise) corrugated metal pipe arch (CMPA) and 64-inch (span) by 43-inch (rise) CMPA.

3) Water Quality Treatment

Based on available storm drain record drawings, survey, and HGDB data, water quality treatment is not being provided for the Quinhagak Street or Askeland Drive systems directly. However, treatment is provided downstream on a broader level by an OGS located directly upstream of two large sedimentation basins north of Meadow Street Park. The OGS serves as pre-treatment for runoff prior to discharging into the interconnected sedimentation basins. Sedimentation basins are designed to detain sediment-laden stormwater runoff, allowing sediment to settle out before the runoff exits the facility. Runoff within the sedimentation basins eventually flows into North Fork Little Campbell Creek.

4) Storm Drain Condition Assessment

In September 2022, MOA Street Maintenance inspected segments of the existing storm drain system using a closed-circuit television (CCTV) camera along E. 63rd Avenue, E. 64th Avenue, and Askeland Drive. For the complete CCTV Pipeline Inspection Report provided by MOA Street Maintenance, refer to Appendix D. Below is a summary of the inspection findings.

Two CPEP pipes (MOA ID #3890 & 38981) were inspected along E. 63rd Avenue. These pipes appeared to be in fair to good condition. Minor joint infiltration and pipe deformation was noted at multiple locations.

Two CMP pipes (MOA ID #26756 & 33051) were inspected along E. 64th Avenue. These pipes appeared to be in good condition, with noted joint separations, light infiltration, and pipe deformation in several locations. One of the joint separations is in the flow line obstructing flow.

Three CMP pipes (MOA ID #10529, 19737 & 26454) were inspected along Askeland Drive. Each inspection attempt was abandoned due to the presence of heavy deposits and sediments in each pipe, prohibiting the inspection equipment from advancing. A broken/separated pipe joint in pipe 10529 was identified with soil visible and entering the pipe.

It was also noted in the report that the pipes downstream of those inspected were visibly surcharged during a surface manhole assessment done previously, and that the further you proceeded downstream the more surcharged the system was.

5) Drainage Concerns

Significant ponding occurs throughout the project limits after rain events and spring break up due to flat grades and heaving curb and gutter. Runoff cannot effectively drain to the existing curb inlets along the roadway in these conditions, resulting in roadway degradation such as potholes, cracking, and pavement failure over time. In addition to the roadway surface issues, the groundwater in the project area is high. High groundwater causes seasonal freeze/thaw issues in the roadway subbase that exacerbates the issues listed above.

Heaving curb & gutter and ponding along Quinhagak Street (looking south)

The CCTV Pipeline Inspection Report (Appendix D) prepared by MOA Street Maintenance identified several issues with the pipes inspected. This was anticipated as most of the pipe and connecting storm drain structures in the project limits were installed in the 1980s and are nearing the end of its design life. In addition to the aging infrastructure, the existing E. 64th

Avenue system has a history of surcharging, and the surcharging increases as you proceed further downstream. The surcharging conditions were confirmed in some of the images and notes provided in the Street Maintenance report.

B. Hydrologic and Hydraulic Analysis

A hydrologic and hydraulic (drainage) model was developed to analyze the existing and proposed conditions for the project corridor and contributing areas. The methodology and key input parameters required to prepare this drainage model are described below.

1) Design Storm Depth and Distribution

The design storm distribution used for this drainage analysis is based on the Anchorage and Eagle River 24-hour storm duration provided in Appendix D of the Anchorage Stormwater Manual (ASM). The base design storm depth values are per ASM Table 4.2-1 (MOA Design Storm Depths) and are as follows:

- Water Quality Treatment: 90th Percentile, 24-hour – 0.52-inches.
- Conveyance Design and Peak Flow Control: 10-year, 24-hour – 2.28-inches.
- Project Flood Bypass: 100-year, 24-hour – 3.59-inches.

The 10-year, 24-hour design storm event was used to evaluate the conveyance capacity of the existing storm drain systems and if they are adequately sized. The proposed storm drain system will utilize the same storm event to size the piped system.

2) Orographic Factor

The mountainous geography around the Anchorage Bowl has a pronounced and generally predictable impact on the precipitation amounts along the mountain fronts. Generally speaking, the closer you are to mountainous terrain, the more precipitation is predicted. This is known as the orographic effect. To account for this from a hydrologic standpoint, an orographic factor is applied to the base design storm values listed above based on the location of the project area to account for the increased intensity.

Based on project location, a *1.08 orographic factor* was applied to the base design storm volumes. Refer to FIGURE 3 in APPENDIX E.

3) Model Information

The Soil Conservation Service (SCS) TR-55 method was used for this drainage analysis. The drainage analysis was developed using 2023 Autodesk Storm and Sanitary Analysis (SSA) computer software. This software allows the user to analyze the stormwater runoff response from the project area and calculate data such as peak flow at specific (design) points in the system, evaluate pipe sizing, and identify problems areas such as flooding and surcharged pipes.

Precipitation losses were estimated using the SCS Curve Numbers based on land cover type, slope, and the hydrologic soil group for the project area. *Soil Type B* used for this drainage analysis based on Web Soil Survey (WSS) mapping developed by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). Refer to FIGURE 2, APPENDIX E for a map showing the project area and the soil groups in the surrounding area.

The time of concentration (T_c) was calculated for each contributing catchment using the SCS TR-55 method. Time of concentration is defined as the time for runoff to travel from the hydraulically most distant point of the watershed to a design point or point of interest.

The input paraments for the existing storm drain piping systems included in the model were based on surveyed data, record drawings, and information from the condition assessment report. These parameters included information like pipe size, type, inverts, and slopes.

4) Model Results

A total of 16 contributing catchments were delineated and evaluated for runoff response for the existing condition drainage model. These catchments were delineated based on the inlet structures that surface runoff will be conveyed to. The peak stormwater runoff of each catchment and the peak discharge leaving the project corridor (at specific locations) during the 10-year, 24-hour design storm event is shown on FIGURE 4, APPENDIX E.

The drainage model results indicate that the existing storm drain is adequately sized on Askeland Drive and is undersized in numerous locations along Quinhagak Street. The entire Quinhagak Street system surcharges during the design storm event and backwaters into the E. 63rd Avenue system causing the E. 63rd Avenue system to also surcharge. Surcharged pipes are identified in FIGURE 4, APPENDIX E. Peak flows during the simulated storm cause pipes to surcharge and manholes to overtop, flowing into the roadway at select locations.

The SSA software does not account for the peak flows associated with the overtopping conditions described above and therefore makes it appear that the peak flows in each piped system are relatively low. While this is true to a point, in that the surcharged pipes have exceeded their design capacity and will allow no additional flow through, the overtopping flows will continue to flow down gradient to the next available inlet, conveyance, or low-lying area, potentially inundating that system or area as well. These conditions should be considered when comparing the existing system capacity with the proposed system capacity.

It should be noted that the E. 64th Avenue system and the Askeland Drive system were not modeled except for catchments within the project area due to the limited scope of this analysis. As such, the effects of any potential backwater and/or surcharge of these systems was not incorporated into the drainage model. While these effects are unknown, it is likely that this would negatively impact the Quinhagak Street and E. 63rd Avenue systems, compounding the surcharging and overtopping issues identified in these systems during peak storm events.

Complete drainage modeling results and input parameters for the existing drainage systems and contributing areas described above are provided in APPENDIX E. For reference, the naming convention used for the storm drain pipes and structures in this modeling analysis uses the identification numbers as presented int the MOA Stormwater Asset online GIS mapping tool.

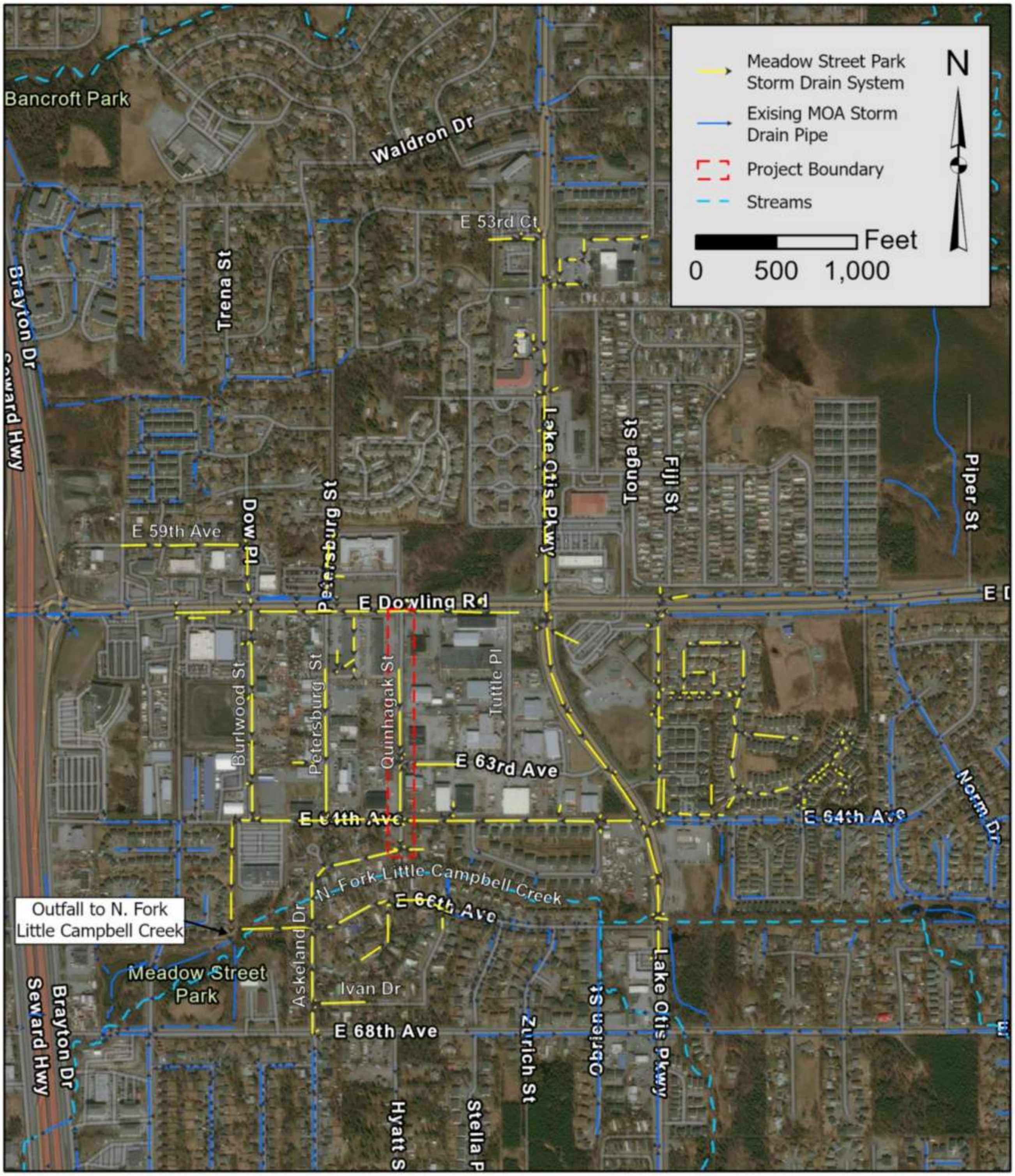


Figure 3 - Existing Storm Drain System Map

IV. Geotechnical Analysis

A. Existing Conditions

CRW conducted a geotechnical investigation for the Quinhagak Street Reconstruction project, which consisted of reviewing existing historic borehole logs and completing a field investigation in the project area.

1) Historic Bore Logs

CRW consulted the online MOA Soil Boring App to evaluate historical borings in the project area. Fourteen historic boreholes were in the project limits. Historical boreholes generally matched information obtained in our field investigation. This included a 2 to 5-foot layer of granular fill, followed by a section of silty sand and clayey silt.

2) CRW Field Investigation

CRW's geotechnical field investigation was conducted in May 2022; the Final Geotechnical Report was published in January 2023 and can be found in APPENDIX F. The investigation included drilling and sampling six borings along Quinhagak Street. Three piezometers were installed to monitor groundwater levels.

Based on the recovered samples, the existing pavement along Quinhagak Street when encountered ranged from 1.5 to 3.0 inches. The subsurface conditions observed within the existing road prism generally consisted of 5 to 6 feet of granular fill composed of poorly graded gravel with sand and silt or poorly graded sand with gravel and silt, decreasing in thickness from north to south. The granular fill was underlain by up to 4 feet of silty sand or sand with silt, decreasing in thickness from north to south and was not observed in BH-06. Beneath the granular fill layer, 6 to 10 feet of silty lean clay was observed increasing in thickness from north to south.

The fines content ranged between 2 and 10 percent in the granular fill, and its frost susceptibility was estimated to be non-frost susceptible (NFS) to class F-2. The silty sand/sand with silt had fines content from 20 to 50 percent and the silty lean clay had fines content of 90 to 100 percent and was estimated to be frost class F-4.

The groundwater table was observed during drilling at depths ranging from 1 to 10 feet below ground surface (BGS), with one boring not encountering groundwater. Subsequent groundwater measurements varied between 2 to 5.6 feet BGS.

Photoionization detector (PID) readings were collected for each sample during the field investigation per the DCM to screen for potential contaminants. Standard practice in the MOA is to consider soil samples with PID readings of 20 parts per million (ppm) or higher potentially contaminated. No samples screened during this investigation exceeded this limit, and no visual or olfactory evidence of contamination was observed.

See the Geotechnical Report for detailed soil boring and laboratory testing information.

B. Recommendations

CRW has developed a recommended road structural section based on the current MOA DCM as outlined in Chapter 1 Streets, Section 1.10 Road Structural Fill Design. The DCM recommends two methods for frost considerations in the structural section design: the Complete Protection Method and the Limited Subgrade Frost Penetration Method. The structural section design uses the latter method, which seeks to reduce the freezing impacts to a specified percentage of the structural section into the subgrade.

The analysis uses the default Anchorage climate parameters with typical soil parameters for classified fill and native soils. The recommended structural section is shown in FIGURE 4 in SECTION VIII as follows:

- 2 inches of asphalt concrete pavement (Class E)
- 2 inches of leveling course
- 16 inches of MOA Type II-A classified material
- 2 inches of rigid board insulation (R-4.5 per inch minimum)
- 24 inches of MOA Type II classified material
- Separation geotextile

The thickness of the recommended section totals 46 inches.

Board insulation is recommended to extend a minimum of 4 feet beyond the back of the curb when no sidewalk is present. When sidewalk is present, the insulation should extend one foot minimum beyond the back of the sidewalks; however, the sidewalk will not perform as well as the curb.

Longitudinal transitions between insulated and non-insulated sections should include extending the insulation 8 to 12 feet into the non-insulated section, reducing the insulation thickness along the extension to minimize the possibility of differential heave. The insulation can be tapered from an R-value of 9 to an R-value of 4.5 in the transition zone. The subgrade transition should be tapered at a 10 horizontal to 1 vertical (H:V) slope, if construction distances permit, but should not be steeper than 5H:1V.

A geotextile should be used for separation between the structural section and the existing subgrade. Geotextile should be placed on top of the existing soils prior to placement of classified fill and insulation and extended up the sides of the excavation.

Any existing fill that meets MOA Type II and Type II-A classified fill gradations can be reused as classified fill in the roadway structural section. It is anticipated that the majority of existing fill and native soils along Quinhagak Street contain frost susceptible material and will not meet MOA Type II and II-A classification.

Incorporation of subdrains into the design of the structural section is recommended to help mitigate against the effects of high ground water levels. High groundwater levels, or groundwater that reaches the pavement structural section, can collect in the structural section and impact the overall road performance. Subdrains will mitigate against water infiltration in the structural section and improve overall road performance. The depth of subdrain installation should be below the roadway structural section for optimal performance.

Edge drains should be placed at the outer edges of the structural section as shown in FIGURE 4 in SECTION VIII and consist of a geotextile wrapped perforated pipe with a minimum O.D. of 10 inches. Construction should be per MASS. Roadway subgrade should be sloped with a minimum of 2 percent towards subdrains to assist with drainage. Termination of the subdrains should be to the drainage system manholes or suitable outfalls. Subdrains should be hydraulically sized and consider potential icing issues.

Should edge drains not be feasible or to save construction costs, an alternate would be a perforated drain placed in a shallow trench near the center of the structural section. As such, an alternate drainage option is a perforated center subdrain as shown in FIGURE 3 in APPENDIX F consisting of a geotextile-wrapped perforated pipe with a minimum O.D. of 18 inches. The use of a center subdrain may result in poorer structural section performance over time compared to the used of edge drains. The center subdrain should be constructed per MASS. Roadway subgrade should be sloped with a minimum of 2 percent towards the subdrain to assist with drainage. Termination of the subdrain should be to the drainage system manholes or suitable outfalls. Subdrains should be hydraulic sized and consider potential icing issues.

For the driven pile light pole foundations, they should be installed to a minimum of 25 feet BGS due to the presence of fine-grained soils starting around 10 feet BGS.

V. Traffic and Safety Analysis

A. Existing Traffic Volumes and Operations

Existing traffic data was gathered from the MOA for the project area. Additionally, new traffic data was gathered by CRW and MOA during development of the Draft DSR. The following table summarizes traffic data used for this study, see APPENDIX G for the detailed traffic data.

Table 2 - Traffic Data Summary

Location	Date	Speed	Volume (Link counts)	Intersection Volume
Quinhagak Street and E. Dowling Road	8/10/2016			X
*Quinhagak Street North of E. 64th Avenue	7/14/2022 -7/19/2022	X	X	
Quinhagak Street and E. 64th Avenue	11/17/2022			X

*E. Dowling Road at Seward Highway was in construction during speed/volume study which may have skewed traffic data.

B. Traffic Volumes

The existing annual average daily traffic (AADT) volume was determined using the volume data (link counts) taken during November of 2022. Seasonal adjustments were factored into the AADT using the nearest permanent Alaska Department of Transportation and Public Facilities (ADOT&PF) traffic recorder located on Lake Otis Parkway at E. 74th Avenue.

The Anchorage Metropolitan Area Transportation Solutions (AMATS) travel demand model includes forecasted future daily traffic volumes for higher volume roadways. The model does not include future traffic volumes for Quinhagak Street. Although much of the project area is built out, traffic volumes on the roadways are anticipated to increase slightly as the local population grows. Much of the traffic on these roadways is destination based and will increase as the population rises. There are undeveloped parcels (Parcels 2, 13, and 14) that, when developed, are also expected to contribute to the projected traffic volumes (See FIGURE 1 for parcel numbers). Local population rates were obtained from the Anchorage 2040 Land Use Plan which estimates population growth between 0.3% and 1.1% with a 0.8% annual growth rate. A 0.8% growth rate was used to determine traffic volumes in the anticipated construction year (2026) and the design year (2046).

The following table summarizes AADT for Quinhagak Street.

Table 3 - AADT Traffic Data

Roadway	2026 Daily Traffic Volumes[1]	2046 Projected Daily Traffic Volumes[1]
Quinhagak Street	1536	1802

1. Annual Growth Rate of 0.8% Source: Anchorage Land Use Plan 2040.

C. Traffic Characteristics

Quinhagak Street exhibits different traffic characteristics in the project area and has been separated into two separate segments for traffic analysis as follows:

1) **E. Dowling Road to E. 64th Avenue** is primarily industrial/commercial, and most parcels are built out or being utilized except Parcels 2, 13, and 14 are vacant land. Parcels in this area are zoned I-1 (Light Industrial).
2) **E. 64th Avenue to Askeland Drive** is local residential, and all adjacent parcels are built out. Parcels in this area are zoned R-5 (Low-Density Residential).

Development and zoning in the project area is not anticipated to change substantially and traffic characteristics are expected to remain relatively consistent for the life of the project. Future development of Parcels 2, 13, and 14 may increase traffic volumes in the area. There are no known plans of development for these parcels currently.

Design hour volume (DHV) represents traffic volumes during the peak hour and was estimated using the 30th Highest Hour of the closest permanent traffic recorder. Directional distribution (DD), representing the distribution of traffic during the peak hour, was estimated using available link counts and turning movement counts. Peak Hour Factors (PHF) are a measure of the uniformity of the traffic and used to convert volumes to 15 minute increments for operations analysis. PHF for each segment were determined using available link counts and turning movement counts.

Traffic data for each segment is summarized in the following table.

Table 4 - Existing and Future Traffic Characteristics

Location	DHV	DD	PHF
Quinhagak Street – E. Dowling Road to E. 64th Avenue	12.0%	55/45	.70
Quinhagak Street – E. 64th Avenue to Askeland Drive	12.0%	75/25	.75

D. Speeds

The current posted speed limit for Quinhagak Street is 25 miles per hour (mph). The traffic speed analyses conducted by CRW in July of 2022 recorded the 85th percentile speed as shown in the following table:

Table 5 - Observed Speeds

Roadway	Date	85th Percentile Speed	
		Northbound	Southbound
Quinhagak Street	7/14/2022 - 7/19/2022	29 mph	27 mph

The 85th percentile speed is the speed at which 85 percent of the drivers are driving at or below and is typically used to determine a reasonable posted speed limit for a given roadway. The remaining 15 percent of drivers whose speed is above the 85th percentile are the minority and considered to be exceeding the reasonable speed. Posted speed limits are often set at or near the 85th percentile speed.

The roadway may be considered eligible for installation of traffic calming measures if the observed 85th percentile speeds exceed the posted speed limit by more than 6 mph. The 85th percentile speeds along Quinhagak Street are 2-4 mph higher than the posted speed limit. Based upon the 85th percentile speeds and in coordination with the MOA Traffic Engineering Department, no traffic calming features are proposed for this project.

E. Collision Data

Collision Data from the MOA was reviewed for the project area between 2014 and 2021. A total of 4 collisions were reported within the project corridor on Quinhagak Street and the cross streets: E. 63rd Avenue and E. 64th Avenue during this time frame. A summary of these collisions, including their locations and characteristics, are provided in TABLE 6 below and included in APPENDIX G.

Table 6 - Project Area Collision History: 2014-2021

Intersection	Collision Type							Total Collisions*
	Angle	Side-Swipe	Rear End	Head On	Fixed Object	Ped/ Bike	Parked Vehicle	
E. 63rd Avenue	1	0	0	0	0	0	0	**1**
E. 64th Avenue	1	1	0	1	0	0	0	**3**

**No fatalities were reported in the collision data.*

Based upon the low number of collisions during the 7-year period, it appears that the collisions do not follow an identifiable pattern and the intersections are currently functioning in a safe manner.

F. Side Street Intersections/Access Control

The intersection of Quinhagak Street with E. Dowling Road is a channelized intersection with left turns from Quinhagak Street onto E. Dowling Road prohibited. This intersection is a "minor street stop controlled" intersection with Quinhagak Street being the stop-controlled approach. Two streets intersect Quinhagak Street in the project area. E. 63rd Avenue is a tee intersection with stop control on E. 63rd Avenue and E. 64th Avenue is a four-way intersection with stop control on E. 64th Avenue. The intersection of Quinhagak Street with Askeland Drive is a tee intersection with stop control on only the east side of the intersection. Quinhagak Street access is as follows:

1) E. Dowling Road to E. 64th Avenue

This segment has twelve commercial driveways and one residential driveway. Parcels 1 and 11 have wide access and parking areas across the full site frontage. These configurations make access and circulation unclear to drivers and increase conflict points between vehicles utilizing the driveways and the street traffic.

2) E. 64th Avenue to Askeland Drive

This segment has two residential driveways. One of the residential driveways is a secondary driveway that accesses the back side of Parcel 6 and appears to be used to park the owner's motorhome. The parked motorhome extends into the ROW by several feet.

The proposed design will incorporate MOA driveway access standards wherever possible to improve the safety and operations of the corridor.

G. Level of Service Analysis

A Level of Service (LOS) analysis was performed in accordance with the Transportation Research Board's Highway Capacity Manual, 2010 for the E. 64th Avenue and Quinhagak Street intersection. The analysis used Trafficware Synchro (Version 11) software. The MOA intersection operation standard for urban areas allows a minimum LOS D during the design year. LOS analysis was not completed for Quinhagak Street at the intersection of E. Dowling Road because proposed roadway improvements do not extend through the intersection.

1) Quinhagak Street and E. 64th Avenue

The intersection of Quinhagak Street and E. 64th Avenue is stop controlled on E. 64th Avenue. There is currently one approach lane in each direction. LOS was determined for both the construction year (2026) and the design year (2046). In 2026, the EB approach will operate at a LOS of B with a delay of 10.3 secs. The overall intersection will operate at a LOS of A. In the design year (2046), the intersection will continue to operate at a LOS of A and the eastbound approach operating at a LOS B with a delay of 10.8 sec. Existing traffic volumes were also reviewed to determine if the stop signs should be moved to Quinhagak Street. However, since traffic volumes on Quinhagak Street are higher than E. 64th Avenue it is recommended that Quinhagak Street remain as the major unstopped movement.

H. All-Way Stop Analysis

An all-way stop analysis based on current conditions was performed at the Quinhagak Street and E. 64th Avenue intersection utilizing recommendations from the latest edition of the Manual of Uniform Traffic Control Devices (MUTCD) guidelines. E. 64th Avenue is two-way stop controlled currently, but this intersection was analyzed for all-way stop warrants due to comments from the public. Quinhagak Street is considered the major street at the intersection with E. 64th Avenue.

The MUTCD provides warrants for when an all-way stop should be considered at an intersection. Applicable warrants for the intersections Quinhagak Street:

- *Crash rate:* five or more crashes in a 12-month period that are susceptible to correction by installation of a multi-way stop.
- *Intersection Volume:* (must meet *both* of the following conditions):
  - The combined minimum vehicular volume from the major street approaches averages at least 300 vehicles per hour for any eight hours during an average day.
  - The combined minimum vehicular volume from the minor street approaches averages at least 200 vehicles per hour for the same eight hours.
- *Combination*: Where no single criterion is established but 80% of their minimum values for the crash rate and major and minor intersection volumes are met.

The MUTCD also allows the option of installing an all-way stop on residential streets of similar classification where installing the all-way stop will improve the traffic operations of the intersection.

The E. 64th Avenue intersection was analyzed to determine if it met the criteria for an all-way stop.

- Seven years of crashes were reviewed to determine the number of crashes in the highest year.
- Existing intersection count data was reviewed to determine the eight highest hours of vehicular volumes for the intersection.

Results of the analysis are summarized in TABLE 7 below. The intersection does not currently meet the warrants for an all-way stop. It should be noted that the highest hour corresponded to the AM Peak Hour with the nearby school Polaris K-12 School start time.

Table 7 – Quinhagak Street at E. 64th Avenue All-Way Stop Analysis

Intersection	Crashes in a 12 month period	Crash Warrant Met?	Highest Hour Int. Volume		Intersection Warrant Met?	Combined Warrant Met?
			Major	Minor		
E. 64th Avenue	1	No	188	150	No	No

I. Sight Distance Analysis

Adequate sight distance is necessary at intersections to allow the driver of a stopped vehicle at a minor road a sufficient view of the intersecting main roadway to decide when to enter or cross the main roadway. If the available sight distance for a minor-road vehicle is at least equal to the required stopping sight distance of the major road vehicle, then drivers have sufficient sight distance to anticipate and avoid collisions. However, in some cases, a major-road vehicle may need to stop or slow to accommodate the maneuver from the minor-road vehicle. Therefore, to provide safe traffic operations, intersection departure sight distances should exceed stopping sight distances along the major road.

The intersection departure sight triangles, per requirements of the DCM, have been drawn at each intersection within the project area to determine any potential issues; see APPENDIX I for intersection departure sight triangles. Features that hinder the sight triangle should be removed or reset to be outside of the intersection departure sight triangles where feasible. The only items that are within the sight triangles are privately owned boulders on the east side of Quinhagak Street south of E. 64th Avenue. The boulders will be placed on property and outside of the sight triangles as part of the proposed improvements. New light poles will also be located outside the sight triangles where feasible.

J. Parking Study

A parking study was conducted to document the current use of on-street parking for consideration in the design of the proposed improvements. Parked vehicles within the adjacent parking lots were also noted during the study to assess available off-street parking. The parking study was based on observations from four separate site visits. Site visits were organized to include one weekday afternoon/evening and one weekend afternoon/evening and took place on Thursday, July 14, 2022 and Saturday, July 16, 2022 (see APPENDIX G for the parking study memorandum). During the parking study only one car was observed parked on the roadway near Askeland Drive. The adjacent parking lots in the industrial/commercial zone north of E. 64th Avenue appeared to have sufficient parking on their private lots. Based upon the parking study results there is not a significant demand for on-street parking along the roadway. The greatest demand for on-street parking is closer to Askeland Drive within the low-density residential zoning area.

K. Traffic Calming

Based upon the 85th percentile speeds and in coordination with the MOA Traffic Engineering Department, no traffic calming features are proposed for this project.

If speeding is a concern upon completion of the project, appropriate traffic calming measures could be installed if approved by the MOA Traffic Engineering Department.

VI. Design Criteria and Standards

Project design criteria are based on the roadway characteristics, functional classification, and road or facility ownership. The roadway is owned and maintained by the MOA.

A. Project Design Standards

The PM&E Design Criteria Manual (DCM) provides detailed design criteria for the development of roadways and infrastructure within the MOA. The documents listed below provide additional design guidance, standards and requirements for this project.

- AMATS Non-Motorized Plan, 2021, AMATS
- Anchorage Pedestrian Plan (APP), 2007, MOA.
- Anchorage Bicycle Plan, 2010, MOA.
- Official Streets and Highways Plan (OS&HP), 2014, MOA.
- Anchorage Bowl 2020 Comprehensive Plan, 2001, MOA.
- Anchorage 2040 Land Use Plan, 2017, MOA.
- 2035 Metropolitan Transportation Plan (MTP), 2015, AMATS.
- 2040 Metropolitan Transportation Plan (MTP), 2020, AMATS.
- Anchorage Stormwater Manual (ASM), July 2017, MOA.
- Neighborhood Traffic Calming Policy Manual, 2016, MOA Traffic.
- Roadside Design Guide (RDG), 4th Edition, 2011, American Association of State Highway and Transportation Officials (AASHTO).
- A Policy on Geometric Design of Highways and Streets, 7th Edition (AASHTOGB), 2018, AASHTO.
- Manual on Uniform Traffic Control Devices (MUTCD), 2009 with Revisions 1 and 2, Federal Highway Administration (FHWA).
- Municipality of Anchorage Standard Specifications, 2015, MOA.
- Alaska DOT&PF Preconstruction Manual (PCM), 2019, ADOT&PF.
- Alaska Traffic Manual (ATM), 2015, ADOT&PF.
- Proposed Accessibility Guidelines for Pedestrians in Public Right-of-Way (PROWAG), 2011, United States Access Board.
- Anchorage Municipal Code Title 21 – Land Use Planning.
- A Strategy for Developing Context Sensitive Transportation Projects, 2008, MOA.
- AWWU Design and Construction Practices Manual, 2018, AWWU.

B. Design Criteria Summary

A summary of roadway design criteria pertinent to this project can be found in TABLE 8 below. Potential deviations from design criteria are described in SECTION XVI. Detailed lighting design criteria is discussed in SECTION VII. D.

Table 8 - Design Criteria Summary

	Criteria	Design Standard Value		Reference
		E. Dowling Road to E. 64th Avenue	E. 64th Avenue to Askeland Dr.	
Traffic Data	Functional Classification	Secondary Street: Urban Residential	Secondary Street: Industrial/Commercial	OSH&P
	AADT – 2026	1,536 vpd		Assumed Growth
	AADT – 2045	3,200 vpd		Assumed Growth
	Design Vehicle	WB-50		DCM 6.4 B
	Design Structural Loading	HS 20		
	Design Speed	30 mph		DCM Table 1-6
	Posted Speed	25 mph		DCM 1.5.E
Horizontal Alignment	Stopping Sight Distance, Min	200 ft		DCM Figure 1-20
	Clear Sight Triangle Length	335 ft		DCM Figure 1-19
Vertical Alignment	Vertical Grade, Maximum	6.0%		DCM 1.9.D.2.b
	Vertical Grade, Minimum	0.5% for street with curb and gutter		DCM 1.9.D.2.a
	Vertical Curve K-Value, Min Crest Curve	19		DCM Figure 1-16
	Vertical Curve K-Value, Min Sag Curve	37		DCM Figure 1-17
Cross Section	Street width (measured to back of curb)	40 ft (if 2 parking lanes are required) 33 ft (if no parking lanes are required)	38 ft (if 2 parking lanes are required) 31 ft (if no parking lanes required)	DCM Table 1-6
	Number of Travel Lanes	2		DCM Table 1-6
	Number of Parking Lanes	2		DCM Table 1-6
	Shoulder Width (No Parking Lane)	3.5 ft		DCM Table 1-6
	Curb & Gutter	Type 2 (DCM) Type 1 or Type 2 if warranted (Title 21)		DCM Figure 1-13 Title 21.08.050.G
	Side slopes	2H:1V maximum		DCM 1.9.D.5

	Criteria	Design Standard Value		Reference
		E. Dowling Road to E. 64th Avenue	**E. 64th Avenue to Askeland Dr.**	
Cross Section	Clear Zone	12 feet minimum		See SECTION VI.C.4)
	Sidewalk Requirements & Width	Both sides of roadway if connecting to existing sidewalk on both ends, 5 ft min One side of roadway, 5 ft min if not connecting to existing sidewalks on both ends	Both sides of roadway, 5 ft min	DCM Figure 1-13, Title 21.07.060.E.2
	Sidewalk Separation from Back of Curb	7 ft (for collectors and higher classification)		DCM 4.2 H
Inter-sections & Driveways	Curb Return Radii at Side Streets	20 ft (local/local) 30 ft (local/collector or arterial)		DCM Figure 1-22
	Driveway width: up to 7-plex	14 – 20 ft; (28 ft with restrictions)		MOA Driveway Standards 11/3/21
	Driveway width: commercial or ≥ 8-plex	24 – 34 ft		MOA Driveway Standards 11/3/21
	Max driveway grade: residential	± 12%		MOA Driveway Standards 11/3/21
	Max driveway grade: commercial, ≥ 8-plex	± 8%		MOA Driveway Standards 11/3/21
	Landing grade/length: residential	± 2% for 12 ft		MOA Driveway Standards 11/3/21
	Landing grade/length: commercial, ≥ 8-plex	± 2% for 20 ft ± 2% for 30 ft for semi-tractors or trailers		MOA Driveway Standards 11/3/21

C. Specific Design Criteria

The appropriate street section is determined by traffic volumes and land use. The DCM classifies Quinhagak Street as a secondary (local) industrial/commercial street from E. Dowling Road to E. 64th Avenue and a secondary (local) urban residential street from E. 64th Avenue to Askeland Drive.

Secondary streets typically have lower design volumes and often provide direct access to adjacent lots. Based on Anchorage Municipal Code (AMC) Title 21 Land Use Zoning, Quinhagak Street is an “urban” street. Urban streets are required to include a paved surface, curb and gutter, sidewalks or trails, street lights, traffic control devices, street signs, landscaping, and storm drains.

1) Design Speed

The design speed governs various geometric features of the roadway and should be a logical speed with respect to anticipated speed limit, topography, and functional classification of the roadway. The design speed affects the length of sight distance available along the roadway’s horizontal alignment and vertical profile, particularly at intersecting roadways and pedestrian facilities. As design speeds increase, longer sight distances are required to provide more reaction time and braking distance to respond to roadway obstacles.

The DCM requires a secondary (local) industrial/commercial street with parking allowed on the street have a design speed of 30 mph. For a secondary (local) urban residential street with more than 1,000 Average Daily Traffic (ADT) the DCM requires a design speed of 30 mph. Generally, the posted speed limit should be 5-10 mph less than the design speed.

2) Accessibility Guidelines

The current requirements for accessibility in the MOA ROW are based on the Americans with Disabilities Act (ADA). The project uses guidelines published in Proposed Accessibility Guidelines for Pedestrian Facilities in Public Right-of-Way, July 26, 2011 (ADA Guidelines) by the United States Access Board. A summary of some of the ADA design criteria pertinent to the project is provided below:

- R302.3 – The continuous clear width of pedestrian access routes shall be 4.0 feet minimum.
- R302.4 – Where the clear width of pedestrian access routes is less than 5.0 feet, passing spaces shall be provided at intervals of 200 feet maximum.
- R302.5 – Where pedestrian access routes are contained within a street or highway right-of-way, the grade of pedestrian access routes shall not exceed the general grade established for the adjacent street or highway.
- R302.5.1 – Where pedestrian access routes are contained within pedestrian street crossings, the running grade of the pedestrian access route shall be 5% maximum.
- R302.6 – The cross slope of pedestrian access routes shall be 2% maximum.
- R304.3 – Parallel curb ramps shall include a turning space with minimum dimensions of 4.0 feet x 4.0 feet at the bottom of the ramp.
- R304.3.2 – The running slope of the curb ramp shall be in-line with the direction of sidewalk travel and shall be 5% minimum and 8.33% maximum but shall not require the ramp length to exceed 15.0 feet maximum. The running slope of the turning space shall be 2% maximum in any direction.
- R304.5.1 – The clear width of curb ramp runs and turning spaces shall be 4.0 feet minimum.

- R304.5.2 – Grade breaks at the top and bottom of curb ramp runs shall be perpendicular to the direction of the ramp run.
- R304.5.3 – The cross slope of curb ramps and turning spaces shall be 2% maximum.

The Public Rights-of-Way Accessibility Guidelines recognize that it is not always possible for altered elements (reconstruction of existing facilities) to fully comply with new construction requirements because of existing physical constraints. The guidelines state:

> *Where existing physical constraints make it impractical for altered elements, spaces, or facilities to fully comply with new construction requirements, compliance is required to the extent practicable within the scope of the project. Existing physical constraints include, but are not limited to, underlying terrain, right-of-way availability, underground structures, adjacent developed facilities, drainage, or the presence of a notable natural or historic feature.*

All elements included in the project that cannot meet the requirements of ADA due to technical infeasibility should be documented.

3) Roadway Cross Section

Based on the DCM, secondary (local) industrial/commercial streets with parking allowed on the street should have a street width of 40 feet (measured from back of curb) with 2 travel lanes, 2 parking lanes, curb and gutter, and pedestrian facilities on both sides of the roadway. The travel lane width is 11 feet and the parking lane width is 7 feet. If a parking lane is not provided due to adequate off-street parking, shoulders should be provided with typical widths of 3.5 feet and a total BOC width of 33 feet. AMC Title 21.07.060.E.2.b states that sidewalks shall be installed on both sides of all local streets. In industrial/commercial zoning districts though, a sidewalk shall be installed on one side of all local streets, and on both sides of local streets if the new sidewalks would connect to existing sidewalks on both ends and the needed length is no greater than one quarter mile.

Based on the DCM, secondary (local) urban residential streets with over 1,000 ADT and houses located on both sides of the roadway should have a street width of 38 feet (measured from back of curb) with 2 travel lanes, 2 parking lanes, curb and gutter, and pedestrian facilities on both sides of the roadway. The typical lane width for a local residential street is 10 or 11 feet depending on existing and forecasted neighborhood densities, zoning, and traffic volumes; the parking lane width is 7 feet. If a parking lane is not provided, shoulders should be provided with typical widths of 3.5 feet for a total BOC width of 31 feet.

Per the DCM Figure 1-13, 5-foot wide sidewalks must be provided on both sides of a local street. It is preferable for the sidewalks to be separated from the roadway to provide pedestrian comfort and safety, increase intersection sight distances, and provide room for snow storage however separation is not required for a local roadway. A clear area of 7 feet beyond the back of curb is required for snow storage. The sidewalk can be considered as part of the snow storage area. Roadway sections with narrow shoulders provide little room for snow storage on the street and require snow to be temporarily plowed behind the curb. This may impede pedestrian passage on an attached sidewalk and/or buffer area during major snow events until the snow is cleared.

DCM curb type for secondary (local) streets is required to be Type 2 (rolled) curb and gutter. AMC Title 21.08.050.G requires curb and gutters to be in accordance with the DCM but shall be Type 1 (barrier) except for the following exceptions: 1). Curb and gutter within the arc of a residential scale cul-de-sac may be Type 2 (rolled) curb and gutter. 2). Type 2 (rolled) curb and gutter may be provided for residential minor streets carrying 500 ADT i.) that do not require installation of sidewalks per Section 21.08.050H; ii.) when the pedestrian facilities will be separated from the curb by a minimum of 3 feet; or iii.) if the Municipal Traffic Engineer determines that strict adherence to Type 1 curb is not expected to improve walkability or is not achievable based on documentation to include topography, developmental lot size, anticipated driveway spacing, and dimensional standards.

4) Roadway Clear Zone and Horizontal Offset

The DCM defines the roadway clear zone to be:

> *…the total roadside border area, starting at the edge of the traveled way, available for safe use by errant vehicles. The desired width of the clear zone is dependent on the traffic volume, design speed, and roadside geometry.*

The DCM references AASHTO's Roadside Design Guide (RDG) for rural conditions (i.e. no curb and gutter) but it is unclear as to the applicability of the clear zone concept to curbed urban roadways. In 2011, FHWA published on their website the following guidance regarding clear zone along curbed roadways:

> *Since curbs are now generally recognized as having no significant containment or redirection capability, clear zone should be based on traffic volumes and speeds, both without and with a curb.*

The recommended clear zone width is a function of the design speed, traffic volume, functional classification of the roadway, and the side slope of the roadway. The clear zone required for a urban roadway with a design speed of <40 mph and an ADT of 1,500 to 6,000 is 12 to 14 feet, with a foreslope of 6H:1V or flatter.

However, the AASHTOGB, similar to the DCM, recognizes the impracticability of constructing a full clear zone in urban areas in accordance with the RDG.

> *Where establishing a full-width clear zone in an urban area is not practical due to right-of-way constraints, consideration should be given to establishing a reduced clear zone or incorporating as many clear zone concepts as practical, such as removing roadside objects or making them crashworthy.*

The typical minimum roadway cross section for a local road with a sidewalk will meet the minimum clear zone width of 12 feet specified in the RDG (3.5-foot wide shoulder + 2-foot wide curb + 5-foot wide sidewalk + 1.5-foot wide sidewalk shoulder = 12 feet).

5) Landscaping

Quinhagak Street is classified as a local road, therefore there are no specific design requirements for landscaping defined within the DCM. However, landscape work for this project will meet the General Considerations for Landscape Installation and Maintenance in the DCM Section 3.3. If new landscaping is installed it will also meet the guidelines for tree and shrub placement in sight triangles found in the DCM and Title 21.

6) Storm Drain

A summary of the pertinent storm drain design criteria per the Anchorage Stormwater Manual (ASM) is provided below:

- Storm drain pipes shall be corrugated polyethylene pipe (CPEP) due to corrosion issues in Anchorage area.
- Minimum diameter of storm drain pipe is 12 inches. Minimum diameter of subdrain pipe is 10 inches.
- Minimum pipe slope is 0.30%.
- The storm drain system shall not be surcharged during the design storm event.
- At the design flow, minimum pipe flow velocity is two feet per second (fps). Maximum pipe flow velocity is 13 fps.
- Minimum depth of cover over a gravity storm drain pipe without thaw protection is four feet.
- Insulation is required for pipes if the depth of cover is less than four feet. If storm drain pipe is located under a roadway structural section and insulation is included in roadway section, additional insulation for pipe is not required.
- A thaw system is required if the depth of cover is less than three feet.
- Maximum manhole spacing is 300 feet.
- Minimum invert elevation difference across a manhole is 0.05 feet

VII. General Design Considerations

A. Complete Streets

A complete streets network is a roadway network that is safe, comfortable, and convenient for users of all ages and abilities and all modes of transportation. Complete streets should provide facilities that balance the needs of pedestrians, bicyclists, transit users, motorists, and movement of goods. A network-based complete streets approach recognizes that, while all roadway users need to be accommodated within a given neighborhood or corridor, no single street can accommodate and prioritize all transportation users at all times. Through a network-based approach, MOA can designate priority streets for a given mode to create a high quality experience for those users, while providing a high-quality facility for other modes on parallel but equally convenient routes.

B. Right-of-Way Acquisition

A key element for the successful completion of any project is the acquisition of any required ROW, easements, and/or permits required for construction while providing fair and equitable treatment to all affected property owners, tenants, and lessees.

The MOA's process for residential and business acquisitions (partial or full) follows the guidelines addressed in the State of Alaska's *Acquiring Real Property for Federal and Federal-Aid Programs and Projects* brochure, the *Relocation Services for Residential Property* brochure, and the *Relocation Services for Businesses, Farms & Non-Profit Organizations* brochure. Individual parcel's acquisition details are determined on a case-by-case basis and negotiated privately between the MOA and the property owner.

In general, public use easements (PUE) are required in areas where the footprint of the improvements exceeds the ROW. Slope easements (SE) are required for areas where the cut and fill slopes are outside of the ROW and need to be maintained. Drainage easements (DE) are required for drainage facilities installed on private property. Temporary construction permits (TCP) are required on private properties for matching new driveway grades to existing driveway grades, installation of storm drain footing services or water key boxes at the property line, and the relocation, removal or repair of improvements such as mailboxes, curbs, landscaping, fencing, and encroaching structures. Temporary construction easements (TCE) allow contractors temporary access onto private property to construct improvements that are within the ROW but where there is insufficient space within the ROW to conduct the work.

Property owners who have personal improvements in the ROW, such as fences, retaining walls or landscaping boulders, have the option of applying for encroachment permits for the improvements, removing them at their own expense, or allowing the corrective action be incorporated into the project design. Encroachment permits for fences, rock gardens, planters, and decorative retaining walls within the roadway clear zone are usually not granted.

C. Mailboxes

There are no individual or cluster mailboxes located directly on Quinhagak Street within the project limits. Parcel 15 has an individual mailbox for mail delivery located on-property approximately 25 feet west of the property line and it's not anticipated that the project will impact it.

There is also a cluster of individual mailboxes just outside of the project limits located at the southeast quadrant of the Quinhagak Street and Askeland Drive intersection. If the project ends up impacting these mailboxes, it's anticipated that these will be replaced as a cluster of individual mailboxes. Previous communication with the United States Postal Service (USPS) indicates that to change from individual to cluster locking mailboxes the following must occur:

- Every affected resident must agree to the change from individual mailboxes to cluster locking mailboxes. If even one resident doesn't agree, the mailboxes cannot be switched to cluster locking style. To officially make the change in mail service, a signed concurrence from each owner is required.
- MOA is required to purchase the locking cluster mailboxes and install concrete foundations.

From past PM&E project experiences, it is very hard to gain concurrence from all affected residents, thus this project plans to re-install individual mailboxes if impacted. Individual mailboxes can be re-used where feasible. If the existing mailboxes do not meet current postal standards, they will be replaced with new boxes that meet current standards.

D. Lighting

Lighting systems shall be designed to the DCM's Chapter 5 criteria and enhance traffic and pedestrian safety. The properly designed lighting system will:

- Provide the minimum maintained average luminance and illuminance levels specified for roadways, sidewalks, and intersections.
- Provide a uniformity of lighting that does not exceed the maximum ratios specified for roadways, sidewalks, stand-alone pathways, and intersections.
- Minimize construction and maintenance costs.
- Avoid adverse impacts to adjacent properties.
- Reveal hazards to pedestrians and vehicular traffic.

The MOA has retrofitted many existing luminaire poles with luminaires that use LEDs as the light source and new roadway projects with lighting improvements now incorporate LED lighting into the design. The new proposed LED lighting system for this project will be designed to provide the light levels specified in the DCM as summarized below:

1) Roadway (not including intersections):

For a local roadway with low pedestrian activity, the DCM recommends a minimum maintained average of 0.4 foot-candles with an average-to-minimum uniformity ratio no greater than 6:1 and a veiling luminance ratio no greater than 0.4.

2) Pedestrian Facilities:

It is anticipated that pedestrian activity along the project roadways will be in the low range per Chapter 5 of the DCM. For adjacent pedestrian facilities within the low pedestrian volume criteria, the DCM requires a minimum maintained average of 0.4 foot-candles with an average-to-minimum uniformity ratio no greater than 4:1.

3) Intersections:

For the purpose of lighting intersections, the DCM uses the following roadway classifications based upon the ADT (note these do not apply to standard MOA DCM street classifications):

- Major: over 3,500 ADT
- Collector: 1,500 to 3,500 ADT
- Local: 100 to 1,500 ADT

Below, in TABLE 9, is a summary from the DCM of lighting for intersections. This table will be used to design lighting improvements at the project intersections. Intersection lighting classifications for the project intersections will be Collector/Local based upon the design year ADT as shown in SECTION V.B .

Table 9 - Illuminance for Intersections (MOA DCM Table 5-5)

Functional Lighting Classification	Average Maintained Illuminance (low pedestrian area)	Maximum Uniformity Ratio
Major/Major	1.8	3.0
Major/Collector	1.5	3.0
Major/Local	1.3	3.0
Collector/Collector	1.2	4.0
Collector/Local	1.0	4.0
Local/Local	0.8	6.0

The luminaires will also provide a full cutoff light distribution to reduce the negative effects of casting light on nearby properties (especially residences) and illuminating the night sky. To minimize the trespass of light on adjacent properties and reduce glare, luminaires are to be installed 30 feet above the pavement and fixtures in certain areas should have backlight control optics. The light poles pile foundations will be installed to a minimum depth of 25 feet below ground surface as recommended per the Geotechnical Report.

One luminaire pole and light fixture at the intersection of Quinhagak Street and E. 64th Ave will be removed. A new continuous lighting system with LED luminaires will be installed to meet minimum illumination requirements. The preliminary lighting design has luminaire poles on the east side of Quinhagak Street and will have double mast arm poles at the intersections with

Askeland Dr., E. 64th Ave and E. 63rd Ave. Power for the new lighting system will come from an existing Type 1A Load Center on E. 63rd Ave, east of the intersection with Quinhagak Street.

E. Landscaping

Since Quinhagak Street is a local road no specific landscaping is proposed as part of the project improvements.

VIII. Roadway Design Alternatives

Roadway plan and profile drawings depicting alternatives for upgrades to the project and the locations of individual parcels can be found in APPENDIX B.

A. Design Challenges

Some of the significant design challenges associated with the Quinhagak Street project include:

1) Full Frontage Driveways and Parking

The existing rolled (Type 2) curb along Quinhagak Stret allows for full frontage access to on-property parking. Parcel 1 and 11 currently utilize the full frontage access to enter onto their property and parking areas. Installation of barrier (Type 1) curb along the roadway would limit property access to driveway curb cut locations and could affect the ability for property owners to access parking lots and spaces.

Parcel 1 full frontage driveway and parking viewing south on Quinhagak Street

2) Driveway Grades and Landings

There are 15 existing driveways/access areas along the project corridor. Driveways will need to be reconstructed to match the proposed roadway design grades. The length of driveway improvements will depend on the proposed grade adjustments required at each driveway. Proposed conceptual driveway grades were analyzed for the preferred alternative only and are summarized along with existing grades in APPENDIX L. Proposed conceptual plan view driveway locations and reconstruction limits are shown on the roadway plan and profile drawings in APPENDIX B.

Many driveways do not have the DCM required 2% landings (20-foot-long for commercial properties, 30-foot-long landing for commercial properties with semi-tractors or trailers, and 12-foot-long for residential) and some have relatively steep grades (9-14%) up to the existing parking lots or structures. Proposed improvements will install a pedestrian facility that is ADA compliant (2% max cross slope). Where pedestrian facilities cross driveways, the ADA compliant pedestrian facility will function as a partial driveway landing however providing the DCM required landings would result in significant driveway and parking lot reconstruction on private property. The proposed driveway grades shown in APPENDIX L reference the grade beyond the proposed pedestrian facility.

3) Driveway Curb Returns and Curb Cuts

The existing driveway access along the project corridor includes full frontage unrestricted rolled (Type 2) curb access.

The MOA DCM requires curb returns be installed at driveways accessing commercial structures, including 8-plex residential structures and greater. For driveways to residential structures up to 7-plex, either curb cuts or curb returns can be installed. Curb returns allow for vehicles to travel into/out of driveways at a higher speed. However, curb returns prevent a continuous gutter/concrete flow path for stormwater drainage across the driveway, compared to curb cuts that construct continuous curb and gutter across the driveway. The curb cuts promote positive drainage across the driveways, which will be critical along some sections of the project corridor that have longitudinal roadway grades less than 1%.

Since Type 2 curb is currently installed no curb returns are proposed for commercial properties, instead curb cuts or Type 2 curb are proposed to be installed at all driveways on this project depending on the proposed typical sections. Roadway cross sections are discussed in more detail in the following section.

4) Flat Grades

The street grade near E. Dowling Road is very flat, as low as 0.1%. Roadway improvements along this segment require a forced high and low spot to facilitate minimum grades to improve drainage. Matching into the existing driveways may be a challenge with proposed grade changes.

5) Fence Slats

There are existing fences with slats on Parcels 2 and 3 along the east side of the roadway that hinder the driveway departure sight distance of proposed sidewalk users by vehicles exiting the driveways, see Parcel 3 driveway gate fence with slats photo below. To mitigate this issue the proposed sidewalk will need to be attached along this segment then the required departure sight distances are achievable.

Parcel 3 driveway gate with fence slats

B. Roadway Alternative Cross Sections

To address the challenges above three roadway cross section alternatives were developed in the Final Technical Memorandum in coordination with MOA PM&E, Traffic Engineering and Street Maintenance, see APPENDIX N for the Final Technical Memorandum and FIGURE 4 below for the three typical section alternatives. Since the project is a local road, no roadway traffic markings are proposed along the project corridor. The typical sections aim to balance the context of the roadway with design criteria and driveway allowances and standards. All alternatives include two 11-foot wide travel lanes with 3.5-foot wide shoulders for a total width measured to back of curb (BOC) equal to 33 feet. Due to the low on-street parking demand no dedicated parking lane is proposed. Since the majority of Quinhagak Street is a secondary (local) industrial/commercial street with low pedestrian activity, a single 5-foot wide sidewalk with a 3-foot wide concrete buffer is proposed on the east side of the roadway. The buffer will be eliminated along Parcels 2 and 3 to improve sight distance of sidewalk users as noted above due to the fence with slats on property. Below is a description of each alternative. Only two alternatives were scoped to be analyzed in depth in the DSR. Based upon approval from PM&E, Alternatives 2 and 3 were analyzed in depth in the DSR.

1) **Alternative 1 – Not analyzed in depth in DSR**

   This alternative includes Type 1 (barrier) curb and gutter proposed on both sides of the roadway. Since only one pedestrian facility is proposed for this project and use of Type 2 rolled curb and gutter was allowed to be used per MOA Traffic Engineering and Street Maintenance feedback which facilitates existing driveways well, this alternative was not chosen to be analyzed in depth in the DSR.

2) **Alternative 2 – Analyzed in depth in DSR**

   This alternative includes Type 2 (rolled) curb and gutter proposed on both sides of the roadway. This alternative matches the existing curb type and allows access to properties on both sides of the roadway but doesn’t provide protection for the pedestrians on the proposed east side sidewalk as compared to Type 1 (barrier) curb and gutter.

3) **Alternative 3 (Preferred) – Analyzed in depth in DSR**

   This alternative includes Type 2 (rolled) curb and gutter proposed on the west side and Type 1 (barrier) curb and gutter proposed on the east side of the roadway. This alternative matches the existing curb type on the west side of the roadway, but barrier curb is proposed on the east side of the roadway where the sidewalk is proposed. The barrier curb delineates the sidewalk better and discourages parking on the sidewalk compared to the rolled curb. Parcel access on the east side will utilize driveway curb cuts. Alternative 3 is the preferred alternative since it functions better than Alternative 2 regarding delineating the sidewalk and protecting the sidewalk from vehicles parking on it.

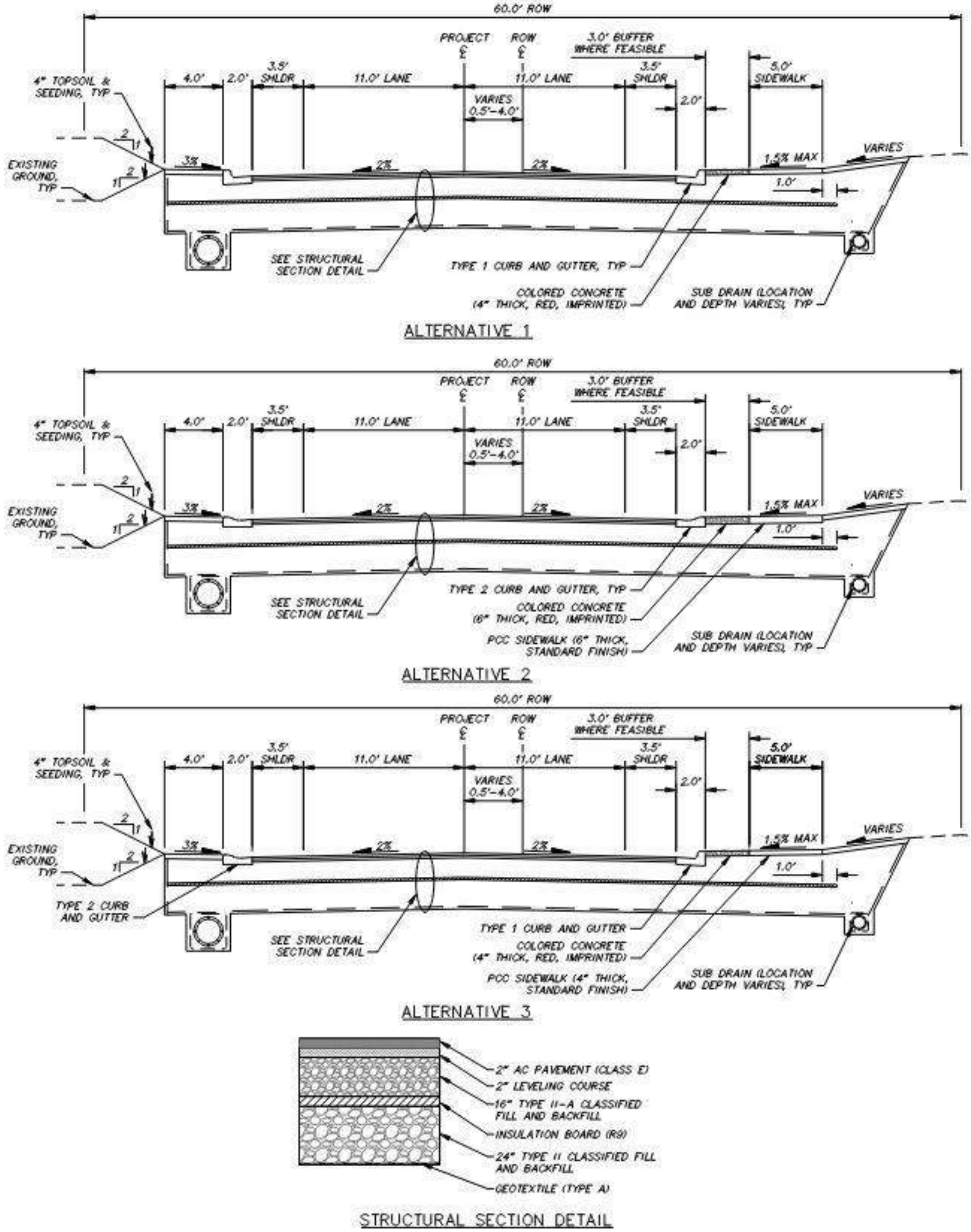


Figure 4 - Proposed Typical Sections

C. Horizontal Alignment

The Quinhagak Street roadway is currently approximately centered on the existing ROW centerline. The goal of the proposed horizontal alignment is to center the proposed overall roadway cross section (measured from back of curb to back of sidewalk) within the ROW to balance improvements and limit impacts to adjacent properties and utilities. The proposed roadway cross section will be centered within the ROW from Askeland Drive to Station 19+25. To avoid the proposed curb and gutter conflicting with existing water valves along Quinhagak Street beginning at Station 19+25 the horizontal alignment will shift to the east by 3.5 feet and will continue along the same alignment until E. Dowling Road. During design development the proposed roadway centerline location may be adjusted.

D. Vertical Alignment

The overall intent of the roadway profile is to maintain adequate grades for drainage along the project corridor while minimizing adverse effects on surrounding driveways, side streets, and infrastructure. The more the proposed roadway grade is changed from the existing grade, the more the cut and fill slopes will impact adjacent properties. Driveways and side streets must also be adjusted to match the new roadway grades. The proposed profile for Quinhagak Street will generally match the existing grade but will force a high point south of E. Dowling Road and increase the grades in this area to a minimum of 0.65%. The proposed conceptual roadway profiles for Alternatives 2 & 3 are shown in Appendix B. The side streets are presented for the Alternative 3 (preferred alternative) only. During design development the proposed profile will be iteratively modified in more detail to provide a well-balanced design that minimizes impacts to adjacent properties and provides acceptable driveway grades.

E. Posted Speed Limit

The DCM recommends that the posted speed limit typically be 5-10 mph lower than the design speed. The recommended posted speed limit is 25 mph, 5 mph below the design speed of 30 mph and matches the current posted speed limit.

IX. Drainage Improvements

The CCTV storm drain inspection performed by MOA Street Maintenance (APPENDIX D) and the drainage analysis discussed in SECTION III identified several deficiencies in the existing storm drain systems within the project limits, as well as adjacent systems downstream of Quinhagak Street. One of the primary goals for this project is to improve drainage and correct any issues within the project corridor.

The proposed drainage improvements consist of the following:

- Replace and upsize the aging Quinhagak Street and Askeland Drive systems to accommodate the current design storm and align with proposed roadway improvements.
- Install new subdrains along length of project corridor to alleviate roadways issues caused by high groundwater levels and extend the life of roadway.
- Install catch basins at designed roadway low points and other areas as necessary to alleviate ponding issues.
- Provide positive roadway drainage to minimize ponding.
- Provide water quality treatment for stormwater runoff.
- Configure proposed subdrain systems to meet separation distance requirements from existing water and sewer mains.
- Provide freeze protection for the proposed subdrain systems if required.

A. Hydrologic and Hydraulic Model Results

A hydrologic and hydraulic (drainage) model was developed for the proposed storm drain conveyance systems, using the same methodology as outlined for the existing conditions drainage model in SECTION III.B. The purpose of the proposed drainage model is to properly size the new stormwater system and correct any issues identified in the existing system. The two primary systems that will be upgraded are the Quinhagak Street system and the Askeland Drive system. Improvements to adjacent and/or connecting storm drain systems that are outside of the project limits will not be upgraded as part of this project.

A total of 22 contributing catchments were delineated and evaluated for runoff response for the proposed condition. Most contributing catchments within the project boundaries were adjusted in size due to account for the addition of new inlets planned along Quinhagak Street.

Peak runoff and pipe flows for the proposed drainage systems are reflected in FIGURE 5, APPENDIX E. The complete SSA modeling report and results can also be found in APPENDIX E. Proposed pipe sizing, type, and configuration for the drainage improvements is described in detail below.

Note that several pipe segments outside the project boundary (E. 64th Avenue System) have been observed by MOA staff experiencing surcharging conditions, these conditions are not represented in the proposed conditions model results even though they are known to directly influence the performance of the Quinhagak Street system. This has not changed from the existing condition model.

To ensure that the proposed Quinhagak Street system can function properly for the duration of its design life, it is recommended that a separate drainage analysis be prepared to account for the surcharging of the adjacent system as currently constructed and to correctly place and size the pipe segments within the project corridor in the event these adjacent systems are upgraded in the future.

B. Proposed Drainage Improvements

The proposed storm drain configuration as described below is shown on the Storm Drain Plan and Profile sheets in APPENDIX C.

1) Quinhagak Street System & E. 63rd Avenue

Geotechnical explorations within the project area (refer to SECTION IV) show high groundwater levels throughout the project corridor, which are contributing to the roadway degradation issues. To mitigate the effects of high groundwater, the recommended roadway structural sections include using subdrains (perforated pipe) on both sides of the roadway section. To accommodate subdrain on both sides of the roadway, the subdrain piping on the west side of the road will serve two functions: 1) subdrain to intercept groundwater and 2) function as the primary conveyance pipe for surface water flows entering the system. The subdrain piping on the east side of the road will be utilized solely as a conduit to intercept groundwater. Both the east and west subdrain systems will be constructed of perforated corrugated polyethylene pipe (CPEP, Type SP). The existing CMP storm drain piping within the project corridor will be removed.

The proposed storm/subdrain pipe (main line) running along the west side of Quinhagak Street ranges in size from 18- to 30-inches in diameter. This pipe will be located below the west curb line to meet separation distance from the water utility and be in accordance with MASS Detail 70-1 (Standard Location for New Utilities). The subdrain pipe on the east side of the road will be located outside of the proposed pedestrian facilities and will be 12-inches in diameter. Type II catch basin manholes will be installed for main line pipe, with connecting catch basins located to the east side of the roadway to intercept curb flow. The Type II catch basin manholes are installed under curb line to collect curb flow, while also providing safer maintenance access through a manhole opening off the roadway. The secondary subdrain on the east will use Type I manholes spaced similar to those in the main line on the west side of the road. Several existing field inlets will also need to be removed and replaced to accommodate the new system. Any existing private storm drain lines connected to structures will be reestablished.

A new Type I manhole will be located west of the roadway improvements on E. 63rd Avenue to intercept the existing storm drain system that extends to the east. A new 18-inch diameter subdrain pipe will extend from this new manhole and connect to the new Quinhagak Street system on the west side of the road.

2) Askeland Drive System

New 12-inch diameter subdrain pipes and Type I manholes will be added to the east and west side of Quinhagak Street south of E. 64th and connect to the existing Askeland Drive system via two new manholes. A new 18-inch diameter 75-foot segment of CPEP, Type SP will connect the two new manholes to the existing Askeland Drive system. The existing subdrain (MOA ID# 19737) that heads east on Askeland Drive will need to be reconnected to the new eastern manhole. The existing catch basins, catch basin leads, and connecting manhole at the Quinhagak Street/Askeland Drive intersection will need to be removed and replaced to accommodate the new curb line. There is a 15-inch CMP stub-out that extends north from the existing manhole at the Quinhagak Street/Askeland Drive intersection that will be removed or abandoned in place.

The CCTV inspection performed by MOA Street Maintenance revealed heavy deposits and sedimentation in the existing storm drain pipes along Askeland Drive and that the system is not functioning well. Additional coordination with Street Maintenance is anticipated during the design phase to determine the best approach to resolving the current issues in this area.

3) Install New Catch Basins

The proposed roadway layout adjusts the existing curb line along the entire project corridor. The locations of the existing catch basins will not line up with the proposed curb line. Therefore, these existing catch basins will need to be removed. New catch basins and connecting leads will be installed to match the proposed curb line. Additional catch basins will be added at designed roadway low points as necessary to alleviate ponding.

4) Minimize Ponding

The proposed roadway profile is designed to establish high and low points throughout the project corridor. These high and low points, along with a more pronounced roadway crown, will direct roadway runoff more effectively to curb inlets. The curb inlets capture curb flow and direct runoff to the piped storm drain system, eliminating standing water. These improvements will help alleviate ponding issues created by runoff from within the project corridor.

5) Water Quality Treatment

The new permit requirements referenced in ASM Section 3.B.1 state that stormwater management systems are to provide water quality treatment through the use of Green Infrastructure (GI) whenever feasible. GI treatment techniques include methods such as retention, infiltration, bioretention, evaporation, and/or any combination of these techniques.

In some cases GI treatment may be determined to be infeasible due to site constraints such as poorly infiltrating soils, high ground water, on-site space constraints, shallow bedrock, etc. For cases where GI treatment is determined to be infeasible, water quality treatment may be provided through the use of traditional gray infrastructure such as an oil and grit separator.

Section 3.3.2.1 of the ASM also states that roadway projects with narrow ROW (60-feet or less) may choose to provide stormwater treatment through either GI or traditional treatment, regardless of site constraints. The ROW width along the Quinhagak Street project corridor is 60-feet.

Due to the limited amount of ROW along the project corridor and layout of existing utilities, providing water quality treatment through GI is not practical. Therefore, water quality treatment will be provided by an OGS. An OGS is proposed just upstream of the tie-in to the E. 64th Ave system to provide water quality treatment for the Quinhagak Street storm drain system. A bypass manhole will be installed upstream of the OGS for maintenance of the structure.

As noted in Section III, MOA maintains one large existing OGS that treats runoff for the entire Meadow Street Park storm drain system, which includes the E 64th Avenue system and Askeland Drive subsystems. The OGS is located just upstream of the outfall into North Fork Little Campbell Creek and will provide water quality treatment for these subsystems.

6) Freeze Protection

According to ASM Section 5.3.3, the minimum depth of cover over a gravity storm drain pipe without thaw protection is four feet. Insulation is required for pipes with a diameter less than 30-inches if the depth of cover is less than four feet. However, if a storm drain pipe is located under a roadway structural section with insulation, additional insulation for the pipe is not required. A thaw system is required if the depth of the depth of cover is less than three feet.

The roadway structural section includes insulation for this project, so additional insulation will not be required for storm drain that is located between three and four feet of cover. Depth of cover is expected to exceed 3-feet for all new piping, so no thaw systems are anticipated.

X. Right-of-Way Impacts

Preliminary estimated easement and permit requirements are summarized in TABLE 10 below and are detailed in APPENDIX H. The number of estimated easements and permits for each alternative are identical, due to the similarities between the alternatives. As the planning and design of this project progresses, the required easements and temporary construction permits will be refined.

Table 10 - Estimated Right-of-Way Easements / Permits

Alternative	Public Use Easements (PUE)	Slope Easements (SE)	Drainage Easements (DE)	Fire Hydrant Easement (FE)	Temporary Construction Easements (TCE)	Temporary Construction Permits (TCP)
2 & 3	0	0	5	3	2	18

XI. Utility Impacts

When roadway and drainage improvements are made in urban areas, impacts to utilities need to be analyzed. Existing utility facilities are shown in APPENDIX A. For safety, overhead and underground clearances must be maintained.

In the ROW, the Municipality requires a minimum burial depth of 42 inches for buried gas lines, electric cables, fiber optic lines, telephone cables, and cable television lines. For this report, it is assumed that the existing buried facilities in the project area are buried at the minimum depth. As a result, any reduction of cover or impacts from storm drain improvements over existing facilities will require relocation of the facility. In some locations, the structural section excavation will impact utilities. In these locations the utilities will either require relocation or will require support in place for the contractor to work around the utility.

AWWU requires a minimum depth of cover of 10 feet over their water mains and 8 feet over their sewer mains. Changes to the roadway grade along the corridor are minor and are not anticipated to substantially reduce the existing cover over the water and sewer utilities. The assumed roadway cross section includes 2-inches of rigid board insulation which would mitigate some reduction in cover above water and sewer mains.

The major estimated utility relocation items for both alternatives include the following:

- Three fire hydrants.
- Multiple cable lines for the entire length of the project.
- The 12” diameter pressurized transmission gas main that crosses Quinhagak Street at E. 64th Avenue.
- The 2” diameter gas line from E. 64th Avenue to E. Dowling Road.

The utility relocation cost estimates for each Alternative are shown in APPENDIX J.

XII. Permitting and Agency Approvals

Permits and agency approvals for the Quinhagak Street Reconstruction project required for construction of proposed improvements will be limited. Because the roadway is classified as a secondary (local) urban road, it is not necessary to obtain approval of the DSR from the MOA Planning and Zoning Commission or the MOA Urban Design Commission. Anticipated permits and agency approvals required for design include:

- MOA Watershed Management Services Stormwater Plan Approval
- ADEC Approval to Construct Storm Drain Improvements and Separation Waivers (assumed)

Additional permit requirements may be identified as the design develops.

XIII. Quantity and Cost Estimates

A summary of estimated project costs for the proposed improvements is presented below for each Alternative. A breakdown of the ROW, construction, utility, design and management cost estimates can be found in APPENDIX J.

Table 11 - Summary of Estimated Project Costs

Category	Alternative 2	Alternative 3 (preferred)
Design & Management Total (estimated)	$808,000	$807,000
ROW Acquisition Total	$72,000	$72,000
Utility Relocation (15% Contingency) Total	$969,000	$969,000
A. Design, ROW Acquisition, Utility Relocation	***$1,849,000***	***$1,848,000***
Construction Roadway Improvements	$2,061,000	$2,051,000
Drainage Improvements	$969,000	$969,000
Illumination Improvements	$216,000	$216,000
Construction Subtotal	*$334,000*	*$333,000*
Construction Contingency (15%)	$487,000	$485,000
Construction Management / Inspection / Testing	$334,000	$333,000
B. Total Estimated Construction Cost (rounded)	***$4,067,000***	***$4,054,000***
C. Overhead / Grant Accounting	***$1,044,000***	***$1,042,000***
Total Estimated Project Cost (A + B + C)	***$6,960,000***	***$6,944,000***

XIV. Stakeholder Coordination/Public Involvement

The public involvement for the Quinhagak Street Reconstruction project is following the MOA Context Sensitive Solutions (CSS) process for a local roadway as a general guide for best practices. The goal of the CSS process is to collaborate with all stakeholders to improve the roadway, balance diverse interests, find areas of compromise that address concerns and solicit feedback from stakeholders. A description of public involvement activities is below in TABLE 13. All public involvement documents can be found in APPENDIX K.

A. Stakeholders

The project team began the public and agency outreach in May of 2022 with the identification of approximately 250 project stakeholders. See TABLE 12 below for list of stakeholders.

Table 12 - List of Stakeholders

MOA Agencies	Other
Project Management & Engineering	Area Residents
Traffic Engineering	Area Property Owners & Business Owners
Watershed Management Services	Area Property Managers & Employees
Economic and Community Development	Abbott Loop Community Council
Maintenance and Operations	Alaska Communications Systems (ACS) and GCI
Planning	Chugach Electric
Transit	ENSTAR Natural Gas Company
Parks & Recreation	Senator Joshua Revak
Anchorage Fire & Police Department	Representative Calvin Schrage
Anchorage School District	
Anchorage Assembly Members Felix Rivera, and Meg Zaletel	
Solid Waste Services	
AWWU	

B. Stakeholder Involvement Activities

A variety of forms of outreach were used to inform, consult, involve, and collaborate with stakeholders including website updates, mailed postcards, e-newsletters, in-person community council updates, a project questionnaire, agency scoping meetings, and a public open house.

TABLE 13 below summarizes each major stakeholder coordination/public involvement event for the duration of the project.

Table 13 - Stakeholder Coordination/Public Involvement Events

Date	Activity	Comments
May 2022	Mailing List Developed	Approximately 250 Contacts
May 2022 - Present	Website Development & Maintenance	Launched and Updated at Key Project Milestones
May 2022	Postcard Mailer #1	Introduce Project & Field Work
June 1, 2022	Postcard Mailer #2	Announce Questionnaire
June 1, 2022	E-Newsletter #1	Announce Questionnaire
June 1 – July 1, 2022	Project Questionnaire	Collected Responses for 30 Days
September 9, 2022	Agency Stakeholder Meeting	Meeting with MOA Traffic Engineering Department and MOA Street Maintenance Department
October 20, 2022	Postcard Mailer #3 & E-Newsletter #2	Announce Open House #1
October 20, 2022	Abbott Loop Community Council Meeting #1	Announce Open House #1, Inform Stakeholders, Answer Project Questions, Listen to Comments
October 31, 2022	E-Newsletter #3	Open House #1 Reminder
November 3, 2022	E-Newsletter #4	Open House #1 Reminder Due to Weather and ASD School Closure
November 3, 2022	Open House #1	Introduce project, concept cross sections, and receive comments on the concepts, existing conditions, and issues in the project area
November 8, 2022	E-Newsletter #5	Thank you for attending Open House #1

C. Project Website

The project website (www.QuinhagakStreetReconstruction.com) was developed for ease of project information sharing and soliciting comments from the public. Website content includes a project home page overview, a documents and resources page, project team contact information, a link to provide comments and a link to sign up to receive e-newsletter project updates. The website will continue to be updated with information, meeting details, and documents as the project progresses.

D. Project Questionnaire

A project questionnaire was mailed via the USPS to the project mailing list to gather additional, site specific information from project stakeholders. This tool also allows people to participate who cannot attend meetings in-person. The paper mailer included return postage and a QR code for respondents to fill out the questionnaire online. There were 21 responses to the questionnaire (6 paper, 15 online). A full summary of questions and results can be found in the APPENDIX K.

E. Agency Stakeholder Meeting

The agency stakeholder meeting, held in September 2022, included representatives from MOA Traffic Engineering and Street Maintenance Departments. The purpose of the meeting was to discuss the traffic and parking studies and gain concurrence of the proposed conceptual roadway cross sections to present at the public Open House #1.

F. Community Council Meetings

Project representatives attended the Abbott Loop Community Council (ALCC) meeting on October 20, 2022, to provide a project introduction, announce Open House #1, answer project questions, and listen to stakeholder comments. The meeting summary can be found in the APPENDIX K.

G. Public Open House Event

A public open house was held on November 3, 2022, from 5:00 – 7:00 pm. The meeting was held at Polaris K-12 School (6200 Ashwood St.). 8 community members were in attendance (6 people signed in). Open House #1 presented scrolls with aerial images of the existing layout of the project corridor. Attendees had the opportunity to draw and mark up the scrolls with comments regarding known issues or concerns of existing conditions along the project corridor. Displays also included a project timeline, summary of proposed improvements, questionnaire responses, and cross-sections of conceptual designs. Comment sheets were provided for attendees to share written comments. Materials presented at the Open House #1, comments received, and sign-in sheets are included in APPENDIX K in the Open House #1 Meeting Summary.

H. Summary of Public Comments Received

Comments were received from individuals through public meetings, community council meetings, and on-line questionnaire responses. Additional comments were recorded on project scrolls and documented in meeting records. All project comments that were received from the beginning of the project through April 28, 2023, are documented in these appendices.

Stakeholders and members of the public will have the continued opportunity to obtain information and provide feedback via the project website, and through direct feedback by phone calls and emails to project staff.

XV. Recommended Improvements

To achieve the project goals, meet the requirements of the DCM and AMC Title 21, and based on comments received from public, agency, and business stakeholders the recommended improvements for the project are as follows:

A. Roadway Cross Section

The preferred roadway cross section is Alternative 3 (see FIGURE 4) and includes two 11-foot wide travel lanes with 3.5-foot wide shoulders (33 feet total width from BOC), and a single 5-foot wide sidewalk with a 3-foot wide concrete buffer on the east side of the roadway. The buffer will be eliminated along Parcels 2 and 3 to improve sight distance of sidewalk users due to the fence with slats on property. Type 2 (rolled) curb and gutter is proposed on the west side and Type 1 (barrier) curb and gutter is proposed on the east side of the roadway. This alternative matches the existing curb type on the west side of the roadway, but barrier curb is proposed on the east side of the roadway where the sidewalk is proposed. Since the project is a local road, no roadway traffic markings are proposed along the project corridor.

B. Design and Posted Speed Limit

It is proposed that the posted speed limit for Quinhagak Street remain at 25 mph. A Design speed of 30 mph is proposed.

C. Roadway Horizontal and Vertical Alignment

The proposed roadway cross section will be centered within the ROW from Askeland Drive to Station 19+25. To avoid the proposed curb and gutter conflicting with existing water valves along Quinhagak Street beginning at Station 19+25 the horizontal alignment will shift to the east by 3.5 feet and will continue along the same alignment until E. Dowling Road. The proposed profile for Quinhagak Street will generally match the existing grade but will force a high point south of E. Dowling Road and increase the grades in this area to a minimum of 0.65%.

D. Intersections:

The existing stop signs within the project limits are proposed to remain as currently installed with stop control on E. 63rd Avenue, E. 64th Avenue, on the east side of Askeland Drive and on Quinhagak Street at E. Dowling Road.

E. Traffic Calming

Based upon the 85th percentile speeds and in coordination with the MOA Traffic Engineering Department, no traffic calming features are proposed for this project.

F. Landscaping

Since Quinhagak Street is a local road no specific landscaping is proposed as part of the project improvements.

G. Drainage

The proposed drainage improvements consist of the following:

- Replace the aging Quinhagak Street & Askeland Drive storm drain system to align with the new roadway improvements.
- Install subdrains on both sides of Quinhagak Street to mitigate the effects of high groundwater.
- Install catch basins at roadway low points and other areas to alleviate ponding issues.
- Provide positive roadway drainage to minimize ponding.
- Provide water quality treatment for storm runoff.

H. Lighting

A continuous LED lighting system, consistent with current MOA standards will be installed along the roadway. Power for the new lighting system will come from an existing Type 1A Load Center on E. 63rd Ave, east of the intersection with Quinhagak Street.

XVI. Proposed Variances from Design Criteria Manual

A. AMC Title 21

AMC Title 21.08.050.G requires that curb and gutters be in accordance with the DCM and MASS. However, it also states that Curbs shall be of the MASS Curb Type 1 (barrier). AMC Title 21.080.050.G.1 allows for MASS Type 2 (rolled curb) but only for residential minor streets with 500 ADT. Since Quinhagak Street has more than 500 ADT a variance requesting relief from the Type 1 (barrier) curb requirement could be required from the Municipal Traffic Engineer.

B. MOA DCM

The proposed variances from the DCM for this project will be justified and approved under a separate document during the design process. There are several design criteria that may not be able to meet the DCM. Below is a list of potential variances for this project for the preferred alternative. Additional variances may be required as the design progresses:

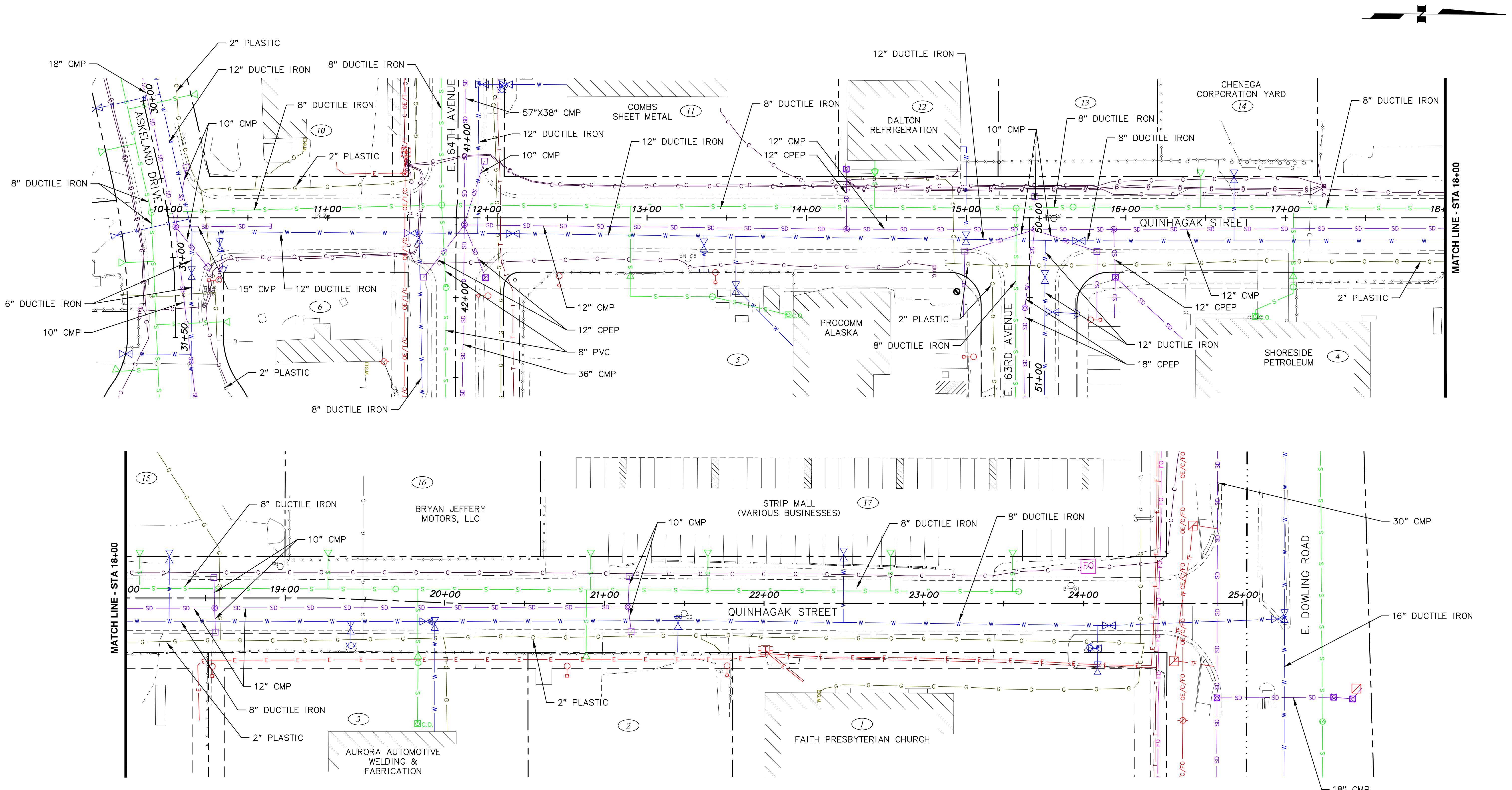
- Sidewalk Requirements – The DCM Figure 1-13 requires sidewalks on both sides of a local roadway. AMC Title 21 21.070.060.E.2 requires sidewalks on both sides of a local residential roadway but only one sidewalk along industrial/commercial roadways that don't connect to existing sidewalks on both ends. A variance will be required for installing only one sidewalk.
- Curb Type – DCM Section 1.9.F requires Type 2 (rolled) curb on local roadways. Type 1 (barrier) curb is recommended along the east side of the roadway where the sidewalk is proposed. A variance will be required for installing Type 1 curb.
- Driveway Width – the DCM allows for driveway widths (up to 7-plexes) of 28 feet, with restrictions; commercial driveways can be up to 34 feet wide. Some of the existing driveways exceed these maximum widths and will require a variance.
- Driveway Curb Cuts – Driveway curb cuts are only allowed at residential driveways that access up to 7-plexes. Commercial driveways including 8-plexes or greater require curb returns. To maintain the flow line of the curb across the driveway to promote positive drainage to the drainage structures and match the current layout which no driveway has curb returns currently, Type 2 curb or driveway curb cuts are proposed for all driveways. A variance will be required for providing curb cuts to commercial driveways.
- Driveway landings and grades – The DCM requires that residential driveways have a minimum 12-foot landing length and a maximum grade of ±12%; commercial driveways must have a 20-foot landing length or 30-foot landing length for semi-tractors or trailers with a maximum driveway grade of ±8%. The grade of the landings must be 2% maximum. Some of the driveways will not be able to meet these landing or grade requirements due to existing infrastructure/grades and will require a variance.
- Driveway Corner Clearance – The DCM recommends that the minimum distance from the nearest face of curb of an intersecting public roadway to the nearest edge of driveway is 40 feet for a local roadway (with less than 10 vehicles per hour). A few existing driveways do not currently meet this requirement. Driveways will typically be replaced in the same

location because existing improvements on property restrict relocating the driveways. A variance from not adhering to the driveway corner clearance requirements will be required.

****** End Report ******

Existing Utilities Drawings

Appendix A



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EXISTING UTILITY LEGEND

SANITARY SEWER
NATURAL GAS
WATER
STORM DRAIN
SUB-DRAIN
FIBER OPTIC
CABLE TELEVISION
TELEPHONE
TELEPHONE (OVERHEAD)
ELECTRIC
ELECTRIC/CABLE/FIBER OPTIC (OVERHEAD)
ELECTRIC/TELEPHONE (OVERHEAD)
ELECTRIC/TELEPHONE/CABLE (OVERHEAD)
TRAFFIC LINE
GRAVEL

CURB & GUTTER
EDGE OF PAVEMENT
PROPERTY LINE
EASMENT
CONCRETE
SANITARY SEWER MANHOLE
SANITARY SEWER SERVICE
SANITARY SEWER CLEANOUT
KEY BOX / WATER VALVE
FIRE HYDRANT
STORM DRAIN CATCH BASIN
STORM DRAIN MANHOLE
STORM DRAIN CATCH BASIN MANHOLE
FIBER OPTIC VAULT

CABLE PEDESTAL
GAS METER
ELECTRIC JUNCTION BOX TYPE II
ELECTRIC METER
LIGHT POLE
LOAD CENTER
TRANSFORMER
JOINT UTILITY POLE
PARCEL NUMBER

30' 0 30' 60'

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PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

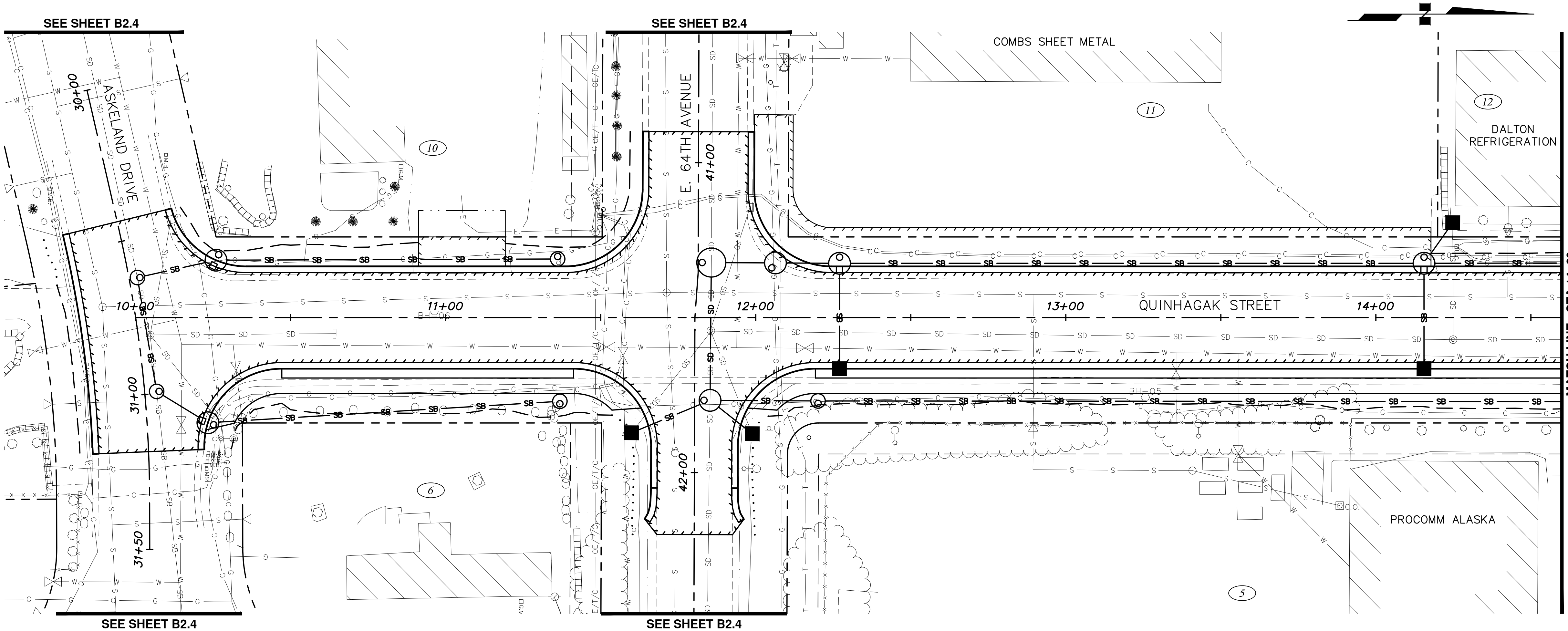
21-13 QUINHAGAK STREET RECONSTRUCTION

EXISTING UTILITY MAP

SCALE	HOR. 1"=30' VER. N/A	GRID SW2033		SHEET A1 of A1
		DATE MAY 2023	STATUS DSR	

Roadway Plan & Profile Drawings

Appendix B



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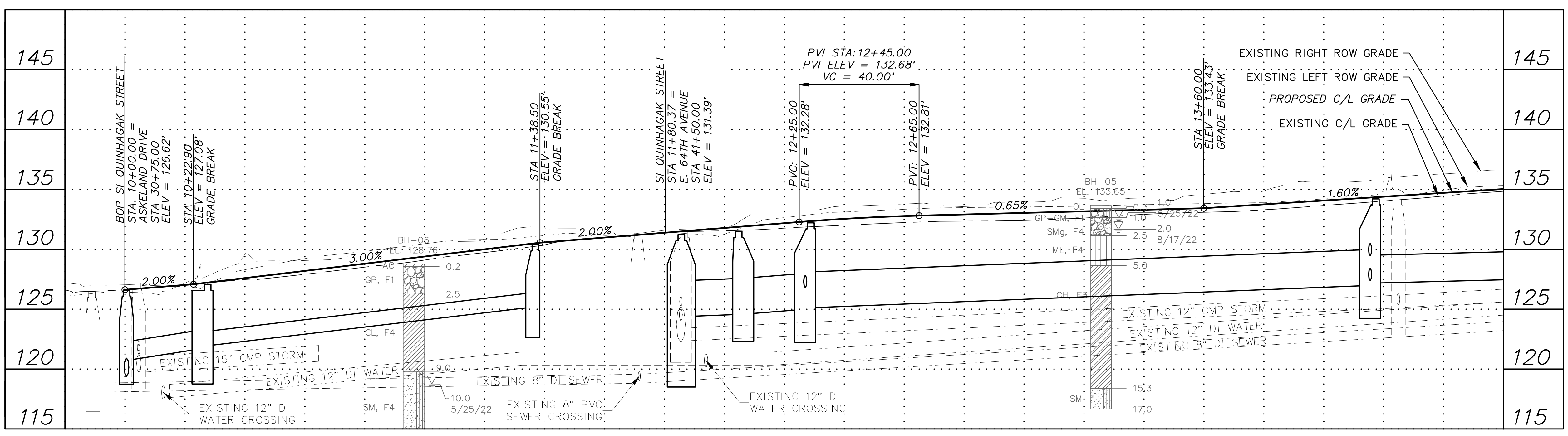

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TOPOGRAPHY	CB	BW
PROFILE	RB	JK
STORM SEWER	KW	JH
WATER/SANITARY SEWER	CK	JK
GAS	CB	BW
TELEPHONE	CB	BW
ELECTRIC	JH	TK
DESIGN	RB	JK
QUANTITIES	RB	JK
PRELIMINARY/FINAL	RB	JK
MUNICIPAL/STATE	RB	JK
PLAN CHECK		

GRAPHIC SCALE 40 20 0 20 40

	FIELD BOOKS
DESIGN	
STAKING	
ASBUILT	
CONTRACTOR	
INSPECTOR	
CONSTRUCTION RECORD	

BM NO.	LOCATION	ELEV.
BASIS OF THIS DATUM		
VERTICAL DATUM		

REV	DATE	DESCRIPTION	BY
REVISIONS			

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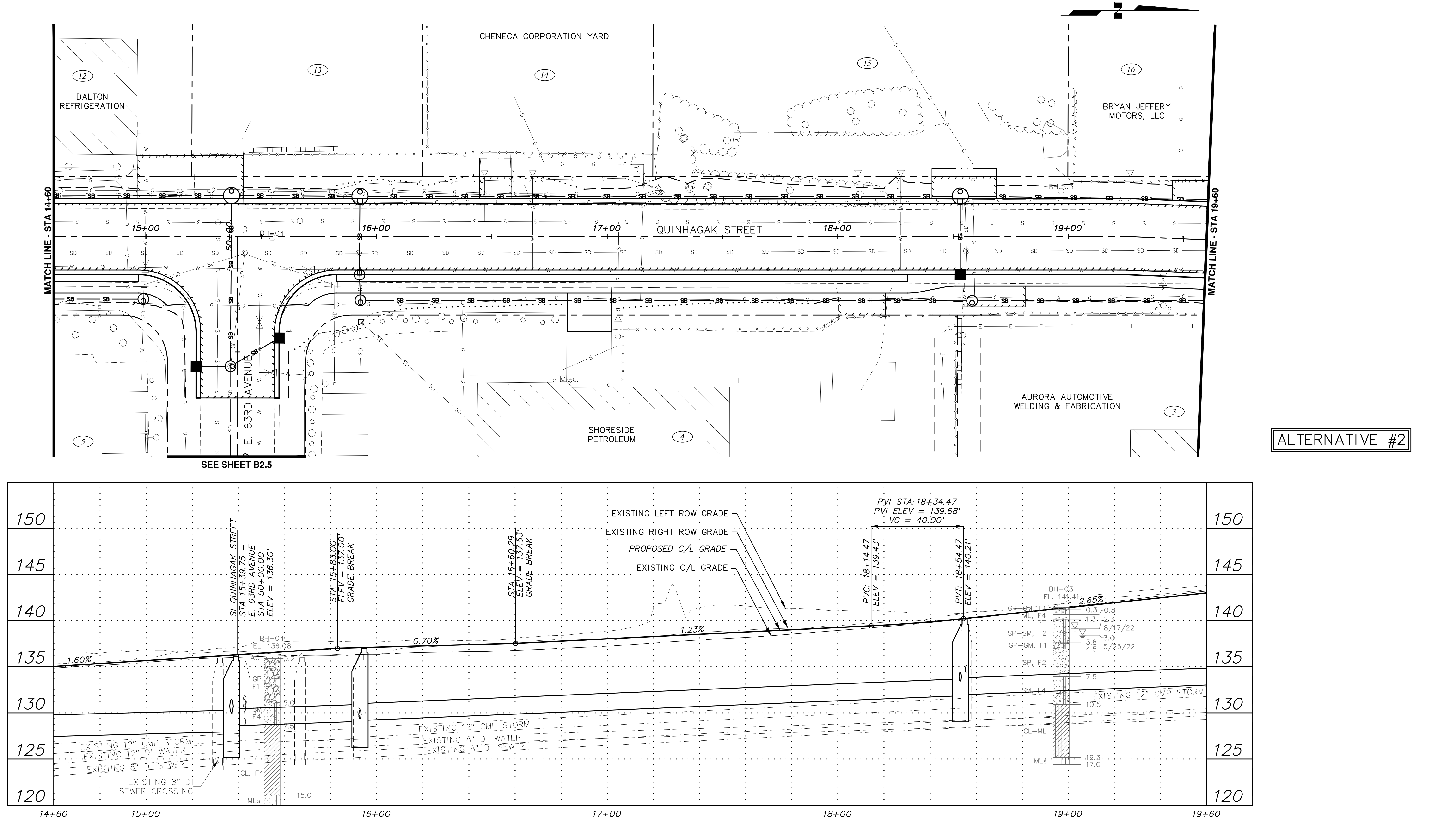
21-13 QUINHAGAK STREET RECONSTRUCTION SCHED A

ROADWAY PLAN & PROFILE

QUINHAGAK STREET – BOP TO STA 14+60

SCALE HOR. 1"=20' VER. 1"=5' | GRID SW2033 | DATE MAY 2023 | STATUS DSR | SHEET B1.1 of B1.3

File: J:\JobsData\10155.00 Quinhagak Street Reconstruction\00 CAD 2019\01 Working Set\01 Civil\10155.00 Plan & Profile – Roadway – Alternative 2.dwg



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DATA	DRAWN BY	CHECKED BY
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TOPOGRAPHY	CB	BW
PROFILE	RB	JK
STORM SEWER	KW	JH
WATER/SANITARY SEWER	CK	JK
GAS	CB	BW
TELEPHONE	CB	BW
ELECTRIC	JH	TK
DESIGN	RB	JK
QUANTITIES	RB	JK
PRELIMINARY/FINAL	RB	JK
MUNICIPAL/STATE	RB	JK

PLAN CHECK

GRAPHIC SCALE 40 20 0 20 40

FIELD BOOKS	
DESIGN	
STAKING	
ASBUILT	
CONTRACTOR	
INSPECTOR	

CONSTRUCTION RECORD

BM NO.	LOCATION	ELEV.
	BASIS OF THIS DATUM	

VERTICAL DATUM

REV	DATE	DESCRIPTION	BY

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21–13 QUINHAGAK STREET RECONSTRUCTION SCHED A

ROADWAY PLAN & PROFILE

QUINHAGAK STREET – STA 14+60 TO STA 19+60

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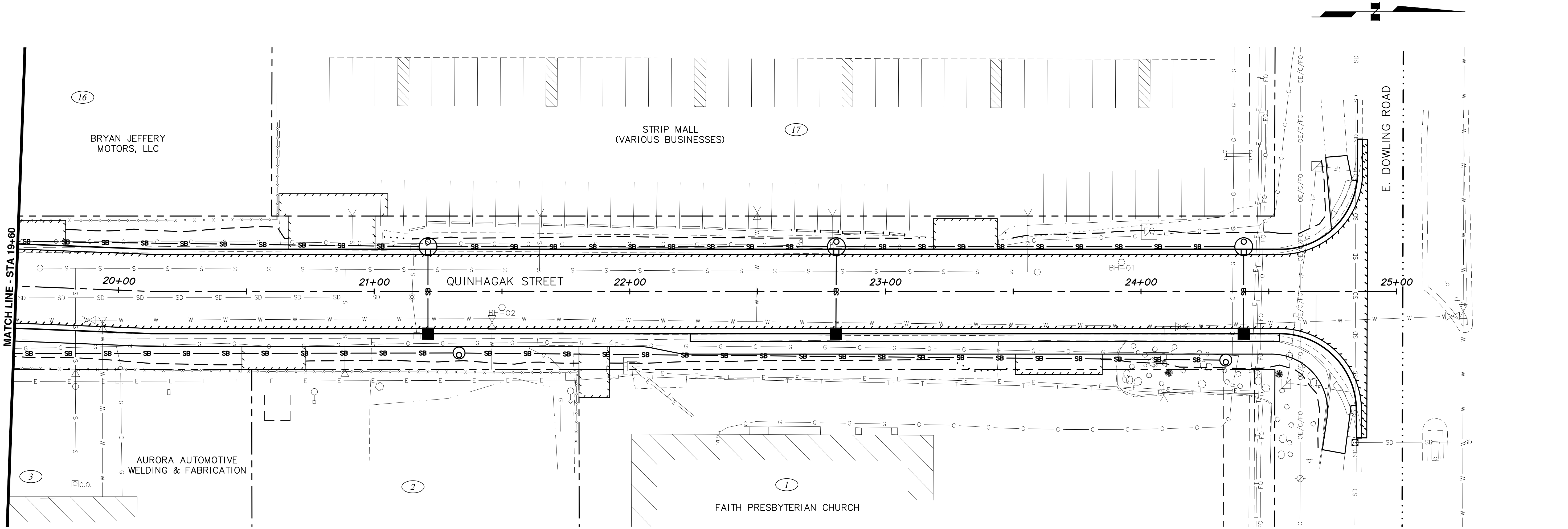

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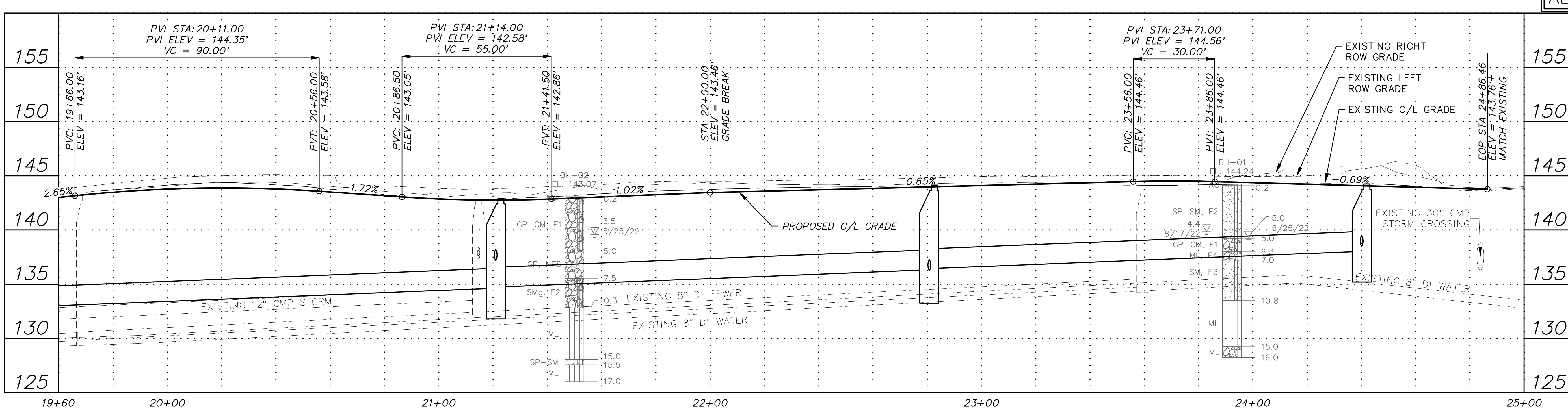

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TOPOGRAPHY	CB	BW
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TELEPHONE	CB	BW
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DESIGN	RB	JK
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PRELIMINARY/FINAL	RB	JK
MUNICIPAL/STATE	RB	JK
PLAN CHECK		

GRAPHIC SCALE 40 20 0 20 40

FIELD BOOKS	
DESIGN	
STAKING	
ASBUILT	
CONTRACTOR	
INSPECTOR	
CONSTRUCTION RECORD	

BM NO.	LOCATION	ELEV.
	BASIS OF THIS DATUM	
VERTICAL DATUM		

REV	DATE	DESCRIPTION	BY
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MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

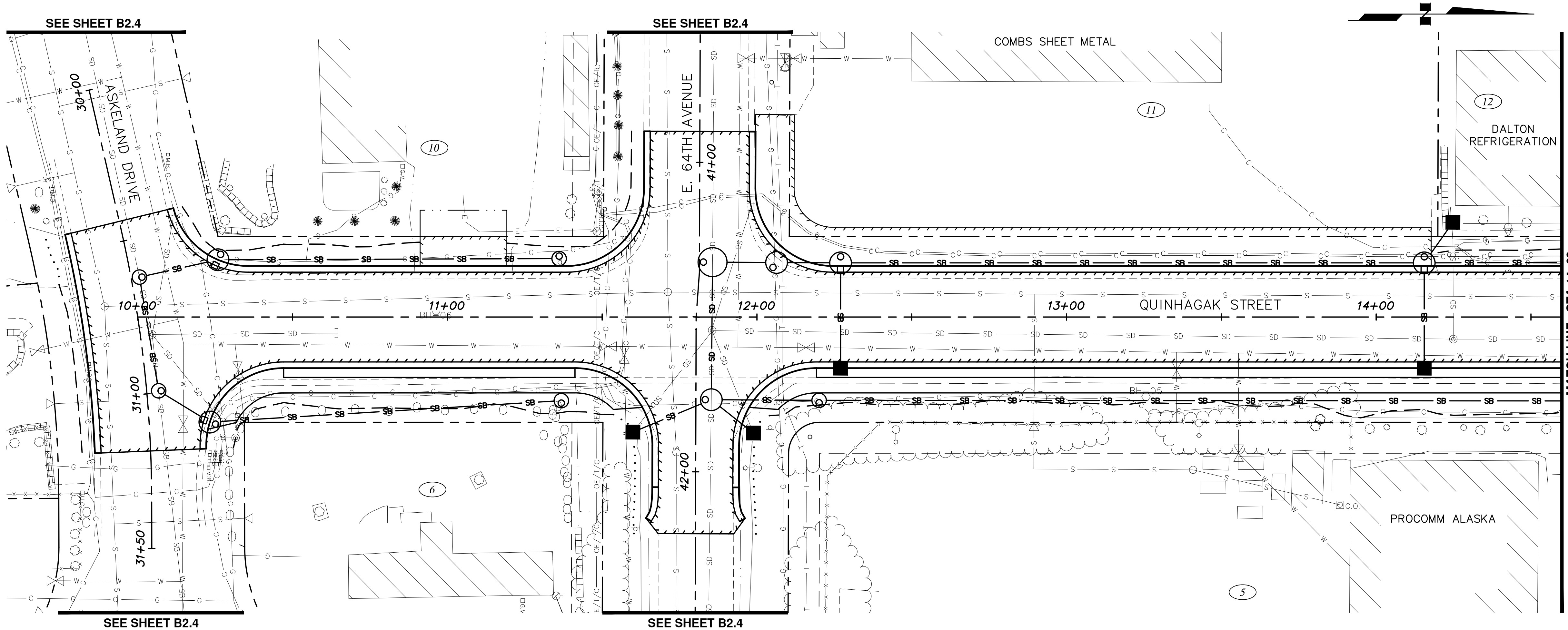
21-13 QUINHAGAK STREET RECONSTRUCTION SCHED A

ROADWAY PLAN & PROFILE

QUINHAGAK STREET - STA 19+60 TO EOP

SCALE HOR. 1"=20' VER. 1"=5' | GRID SW2033 | DATE MAY 2023 | STATUS DSR | SHEET B1.3 of B1.3

File: L:\JobsData\10155.00 Quinhagak Street Reconstruction\00 CADD 2019\01 Working Set\01 Civil\10155.00 Plan & Profile - Roadway - Alternative 2.dwg



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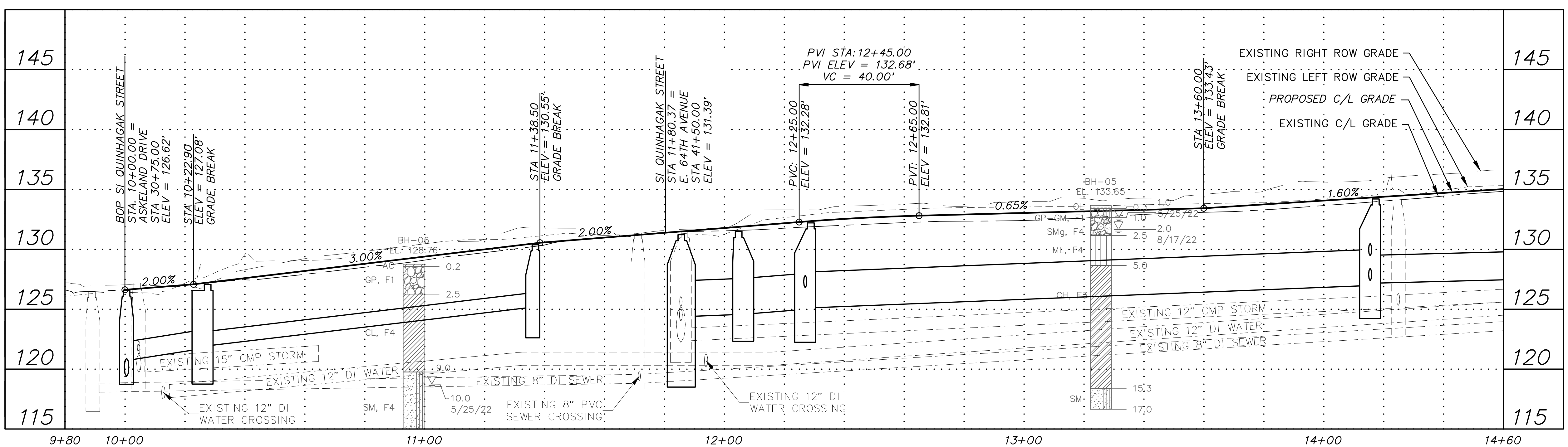
PREFERRED ALTERNATIVE



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CONTRACTOR: ______
BY: ______ TITLE: ______ DATE: ______
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COMPANY: ______ DATE: ______
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COMPANY: ______ DATE: ______
BY: ______

DATA	DRAWN BY	CHECKED BY
BASE	CB	BW
TOPOGRAPHY	CB	BW
PROFILE	RB	JK
STORM SEWER	KW	JH
WATER/SANITARY SEWER	CK	JK
GAS	CB	BW
TELEPHONE	CB	BW
ELECTRIC	JH	TK
DESIGN	RB	JK
QUANTITIES	RB	JK
PRELIMINARY/FINAL	RB	JK
MUNICIPAL/STATE	RB	JK

PLAN CHECK

GRAPHIC SCALE 40 20 0 20 40

FIELD BOOKS	
DESIGN	
STAKING	
ASBUILT	
CONTRACTOR	
INSPECTOR	

CONSTRUCTION RECORD

BM NO.	LOCATION	ELEV.
	BASIS OF THIS DATUM	

VERTICAL DATUM

REV	DATE	DESCRIPTION	BY

REVISIONS

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD. SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 562-3252
#AECL882-AK

CONSULTANT

SEAL

MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

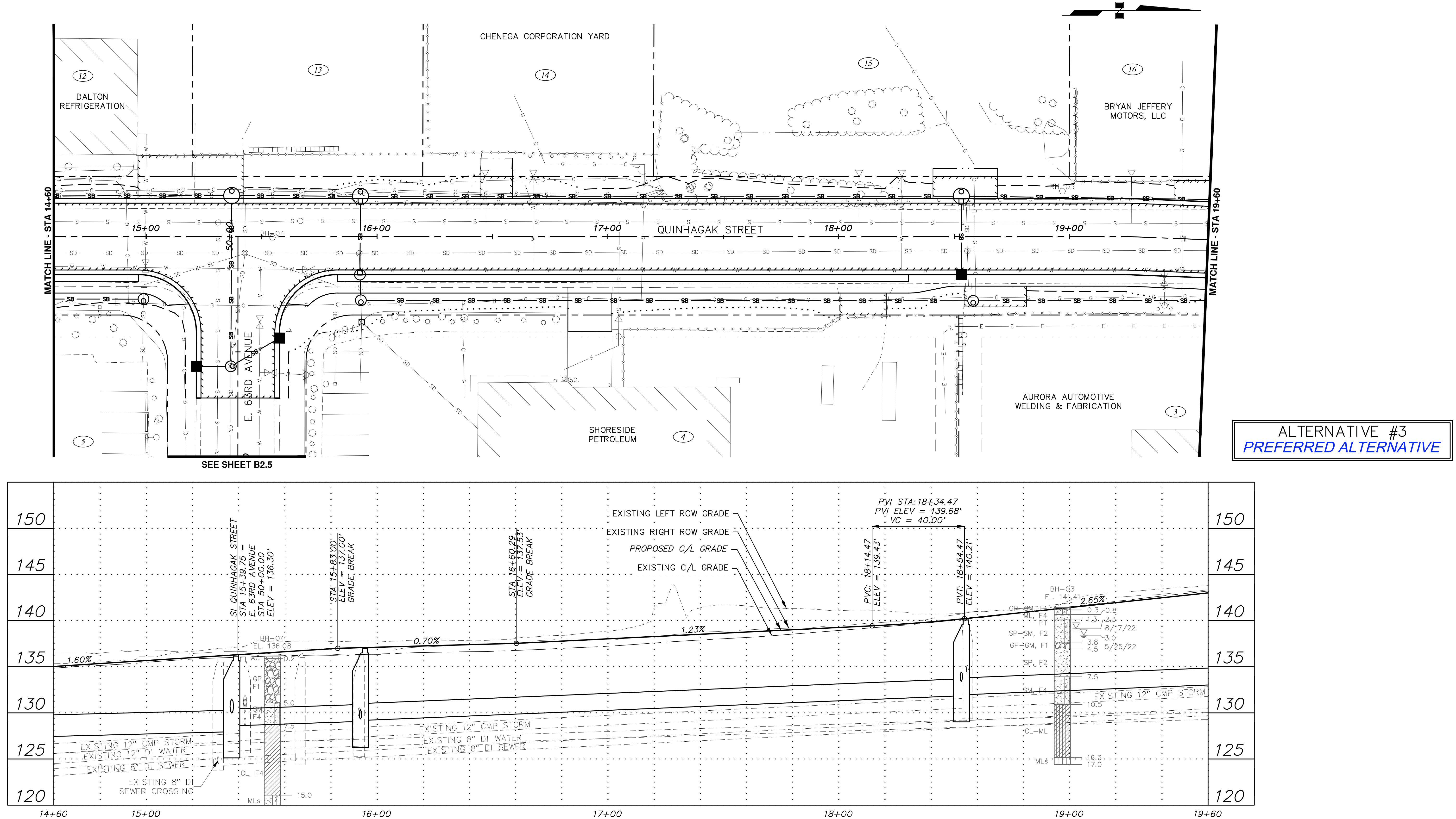
21-13 QUINHAGAK STREET RECONSTRUCTION SCHED A

ROADWAY PLAN & PROFILE

QUINHAGAK STREET – BOP TO STA 14+60

SCALE HOR. 1"=20' VER. 1"=5' | GRID SW2033 | DATE MAY 2023 | STATUS DSR | SHEET B2.1 of B2.5

File:J:\JobsData\10155 Quinhagak Street Reconstruction\00 CADD 2019\01 Working Set\01 Civil\10155.00 Plan & Profile - Roadway - Alternative 3.dwg



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TOPOGRAPHY	CB	BW
PROFILE	RB	JK
STORM SEWER	KW	JH
WATER/SANITARY SEWER	CK	JK
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PLAN CHECK

GRAPHIC SCALE 40 20 0 20 40

FIELD BOOKS	
DESIGN	
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ASBUILT	
CONTRACTOR	
INSPECTOR	

CONSTRUCTION RECORD

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PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

21-13 QUINHAGAK STREET RECONSTRUCTION SCHED A

ROADWAY PLAN & PROFILE

QUINHAGAK STREET – STA 14+60 TO STA 19+60

SCALE HOR. 1"=20' VER. 1"=5' | GRID SW2033 | DATE MAY 2023 | STATUS DSR | SHEET B2.2 of B2.5

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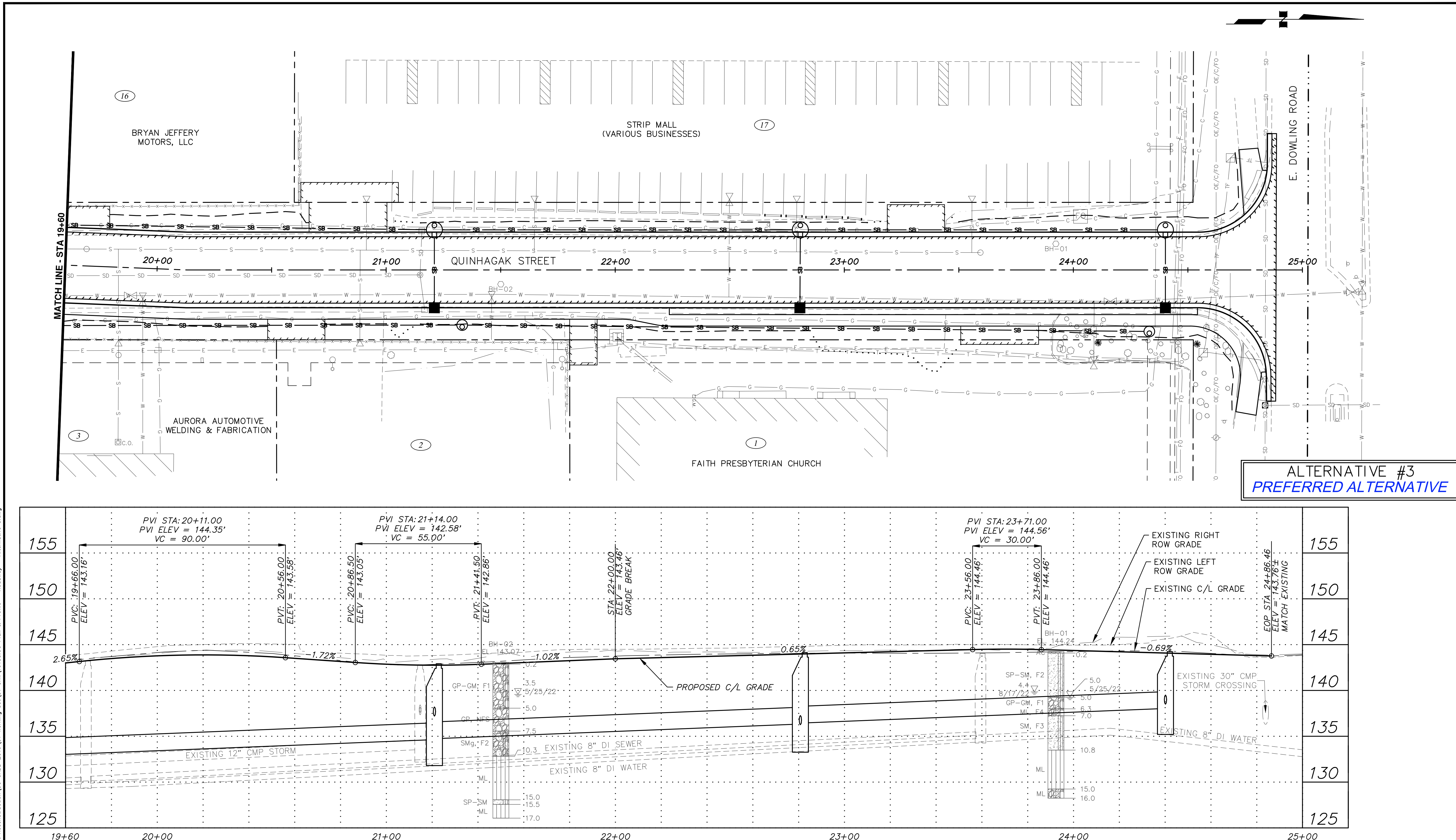

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PROFILE	RB	JK
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GAS	CB	BW
TELEPHONE	CB	BW
ELECTRIC	JH	TK
DESIGN	RB	JK
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PRELIMINARY/FINAL	RB	JK
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PLAN CHECK		

GRAPHIC SCALE 40 20 0 20 40

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CONSTRUCTION RECORD	

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MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

21-13 QUINHAGAK STREET RECONSTRUCTION SCHED A

ROADWAY PLAN & PROFILE

QUINHAGAK STREET – STA 19+60 TO EOP

SCALE HOR. 1"=20' VER. 1"=5' | GRID SW2033 | DATE MAY 2023 | STATUS DSR | SHEET B2.3 of B2.5

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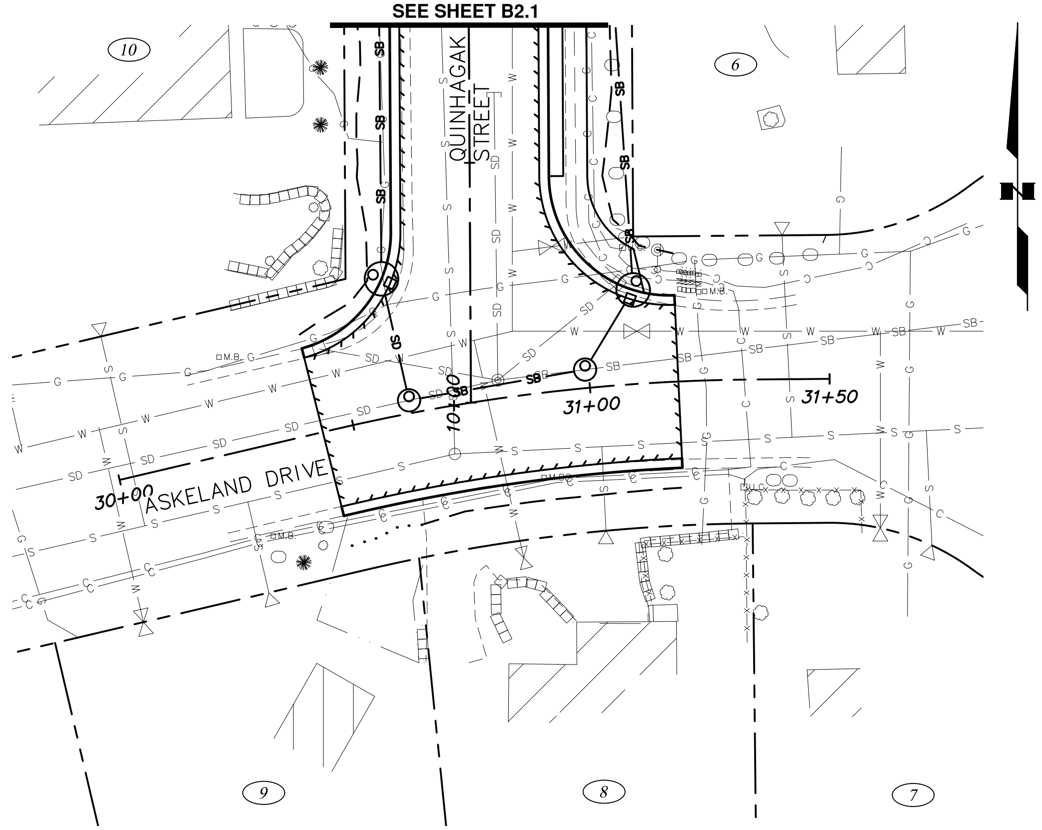

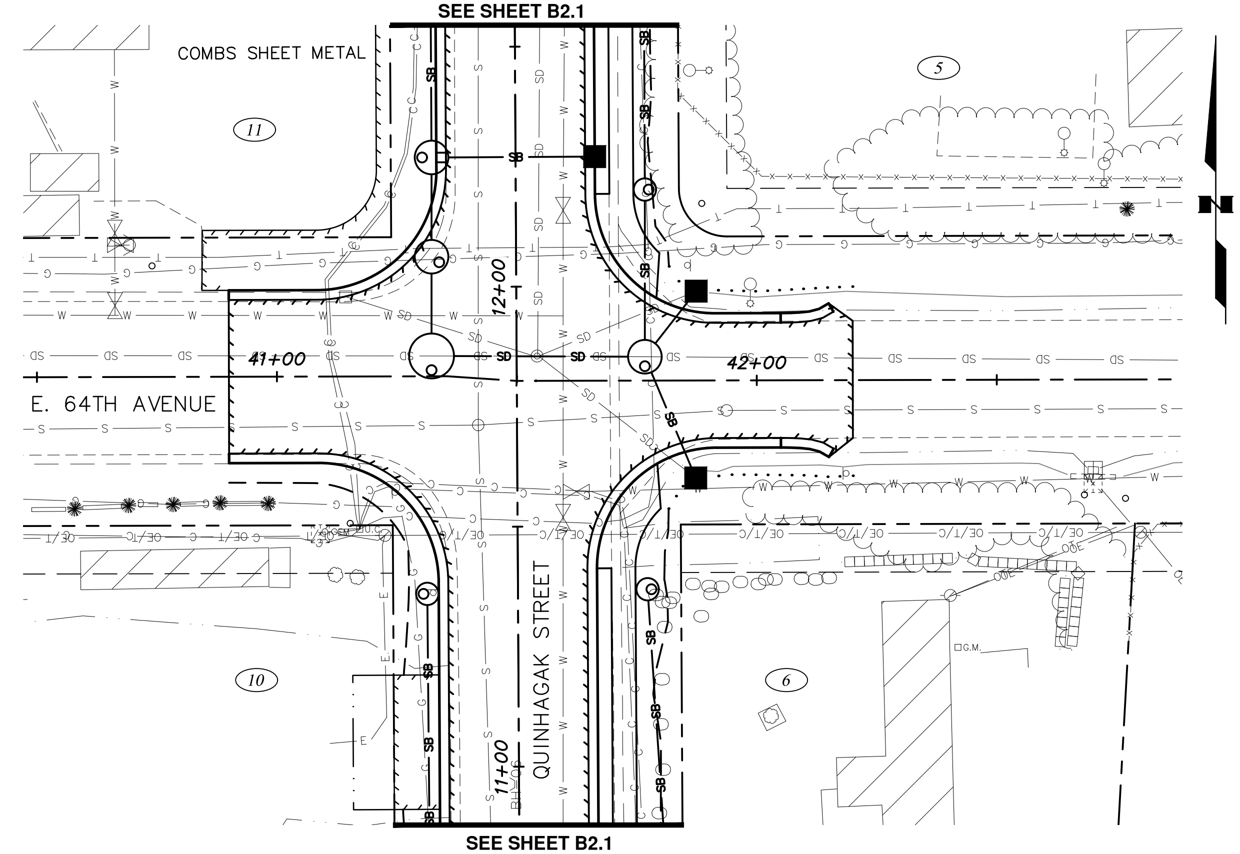

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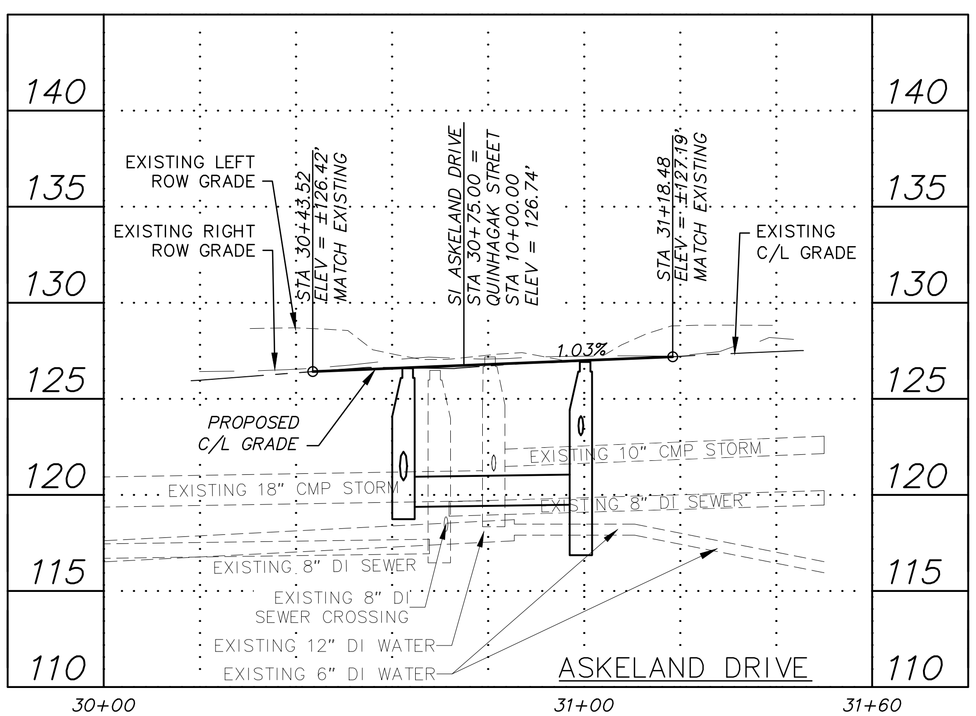

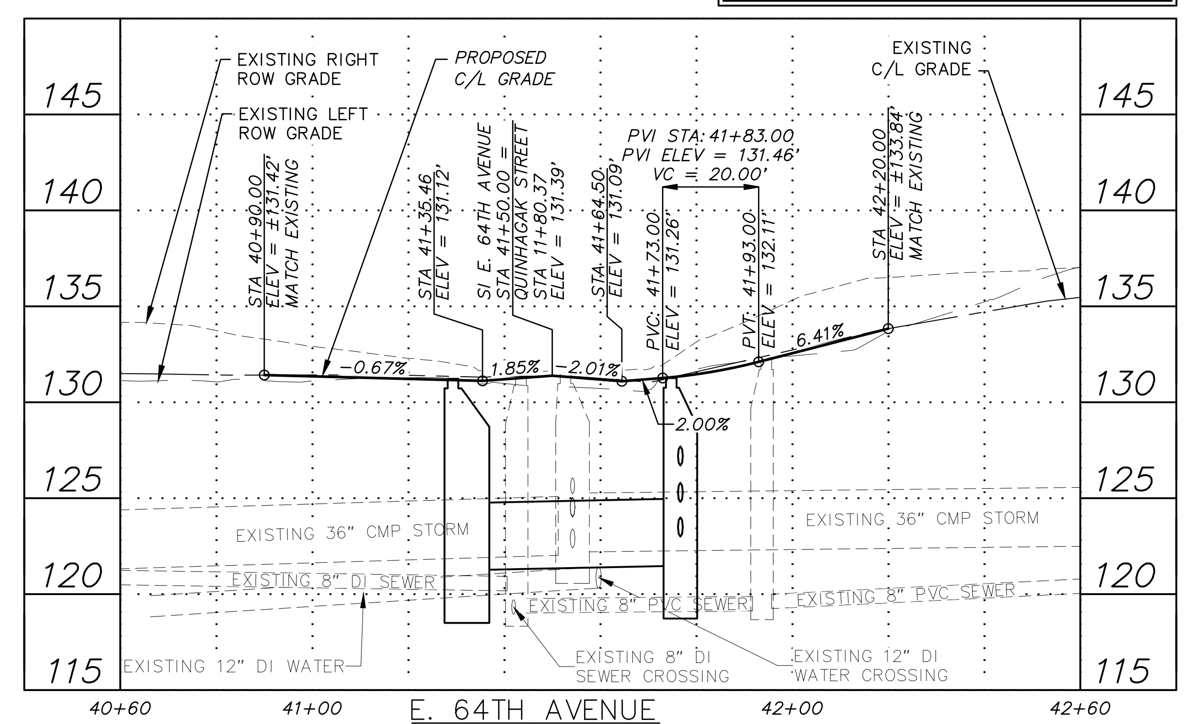

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GAS	CB	BW
TELEPHONE	CB	BW
ELECTRIC	JH	TK
DESIGN	RB	JK
QUANTITIES	RB	JK
PRELIMINARY/FINAL	RB	JK
MUNICIPAL/STATE	RB	JK
PLAN CHECK		

GRAPHIC SCALE 40 20 0 20 40

FIELD BOOKS	
DESIGN	
STAKING	
ASBUILT	
CONTRACTOR	
INSPECTOR	
CONSTRUCTION RECORD	

BM NO.	LOCATION	ELEV.
	BASIS OF THIS DATUM	
VERTICAL DATUM		

REV	DATE	DESCRIPTION	BY
REVISIONS			

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CONSULTANT

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PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

21-13 QUINHAGAK STREET RECONSTRUCTION SCHED A

ROADWAY PLAN & PROFILE

ASKELAND DRIVE & E. 64TH AVENUE

SCALE HOR. 1"=20' VER. 1"=5' | GRID SW2033 | DATE MAY 2023 | STATUS DSR | SHEET B2.4 of B2.5

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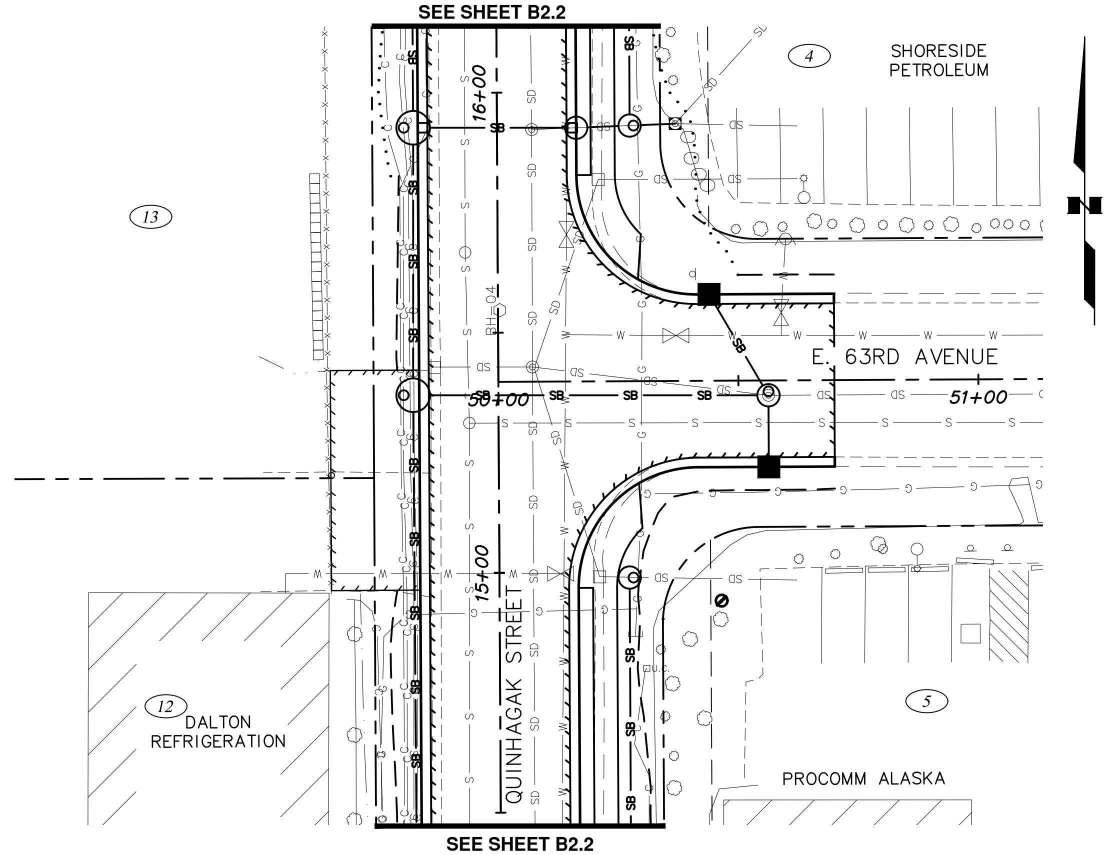

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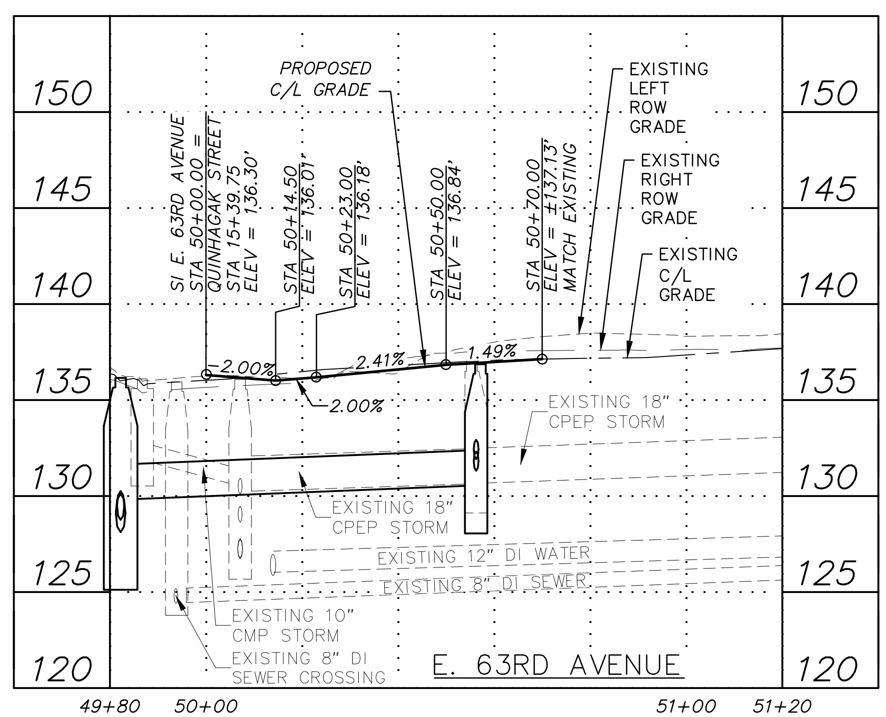

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DATA	DRAWN BY	CHECKED BY
BASE		
TOPOGRAPHY		
PROFILE		
STORM SEWER		
WATER/SANITARY SEWER		
GAS		
TELEPHONE		
ELECTRIC		
DESIGN		
QUANTITIES		
PRELIMINARY/FINAL		
MUNICIPAL/STATE		
PLAN CHECK		

GRAPHIC SCALE 40 20 0 20 40

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STAKING			
ASBUILT			
CONTRACTOR	BASIS OF THIS DATUM		
INSPECTOR			
CONSTRUCTION RECORD	VERTICAL DATUM		

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		REVISIONS	

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21-13 QUINHAGAK STREET RECONSTRUCTION SCHED A

ROADWAY PLAN & PROFILE

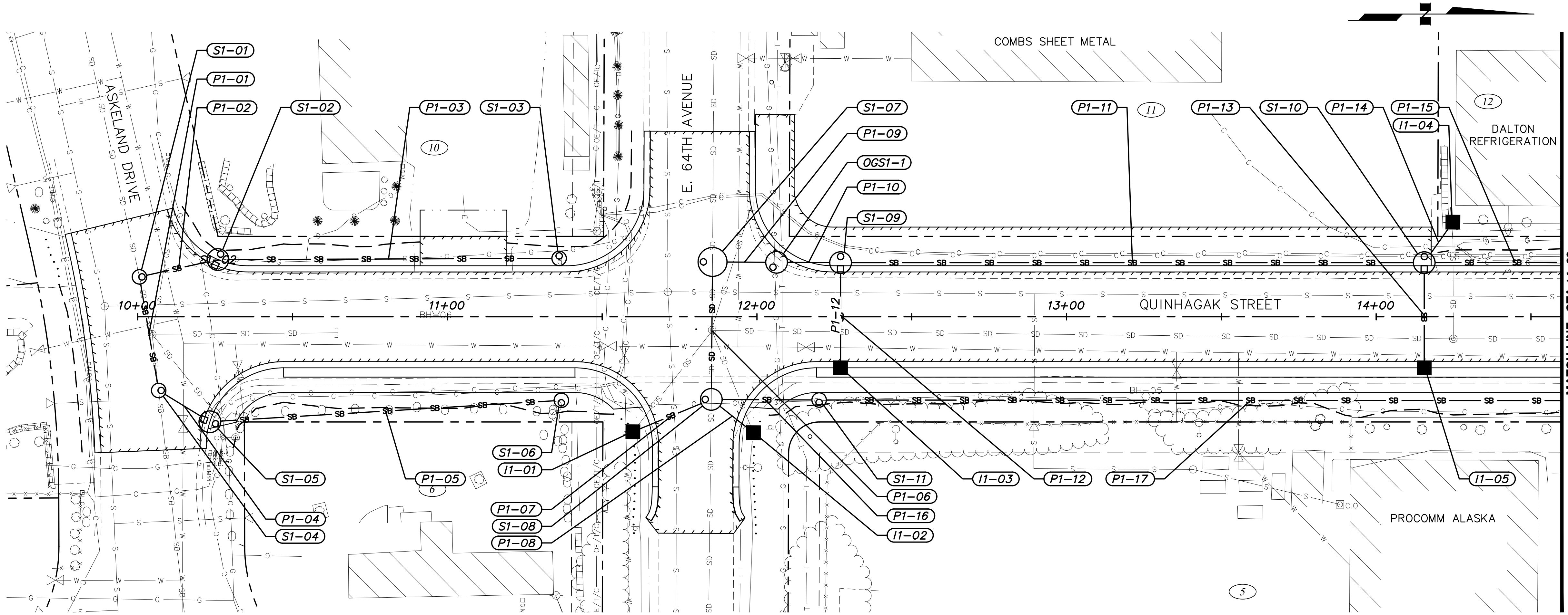
E. 63RD AVENUE

SCALE HOR. 1"=20' VER. 1"=5' | GRID SW2033 | DATE MAY 2023 | STATUS DSR | SHEET B2.5 of B2.5

File:J:\JobsData\10155.00 Quinhagak Street Reconstruction\00 CADD 2019\01 Working Set\01 Civil\10155.00 Plan & Profile - Roadway - Sidestreets- Alternative 3.dwg

Storm Drain Plan & Profile Drawings

Appendix C



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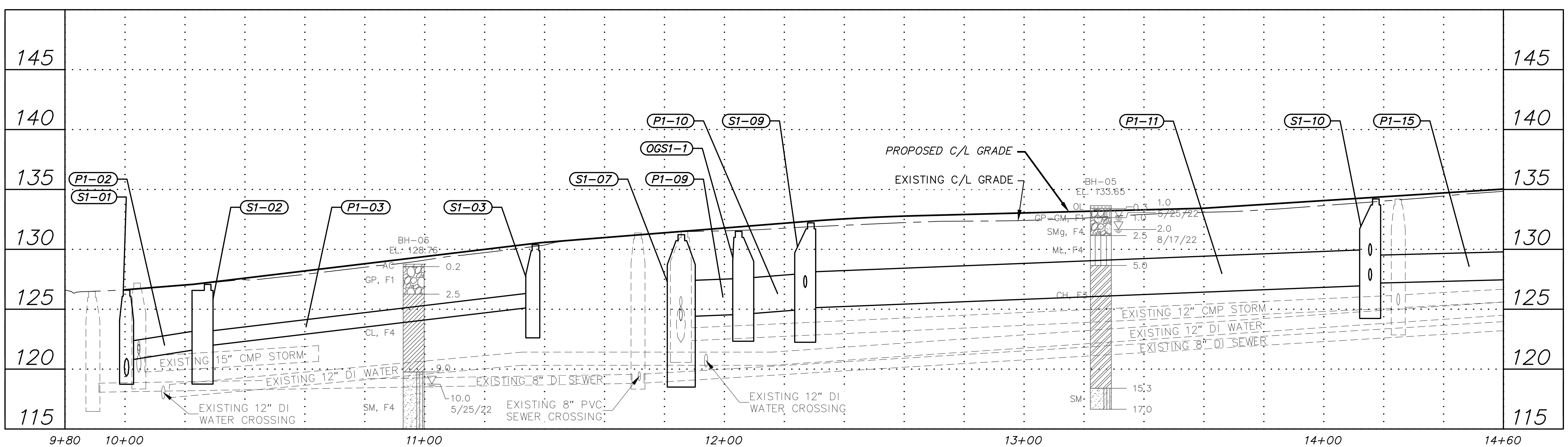

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TOPOGRAPHY	CB	BW
PROFILE	RB	JK
STORM SEWER	KW	JH
WATER/SANITARY SEWER	CK	JK
GAS	CB	BW
TELEPHONE	CB	BW
ELECTRIC	JH	TK
DESIGN	RB	JK
QUANTITIES	RB	JK
PRELIMINARY/FINAL	RB	JK
MUNICIPAL/STATE	RB	JK

PLAN CHECK

GRAPHIC SCALE 40 20 0 20 40

FIELD BOOKS	BM NO.	LOCATION	ELEV.
DESIGN			
STAKING			
ASBUILT			
CONTRACTOR	BASIS OF THIS DATUM		
INSPECTOR			

CONSTRUCTION RECORD — VERTICAL DATUM

REV	DATE	DESCRIPTION	BY

REVISIONS

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD. SUITE 300
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PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

21-13 QUINHAGAK STREET RECONSTRUCTION SCHED B

STORM DRAIN PLAN & PROFILE

QUINHAGAK STREET – BOP TO STA 14+60

SCALE	HOR. 1"=20' VER. 1"=5'	GRID SW2033 DATE MAY 2023	STATUS DSR	SHEET C1.1 of C1.3

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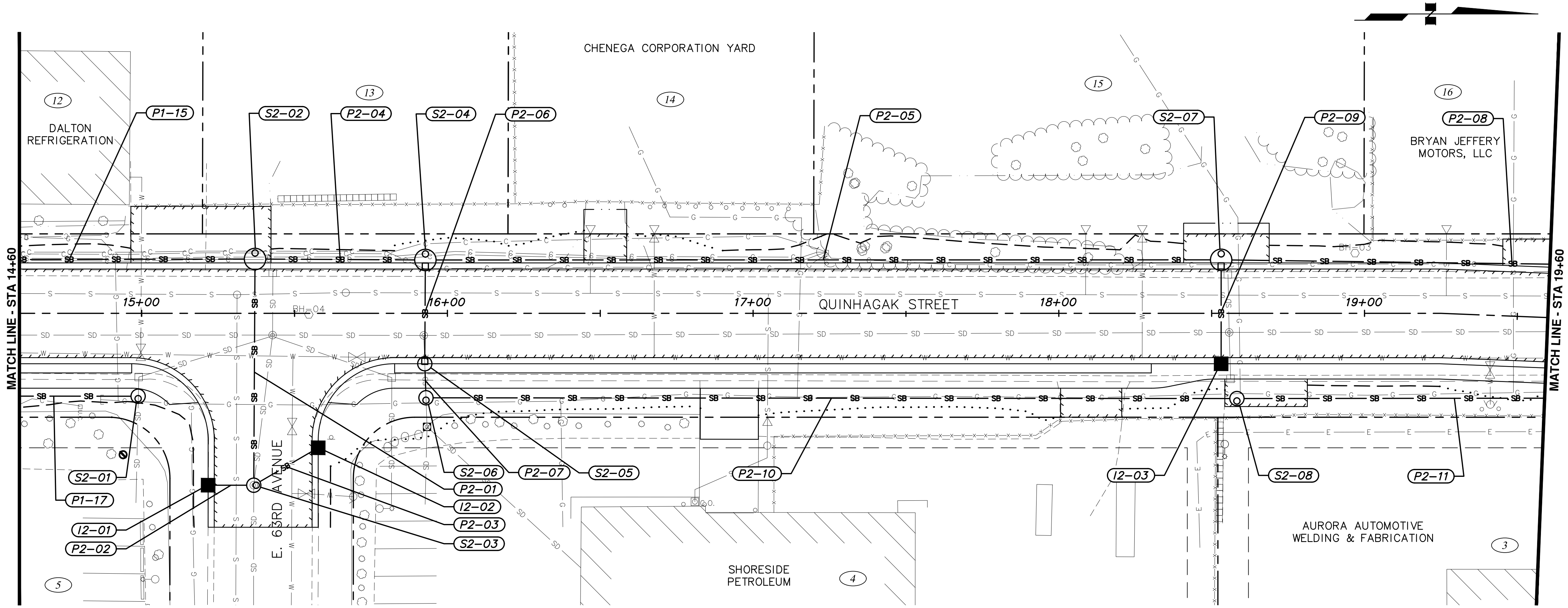

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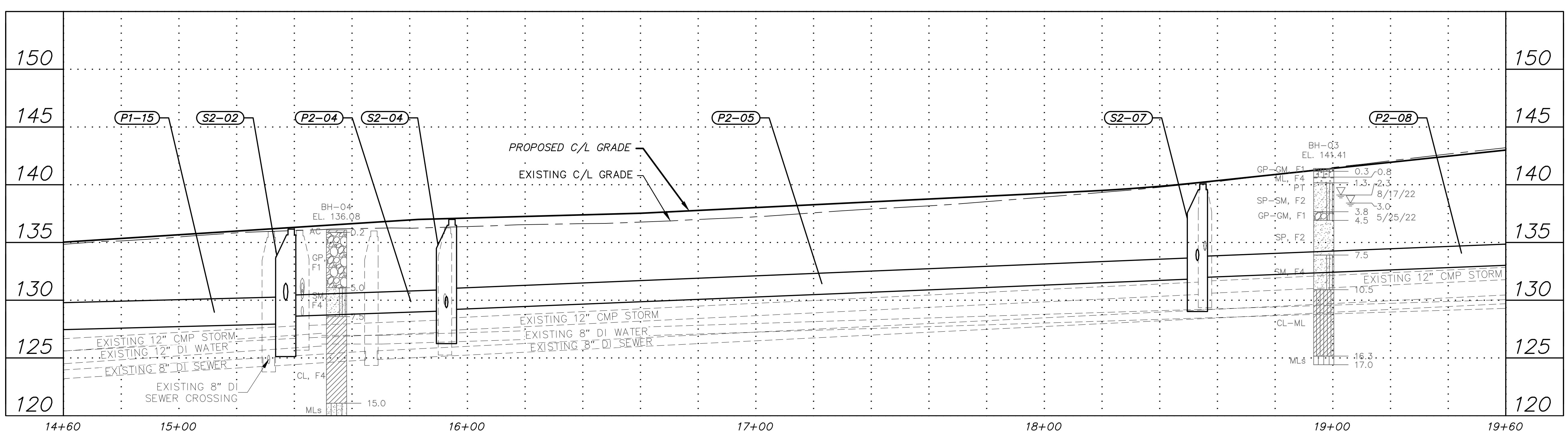

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TOPOGRAPHY	CB	BW
PROFILE	RB	JK
STORM SEWER	KW	JH
WATER/SANITARY SEWER	CK	JK
GAS	CB	BW
TELEPHONE	CB	BW
ELECTRIC	JH	TK
DESIGN	RB	JK
QUANTITIES	RB	JK
PRELIMINARY/FINAL	RB	JK
MUNICIPAL/STATE	RB	JK

PLAN CHECK

GRAPHIC 40 20 0 20 40 SCALE

FIELD BOOKS	
DESIGN	
STAKING	
ASBUILT	
CONTRACTOR	
INSPECTOR	

CONSTRUCTION RECORD

BM NO.	LOCATION	ELEV.
BASIS OF THIS DATUM		

VERTICAL DATUM

REV	DATE	DESCRIPTION	BY

REVISIONS

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ANCHORAGE, ALASKA 99503
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#AECL882-AK

CONSULTANT

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MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

21-13 QUINHAGAK STREET RECONSTRUCTION SCHED B

STORM DRAIN PLAN & PROFILE

QUINHAGAK STREET - STA 14+60 TO STA 19+60

SCALE HOR. 1"=20' VER. 1"=5' | GRID SW2033 | DATE MAY 2023 | STATUS DSR | SHEET C1.2 of C1.3

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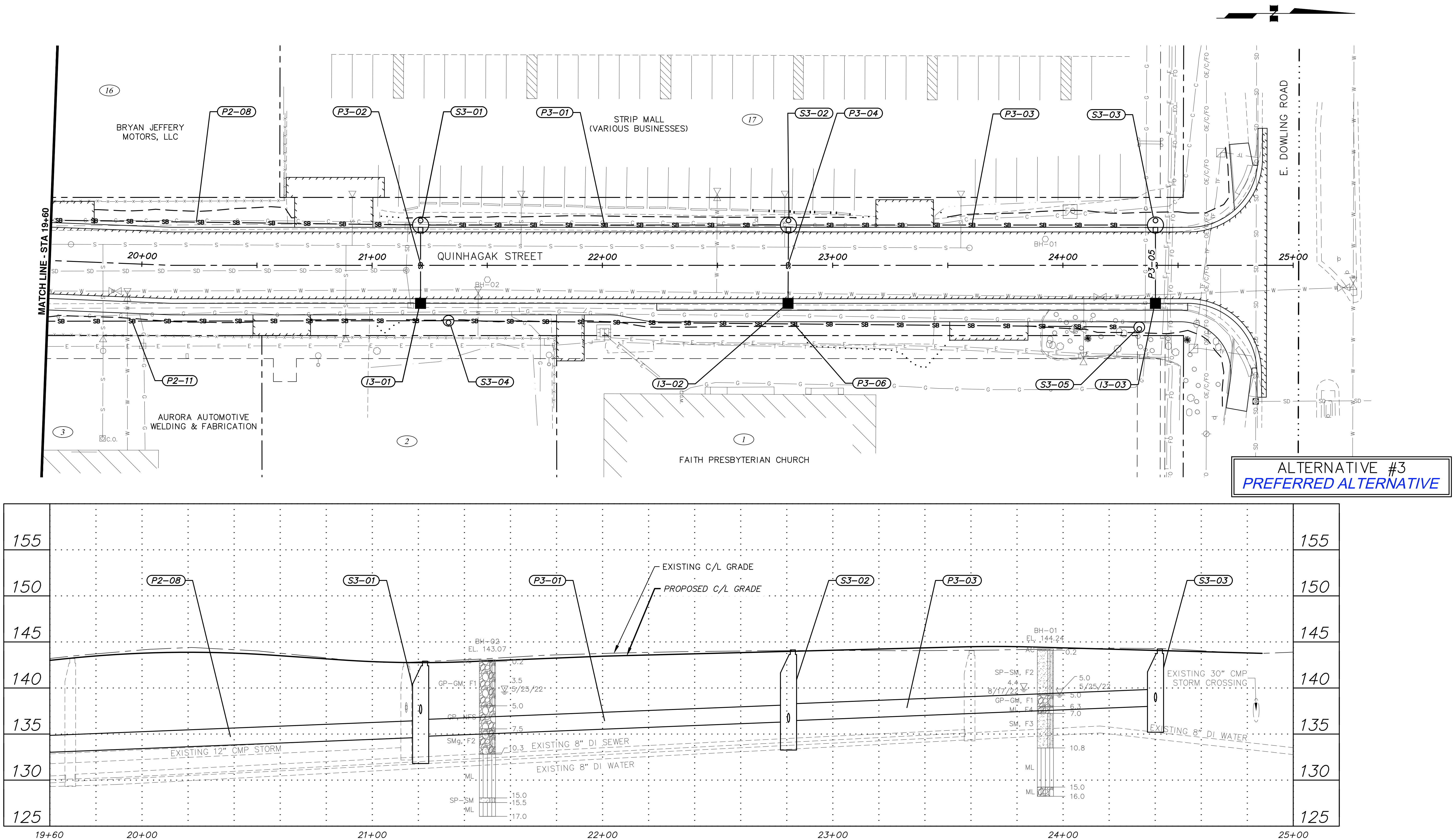

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TOPOGRAPHY	CB	BW
PROFILE	RB	JK
STORM SEWER	KW	JH
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ELECTRIC	JH	TK
DESIGN	RB	JK
QUANTITIES	RB	JK
PRELIMINARY/FINAL	RB	JK
MUNICIPAL/STATE	RB	JK
PLAN CHECK		

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ASBUILT			
CONTRACTOR	BASIS OF THIS DATUM		
INSPECTOR			
CONSTRUCTION RECORD	VERTICAL DATUM		

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		REVISIONS	

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PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

21-13 QUINHAGAK STREET RECONSTRUCTION SCHED B

STORM DRAIN PLAN & PROFILE

QUINHAGAK STREET – STA 19+60 TO EOP

SCALE	GRID SW2033		SHEET
HOR. 1"=20' VER. 1"=5'	DATE MAY 2023	STATUS DSR	C1.3 of C1.3

CCTV Pipeline Inspection Report from MOA Street Maintenance Department

Appendix D

Municipality of Anchorage

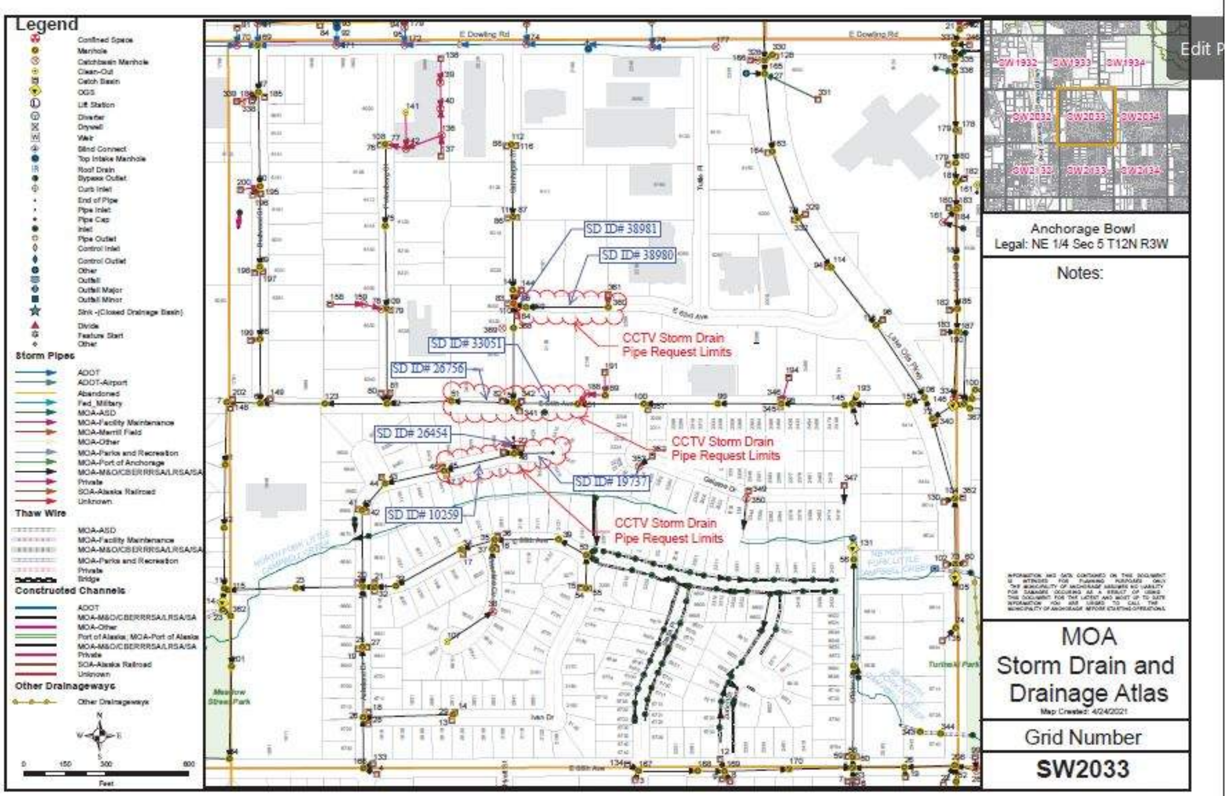
Maintenance & Operations Department
Street Maintenance Division
Stormwater Drainage System (SDS)

SDS CCTV PIPELINE & STRUCTURE INSPECTIONS
OPERATOR'S REPORT
Performed By: Ryan A Frise
Supervisor Review: Steven N. Rupp
PM&E Project: 21-13
CCTV Request: #22-14
Project Name: Quinhagak Street Upgrade-E Dowling Road to Askeland Drive
Requested From: Ryan Kim, P.E.
Completion Date: 9/7/2022

Inspection Information

Summary

This inspection consists of seven pipes to be inspected on Quinhagak between Askeland and 63rd



Asset 38980 – 18” CPEP – This inspection was performed against the flow from the structure 2033-359 this pipe appears to be in fair condition with normal function and grade. This inspection noted multiple areas of infiltration. This survey noted deformed areas in in the pipe approx. 8’, 129’, and 210’ in pipe. This main is approx. 300’ in length. *Pictured to the right is the DUC flat image of the entire pipe run of this asset. Highlighted in yellow indicated the two more prominent deformities. Red lines indicate the more prominent joint infiltration.*

Asset 38981 – 18” CPEP – This inspection was performed with the flow from structure 2033-359 This pipe appears to be in good working condition with normal function and grade. This inspection noted minor infiltration. This survey noted deformed areas approx. 7’, 26’ in pipe. This main is approx. 46’ in length. *Pictured to the right is a snippet of the DUC video at 6.5’ showing a deformity prior to any cracking. Appears predisposed to hinge fracturing in the CPEP at 3 and 6 o’clock positions.*

Asset 10259 – 18" CMP – This inspection was performed with the flow from structure 2033-048 This pipe was found with heavy deposits; the camera was unable to proceed to complete inspection. There was a small joint separation visible. A reversal was attempted, similar presents of deposits was noted. A separation with soil visible was noted. This survey was abandoned, camera could not proceed through deposits. The length of this main is approx. and undetermined.

Pictured to the right is a screenshot of the DUC video footage upon camera launch where the survey had to be abandoned of the DS attempt.

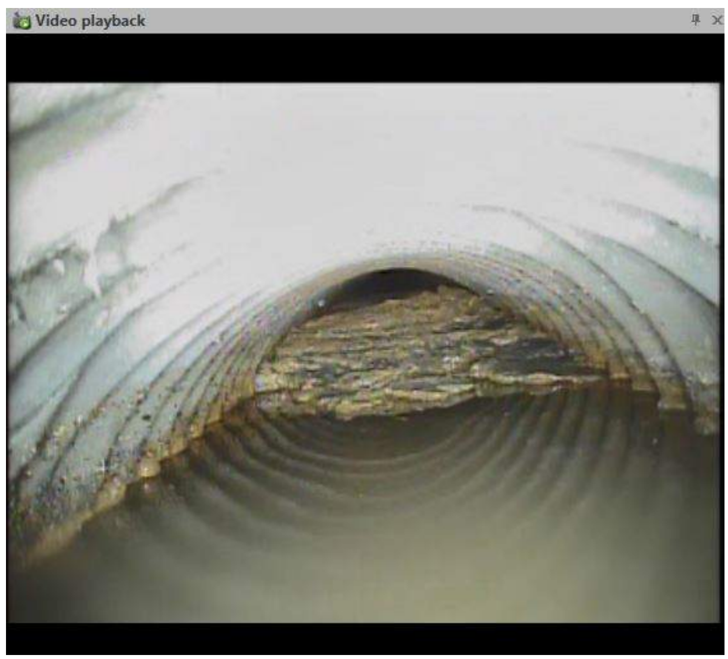
Pictured to the left is a screenshot of the DUC video footage of the reversal attempt headed against the flow. Also abandoned survey on this reversal attempt due to heavy deposits just downstream of the broken/separated pipe (with soil visible).

Asset 19737 – 10" CMP – This inspection was performed Upstream from structure 2033-048 This pipe was found with heavy deposits. This survey was abandoned, camera was unable to proceed to complete inspection. The length of this pipe is approx. and undetermined.

Pictured to the right is a screenshot of the TV footage at 6' into the assessment where the survey was abandoned due to heavy deposits in the pipe.

Asset 26454 – 15" CMP – This inspection was performed against the flow from structure 2033-048 This survey was abandoned heavy deposits noted, camera was unable to proceed. The length of this pipe is approx. and undetermined.

Pictured to the right is a screenshot of the TV footage 0' into the assessment where the DUC and transporter were unable to be launched due to severe deposits in the pipe. The pipe is surcharged in this photo.



Asset 33051 – 36" CMP – This inspection was performed Upstream from structure 2033-050 This pipe appears to be in good condition with normal function and grade. The inspection noted joint separation approx. 136' and 197' with light infiltration. This survey noted the pipe was deformed approx. 200' in pipe. This main is approx. 220' in length.

Asset 26756 – 48” CMP – This inspection was performed Downstream from structure 2033-050 This pipe appears to be in good working condition with normal function and grade. This inspection noted the pipe was deformed in multiple areas approx. 13’, 32’, 106’, and 200’. This survey noted joint separation near the Downstream structure. This separation occurs in the flow line obstructing flow. This main is approx. 218’ in length.

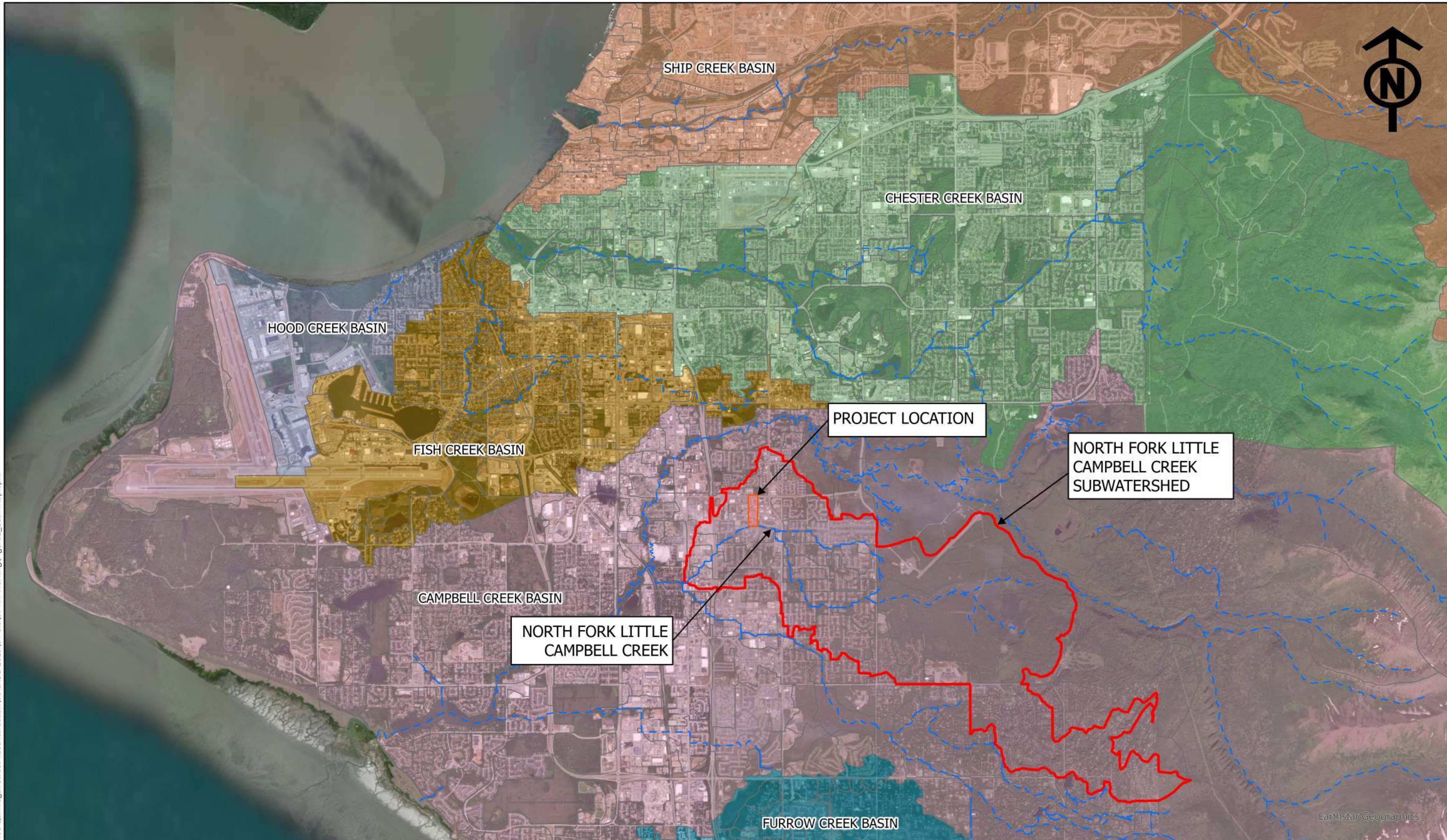
Pictured to the right is a screenshot of the TV footage 12.5’ into the assessment where the deformities and small sags are visible in the CMP. This defect was the most notable from reviewing the footage.

Additional Information

The mains at Askeland and Quinhagak have heavy sediment with minimal flow. The integrity of the pipes is undetermined due to being unable to view under the water level and sediment in the assessments as well as being unable to run the transporter through the entirety of the pipe. The structures entered and viewed during the inspections appeared to be in fair condition. Pipes downstream from the requested assests were visibly surcharged from a surface manhole assessment done previously showing that the further you proceed downstream the more surcharged the system is on a high level overview.

Storm Drain Modeling Data

Appendix E



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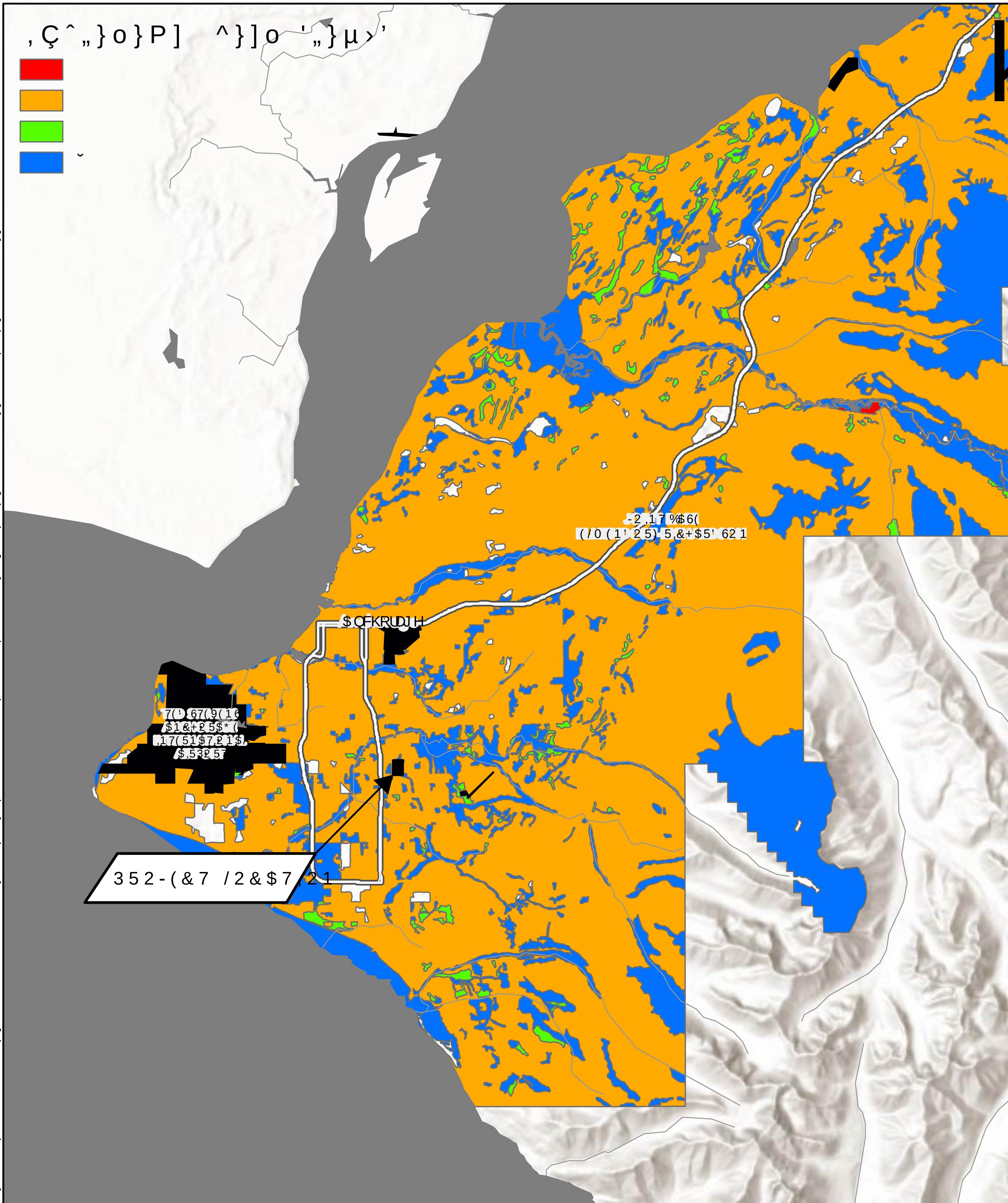
PHONE (907) 562-3252
#AECL882-AK

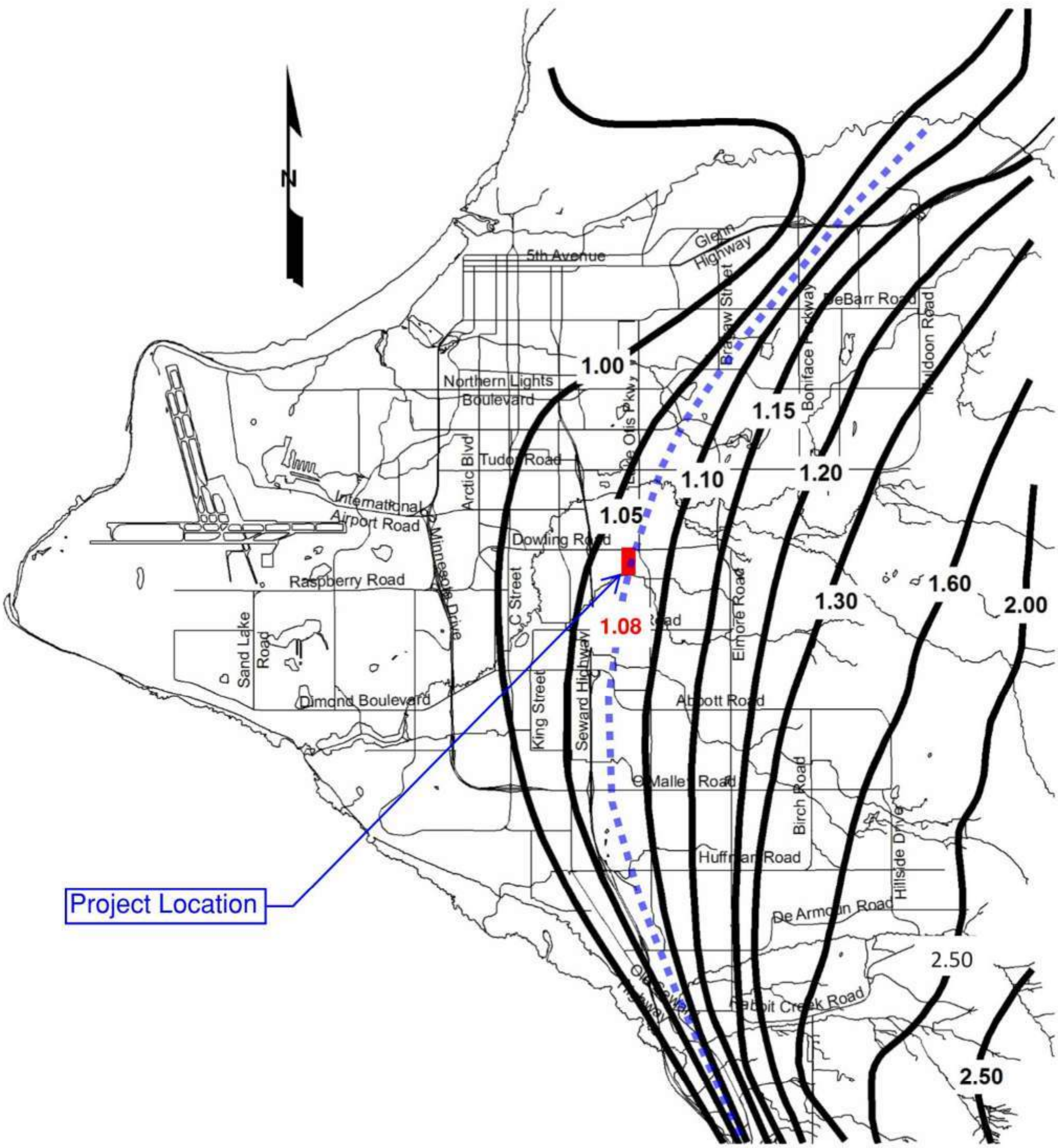
PROJECT LOCATION AND MOA WATERSHED BOUNDARIES MAP
QUINHAGAK STREET RECONSTRUCTION- E. DOWLING ROAD TO ASKELAND DRIVE
MOA PM&E PROJECT #21-13
ANCHORAGE, ALASKA

0 0.5 1 2 Miles

Project:	10155
Drawn By:	KEW
Scale:	1 in : 1 mi
Date:	MAY 2023
Figure:	1

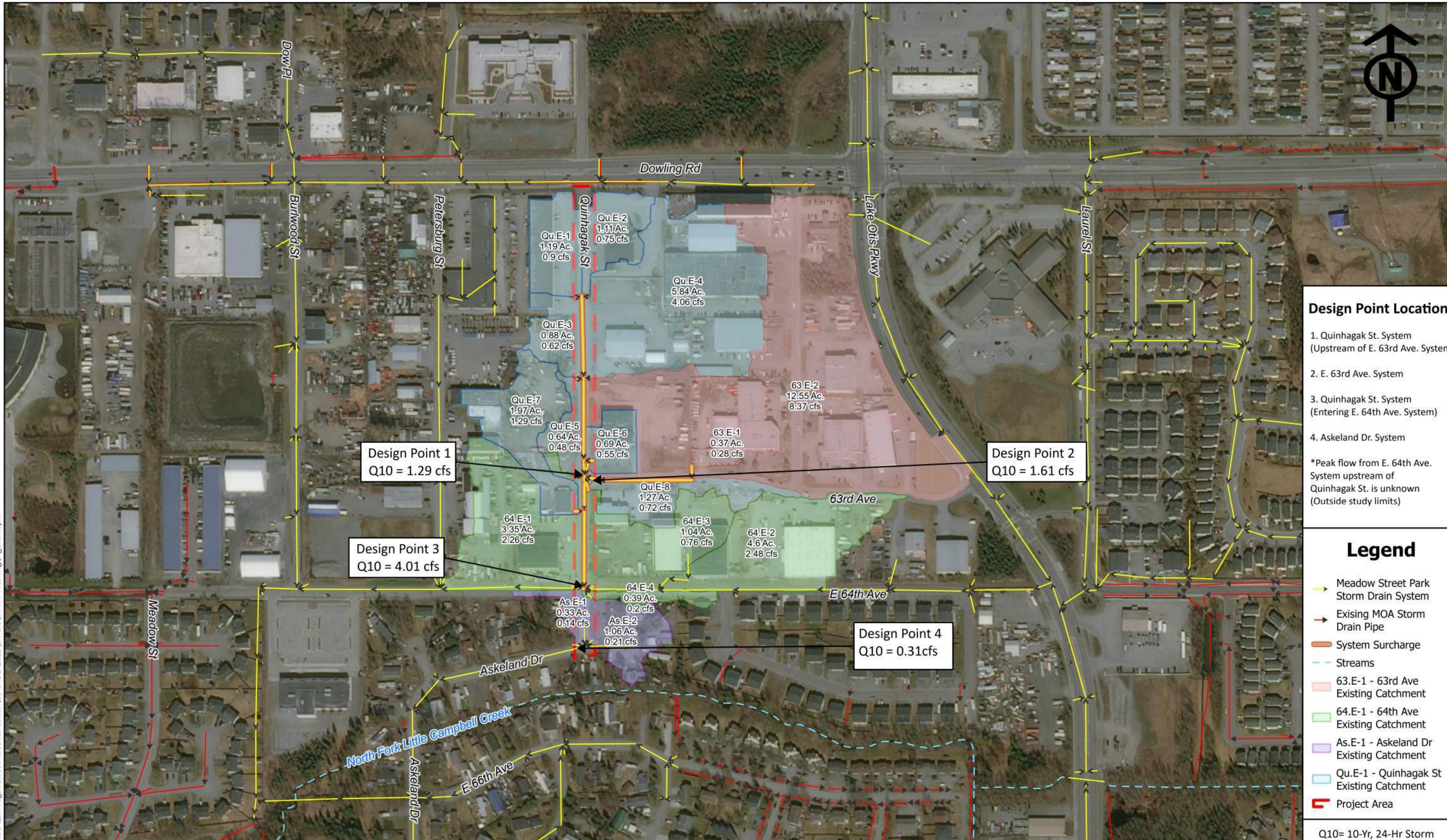
File Path: J:\JobsData\10155.00 Quinhagak Street Reconstruction\00 CADD 2019\04 GIS\07 HH Working\Figure1_BasinMap.aprx





OROGRAPHIC FACTOR MAP (ANCHORAGE)

FIGURE 3



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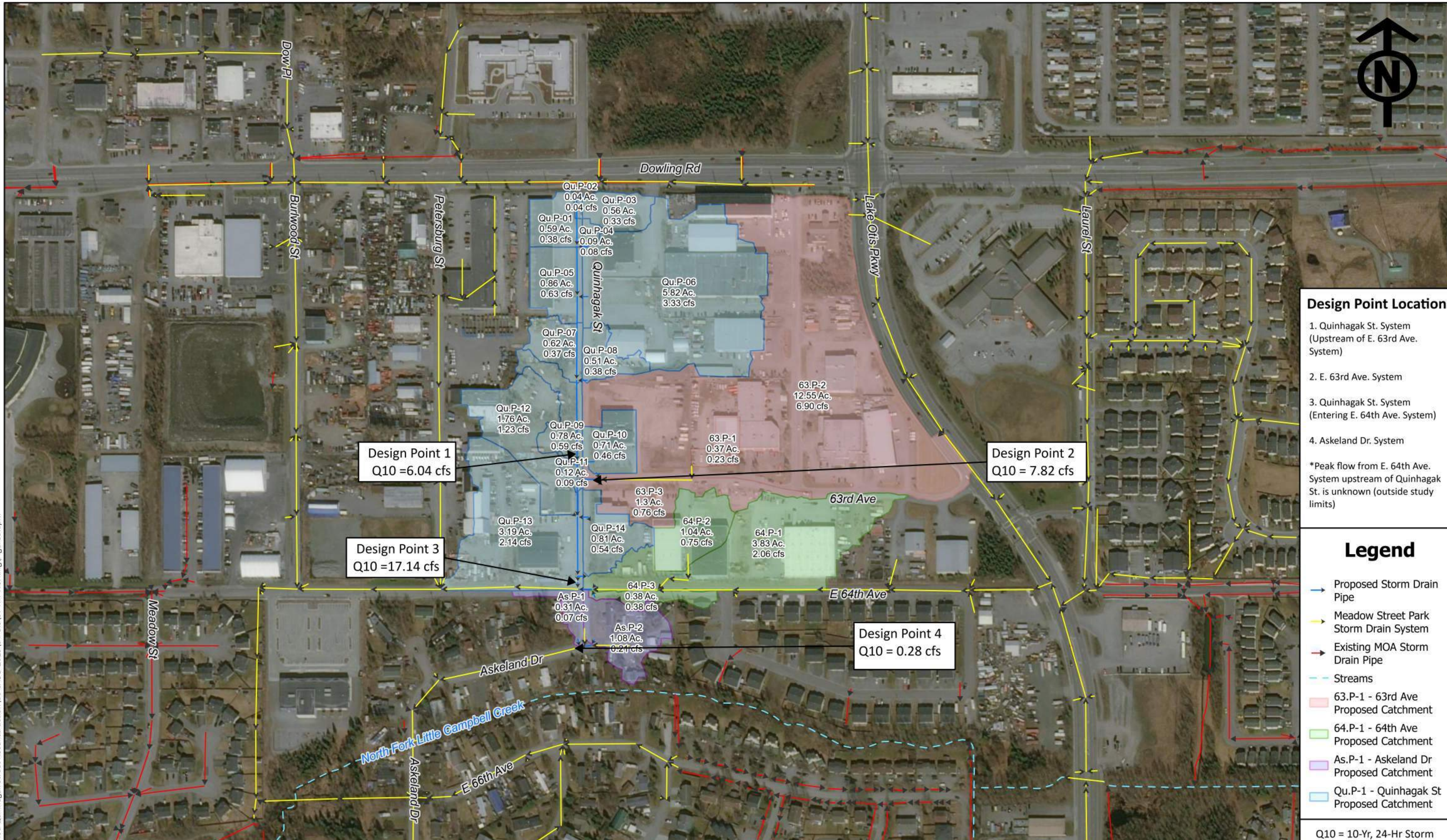
EXISTING STORMWATER SYSTEM & CONTRIBUTING CATCHMENTS

QUINHAGAK STREET RECONSTRUCTION- E. DOWLING ROAD TO ASKELAND DRIVE
MOA PM&E PROJECT #21-13
ANCHORAGE, ALASKA

Project:	10155
Drawn By:	KEW
Scale:	1 in : 300 ft
Date:	MAY 2023
Figure:	4

File Path: J:\JobsData\10155.00 Quinhagak Street Reconstruction\00 CADD 2019\04 GIS\07 HH Working\Figure4.aprx



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ANCHORAGE, ALASKA 99503
PHONE (907) 562-3252
#AECL882-AK

PROPOSED STORMWATER SYSTEM & CONTRIBUTING CATCHMENTS

QUINHAGAK STREET RECONSTRUCTION- E. DOWLING ROAD TO ASKELAND DRIVE
MOA PM&E PROJECT #21-13
ANCHORAGE, ALASKA

0 150 300 600 Feet

Project:	10155
Drawn By:	KEW
Scale:	1 in : 300 ft
Date:	MAY 2023
Figure:	5

File Path: J:\JobsData\10155.00 Quinhagak Street Reconstruction\00 CADD 2019\04 GIS\07 HH Working\Figure5.aprx

Existing Stormwater System SSA Report & Results

Project Description

File Name .... Quinhagak_SSA_Existing.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	SCS TR-55
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Hydrodynamic
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	NO

Analysis Options

Start Analysis On	00:00:00	0:00:00
End Analysis On	00:00:00	0:00:00
Start Reporting On	00:00:00	0:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins..	16
Nodes..	28
Junctions	15
Outfalls	2
Flow Diversions	0
Inlets	10
Storage Nodes	1
Links..	36
Channels	10
Pipes	26
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	MOA	Time Series	MOA Design Storm Distribution	Cumulative	inches				0.00	

Subbasin Summary

SN	Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	B-2033-022	1.06	484.00	75.00	2.46	0.63	0.67	0.21	0 00:36:45
2	B-2033-049	0.33	484.00	75.00	2.46	0.63	0.20	0.14	0 00:06:00
3	B-2033-082	3.35	484.00	88.00	2.46	1.35	4.52	2.26	0 00:19:09
4	B-2033-083	0.64	484.00	88.00	2.46	1.35	0.86	0.48	0 00:15:12
5	B-2033-084	1.27	484.00	88.00	2.46	1.35	1.71	0.72	0 00:27:12
6	B-2033-085	12.55	484.00	88.00	2.46	1.35	16.93	6.90	0 00:28:50
7	B-2033-086	0.88	484.00	88.00	2.46	1.35	1.18	0.62	0 00:17:07
8	B-2033-087	5.84	484.00	92.00	2.46	1.66	9.68	4.06	0 00:26:47
9	B-2033-088	1.19	484.00	92.00	2.46	1.66	1.97	0.90	0 00:22:50
10	B-2033-101	1.04	484.00	88.00	2.46	1.35	1.40	0.76	0 00:16:18
11	B-2033-116	1.11	484.00	92.00	2.46	1.66	1.84	0.75	0 00:28:26
12	B-2033-144	0.69	484.00	92.00	2.46	1.66	1.15	0.55	0 00:20:37
13	B-2033-341	0.39	484.00	89.00	2.46	1.42	0.55	0.20	0 00:37:05
14	B-2033-342	4.60	484.00	88.00	2.46	1.35	6.21	2.48	0 00:30:00
15	B-2033-360	0.37	484.00	92.00	2.46	1.66	0.61	0.28	0 00:23:14
16	B-2033-369	1.97	484.00	88.00	2.46	1.35	2.66	1.29	0 00:20:17

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	S-2033-045	Junction	118.66	124.60	118.66	0.00	0.00	0.31	119.03	0.00	6.04	0 00:00	0.00	0.00
2	S-2033-048	Junction	119.01	126.73	119.01	0.00	0.00	0.31	120.02	0.00	6.71	0 00:00	0.00	0.00
3	S-2033-051	Junction	119.93	131.82	119.93	0.00	0.00	9.36	121.39	0.00	10.43	0 00:00	0.00	0.00
4	S-2033-101	Junction	122.24	136.78	122.24	0.00	0.00	0.72	123.38	0.00	13.40	0 00:00	0.00	0.00
5	S-2033-110	Junction	126.34	136.07	126.34	0.00	0.00	4.56	136.07	0.00	0.00	0 12:16	0.00	0.00
6	S-2033-111	Junction	130.03	140.14	130.03	0.00	0.00	2.89	140.14	0.00	0.00	0 12:20	0.09	15.00
7	S-2033-112	Junction	132.85	142.82	132.85	0.00	0.00	1.37	140.15	0.00	2.67	0 00:00	0.00	0.00
8	S-2033-143	Junction	125.92	136.25	125.92	0.00	0.00	2.37	136.13	0.00	0.12	0 00:00	0.00	0.00
9	S-2033-144	Junction	128.23	136.00	128.23	0.00	0.00	2.11	136.00	0.00	0.00	0 12:20	1.03	54.00
10	S-2033-341	Junction	123.72	130.72	123.72	0.00	0.00	0.20	125.29	0.00	5.43	0 00:00	0.00	0.00
11	S-2033-342	Junction	124.26	131.49	124.26	0.00	0.00	2.47	126.18	0.00	5.31	0 00:00	0.00	0.00
12	S-2033-359	Junction	129.79	137.01	129.79	0.00	0.00	1.61	136.11	0.00	0.89	0 00:00	0.00	0.00
13	S-2033-360	Junction	131.80	140.54	131.80	0.00	0.00	1.75	140.53	0.00	0.00	0 12:09	0.00	0.00
14	S-2033-368	Junction	123.52	134.20	123.52	0.00	0.00	4.01	133.62	0.00	0.58	0 00:00	0.00	0.00
15	S-2033-369	Junction	124.66	135.06	124.66	0.00	10.00	1.29	133.69	0.00	1.37	0 00:00	0.00	0.00
16	Outfall-64th	Outfall	120.20					9.33	121.12					
17	Outfall-Askeland	Outfall	118.62					0.31	118.95					
18	S-2033-050	Storage Node	121.56	131.74	121.56		0.00	8.41	122.74				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Reported Condition
1	P-022-048	Pipe	I-2033-022	S-2033-048	29.40	122.60	121.26	4.5600	10.000	0.0240	0.27	2.53	0.11	2.94	0.19	0.23	0.00	Calculated
2	P-048-045	Pipe	S-2033-048	S-2033-045	258.54	119.73	118.66	0.4100	18.000	0.0240	0.31	3.66	0.08	1.07	0.33	0.22	0.00	Calculated
3	P-049-048	Pipe	I-2033-049	S-2033-048	35.04	122.60	121.23	3.9100	10.000	0.0240	0.12	2.35	0.05	2.20	0.13	0.15	0.00	Calculated
4	P-050-051	Pipe	S-2033-050	S-2033-051	217.73	122.06	120.38	0.7700	38.000	0.0240	8.41	62.17	0.14	2.61	0.84	0.27	0.00	Calculated
5	P-050-082	Pipe	I-2033-082	S-2033-050	41.71	126.85	122.41	10.6600	10.000	0.0240	1.27	3.87	0.33	6.07	0.34	0.41	0.00	Calculated
6	P-050-101	Pipe	S-2033-050	S-2033-101	232.53	122.41	122.89	-0.2100	36.000	0.0240	0.73	19.79	0.04	1.26	0.41	0.14	0.00	Calculated
7	P-050-341	Pipe	S-2033-050	S-2033-341	40.80	122.41	125.19	-6.8300	12.000	0.0120	0.20	10.08	0.02	2.86	0.21	0.21	0.00	Calculated
8	P-060-342	Pipe	S-2033-050	S-2033-342	35.05	122.41	125.67	-9.3100	12.000	0.0240	2.47	5.89	0.42	6.65	0.48	0.48	0.00	Calculated
9	P-083-110	Pipe	I-2033-083	S-2033-110	18.00	131.89	130.68	6.7200	10.000	0.0240	0.80	3.08	0.26	2.53	0.83	1.00	111.00	SURCHARGED
10	P-084-110	Pipe	I-2033-084	S-2033-110	42.97	132.19	128.64	8.2500	10.000	0.0240	1.83	3.41	0.54	4.39	0.83	1.00	110.00	SURCHARGED
11	P-085-110	Pipe	I-2033-085	S-2033-110	38.71	132.06	130.10	5.0600	10.000	0.0240	2.03	2.67	0.76	20.94	0.83	1.00	113.00	SURCHARGED
12	P-086-111	Pipe	I-2033-086	S-2033-111	14.99	136.64	134.30	15.6100	10.000	0.0240	0.79	4.69	0.17	4.88	0.83	1.00	39.00	SURCHARGED
13	P-087-111	Pipe	I-2033-087	S-2033-111	11.20	136.11	134.30	16.1600	10.000	0.0240	2.14	4.77	0.45	8.09	0.83	1.00	58.00	SURCHARGED
14	P-088-112	Pipe	I-2033-088	S-2033-112	15.18	138.44	137.34	7.2400	1.000	0.0240	0.02	0.01	2.19	2.76	0.08	1.00	1150.00	SURCHARGED
15	P-110-368	Pipe	S-2033-110	S-2033-368	113.90	126.74	125.11	1.4300	12.000	0.0240	3.41	2.31	1.48	4.34	1.00	1.00	243.00	SURCHARGED
16	P-111-143	Pipe	S-2033-111	S-2033-143	259.46	130.54	127.43	1.2000	12.000	0.0240	2.37	2.11	1.12	3.02	1.00	1.00	143.00	SURCHARGED
17	P-112-111	Pipe	S-2033-112	S-2033-111	255.00	133.56	130.64	1.1500	12.000	0.0240	1.34	2.07	0.65	1.70	1.00	1.00	100.00	SURCHARGED
18	P-116-112	Pipe	I-2033-116	S-2033-112	12.67	138.52	137.60	7.2600	1.000	0.0240	0.02	0.01	2.33	2.95	0.08	1.00	1139.00	SURCHARGED
19	P-143-110	Pipe	S-2033-143	S-2033-110	45.46	127.24	126.78	1.0100	14.000	0.0240	1.29	2.93	0.44	1.61	1.17	1.00	204.00	SURCHARGED
20	P-144-143	Pipe	S-2033-144	S-2033-143	29.35	129.78	129.58	0.6800	12.000	0.0120	1.56	3.19	0.49	1.99	1.00	1.00	148.00	SURCHARGED
21	P-359-110	Pipe	S-2033-359	S-2033-110	46.47	130.80	130.42	0.8200	18.000	0.0120	1.61	10.29	0.16	1.54	1.50	1.00	117.00	SURCHARGED
22	P-360-359	Pipe	S-2033-360	S-2033-359	296.33	133.50	130.85	0.9000	18.000	0.0120	1.61	10.77	0.15	1.68	1.50	1.00	78.00	SURCHARGED
23	P-368-050	Pipe	S-2033-368	S-2033-050	234.41	125.11	122.41	1.1500	12.000	0.0240	4.01	2.07	1.94	5.29	0.92	0.92	0.00	> CAPACITY
24	P-369-368	Pipe	S-2033-369	S-2033-368	24.40	126.32	125.32	4.1000	12.000	0.0120	1.29	7.81	0.16	1.64	1.00	1.00	182.00	SURCHARGED
25	P-Outfall1	Pipe	S-2033-051	Outfall-64th	59.86	120.38	120.20	0.3000	38.000	0.0240	9.33	38.81	0.24	2.45	0.96	0.30	0.00	Calculated
26	P-Outfall2	Pipe	S-2033-045	Outfall-Askeland	25.21	118.66	118.62	0.1600	16.000	0.0240	0.31	2.28	0.13	1.04	0.35	0.26	0.00	Calculated
27	022-Bypass	Channel	I-2033-022	I-2033-049	62.37	122.60	121.10	2.4100	5.640	0.0320	0.00	53.96	0.00	0.01	0.24	0.52	0.00	
28	049-Bypass	Channel	I-2033-049	S-2033-045	226.83	126.59	124.60	0.8800	5.640	0.0320	0.01	17.64	0.00	1.11	0.03	0.07	0.00	
29	082-Bypass	Channel	I-2033-082	S-2033-051	189.59	131.23	129.28	1.0300	5.640	0.0320	1.00	19.10	0.05	2.69	0.19	0.41	0.00	
30	083-Bypass	Channel	I-2033-083	I-2033-082	345.58	136.10	131.23	1.4100	5.640	0.0320	0.03	22.36	0.00	1.66	0.06	0.12	0.00	
31	084-Bypass	Channel	I-2033-084	I-2033-022	475.80	135.57	127.00	1.8000	5.640	0.0320	0.08	25.28	0.00	4.43	0.08	0.16	0.00	
32	085-Bypass	Channel	I-2033-085	I-2033-084	81.18	136.39	135.57	1.0100	5.640	0.0320	4.50	18.93	0.24	2.49	0.39	0.83	0.00	
33	086-Bypass	Channel	I-2033-086	I-2033-083	312.43	140.72	136.10	1.4800	5.640	0.0320	0.04	22.90	0.00	2.61	0.06	0.12	0.00	
34	087-Bypass	Channel	I-2033-087	I-2033-085	275.03	140.42	136.39	1.4700	5.640	0.0320	2.31	22.80	0.10	2.69	0.35	0.74	0.00	
35	088-Bypass	Channel	I-2033-088	I-2033-086	260.08	142.83	140.72	0.8100	5.640	0.0320	0.22	16.96	0.01	2.28	0.13	0.27	0.00	
36	116-Bypass	Channel	I-2033-116	I-2033-087	260.51	142.84	140.42	0.9300	5.640	0.0320	0.16	18.13	0.01	2.13	0.23	0.49	0.00	

Inlet Summary

SN	Element ID	Inlet Manufacturer	Manufacturer Part Number	Inlet Location	Number of Inlets	Catchbasin Invert Elevation (ft)	Max (Rim) Elevation (ft)	Initial Water Elevation (ft)	Ponded Area (ft^2)	Peak Flow (cfs)	Peak Flow Intercepted by Inlet (cfs)	Peak Flow Bypassing Inlet (cfs)	Inlet Efficiency during Peak Flow (%)	Allowable Spread (ft)	Max Gutter Spread during Peak Flow (ft)	Max Gutter Water Elev. during Peak Flow (ft)
1	I-2033-022	FHWA HEC-22 GENERIC	N/A	On Grade	1	121.92	127.00	121.92	N/A	0.21	0.21	0.00	99.99	7.00	1.48	127.12
2	I-2033-049	FHWA HEC-22 GENERIC	N/A	On Grade	1	121.88	126.59	121.88	N/A	0.12	0.12	0.00	100.00	7.00	1.63	126.69
3	I-2033-082	FHWA HEC-22 GENERIC	N/A	On Grade	1	126.31	131.23	126.31	N/A	2.24	1.24	1.00	55.48	7.00	8.36	131.52
4	I-2033-083	FHWA HEC-22 GENERIC	N/A	On Grade	1	131.19	136.10	131.19	N/A	0.46	0.24	0.22	52.67	7.00	2.26	136.15
5	I-2033-084	FHWA HEC-22 GENERIC	N/A	On Grade	1	132.19	135.57	132.19	N/A	0.72	0.15	0.57	20.31	7.00	2.36	135.62
6	I-2033-085	FHWA HEC-22 GENERIC	N/A	On Grade	1	131.28	136.39	131.28	N/A	6.89	2.42	4.47	35.10	7.00	14.38	136.80
7	I-2033-086	FHWA HEC-22 GENERIC	N/A	On Grade	1	136.09	140.72	136.09	N/A	0.60	0.05	0.55	8.19	7.00	2.05	140.76
8	I-2033-087	FHWA HEC-22 GENERIC	N/A	On Grade	1	135.45	140.42	135.45	N/A	4.03	0.00	4.03	0.00	7.00	8.99	140.73
9	I-2033-088	FHWA HEC-22 GENERIC	N/A	On Grade	1	137.77	142.83	137.77	N/A	0.89	0.68	0.21	76.06	7.00	5.38	143.06
10	I-2033-116	FHWA HEC-22 GENERIC	N/A	On Grade	1	137.79	142.84	137.79	N/A	0.75	0.60	0.14	80.99	7.00	4.77	143.06

Junction Input

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft²)	Minimum Pipe Cover (in)
1	S-2033-045	118.66	124.60	5.94	118.66	0.00	0.00	-124.60	0.00	0.00
2	S-2033-048	119.01	126.73	7.72	119.01	0.00	0.00	-126.73	0.00	0.00
3	S-2033-051	119.93	131.82	11.89	119.93	0.00	0.00	-131.82	0.00	0.00
4	S-2033-101	122.24	136.78	14.54	122.24	0.00	0.00	-136.78	0.00	0.00
5	S-2033-110	126.34	136.07	9.73	126.34	0.00	0.00	-136.07	0.00	0.00
6	S-2033-111	130.03	140.14	10.11	130.03	0.00	0.00	-140.14	0.00	0.00
7	S-2033-112	132.85	142.82	9.97	132.85	0.00	0.00	-142.82	0.00	0.00
8	S-2033-143	125.92	136.25	10.33	125.92	0.00	0.00	-136.25	0.00	0.00
9	S-2033-144	128.23	136.00	7.77	128.23	0.00	0.00	-136.00	0.00	0.00
10	S-2033-341	123.72	130.72	7.00	123.72	0.00	0.00	-130.72	0.00	0.00
11	S-2033-342	124.26	131.49	7.23	124.26	0.00	0.00	-131.49	0.00	0.00
12	S-2033-359	129.79	137.01	7.22	129.79	0.00	0.00	-137.01	0.00	0.00
13	S-2033-360	131.80	140.54	8.74	131.80	0.00	0.00	-140.54	0.00	0.00
14	S-2033-368	123.52	134.20	10.68	123.52	0.00	0.00	-134.20	0.00	0.00
15	S-2033-369	124.66	135.06	10.40	124.66	0.00	0.00	-135.06	10.00	0.00

Junction Results

SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	S-2033-045	0.31	0.00	119.03	0.37	0.00	6.04	118.79	0.13	0 12:29	0 00:00	0.00	0.00
2	S-2033-048	0.31	0.00	120.02	1.01	0.00	6.71	119.69	0.68	0 12:26	0 00:00	0.00	0.00
3	S-2033-051	9.36	0.00	121.39	1.46	0.00	10.43	120.83	0.90	0 12:21	0 00:00	0.00	0.00
4	S-2033-101	0.72	0.72	123.38	1.14	0.00	13.40	123.07	0.83	0 12:18	0 00:00	0.00	0.00
5	S-2033-110	4.56	0.00	136.07	9.73	0.00	0.00	128.25	1.91	0 12:16	0 12:16	0.00	0.00
6	S-2033-111	2.89	0.00	140.14	10.11	0.00	0.00	131.37	1.34	0 12:16	0 12:20	0.09	15.00
7	S-2033-112	1.37	0.00	140.15	7.30	0.00	2.67	133.88	1.03	0 12:16	0 00:00	0.00	0.00
8	S-2033-143	2.37	0.00	136.13	10.21	0.00	0.12	128.48	2.56	0 12:16	0 00:00	0.00	0.00
9	S-2033-144	2.11	0.55	136.00	7.77	0.00	0.00	130.36	2.13	0 12:10	0 12:20	1.03	54.00
10	S-2033-341	0.20	0.20	125.29	1.57	0.00	5.43	125.17	1.45	0 12:30	0 00:00	0.00	0.00
11	S-2033-342	2.47	2.47	126.18	1.92	0.00	5.31	125.78	1.52	0 12:25	0 00:00	0.00	0.00
12	S-2033-359	1.61	0.00	136.11	6.33	0.00	0.89	131.19	1.41	0 12:09	0 00:00	0.00	0.00
13	S-2033-360	1.75	0.28	140.53	8.74	0.00	0.00	133.64	1.85	0 12:09	0 12:09	0.00	0.00
14	S-2033-368	4.01	0.00	133.62	10.10	0.00	0.58	126.53	3.01	0 12:20	0 00:00	0.00	0.00
15	S-2033-369	1.29	1.29	133.69	9.03	0.00	1.37	126.97	2.31	0 12:20	0 00:00	0.00	0.00

Channel Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Shape	Height (ft)	Width (ft)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate
1	022-Bypass	62.37	122.60	0.68	121.10	-0.78	1.50	2.4100	User-Defined	0.470	20.500	0.0320	0.5000	0.5000	0.0000	0.00	No
2	049-Bypass	226.83	126.59	4.71	124.60	5.94	1.99	0.8800	User-Defined	0.470	20.500	0.0320	0.5000	0.5000	0.0000	0.00	No
3	082-Bypass	189.59	131.23	4.92	129.28	9.35	1.95	1.0300	User-Defined	0.470	20.500	0.0320	0.5000	0.5000	0.0000	0.00	No
4	083-Bypass	345.58	136.10	4.91	131.23	4.92	4.87	1.4100	User-Defined	0.470	20.500	0.0320	0.5000	0.5000	0.0000	0.00	No
5	084-Bypass	475.80	135.57	3.39	127.00	5.08	8.57	1.8000	User-Defined	0.470	20.500	0.0320	0.5000	0.5000	0.0000	0.00	No
6	085-Bypass	81.18	136.39	5.11	135.57	3.39	0.82	1.0100	User-Defined	0.470	20.500	0.0320	0.5000	0.5000	0.0000	0.00	No
7	086-Bypass	312.43	140.72	4.63	136.10	4.91	4.62	1.4800	User-Defined	0.470	20.500	0.0320	0.5000	0.5000	0.0000	0.00	No
8	087-Bypass	275.03	140.42	4.97	136.39	5.11	4.03	1.4700	User-Defined	0.470	20.500	0.0320	0.5000	0.5000	0.0000	0.00	No
9	088-Bypass	260.08	142.83	5.06	140.72	4.63	2.11	0.8100	User-Defined	0.470	20.500	0.0320	0.5000	0.5000	0.0000	0.00	No
10	116-Bypass	260.51	142.84	5.05	140.42	4.97	2.42	0.9300	User-Defined	0.470	20.500	0.0320	0.5000	0.5000	0.0000	0.00	No

Channel Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	022-Bypass	0.00	0 12:30	53.96	0.00	0.01	103.95	0.24	0.52	0.00		
2	049-Bypass	0.01	0 12:10	17.64	0.00	1.11	3.41	0.03	0.07	0.00		
3	082-Bypass	1.00	0 12:19	19.10	0.05	2.69	1.17	0.19	0.41	0.00		
4	083-Bypass	0.03	0 12:15	22.36	0.00	1.66	3.47	0.06	0.12	0.00		
5	084-Bypass	0.08	0 12:25	25.28	0.00	4.43	1.79	0.08	0.16	0.00		
6	085-Bypass	4.50	0 12:25	18.93	0.24	2.49	0.54	0.39	0.83	0.00		
7	086-Bypass	0.04	0 12:19	22.90	0.00	2.61	2.00	0.06	0.12	0.00		
8	087-Bypass	2.31	0 12:24	22.80	0.10	2.69	1.70	0.35	0.74	0.00		
9	088-Bypass	0.22	0 12:20	16.96	0.01	2.28	1.90	0.13	0.27	0.00		
10	116-Bypass	0.16	0 12:25	18.13	0.01	2.13	2.04	0.23	0.49	0.00		

Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1	P-022-048	29.40	122.60	0.68	121.26	2.25	1.34	4.5600	CIRCULAR	9.960	9.960	0.0240	0.5000	0.9000	0.0000	0.00	No	1
2	P-048-045	258.54	119.73	0.72	118.66	0.00	1.07	0.4100	CIRCULAR	18.000	18.000	0.0240	0.5000	0.5000	0.0000	0.00	No	1
3	P-049-048	35.04	122.60	0.72	121.23	2.22	1.37	3.9100	CIRCULAR	9.960	9.960	0.0240	0.5000	0.9000	0.0000	0.00	No	1
4	P-050-051	217.73	122.06	0.50	120.38	0.45	1.68	0.7700	Arch	38.040	57.000	0.0240	0.5000	0.5000	0.0000	0.00	No	1
5	P-050-082	41.71	126.85	0.54	122.41	0.85	4.44	10.6600	CIRCULAR	9.960	9.960	0.0240	0.5000	1.0000	0.0000	0.00	No	1
6	P-050-101	232.53	122.41	0.85	122.89	0.65	-0.48	-0.2100	CIRCULAR	36.000	36.000	0.0240	0.5000	0.5000	0.0000	0.00	No	1
7	P-050-341	40.80	122.41	0.85	125.19	1.47	-2.79	-6.8300	CIRCULAR	12.000	12.000	0.0120	0.5000	1.0000	0.0000	0.00	No	1
8	P-060-342	35.05	122.41	0.85	125.67	1.41	-3.27	-9.3100	CIRCULAR	12.000	12.000	0.0240	0.5000	1.0000	0.0000	0.00	No	1
9	P-083-110	18.00	131.89	0.70	130.68	4.34	1.21	6.7200	CIRCULAR	9.960	9.960	0.0240	0.5000	1.0000	0.0000	0.00	No	1
10	P-084-110	42.97	132.19	0.00	128.64	2.30	3.55	8.2500	CIRCULAR	9.960	9.960	0.0240	0.5000	1.0000	0.0000	0.00	No	1
11	P-085-110	38.71	132.06	0.78	130.10	3.76	1.96	5.0600	CIRCULAR	9.960	9.960	0.0240	0.5000	1.0000	0.0000	0.00	No	1
12	P-086-111	14.99	136.64	0.55	134.30	4.27	2.34	15.6100	CIRCULAR	9.960	9.960	0.0240	0.5000	0.6000	0.0000	0.00	No	1
13	P-087-111	11.20	136.11	0.66	134.30	4.27	1.81	16.1600	CIRCULAR	9.960	9.960	0.0240	0.5000	0.6000	0.0000	0.00	No	1
14	P-088-112	15.18	138.44	0.67	137.34	4.49	1.10	7.2400	CIRCULAR	0.960	0.960	0.0240	0.5000	0.6000	0.0000	0.00	No	1
15	P-110-368	113.90	126.74	0.40	125.11	1.59	1.63	1.4300	CIRCULAR	12.000	12.000	0.0240	0.5000	0.5000	0.0000	0.00	No	1
16	P-111-143	259.46	130.54	0.51	127.43	1.51	3.10	1.2000	CIRCULAR	12.000	12.000	0.0240	0.5000	0.5000	0.0000	0.00	No	1
17	P-112-111	255.00	133.56	0.71	130.64	0.61	2.92	1.1500	CIRCULAR	12.000	12.000	0.0240	0.5000	0.5000	0.0000	0.00	No	1
18	P-116-112	12.67	138.52	0.74	137.60	4.75	0.92	7.2600	CIRCULAR	0.960	0.960	0.0240	0.5000	0.6000	0.0000	0.00	No	1
19	P-143-110	45.46	127.24	1.32	126.78	0.44	0.46	1.0100	CIRCULAR	14.040	14.040	0.0240	0.5000	0.5000	0.0000	0.00	No	1
20	P-144-143	29.35	129.78	1.55	129.58	3.66	0.20	0.6800	CIRCULAR	12.000	12.000	0.0120	0.5000	0.6000	0.0000	0.00	No	1
21	P-359-110	46.47	130.80	1.02	130.42	4.08	0.38	0.8200	CIRCULAR	18.000	18.000	0.0120	0.5000	1.0000	0.0000	0.00	No	1
22	P-360-359	296.33	133.50	1.71	130.85	1.06	2.66	0.9000	CIRCULAR	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
23	P-368-050	234.41	125.11	1.59	122.41	0.85	2.71	1.1500	CIRCULAR	12.000	12.000	0.0240	0.5000	1.0000	0.0000	0.00	No	1
24	P-369-368	24.40	126.32	1.66	125.32	1.80	1.00	4.1000	CIRCULAR	12.000	12.000	0.0120	0.5000	0.7000	0.0000	0.00	No	1
25	P-Outfall1	59.86	120.38	0.45	120.20	0.00	0.18	0.3000	Arch	38.040	57.000	0.0240	0.5000	0.5000	0.0000	0.00	No	1
26	P-Outfall2	25.21	118.66	0.00	118.62	0.00	0.04	0.1600	CIRCULAR	15.960	15.960	0.0240	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	P-022-048	0.27	0 12:25	2.53	0.11	2.94	0.17	0.19	0.23	0.00		Calculated
2	P-048-045	0.31	0 12:26	3.66	0.08	1.07	4.03	0.33	0.22	0.00		Calculated
3	P-049-048	0.12	0 12:10	2.35	0.05	2.20	0.27	0.13	0.15	0.00		Calculated
4	P-050-051	8.41	0 12:22	62.17	0.14	2.61	1.39	0.84	0.27	0.00		Calculated
5	P-050-082	1.27	0 12:20	3.87	0.33	6.07	0.11	0.34	0.41	0.00		Calculated
6	P-050-101	0.73	0 12:20	19.79	0.04	1.26	3.08	0.41	0.14	0.00		Calculated
7	P-050-341	0.20	0 12:30	10.08	0.02	2.86	0.24	0.21	0.21	0.00		Calculated
8	P-060-342	2.47	0 12:25	5.89	0.42	6.65	0.09	0.48	0.48	0.00		Calculated
9	P-083-110	0.80	0 12:09	3.08	0.26	2.53	0.12	0.83	1.00	111.00		SURCHARGED
10	P-084-110	1.83	0 12:09	3.41	0.54	4.39	0.16	0.83	1.00	110.00		SURCHARGED
11	P-085-110	2.03	0 12:09	2.67	0.76	20.94	0.03	0.83	1.00	113.00		SURCHARGED
12	P-086-111	0.79	0 12:20	4.69	0.17	4.88	0.05	0.83	1.00	39.00		SURCHARGED
13	P-087-111	2.14	0 12:25	4.77	0.45	8.09	0.02	0.83	1.00	58.00		SURCHARGED
14	P-088-112	0.02	0 06:56	0.01	2.19	2.76	0.09	0.08	1.00	1150.00		SURCHARGED
15	P-110-368	3.41	0 13:09	2.31	1.48	4.34	0.44	1.00	1.00	243.00		SURCHARGED
16	P-111-143	2.37	0 12:31	2.11	1.12	3.02	1.43	1.00	1.00	143.00		SURCHARGED
17	P-112-111	1.34	0 12:10	2.07	0.65	1.70	2.50	1.00	1.00	100.00		SURCHARGED
18	P-116-112	0.02	0 05:23	0.01	2.33	2.95	0.07	0.08	1.00	1139.00		SURCHARGED
19	P-143-110	1.29	0 13:55	2.93	0.44	1.61	0.47	1.17	1.00	204.00		SURCHARGED
20	P-144-143	1.56	0 12:20	3.19	0.49	1.99	0.25	1.00	1.00	148.00		SURCHARGED
21	P-359-110	1.61	0 12:08	10.29	0.16	1.54	0.50	1.50	1.00	117.00		SURCHARGED
22	P-360-359	1.61	0 12:08	10.77	0.15	1.68	2.94	1.50	1.00	78.00		SURCHARGED
23	P-368-050	4.01	0 12:20	2.07	1.94	5.29	0.74	0.92	0.92	0.00		> CAPACITY
24	P-369-368	1.29	0 12:20	7.81	0.16	1.64	0.25	1.00	1.00	182.00		SURCHARGED
25	P-Outfall1	9.33	0 12:21	38.81	0.24	2.45	0.41	0.96	0.30	0.00		Calculated
26	P-Outfall2	0.31	0 12:29	2.28	0.13	1.04	0.40	0.35	0.26	0.00		Calculated

Inlet Input

SN	Element ID	Inlet Manufacturer	Manufacturer Part Number	Inlet Location	Number of Inlets	Catchbasin Invert Elevation (ft)	Max (Rim) Elevation (ft)	Inlet Depth (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Ponded Area (ft²)	Grate Clogging Factor (%)
1	I-2033-022	FHWA HEC-22 GENERIC	N/A	On Grade	1	121.92	127.00	5.08	121.92	0.00	N/A	0.00
2	I-2033-049	FHWA HEC-22 GENERIC	N/A	On Grade	1	121.88	126.59	4.71	121.88	0.00	N/A	0.00
3	I-2033-082	FHWA HEC-22 GENERIC	N/A	On Grade	1	126.31	131.23	4.92	126.31	0.00	N/A	0.00
4	I-2033-083	FHWA HEC-22 GENERIC	N/A	On Grade	1	131.19	136.10	4.91	131.19	0.00	N/A	0.00
5	I-2033-084	FHWA HEC-22 GENERIC	N/A	On Grade	1	132.19	135.57	3.39	132.19	0.00	N/A	0.00
6	I-2033-085	FHWA HEC-22 GENERIC	N/A	On Grade	1	131.28	136.39	5.11	131.28	0.00	N/A	0.00
7	I-2033-086	FHWA HEC-22 GENERIC	N/A	On Grade	1	136.09	140.72	4.63	136.09	0.00	N/A	0.00
8	I-2033-087	FHWA HEC-22 GENERIC	N/A	On Grade	1	135.45	140.42	4.97	135.45	0.00	N/A	0.00
9	I-2033-088	FHWA HEC-22 GENERIC	N/A	On Grade	1	137.77	142.83	5.06	137.77	0.00	N/A	0.00
10	I-2033-116	FHWA HEC-22 GENERIC	N/A	On Grade	1	137.79	142.84	5.05	137.79	0.00	N/A	0.00

Roadway & Gutter Input

SN	Element ID	Roadway Longitudinal Slope (ft/ft)	Roadway Cross Slope (ft/ft)	Roadway Manning's Roughness	Gutter Cross Slope (ft/ft)	Gutter Width (ft)	Gutter Depression (in)	Allowable Spread (ft)
1	I-2033-022	0.0178	0.0200	0.0160	0.0830	2.00	0.0000	7.00
2	I-2033-049	0.0100	0.0200	0.0160	0.0620	2.00	0.0656	7.00
3	I-2033-082	0.0110	0.0200	0.0160	0.0830	2.00	0.0000	7.00
4	I-2033-083	0.0091	0.0200	0.0160	0.0830	2.00	0.0000	7.00
5	I-2033-084	0.0177	0.0200	0.0160	0.0830	2.00	0.0000	7.00
6	I-2033-085	0.0091	0.0200	0.0160	0.0830	2.00	0.0000	7.00
7	I-2033-086	0.0264	0.0200	0.0160	0.0830	2.00	0.0000	7.00
8	I-2033-087	0.0264	0.0200	0.0160	0.0830	2.00	0.0000	7.00
9	I-2033-088	0.0083	0.0200	0.0160	0.0830	2.00	0.0000	7.00
10	I-2033-116	0.0083	0.0200	0.0160	0.0830	2.00	0.0000	7.00

Inlet Results

SN	Element ID	Peak Flow (cfs)	Peak Lateral Inflow (cfs)	Peak Flow Intercepted by Inlet (cfs)	Peak Flow Bypassing Inlet (cfs)	Inlet Efficiency during Peak Flow (%)	Max Gutter Spread during Peak Flow (ft)	Max Gutter Water Elev. during Peak Flow (ft)	Max Gutter Water Depth during Peak Flow (ft)	Time of Max Depth Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	I-2033-022	0.21	0.21	0.21	0.00	99.99	1.48	127.12	0.12	0 12:25	0.00	0.00
2	I-2033-049	0.12	0.12	0.12	0.00	100.00	1.63	126.69	0.10	0 12:10	0.00	0.00
3	I-2033-082	2.24	2.24	1.24	1.00	55.48	8.36	131.52	0.29	0 12:20	0.00	0.00
4	I-2033-083	0.46	0.46	0.24	0.22	52.67	2.26	136.15	0.05	0 12:20	0.00	0.00
5	I-2033-084	0.72	0.72	0.15	0.57	20.31	2.36	135.62	0.05	0 12:09	2.58	67.00
6	I-2033-085	6.89	6.89	2.42	4.47	35.10	14.38	136.80	0.41	0 12:09	1.19	45.00
7	I-2033-086	0.60	0.60	0.05	0.55	8.19	2.05	140.76	0.04	0 12:20	0.00	0.00
8	I-2033-087	4.03	4.03	0.00	4.03	0.00	8.99	140.73	0.31	0 12:25	0.00	0.00
9	I-2033-088	0.89	0.89	0.68	0.21	76.06	5.38	143.06	0.23	0 05:08	1.46	1132.00
10	I-2033-116	0.75	0.75	0.60	0.14	80.99	4.77	143.06	0.22	0 05:23	1.33	1117.00

Storage Nodes

Storage Node : S-2033-050

Input Data

Invert Elevation (ft) 121.56
Max (Rim) Elevation (ft) 131.74
Max (Rim) Offset (ft) 10.18
Initial Water Elevation (ft) 121.56
Initial Water Depth (ft) 0.00
Ponded Area (ft^2) 0.00
Evaporation Loss 0.00

Output Summary Results

Peak Inflow (cfs) 8.41
Peak Lateral Inflow (cfs) 0
Peak Outflow (cfs) 8.41
Peak Exfiltration Flow Rate (cfm) 0
Max HGL Elevation Attained (ft) 122.74
Max HGL Depth Attained (ft) 1.18
Average HGL Elevation Attained (ft) 122.39
Average HGL Depth Attained (ft) 0.83
Time of Max HGL Occurrence (days hh:mm) 0 12:22
Total Exfiltration Volume (1000-ft^3) 0
Total Flooded Volume (ac-in) 0
Total Time Flooded (min) 0
Total Retention Time (sec) 0

Proposed Stormwater System
SSA Report & Results

Project Description

File Name .... Quinhagak_SSA_Proposed_V1Test.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	SCS TR-55
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Hydrodynamic
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	NO

Analysis Options

Start Analysis On	00:00:00	0:00:00
End Analysis On	00:00:00	0:00:00
Start Reporting On	00:00:00	0:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	22
Nodes	32
Junctions	28
Outfalls	2
Flow Diversions	0
Inlets	0
Storage Nodes	2
Links	30
Channels	0
Pipes	30
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	MOA	Time Series	MOA Design Storm Distribution	Cumulative	inches				0.00	

Subbasin Summary

SN	Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	1	0.04	484.00	88.00	2.46	1.32	0.05	0.04	0 00:08:43
2	4	0.59	484.00	88.00	2.46	1.35	0.80	0.38	0 00:20:51
3	63rd_Island	0.37	484.00	88.00	2.46	1.35	0.50	0.23	0 00:23:14
4	E1	0.56	484.00	88.00	2.46	1.35	0.75	0.33	0 00:25:41
5	E10	1.04	484.00	88.00	2.46	1.35	1.40	0.75	0 00:16:18
6	E10A	3.83	484.00	88.00	2.46	1.35	5.16	2.06	0 00:29:58
7	E11	1.08	484.00	75.00	2.46	0.63	0.68	0.21	0 00:36:45
8	E12	0.38	484.00	89.00	2.46	1.42	0.53	0.19	0 00:37:05
9	E2	0.09	484.00	88.00	2.46	1.34	0.13	0.08	0 00:13:00
10	E4	0.51	484.00	88.00	2.46	1.35	0.69	0.38	0 00:15:25
11	E5	12.55	484.00	88.00	2.46	1.35	16.93	6.90	0 00:28:50
12	E8	1.30	484.00	88.00	2.46	1.35	1.76	0.76	0 00:25:58
13	E9	0.81	484.00	88.00	2.46	1.35	1.09	0.54	0 00:19:35
14	Quinhagak_63rd_Island	0.71	484.00	88.00	2.46	1.35	0.96	0.46	0 00:20:37
15	Quinhagak_Sag_East	5.82	484.00	88.00	2.46	1.35	7.85	3.31	0 00:26:58
16	Quinhagak_Sag_West	0.86	484.00	88.00	2.46	1.35	1.16	0.63	0 00:15:59
17	W4	0.62	484.00	88.00	2.46	1.35	0.83	0.37	0 00:23:40
18	W5	0.78	484.00	88.00	2.46	1.35	1.05	0.59	0 00:14:47
19	W6	0.12	484.00	88.00	2.46	1.34	0.16	0.09	0 00:14:25
20	W7	1.76	484.00	88.00	2.46	1.35	2.37	1.23	0 00:17:49
21	W8	3.17	484.00	88.00	2.46	1.35	4.27	2.14	0 00:19:06
22	W9	0.33	484.00	75.00	2.46	0.63	0.21	0.07	0 00:30:48

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	S-63A	Junction	126.34	136.07	126.34	0.00	0.00	7.86	131.91	0.00	4.16	0 00:00	0.00	0.00
2	S-63B	Junction	131.80	140.54	131.80	0.00	0.00	0.22	133.65	0.00	6.89	0 00:00	0.00	0.00
3	S-64B	Junction	120.23	133.90	120.23	0.00	0.00	2.79	123.34	0.00	10.56	0 00:00	0.00	0.00
4	S-64C	Junction	122.24	136.78	122.24	0.00	0.00	0.72	123.35	0.00	13.43	0 00:00	0.00	0.00
5	S-AE	Junction	123.00	127.99	123.00	127.99	0.00	0.21	124.62	0.00	3.37	0 00:00	0.00	0.00
6	S-AW	Junction	120.25	127.77	121.75	127.77	0.00	0.28	121.90	0.00	5.87	0 00:00	0.00	0.00
7	S-B1	Junction	128.23	136.00	128.23	0.00	0.00	0.46	131.75	0.00	4.25	0 00:00	0.00	0.00
8	S-B2	Junction	124.66	135.06	124.66	0.00	0.00	1.20	128.38	0.00	6.68	0 00:00	0.00	0.00
9	S-B3	Junction	124.26	131.47	124.26	0.00	0.00	2.06	126.20	0.00	5.27	0 00:00	0.00	0.00
10	S-B4	Junction	123.72	130.72	125.19	1.10	0.00	0.19	125.29	0.00	5.43	0 00:00	0.00	0.00
11	S-E1	Junction	140.45	144.19	140.45	144.19	0.00	0.32	142.07	0.00	2.12	0 00:00	0.00	0.00
12	S-E2	Junction	138.98	144.10	138.98	144.10	0.00	0.08	139.04	0.00	5.06	0 00:00	0.00	0.00
13	S-E3	Junction	135.70	142.87	135.70	142.87	0.00	3.30	138.71	0.00	4.16	0 00:00	0.00	0.00
14	S-E4	Junction	133.28	140.28	133.28	140.28	0.00	0.37	134.94	0.00	5.34	0 00:00	0.00	0.00
15	S-E5	Junction	129.12	137.12	129.12	137.12	0.00	0.46	130.78	0.00	6.34	0 00:00	0.00	0.00
16	S-E6	Junction	129.36	135.69	130.86	135.69	0.00	0.00	130.86	0.00	4.83	0 00:00	0.00	0.00
17	S-E7	Junction	127.60	122.16	127.60	122.16	0.00	0.54	128.37	0.00	0.80	0 00:00	0.00	0.00
18	S-OGS2	Junction	118.88	131.29	118.88	0.00	0.00	19.82	122.52	0.00	8.76	0 00:00	0.00	0.00
19	S-Q1	Junction	127.15	136.16	127.15	0.00	0.00	13.70	130.19	0.00	5.97	0 00:00	0.00	0.00
20	S-Q2	Junction	126.62	135.48	126.62	0.00	0.00	13.70	129.48	0.00	6.00	0 00:00	0.00	0.00
21	Structure - (67)	Junction	119.53	121.26	119.53	121.26	0.00	0.28	119.90	0.00	2.35	0 00:00	0.00	0.00
22	S-W1	Junction	136.70	144.19	136.70	144.19	0.00	0.34	138.38	0.00	5.81	0 00:00	0.00	0.00
23	S-W2	Junction	135.00	144.09	135.00	144.09	0.00	0.77	136.76	0.00	7.32	0 00:00	0.00	0.00
24	S-W3	Junction	133.30	142.87	133.30	142.87	0.00	4.52	135.42	0.00	7.45	0 00:00	0.00	0.00
25	S-W4	Junction	130.52	140.05	130.52	140.05	0.00	5.20	132.65	0.00	7.40	0 00:00	0.00	0.00
26	S-W5	Junction	127.74	136.89	127.74	136.89	0.00	6.15	130.29	0.00	6.60	0 00:00	0.00	0.00
27	S-W6	Junction	125.73	134.20	125.73	134.20	0.00	14.73	128.37	0.00	5.82	0 00:00	0.00	0.00
28	S-W7	Junction	123.74	132.20	123.74	132.20	0.00	17.15	126.78	0.00	5.42	0 00:00	0.00	0.00
29	Outfall-64th	Outfall	120.38					19.82	121.36					
30	Outfall-Askeland	Outfall	118.66					0.28	118.85					
31	S-64A	Storage Node	119.90	131.22	119.90		0.00	19.82	123.33				0.00	0.00
32	S-OGS1	Storage Node	119.75	131.17	119.75		0.00	19.82	122.98				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Reported Condition
1	0.28x	Pipe	Structure - (67)	Outfall-Askeland	238.57	119.53	118.66	0.3600	18.000	0.0240	0.28	3.44	0.08	1.22	0.28	0.19	0.00	Calculated
2	P-63B	Pipe	S-63A	S-Q1	74.02	130.72	129.98	1.0000	18.000	0.0120	7.82	11.38	0.69	5.90	1.05	0.70	0.00	Calculated
3	P-63C	Pipe	S-63B	S-63A	300.33	133.50	130.85	0.8800	18.000	0.0120	0.22	10.70	0.02	0.73	0.61	0.41	0.00	Calculated
4	P-64A	Pipe	S-OGS2	Outfall-64th	166.57	121.10	120.38	0.4300	38.000	0.0240	19.82	46.53	0.43	4.04	1.20	0.38	0.00	Calculated
5	P-64B	Pipe	S-64B	S-64A	44.44	121.73	121.50	0.5200	42.000	0.0240	2.89	39.21	0.07	1.14	1.72	0.49	0.00	Calculated
6	P-64C	Pipe	S-64C	S-64B	213.07	122.89	121.83	0.5000	36.000	0.0240	0.71	25.48	0.03	0.72	0.98	0.33	0.00	Calculated
7	P-A2	Pipe	S-AW	Structure - (67)	50.16	121.75	120.75	1.9900	18.000	0.0120	0.28	16.07	0.02	3.27	0.14	0.10	0.00	Calculated
8	P-A3	Pipe	S-AE	S-AW	33.80	124.50	123.10	4.1400	12.000	0.0120	0.21	7.86	0.03	4.14	0.12	0.12	0.00	Calculated
9	P-B1	Pipe	S-B1	S-E5	23.85	131.55	130.80	3.1400	12.000	0.0120	0.46	6.84	0.07	4.44	0.19	0.19	0.00	Calculated
10	P-B2	Pipe	S-B2	S-W6	16.05	128.04	127.40	4.0000	12.000	0.0150	1.20	6.17	0.19	3.26	0.65	0.65	0.00	Calculated
11	P-B3	Pipe	S-B3	S-64B	17.35	125.67	124.80	5.0100	12.000	0.0120	2.06	8.64	0.24	6.33	0.43	0.43	0.00	Calculated
12	P-B4	Pipe	S-B4	S-64B	27.40	125.19	123.00	7.9900	12.000	0.0120	0.19	10.91	0.02	4.88	0.21	0.21	0.00	Calculated
13	PC-1	Pipe	S-E1	S-W1	34.00	141.95	138.50	10.1500	12.000	0.0120	0.32	12.29	0.03	6.40	0.12	0.12	0.00	Calculated
14	PC-2	Pipe	S-E2	S-W2	35.00	138.98	136.26	7.7700	12.000	0.0120	0.08	10.76	0.01	0.44	0.28	0.28	0.00	Calculated
15	PC-3	Pipe	S-W3	S-E3	34.00	137.20	134.56	7.7600	12.000	0.0150	3.30	6.49	0.51	5.20	0.75	0.75	0.00	Calculated
16	PC-4	Pipe	S-E4	S-W4	34.00	134.78	133.42	4.0000	12.000	0.0120	0.37	7.72	0.05	4.73	0.15	0.15	0.00	Calculated
17	PC-5	Pipe	S-E5	S-W5	33.80	130.62	129.34	3.7900	15.000	0.0120	0.46	13.62	0.03	2.23	0.55	0.44	0.00	Calculated
18	PC-6	Pipe	S-E6	S-Q2	34.51	130.86	129.48	4.0000	12.000	0.0120	0.00	7.72	0.00	0.00	0.00	0.00	0.00	Calculated
19	PC-7	Pipe	S-E7	S-W7	34.00	128.17	126.81	4.0000	12.000	0.0120	0.54	7.72	0.07	5.22	0.19	0.19	0.00	Calculated
20	P-OGS1	Pipe	S-64A	S-OGS1	10.00	121.40	121.35	0.5000	42.000	0.0120	19.82	77.07	0.26	4.68	1.78	0.51	0.00	Calculated
21	P-OGS2	Pipe	S-OGS1	S-OGS2	10.00	121.25	121.20	0.5000	42.000	0.0120	19.82	77.07	0.26	4.91	1.53	0.44	0.00	Calculated
22	PW-1	Pipe	S-W1	S-W2	159.38	138.20	136.61	1.0000	18.000	0.0120	0.33	11.38	0.03	2.82	0.18	0.12	0.00	Calculated
23	P-W2	Pipe	S-W2	S-W3	159.76	136.50	134.90	1.0000	18.000	0.0120	0.77	11.39	0.07	2.16	0.39	0.26	0.00	Calculated
24	P-W3	Pipe	S-W3	S-W4	267.89	134.80	132.12	1.0000	24.000	0.0120	4.51	24.51	0.18	5.71	0.60	0.30	0.00	Calculated
25	P-W4	Pipe	S-W4	S-W5	267.86	132.02	129.34	1.0000	24.000	0.0120	5.20	24.51	0.21	5.16	0.78	0.39	0.00	Calculated
26	P-W5	Pipe	S-W5	S-Q1	48.18	129.24	128.76	1.0000	24.000	0.0120	6.06	24.46	0.25	3.28	1.24	0.62	0.00	Calculated
27	P-W6	Pipe	S-Q1	S-Q2	42.64	128.65	128.22	1.0000	24.000	0.0120	13.70	24.50	0.56	5.84	1.40	0.70	0.00	Calculated
28	P-W7	Pipe	S-Q2	S-W6	78.91	128.12	127.33	1.0000	24.000	0.0120	13.70	24.51	0.56	6.85	1.22	0.61	0.00	Calculated
29	P-W8	Pipe	S-W6	S-W7	188.51	127.23	125.35	1.0000	30.000	0.0120	14.73	44.43	0.33	5.82	1.28	0.52	0.00	Calculated
30	PW-9	Pipe	S-W7	S-64A	41.35	125.24	124.83	1.0000	30.000	0.0120	17.14	44.44	0.39	6.58	1.30	0.52	0.00	Calculated

Junction Input

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft²)	Minimum Pipe Cover (in)
1	S-63A	126.34	136.07	9.73	126.34	0.00	0.00	-136.07	0.00	0.00
2	S-63B	131.80	140.54	8.74	131.80	0.00	0.00	-140.54	0.00	0.00
3	S-64B	120.23	133.90	13.67	120.23	0.00	0.00	-133.90	0.00	0.00
4	S-64C	122.24	136.78	14.54	122.24	0.00	0.00	-136.78	0.00	0.00
5	S-AE	123.00	127.99	4.99	123.00	0.00	127.99	0.00	0.00	0.00
6	S-AW	120.25	127.77	7.52	121.75	1.50	127.77	0.00	0.00	0.00
7	S-B1	128.23	136.00	7.77	128.23	0.00	0.00	-136.00	0.00	0.00
8	S-B2	124.66	135.06	10.40	124.66	0.00	0.00	-135.06	0.00	0.00
9	S-B3	124.26	131.47	7.21	124.26	0.00	0.00	-131.47	0.00	0.00
10	S-B4	123.72	130.72	7.00	125.19	1.47	1.10	-129.62	0.00	0.00
11	S-E1	140.45	144.19	3.74	140.45	0.00	144.19	0.00	0.00	0.00
12	S-E2	138.98	144.10	5.12	138.98	0.00	144.10	0.00	0.00	0.00
13	S-E3	135.70	142.87	7.17	135.70	0.00	142.87	0.00	0.00	0.00
14	S-E4	133.28	140.28	7.00	133.28	0.00	140.28	0.00	0.00	0.00
15	S-E5	129.12	137.12	8.00	129.12	0.00	137.12	0.00	0.00	0.00
16	S-E6	129.36	135.69	6.33	130.86	1.50	135.69	0.00	0.00	0.00
17	S-E7	127.60	122.16	-5.44	127.60	0.00	122.16	0.00	0.00	0.00
18	S-OGS2	118.88	131.29	12.41	118.88	0.00	0.00	-131.29	0.00	0.00
19	S-Q1	127.15	136.16	9.01	127.15	0.00	0.00	-136.16	0.00	0.00
20	S-Q2	126.62	135.48	8.86	126.62	0.00	0.00	-135.48	0.00	0.00
21	Structure - (67)	119.53	121.26	1.73	119.53	0.00	121.26	0.00	0.00	0.00
22	S-W1	136.70	144.19	7.49	136.70	0.00	144.19	0.00	0.00	0.00
23	S-W2	135.00	144.09	9.09	135.00	0.00	144.09	0.00	0.00	0.00
24	S-W3	133.30	142.87	9.57	133.30	0.00	142.87	0.00	0.00	0.00
25	S-W4	130.52	140.05	9.53	130.52	0.00	140.05	0.00	0.00	0.00
26	S-W5	127.74	136.89	9.15	127.74	0.00	136.89	0.00	0.00	0.00
27	S-W6	125.73	134.20	8.47	125.73	0.00	134.20	0.00	0.00	0.00
28	S-W7	123.74	132.20	8.46	123.74	0.00	132.20	0.00	0.00	0.00

Junction Results

SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	S-63A	7.86	7.64	131.91	5.57	0.00	4.16	131.04	4.70	0 12:25	0 00:00	0.00	0.00
2	S-63B	0.22	0.22	133.65	1.86	0.00	6.89	133.50	1.71	0 12:21	0 00:00	0.00	0.00
3	S-64B	2.79	0.00	123.34	3.11	0.00	10.56	122.19	1.96	0 12:24	0 00:00	0.00	0.00
4	S-64C	0.72	0.72	123.35	1.11	0.00	13.43	123.02	0.78	0 12:24	0 00:00	0.00	0.00
5	S-AE	0.21	0.21	124.62	1.62	0.00	3.37	124.42	1.42	0 12:30	0 00:00	0.00	0.00
6	S-AW	0.28	0.07	121.90	1.65	0.00	5.87	121.83	1.58	0 12:30	0 00:00	0.00	0.00
7	S-B1	0.46	0.46	131.75	3.52	0.00	4.25	131.49	3.26	0 12:20	0 00:00	0.00	0.00
8	S-B2	1.20	1.20	128.38	3.72	0.00	6.68	128.04	3.38	0 12:23	0 00:00	0.00	0.00
9	S-B3	2.06	2.06	126.20	1.94	0.00	5.27	125.83	1.57	0 12:25	0 00:00	0.00	0.00
10	S-B4	0.19	0.19	125.29	1.57	0.00	5.43	125.24	1.52	0 12:34	0 00:00	0.00	0.00
11	S-E1	0.32	0.32	142.07	1.62	0.00	2.12	141.94	1.49	0 12:25	0 00:00	0.00	0.00
12	S-E2	0.08	0.08	139.04	0.06	0.00	5.06	139.01	0.03	0 12:15	0 00:00	0.00	0.00
13	S-E3	3.30	3.30	138.71	3.01	0.00	4.16	137.62	1.92	0 12:25	0 00:00	0.00	0.00
14	S-E4	0.37	0.37	134.94	1.66	0.00	5.34	134.79	1.51	0 12:15	0 00:00	0.00	0.00
15	S-E5	0.46	0.00	130.78	1.66	0.00	6.34	130.62	1.50	0 12:20	0 00:00	0.00	0.00
16	S-E6	0.00	0.00	130.86	1.50	0.00	4.83	130.86	1.50	0 00:00	0 00:00	0.00	0.00
17	S-E7	0.54	0.54	128.37	0.77	0.00	0.80	128.23	0.63	0 12:20	0 00:00	0.00	0.00
18	S-OGS2	19.82	0.00	122.52	3.64	0.00	8.76	121.64	2.76	0 12:24	0 00:00	0.00	0.00
19	S-Q1	13.70	0.00	130.19	3.04	0.00	5.97	129.20	2.05	0 12:25	0 00:00	0.00	0.00
20	S-Q2	13.70	0.00	129.48	2.86	0.00	6.00	128.62	2.00	0 12:25	0 00:00	0.00	0.00
21	Structure - (67)	0.28	0.00	119.90	0.37	0.00	2.35	119.73	0.20	0 12:32	0 00:00	0.00	0.00
22	S-W1	0.34	0.04	138.38	1.68	0.00	5.81	138.22	1.52	0 12:22	0 00:00	0.00	0.00
23	S-W2	0.77	0.38	136.76	1.76	0.00	7.32	136.56	1.56	0 12:20	0 00:00	0.00	0.00
24	S-W3	4.52	0.60	135.42	2.12	0.00	7.45	135.02	1.72	0 12:21	0 00:00	0.00	0.00
25	S-W4	5.20	0.37	132.65	2.13	0.00	7.40	132.26	1.74	0 12:21	0 00:00	0.00	0.00
26	S-W5	6.15	0.57	130.29	2.55	0.00	6.60	129.56	1.82	0 12:23	0 00:00	0.00	0.00
27	S-W6	14.73	0.09	128.37	2.64	0.00	5.82	127.66	1.93	0 12:23	0 00:00	0.00	0.00
28	S-W7	17.15	2.12	126.78	3.04	0.00	5.42	125.83	2.09	0 12:22	0 00:00	0.00	0.00

Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1	0.28x	238.57	119.53	0.00	118.66	0.00	0.87	0.3600	CIRCULAR	18.000	18.000	0.0240	0.5000	0.5000	0.0000	0.00	No	1
2	P-63B	74.02	130.72	4.38	129.98	2.83	0.74	1.0000	CIRCULAR	18.000	18.000	0.0120	0.5000	0.7000	0.0000	0.00	No	1
3	P-63C	300.33	133.50	1.71	130.85	4.51	2.66	0.8800	CIRCULAR	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
4	P-64A	166.57	121.10	2.22	120.38	0.00	0.72	0.4300	Arch	38.040	57.000	0.0240	0.5000	0.5000	0.0000	0.00	No	1
5	P-64B	44.44	121.73	1.50	121.50	1.60	0.23	0.5200	CIRCULAR	42.000	42.000	0.0240	0.5000	0.5000	0.0000	0.00	No	1
6	P-64C	213.07	122.89	0.65	121.83	1.60	1.06	0.5000	CIRCULAR	36.000	36.000	0.0240	0.5000	0.5000	0.0000	0.00	No	1
7	P-A2	50.16	121.75	1.50	120.75	1.22	1.00	1.9900	CIRCULAR	18.000	18.000	0.0120	0.5000	0.8000	0.0000	0.00	No	1
8	P-A3	33.80	124.50	1.50	123.10	2.85	1.40	4.1400	CIRCULAR	12.000	12.000	0.0120	0.5000	0.6000	0.0000	0.00	No	1
9	P-B1	23.85	131.55	3.32	130.80	1.68	0.75	3.1400	CIRCULAR	12.000	12.000	0.0120	0.5000	0.6000	0.0000	0.00	No	1
10	P-B2	16.05	128.04	3.38	127.40	1.67	0.64	4.0000	CIRCULAR	12.000	12.000	0.0150	0.5000	0.6000	0.0000	0.00	No	1
11	P-B3	17.35	125.67	1.41	124.80	4.57	0.87	5.0100	CIRCULAR	12.000	12.000	0.0120	0.5000	1.0000	0.0000	0.00	No	1
12	P-B4	27.40	125.19	1.47	123.00	2.77	2.19	7.9900	CIRCULAR	12.000	12.000	0.0120	0.5000	1.0000	0.0000	0.00	No	1
13	PC-1	34.00	141.95	1.50	138.50	1.80	3.45	10.1500	CIRCULAR	12.000	12.000	0.0120	0.5000	0.6000	0.0000	0.00	No	1
14	PC-2	35.00	138.98	0.00	136.26	1.26	2.72	7.7700	CIRCULAR	12.000	12.000	0.0120	0.5000	0.6000	0.0000	0.00	No	1
15	PC-3	34.00	137.20	3.90	134.56	-1.14	2.64	7.7600	CIRCULAR	12.000	12.000	0.0150	0.5000	0.6000	0.0000	0.00	No	1
16	PC-4	34.00	134.78	1.50	133.42	2.90	1.36	4.0000	CIRCULAR	12.000	12.000	0.0120	0.5000	0.6000	0.0000	0.00	No	1
17	PC-5	33.80	130.62	1.50	129.34	1.60	1.28	3.7900	CIRCULAR	15.000	15.000	0.0120	0.5000	0.6000	0.0000	0.00	No	1
18	PC-6	34.51	130.86	1.50	129.48	2.86	1.38	4.0000	CIRCULAR	12.000	12.000	0.0120	0.5000	0.6000	0.0000	0.00	No	1
19	PC-7	34.00	128.17	0.57	126.81	3.07	1.36	4.0000	CIRCULAR	12.000	12.000	0.0120	0.5000	0.6000	0.0000	0.00	No	1
20	P-OGS1	10.00	121.40	1.50	121.35	1.60	0.05	0.5000	CIRCULAR	42.000	42.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
21	P-OGS2	10.00	121.25	1.50	121.20	2.32	0.05	0.5000	CIRCULAR	42.000	42.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
22	PW-1	159.38	138.20	1.50	136.61	1.61	1.59	1.0000	CIRCULAR	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
23	P-W2	159.76	136.50	1.50	134.90	1.60	1.60	1.0000	CIRCULAR	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
24	P-W3	267.89	134.80	1.50	132.12	1.60	2.68	1.0000	CIRCULAR	24.000	24.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
25	P-W4	267.86	132.02	1.50	129.34	1.60	2.68	1.0000	CIRCULAR	24.000	24.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
26	P-W5	48.18	129.24	1.50	128.76	1.61	0.48	1.0000	CIRCULAR	24.000	24.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
27	P-W6	42.64	128.65	1.50	128.22	1.60	0.43	1.0000	CIRCULAR	24.000	24.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
28	P-W7	78.91	128.12	1.50	127.33	1.60	0.79	1.0000	CIRCULAR	24.000	24.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
29	P-W8	188.51	127.23	1.50	125.35	1.61	1.89	1.0000	CIRCULAR	30.000	30.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
30	PW-9	41.35	125.24	1.50	124.83	4.93	0.41	1.0000	CIRCULAR	30.000	30.000	0.0120	0.5000	0.7000	0.0000	0.00	No	1

Pipe Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	0.28x	0.28	0 12:32	3.44	0.08	1.22	3.26	0.28	0.19	0.00		Calculated
2	P-63B	7.82	0 12:25	11.38	0.69	5.90	0.21	1.05	0.70	0.00		Calculated
3	P-63C	0.22	0 12:21	10.70	0.02	0.73	6.86	0.61	0.41	0.00		Calculated
4	P-64A	19.82	0 12:24	46.53	0.43	4.04	0.69	1.20	0.38	0.00		Calculated
5	P-64B	2.89	0 12:29	39.21	0.07	1.14	0.65	1.72	0.49	0.00		Calculated
6	P-64C	0.71	0 12:19	25.48	0.03	0.72	4.93	0.98	0.33	0.00		Calculated
7	P-A2	0.28	0 12:30	16.07	0.02	3.27	0.26	0.14	0.10	0.00		Calculated
8	P-A3	0.21	0 12:30	7.86	0.03	4.14	0.14	0.12	0.12	0.00		Calculated
9	P-B1	0.46	0 12:20	6.84	0.07	4.44	0.09	0.19	0.19	0.00		Calculated
10	P-B2	1.20	0 12:20	6.17	0.19	3.26	0.08	0.65	0.65	0.00		Calculated
11	P-B3	2.06	0 12:25	8.64	0.24	6.33	0.05	0.43	0.43	0.00		Calculated
12	P-B4	0.19	0 12:30	10.91	0.02	4.88	0.09	0.21	0.21	0.00		Calculated
13	PC-1	0.32	0 12:25	12.29	0.03	6.40	0.09	0.12	0.12	0.00		Calculated
14	PC-2	0.08	0 12:15	10.76	0.01	0.44	1.33	0.28	0.28	0.00		Calculated
15	PC-3	3.30	0 12:25	6.49	0.51	5.20	0.11	0.75	0.75	0.00		Calculated
16	PC-4	0.37	0 12:15	7.72	0.05	4.73	0.12	0.15	0.15	0.00		Calculated
17	PC-5	0.46	0 12:20	13.62	0.03	2.23	0.25	0.55	0.44	0.00		Calculated
18	PC-6	0.00	0 00:00	7.72	0.00	0.00		0.00	0.00	0.00		Calculated
19	PC-7	0.54	0 12:20	7.72	0.07	5.22	0.11	0.19	0.19	0.00		Calculated
20	P-OGS1	19.82	0 12:24	77.07	0.26	4.68	0.04	1.78	0.51	0.00		Calculated
21	P-OGS2	19.82	0 12:24	77.07	0.26	4.91	0.03	1.53	0.44	0.00		Calculated
22	PW-1	0.33	0 12:22	11.38	0.03	2.82	0.94	0.18	0.12	0.00		Calculated
23	P-W2	0.77	0 12:20	11.39	0.07	2.16	1.23	0.39	0.26	0.00		Calculated
24	P-W3	4.51	0 12:22	24.51	0.18	5.71	0.78	0.60	0.30	0.00		Calculated
25	P-W4	5.20	0 12:21	24.51	0.21	5.16	0.87	0.78	0.39	0.00		Calculated
26	P-W5	6.06	0 12:22	24.46	0.25	3.28	0.24	1.24	0.62	0.00		Calculated
27	P-W6	13.70	0 12:25	24.50	0.56	5.84	0.12	1.40	0.70	0.00		Calculated
28	P-W7	13.70	0 12:25	24.51	0.56	6.85	0.19	1.22	0.61	0.00		Calculated
29	P-W8	14.73	0 12:23	44.43	0.33	5.82	0.54	1.28	0.52	0.00		Calculated
30	PW-9	17.14	0 12:22	44.44	0.39	6.58	0.10	1.30	0.52	0.00		Calculated

Storage Nodes

Storage Node : S-64A

Input Data

Invert Elevation (ft)	119.90
Max (Rim) Elevation (ft)	131.22
Max (Rim) Offset (ft)	11.32
Initial Water Elevation (ft)	119.90
Initial Water Depth (ft)	0.00
Ponded Area (ft²)	0.00
Evaporation Loss	0.00

Output Summary Results

Peak Inflow (cfs)	19.82
Peak Lateral Inflow (cfs)	0
Peak Outflow (cfs)	19.82
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	123.33
Max HGL Depth Attained (ft)	3.43
Average HGL Elevation Attained (ft)	122.14
Average HGL Depth Attained (ft)	2.24
Time of Max HGL Occurrence (days hh:mm)	0 12:24
Total Exfiltration Volume (1000-ft³)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : S-OGS1

Input Data

Invert Elevation (ft)	119.75
Max (Rim) Elevation (ft)	131.17
Max (Rim) Offset (ft)	11.42
Initial Water Elevation (ft)	119.75
Initial Water Depth (ft)	0.00
Ponded Area (ft²)	0.00
Evaporation Loss	0.00

Output Summary Results

Peak Inflow (cfs)	19.82
Peak Lateral Inflow (cfs)	0
Peak Outflow (cfs)	19.82
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	122.98
Max HGL Depth Attained (ft)	3.23
Average HGL Elevation Attained (ft)	121.94
Average HGL Depth Attained (ft)	2.19
Time of Max HGL Occurrence (days hh:mm)	0 12:24
Total Exfiltration Volume (1000-ft³)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Geotechnical Report

Appendix F

Geotechnical Report

Quinhagak Street Reconstruction

MOA PM&E Project No. 21-13

January 2023

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Geotechnical Report
Quinhagak Street Reconstruction
(MOA PM&E Project No. 21-13)

Submitted To:

Russ Oswald, PE, PLS – Project Manager
Jennifer Noffke - Project Administrator
Municipality of Anchorage
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Geotechnical Engineer

January 2023
CRW Project Number 10155.00

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Appendices

1. Introduction, Project Description, and Existing conditions

CRW Engineering Group, Inc. (CRW) is pleased to present this geotechnical investigation and design recommendations report to support the upgrades to Quinhagak Street in Anchorage, Alaska. A vicinity map is shown in Figure 1.

The project is being managed by the Municipality of Anchorage (MOA) Project Management & Engineering Department (PM&E) and has been assigned MOA PM&E project number 21-13. Improvements are expected to include a new roadway structural section, pavement, drainage improvements, curb and gutter, pedestrian facilities, and light poles.

The scope of geotechnical work included:

- Reviewing historical geotechnical investigations within and near the project area.
- Performing a geotechnical field investigation which included advancing boreholes along the project alignment and soil sampling.
- Installing piezometer wells for groundwater level monitoring.
- Overseeing index laboratory testing of recovered soil samples including moisture content, grain size distribution including hydrometer, and Atterberg Limits.
- Analyzing field observations and testing results.
- Preparing the geotechnical report to provide design recommendations for the project.

The project area is the length of Quinhagak Street in Anchorage, beginning south of E Dowling Road and extending to Askeland Drive (Figure 1). Properties along Quinhagak Street are primarily commercial or light industrial with a small residential subdivision south of E 64th Avenue.

The existing street is a two-lane roadway surface with curbs and gutters. There are currently no sidewalks along any length of the street. The street pavements show significant distresses including cracking, settling, heaving, and rolled curb and gutters.

2. Subsurface Investigation

CRW's geotechnical investigation consisted of drilling and sampling six boreholes (BH-01 through BH-06) on May 25, 2022, at the locations shown in Figure 2. Borehole locations were selected by CRW following the guidelines presented in the 2007 MOA PM&E Design Criteria Manual (DCM) Section 1.7 – Soil Investigation Standards and allowing traffic to pass through as much as possible during drilling operations. The soil boring locations were approved by PM&E prior to performing the field investigations.

Utility locates were submitted to the Alaska Digline and site walks were arranged with all entities known to have utilities in the project area. Several borehole locations were adjusted due to the presence of utilities.

2.1 Subsurface Drilling

Drilling services were provided by Discovery Drilling Inc. (Discovery) of Anchorage, Alaska, using a truck-mounted CME-75 drill rig equipped with a nominal 8-inch outer diameter (O.D.) hollow-stem auger. When drilling through the asphalt pavement, an approximately 12-inch diameter hole was cut in the pavement with a saw tooth bit prior to advancing the borehole.

Traffic control was performed in accordance with the requirements of the MOA approved traffic control plan.

A CRW engineer supervised the field investigation program, recovered soil samples, and managed field operations. Borings were advanced to a depth of 17 feet below ground surface (BGS) except BH-01 which terminated at 16 feet BGS due to refusal of the sampler.

2.2 Sample Collection

Soil samples were obtained by advancing an oversized split-spoon sampler into the soil beyond the bottom of the auger or by collecting cuttings from the auger. Samples were collected using a 3-inch O.D. split-spoon sampler as a modified Standard Penetration Test (SPT). The sampler was advanced 24 inches, counted in 6-inch intervals, except where refusal was encountered in sampling and used a 340-pound automatic hammer. The number of blows required to drive the sampler each 6-inch interval is reported on the borehole logs in Appendix A. The blow counts shown on the borehole logs are field values that have not been corrected for overburden, sampler size, hammer energy, rod length, or other factors.

Split-spoon samples were collected at approximately 2.5-foot intervals in the first 10 feet and every 5 feet thereafter. Recovered samples were visually classified in the field before being individually sealed in two polyurethane bags and transported to the soil's laboratory for additional testing. Field visual classifications were verified through laboratory testing. Soil characteristics, such as classification, consistency, moisture, and color were noted for each sample recovered. Classification was performed following the Unified Soil Classification System (USCS) according to ASTM D2487/D2488. Frost classifications of the soil were described according to the MOA DCM standards.

2.3 Borehole Completion and Piezometer Well Installation

All boreholes were backfilled with cuttings brought to the ground surface during drilling. In select borings (BH-01, BH-03, and BH-05), a 1-inch PVC piezometer well was installed for groundwater level monitoring. The PVC pipe was hand-slotted over various portions and was installed over the length of each boring.

After the piezometer was installed, the annular space around the PVC was backfilled with cuttings. A 7-inch flush mount cover was installed at the surface with the annulus filled with pea gravel. A cold patch asphalt was placed around the flush mount to match the existing pavement surface where required. If no piezometer well was installed, the boring was backfilled with cuttings and cold patch asphalt was placed at the surface to match the existing pavement where required.

2.4 Groundwater Monitoring

Groundwater levels were noted during drilling, and two weeks after completion of drilling. Groundwater levels are presented on the borehole logs, in Appendix A, and in this report in Table 4-1.

2.5 PID Field Testing

Soil samples were tested with a photo ionization detector (PID) to test for the presence of volatile organic compounds (VOC) after being placed into polyurethane bags during sampling. The PID was calibrated at the beginning of each field day with 100 parts per million (ppm) isobutylene calibration gas. The PID used was equipped with a 10.2-eV lamp. Screening was performed between 15 and 60 minutes after the sample was placed in the bag. Prior to screening, each sample was shaken or agitated for 15 seconds to assist volatilization. After vapor development, the PID sampling probe was inserted into the top of the bag and the highest measurement was recorded. Care was taken when inserting the sampling probe into the bag to avoid uptake of any moisture or soil particles. The field PID readings are presented on the borehole logs in Appendix A.

3. Laboratory Testing and Results

Soil laboratory tests to evaluate index properties of recovered samples were performed by Alaska Testlab (ATL) in their Anchorage facility. The laboratory testing programs consisted of soil index tests to determine water content, grain-size distribution including hydrometer, No. 200 Wash, Atterberg Limits, and Limited Mechanical Analysis (LMA) to determine percentages of gravel, sand, and fines content. LMA consists of washing a sample over the Number 200 mesh sieve. The coarse fraction of the remaining soil is then dried and sieved through the Number 4 sieve to determine the sand and gravel content. The LMA is a means to determine the percentage of coarse and fine soil in a sample without having to perform full gradations. Because LMAs are not full gradations, all classifications of clean granular soils are “poorly graded” even though the soil may, in fact, be well graded. Qualitative observations of grain sizes are included in the soil descriptions on the logs in Appendix A.

The laboratory tests were performed in accordance with the test methods of ASTM International as summarized in Table 3-1.

Table 3-1. Laboratory Analyses and Methods

Analysis	Method	Number of Samples
Water Content	ASTM D2216	48
Grain-size Distribution	ASTM D6913 ASTM D422	6
Limited Mechanical Analysis	ASTM D1140	15
Atterberg Limits	ASTM D4318	3

Results of the laboratory testing are presented on borehole logs in Appendix A and in full in Appendix B.

4. Site Conditions

4.1 Geology

The geology for the project area was determined from the Simplified Geologic Map of Central and East Anchorage, Alaska, as mapped by R.A. Combellick with the Alaska Division of Geologic and Geophysical Surveys (DGGS) in 1999, in addition to the 1972 map by Schmoll and Dobrovolny (Combellick, 1999; Schmoll and Dobrovolny, 1972). The geology of the project area consists primarily of 50 feet or more of glacioestuarine or eolian silt and fine sand, with Holocene alluvium to the south, underlain by undifferentiated glacial drift.

Geologic conditions in the boreholes agreed with the general geology though variations between borings was noted.

4.2 Historical Geotechnical Investigations

CRW consulted the online MOA Soil Boring App to evaluate historical borings in the project area. Fourteen historic boreholes were located in the project limits. Historical boreholes generally matched information obtained in our field investigation. This included a 2 to 5-foot layer of granular fill, followed by a section of silty sand and clayey silt. Historical borehole logs can be found in Appendix C.

4.3 Pavement Thickness and General Soil Lithology

The pavement thickness, where encountered, ranged from 1.5 to 3.0 inches based on measurements of recovered samples.

The subsurface conditions observed within the existing road prism generally consisted of 5 to 6 feet of granular fill composed of poorly graded gravel with sand and silt or poorly graded sand with gravel and silt, decreasing in thickness from north to south. At BH-06, granular fill was 2.5 feet thick. The granular fill was underlain by up to 4 feet of silty sand or sand with silt, decreasing in thickness from north to south, and was not observed in BH-06.

Beneath the granular fill layer, 6 to 10 feet of silty lean clay was observed increasing in thickness from north to south. Beneath the silty lean clay, 3 to 5 feet of silty sand was generally present increasing in thickness from north to south. Cobbles were noted in the granular fill ranging from 4 to 5 inches in size and were present from 5 to 10 percent by volume.

The moisture content ranged between 4 to 8 percent in the granular fill, 18 to 20 percent in the of silty sand/ sand with silt, 10 to 40 percent in the silty lean clay, and 20 to 25 percent in the silty sand.

The fines content ranged between 2 and 10 percent in the granular fill, and its frost susceptibility was estimated to be non-frost susceptible (NFS) to frost class F-2. The silty sand/sand with silt had fines content from 20 to 50 percent and the silty lean clay had fines content of 90 to 100 percent and were estimated to be frost class F-4.

A layer of peat was encountered in BH-03 from approximately 1.0 to 2.5 feet BGS. The moisture content was 164 percent. BH-03 was located just off the road surface in the gravel lot to the west of the roadway (Figure 2). Peat was not encountered in any other borings.

Fat clay was encountered in BH-05 from 5 to 15 feet BGS, with a moisture content of 30 to 40 percent, an estimated fines content of 100 percent, and Atterberg limits with a liquid limit of 54 percent, plastic limit of 25, and plasticity index of 29 percent. Fat clay was not encountered in any other borings.

The observed subsurface conditions generally agreed with the historic geotechnical investigation findings. Detailed subsurface conditions are presented on the borehole logs in Appendix A. It should be noted that subsurface conditions outside the existing road prism could vary from the borehole logs.

4.4 Groundwater Conditions

Groundwater, if observed, was recorded on the borehole logs. Only the most recent measurement taken after drilling is displayed on the borehole logs in Appendix A. Table 4-1 provides a summary of the groundwater levels at the time of drilling and all subsequent measurements. All depths are relative to the existing roadway surface. Screen intervals consist of the depth of the piezometer that was slotted prior to installation.

Table 4-1. Summary of Groundwater Levels

Borehole	Screened Interval if Completed as Piezometer (Feet BGS)	Groundwater Levels At Time of Drilling on 5/25/2022 (Feet BGS)	Groundwater Levels on 6/9/2022 (Feet BGS)	Groundwater Levels on 8/17/2022 (Feet BGS)
BH-01	4.0 – 16.0	5.0	5.55	4.35
BH-02	No Piezometer Installed	3.5	N/A	N/A
BH-03	2.75 – 16.75	3.0	3.65	2.33
BH-04	No Piezometer Installed	Not Observed	N/A	N/A
BH-05	9.6 – 14.6	1.0	3.05	1.98
BH-06	No Piezometer Installed	10.0	N/A	N/A

4.5 PID Field Testing Results

Standard practice in the MOA is to consider soil samples with PID readings of 20 parts per million (ppm) or higher potentially contaminated. No samples screened during this investigation exceeded this limit, and no visual or olfactory evidence of contamination was observed.

4.6 Contaminated Site Review

Soil samples were tested using a PID during the field investigation per MOA requirements with results previously discussed in this report and values provided on the borehole logs. In addition, CRW consulted the Alaska Department of Environmental Conservation (ADEC) Contaminated Sites Program (CSP) on-line database for nearby recorded contaminated sites. A review of the CSP database revealed no sites within 500 feet of the project area.

5. Geotechnical Engineering Recommendations

CRW has developed the following recommendations based on our understanding of the project scope and considering the data obtained during our geotechnical investigation.

5.1 Site Preparation

All existing pavements, fill, curbs and gutters, trees, stumps, and other deleterious material should be cleared from the roadway reconstruction limits. Exposed subgrade at the bottoms of excavations should be scarified a minimum of 6 inches, moisture conditioned, and compacted to 95 percent of the maximum Proctor density as determined from ASTM D1557. If the subgrade cannot be moisture conditioned, we recommend the contractor over excavate the subgrade a minimum of 1 foot and replace with non-frost susceptible (NFS) material.

5.2 Excavations

All excavations should follow proper local, state, and federal requirements including those in 29 Code of Federal Regulations (CFR) Part 1926 Occupational Safety and Health Standards Subpart P – Excavations (Occupational Safety and Health Administration [OSHA], 2020).

The contractor is responsible for trench stability, worker safety, and regulatory compliance as he will be present on a daily basis and can adjust efforts to obtain the needed stability. Surface runoff entering the excavation could present challenges and should be accounted for during construction. We anticipate excavations will use benching/sloping or shoring/shielding as OSHA requires this due to the depth of the excavation. If trench shoring, like cantilever or braced excavations, is utilized, additional recommendations for lateral earth pressures can be provided.

Utility or roadway excavations above the water table may stand relatively steeply initially but fail suddenly without warning. As the in-situ soils dry, they will tend to ravel and slough to their natural angle of repose, which we estimate to be between 1.5 to 1.8H:1V (horizontal to vertical). Below the water table, or if surface water is allowed to enter the trench, in-situ soils may slough, soften, squeeze, slump over time or due to disturbance, to slopes of 2 to 2.5H:1V or flatter if not benched/sloped or shored/shielded.

Additionally, the sequencing of excavation for the utility line and the excavation for the roadway should be considered by the designers and the contractor. Should the roadway construction occur prior to utility installation, poor performance of the roadway may occur due to dissimilar material in the utility trench compared to the roadway structural section as well as damage and repair to any insulation and/or geotextile.

5.3 Dewatering and Radius of Influence

Based on our observations during drilling and measurements of groundwater in piezometers after drilling, shallow groundwater is present in the project area. Excavations are anticipated to be 5 to 8 feet BGS and groundwater levels were measured between 1.0 to 5.6 feet BGS. Groundwater is likely to be encountered during excavation activities. Groundwater conditions will vary with environmental variations and seasonal conditions, such as the frequency and magnitude of rainfall patterns, as well as man-made influences, such as existing curbs, gutters, and other roadside features.

We recommend that the contractor determine the actual groundwater levels at the time of construction to evaluate groundwater impacts on the construction procedures, if necessary. We recommend the ground around any excavation be contoured to direct surface water away from the excavation and to minimize surface water or runoff from entering the excavation.

Based on the observed groundwater and anticipated excavation depths, dewatering will likely be required. Dewatering methods include open pumping, wellpoints, deep wells, ejector wells, cutoff methods, or some combination. Considering the lithology encountered and anticipated depths, we do not recommend open pumping, ejector wells, or cutoff methods due to the anticipated groundwater drainage potential based on estimated hydraulic conductivity (discussed later, also see Powers et al., 2007 and Powrie, 2014). We recommend wellpoints be considered for construction dewatering. Depending on spacing and size, wellpoints may be either 1.5- or 2-inch diameter.

We recommend construction dewatering be the responsibility of the contractor including submitting a dewatering plan for approval as part of the submittal process. The dewatering plan should show anticipated wellpoint/well layout including spacing, diameters, well screens, filters, location of pumps, and discharge point(s).

Permits from the Alaska Department of Natural Resources and potentially other local and state agencies will be necessary for construction dewatering.

For preliminary planning, we have estimated pumping rates for the storm drain excavation based on an assumed dewatering effective trench width of 6 feet and drawdown of up to 5 feet. We estimate the hydraulic conductivity from empirical and literature values, based on the encountered soils, ranging from 0.02 to 10 feet per day (FT/day) with higher flows in the silty sands and lower flows in the silt with sand. We note there is tremendous uncertainty in conductivity estimates using empirical/literature values as they are affected by soil type, excavation/dewatering methods, and seasonal groundwater fluctuations and will vary during construction.

We estimate an initial required pumping rate of 0.1 to 3 gallons per minute per linear foot (GPM/FT) which decreases to steady-state pumping rates of 0.1 to 2 GPM/FT during dewatering efforts. We estimate the radius of influence of the cone of depression from dewatering to vary from 3 to 60 FT (measured from the center of the trench). These estimates do not consider the effect of "tailwater" from water flowing into the excavation due to the high permeability of bedding material.

Dewatering activities should consider the potential for settlement if buildings and other infrastructure are within the radius of influence. When the water table is lowered, compressible soils can consolidate, due to an increase of the effective weight of overlying soils. Consolidation has the potential to impact development adjacent to the project area. While construction and dewatering are anticipated to be of short duration and impacts minimal, considerations should be made as to whether monitoring of settlement is required. CRW's geotechnical engineer will work closely with the designers to evaluate the magnitude of settlement and tolerable settlement values will be determined considering input from MOA, CRW designers, and stakeholders during detailed design.

If dewatering is anticipated to produce unacceptable settlements, the designers should perform pre- and post-condition surveys of nearby building finish floors/foundations and other infrastructure to evaluate if dewatering activities resulted in damage. In addition, survey points should be placed at and around buildings and other infrastructure to verify settlement due to dewatering. If settlement is observed during monitoring the contractor should reevaluate the dewatering technique to reduce the potential for continued settlement.

5.4 Frost Depth and Permafrost

Typical design frost depths are estimated between 8 and 11 feet BGS in Anchorage and are common for relatively dry granular soils. It should be noted that seasonal fluctuations of snow cover, temperatures, infiltration/evaporation, groundwater table, and other climatic effects will have an impact on the design frost depth therefore any calculated value should only be considered a reasonable estimate of the design value as deeper frost penetrations are possible. In addition, the presence of groundwater within the upper 11 feet will also affect the frost depth in addition to the potential for ice lensing and heaving.

We have modeled design frost depths based on the modified Berggren equation using the commercially available Microsoft DOS program BERG2 as discussed in the next section of this report.

Permafrost was not encountered in the boreholes and is not expected at the project site.

5.5 Recommended Road Structural Section

CRW has developed a recommended road structural section based on the current MOA DCM as outlined in Chapter 1 Streets, Section 1.10 Road Structural Fill Design. The DCM recommends two methods for frost considerations in the structural section design: the Complete Protection Method and the Limited Subgrade Frost Penetration Method.

The structural section design uses the latter method, which seeks to reduce the freezing impacts to a specified percentage of the structural section into the subgrade.

The Complete Protection Method involves the removal of all frost susceptible subgrade soils beneath the roadway to the calculated frost penetration depth. These soils are replaced with non-frost susceptible fill. This method may be used regardless of the frost susceptibility of the subgrade soils. Rigid board insulation may also be used in the subbase of the structural section to reduce the required depth of classified fill and backfill. The Complete Protection Method would require excavation and replacement of frost susceptible soils down to depths of 8 to 10 feet, excluding insulation, which is not economical and therefore is not recommended.

The Limited Subgrade Frost Penetration Method attempts to restrict roadway surface movements to levels that will not adversely affect road surface life or quality. The method permits frost penetration into a frost susceptible subgrade equal to a maximum of 10 percent of the structural section design thickness.

The frost depth was analyzed using the commercially available Microsoft DOS computer program BERG2 written by Braley and Connor (Braley and Connor, 1989) as approved in the DCM. The analysis calculates the estimated total frost penetration depth for a given soil lithology. For our analysis, we used the program default climate parameters for Anchorage and assumed conservative surface freeze/thaw n-factors based on local practice and published values. Soil layers were assigned in the program with estimated dry unit weights of the soil and average or anticipated water contents. Soil thermal parameters were calculated from the equations built into the BERG2 program (see Braley and Connor for further discussion).

5.5.1 Recommended Structural Section – Limited Subgrade Frost Protection Method

The project area contains frost susceptible subgrade with a F-3 and F-4 frost classification within 8 feet of the ground surface. Based on this, we recommend an insulated structural section using the Limited Subgrade Frost Penetration for the entire project alignment. We have developed a recommended structural section based on the BERG2 analysis and have evaluated 2 inches of insulation. The insulation for the structural section in this analysis assumed a minimum R-value of R-4.5 per inch. Our recommended structural sections are presented in Table 5-1. A typical insulated section is presented in Figure 3.

Table 5-1. Recommended Structural Section (Insulated)

Minimum Thickness (inches)	Layer	Material	Compaction (percent)
2	Wearing Course	Asphalt Pavement (Class E)	-
2	Leveling Course	MOA Leveling Course	95
16	Base Course	MOA Type II-A	95
2	Insulation	XPS or EPS (60 psi R-4.5)	-
24	Subbase Course	MOA Type II	95
N/A	Separation Geotextile	MOA Class 2, Type A	-
N/A	Subgrade	Existing soils	95 (top 6 inches)
46	**Total Thickness**	-	-

See Appendix D for BERG2 analysis and detailed results. Note that the recommended structural section considers only minimum thicknesses.

5.6 Compaction Requirements

Pavement structural section fill material should be placed in loose lift thickness, no more than 12 inches, and compacted to the percentage as outlined in Table 5-1 based on the material's Modified Proctor maximum dry density in accordance with ASTM D1557. Compaction verification of the backfill by a qualified inspector is also recommended.

5.7 Rigid Insulation

We recommend that rigid board insulation for the road structural section have a minimum compressive strength of 60 pounds per square inch (psi) and a maximum water absorption of 0.3 percent by volume in accordance with the current version of Municipality of Anchorage Standard Specifications (MASS). We recommend the insulation have a minimum R-value of R-4.5 per inch. We recommend a minimum of 12 inches of loose fill be placed over the insulation to protect from wheel loads during construction. We also recommend a minimum of 18 inches of fill over the insulation for design to prevent frost formation in the form of differential icing.

Board insulation should be extended a minimum of 4 feet beyond the back of curbs when no sidewalk is present. Extending the insulation 4 feet will reduce the risk of the curb heaving up or "curb rolling." The potential for curb rolling decreases as the distance the insulation extends beyond the back of curb increases. The 4-foot layout has protected the curb well on past projects especially where the curbs need to be protected due to the flat longitudinal roadway grades like those on this project.

The insulation should extend 1 foot minimum beyond the back of any sidewalk but will not perform as well as the curb. To increase the performance of any sidewalk, the owner could consider extending the insulation 4 feet as well. Additionally, insulation below separated sidewalks that are separated by 4 feet or more could be reduced in thickness to save cost but will not perform as well.

Transitions between insulated and uninsulated sections should involve the extension of insulation beyond the roadway section 8 to 12 feet with the thickness reduced in these areas to minimize the possibility of differential heave. The insulation can be tapered from 2 inches thick to 1 inch thick in the transition zone. The subgrade in transitions should be graded (tapered) at a 10H:1V (horizontal to vertical) slope if construction distances permit. We recommend the transitions not be steeper than 5H:1V.

5.8 Geotextiles

We recommend that a geotextile be used at the base of the structural section along the entire project alignment. The use of a geotextile reduces the effects of thaw weakening, prevents fines migration, and increases lateral drainage at the base of the structural section. If soil layers at the base of the excavation are loose or soft, the geotextile will provide additional stabilization.

We recommend using a non-woven geotextile meeting MASS similar to Class 2, Type A. The geotextile should be placed on top of the excavated subgrade soils prior to placement of classified fill. The geotextile should be extended up the sides of excavations.

Typical installation involves placing the geotextile transverse to the centerline in order to avoid large overlaps. Fabric joints should be overlapped according to manufactures recommendations. Fabric joints may require sewing depending on subgrade conditions and should follow the manufacturer's requirements.

5.9 Subdrains

Incorporation of subdrains into the design of the structural section is recommended to help mitigate against the effects of high ground water levels. High groundwater levels, or groundwater that reaches the pavement structural section, can collect in the structural section and impact the overall road performance. Subdrains will mitigate against water infiltration in the structural section and improve overall road performance. The depth of subdrain installation should be below the roadway structural section for optimal performance.

Edge drains should be placed at the outer edges of the structural section as shown in Figure 3 and consist of a geotextile wrapped perforated pipe with a minimum O.D. of 10 inches. Construction should be per

MASS. Roadway subgrade should be sloped with a minimum of 2 percent towards subdrains to assist with drainage. Termination of the subdrains should be to the drainage system manholes or suitable outfalls. Subdrains should be hydraulically sized and consider potential icing issues.

Should edge drains not be feasible, an alternate would be a perforated drain placed in a shallow trench near the center of the structural section. As such, an alternate drainage option is a perforated center subdrain as shown in Figure 4 consisting of a geotextile-wrapped perforated pipe with a minimum O.D. of 18 inches. The use of a center subdrain may result in poorer structural section performance over time compared to the used of edge drains. The center subdrain should be constructed per MASS. Roadway subgrade should be sloped with a minimum of 2 percent towards the subdrain to assist with drainage. Termination of the subdrain should be to the drainage system manholes or suitable outfalls. Subdrains should be hydraulic sized and consider potential icing issues.

5.10 Reuse of Material

Existing fill and native material that meets the classification for MOA Type II and Type II-A fill can be reused as classified fill in the roadway structural section. It is anticipated that the majority of existing fill and native material along the project alignment contain frost susceptible material and will not meet MOA Type II and Type II-A classification.

Existing fill and native material that meets the classification for bedding material can be reused around utility pipes. Existing fill and native materials can be reused in utility trenches as backfill over the bedding but below the pavement structural section.

The amount and quality of reuse of material will vary depending on factors including lateral extent of deposits, transitional lithology, degree of saturation and moisture control during construction, and mixing of excavated materials. Higher fines content soils were encountered near the ground surface which could make granular soils difficult to compact if mixed and water content increases. We recommend native material excavated for reuse be visually inspected for fines content and if the material becomes wet will require storage to be dried for reuse. This effort may be less efficient and cost more than complete removal and replacement with imported materials.

5.11 Utility Recommendations

All utilities should be bedded, backfilled, and compacted per MASS. The satisfactory performance of piped utilities is highly dependent upon the quality of soil below and along the sides of the pipe.

MOA standard is to adequately bury water, sanitary sewer, and storm sewer utilities to protect from freezing. If inadequate burial depths cannot be achieved as design proceeds, alternate methods such as insulation, active freeze protection like heat trace, or some combination is recommended. Recommendations on insulation for utility protection can be provided on request.

5.12 Light Pole Foundations

We understand streetlights are planned along the project corridor and anticipate the design to follow MASS. We anticipate driven steel piles for the light pole foundations.

We recommended driven piles be installed such that the minimum embedment is achieved without damage to the piles. We recommend the light pole foundations be installed to a minimum of 25 feet BGS due to the presence of fine-grained soils starting around 10 feet BGS.

Additional recommendations for lateral or axial pile foundation considerations can be provided as needed.

6. Limitations and Closure

The information submitted in this report is based on our interpretation of data from a field geotechnical investigation performed for this project. The conclusions contained in this report are based on site conditions as they were observed on the drilling dates indicated. It is presumed that the borings in this investigation are representative of the subsurface conditions throughout the site. Effort was made to obtain information representative of existing conditions at the site. If, however, subsurface conditions are found to differ, we should be notified immediately to review these recommendations in light of additional information.

If there is substantial lapse of time between the submittal of this report and the start of work at the site, or if conditions have changed due to natural causes or construction operations at or adjacent to the site, we recommend that this report be reviewed to determine the applicability of the conclusions considering the changed conditions and time lapse. Unanticipated soil conditions are commonly encountered and cannot fully be determined by collecting discrete samples or advancing borings. The client and contractor should be aware of this risk and account for contingency accordingly.

Samples will be retained by CRW for six months following the date on which the final report is issued. Other arrangements may be made at the client's request.

This report was prepared by CRW for use on this project only and may not be used in any manner that would constitute a detriment to CRW. CRW is not responsible for conclusions, opinions, or recommendations made by others based on data presented in this report.

7. References

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Figures

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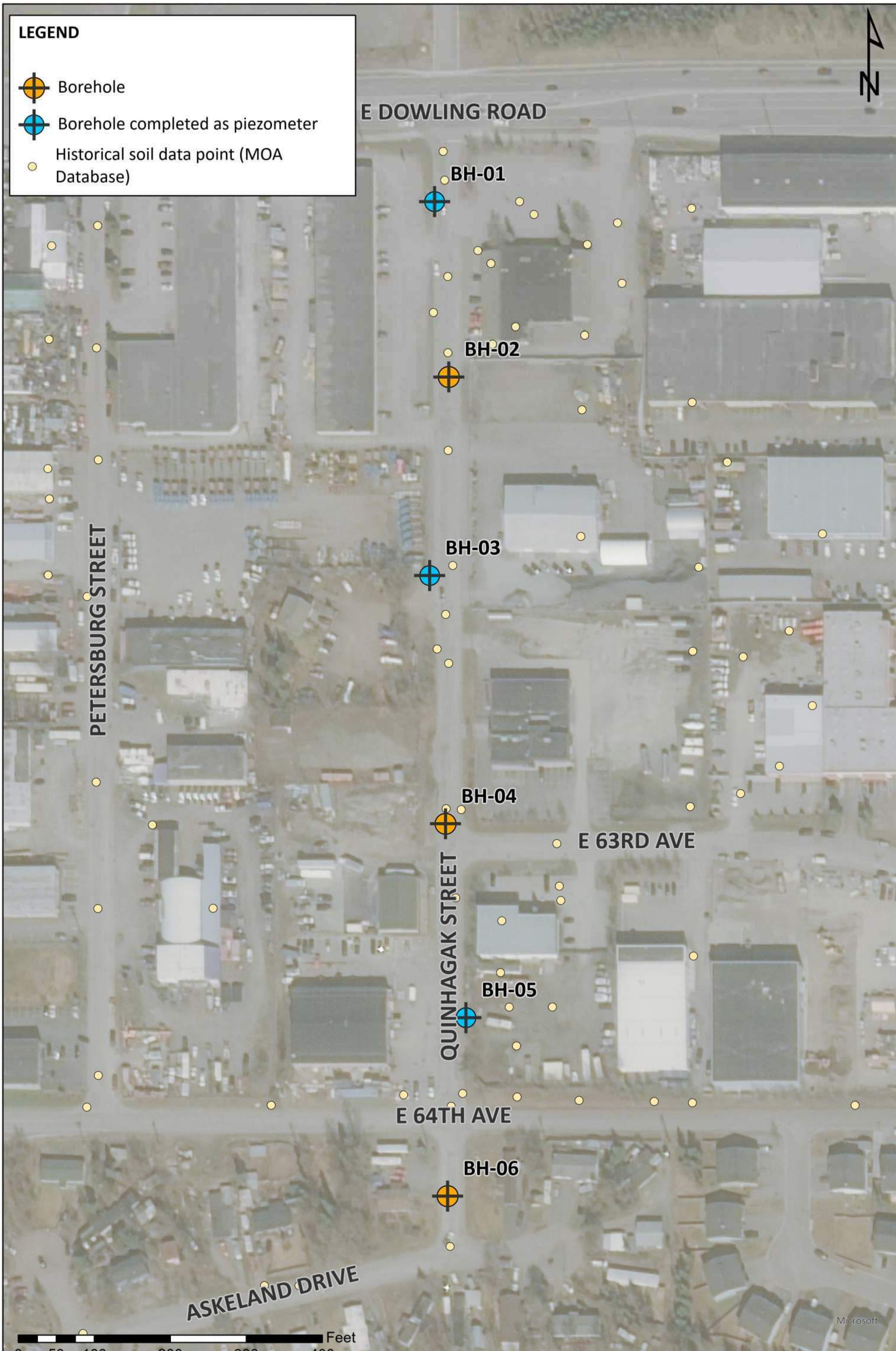
QUINHAGAK STREET RECONSTRUCTION
GEOTECHNICAL INVESTIGATION
VICINITY MAP
ANCHORAGE, ALASKA

Project:	10155.00
Drawn By:	AFS
Scale:	Graphical Scale
Date:	Jan 2023
Figure:	1



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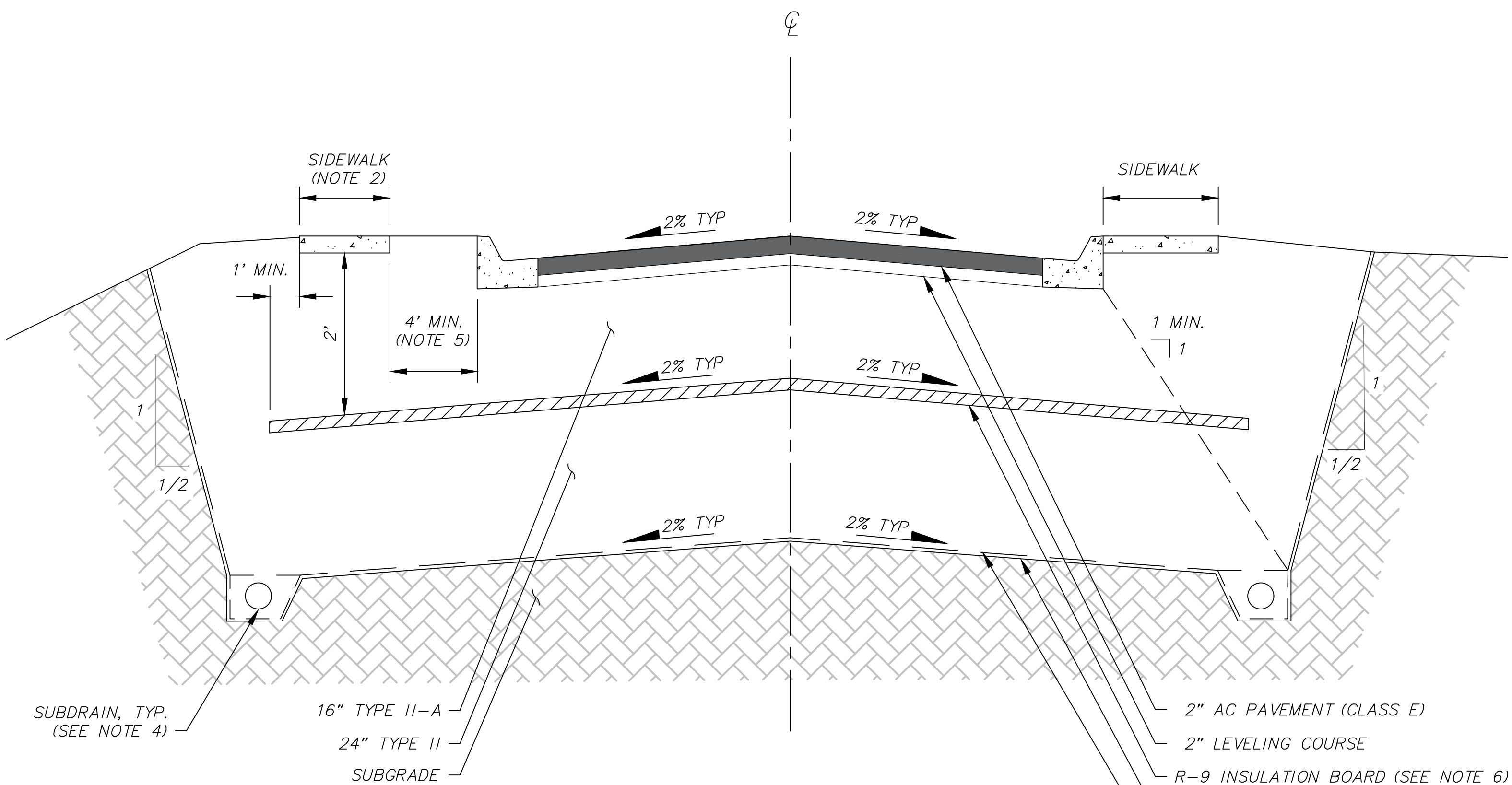
QUINHAGAK STREET RECONSTRUCTION
GEOTECHNICAL REPORT
BOREHOLE LOCATIONS
ANCHORAGE, ALASKA

Project:	10155.00
Drawn By:	AFS
Scale:	Graphical
Date:	Jan 2023
Figure:	2



NOTES:

1. ALL MEASUREMENTS ARE MINIMUM VALUES.
2. INSULATION SHOULD EXTEND BENEATH SEPARATED PATHWAYS WHEN PRESENT. THICKNESS MAY BE REDUCED TO R-VALUE OF R-4.5.
3. GEOTEXTILE SHALL MEET MOA MASS SECTION 20.25 CLASS 2, TYPE A, NON-WOVEN FABRIC WHEN SPECIFIED.
4. INSTALL SUBDRAINS PER MASS DETAIL #55-3.
5. EXTEND INSULATION A MINIMUM OF 4 FEET BEYOND THE BACK OF CURB WHEN NO SIDEWALKS ARE PRESENT.
6. INSULATION MIN. 60 PSI, ABSORPTION 0.30% MAX. BY VOLUME PER MASS SECTION 20.26.

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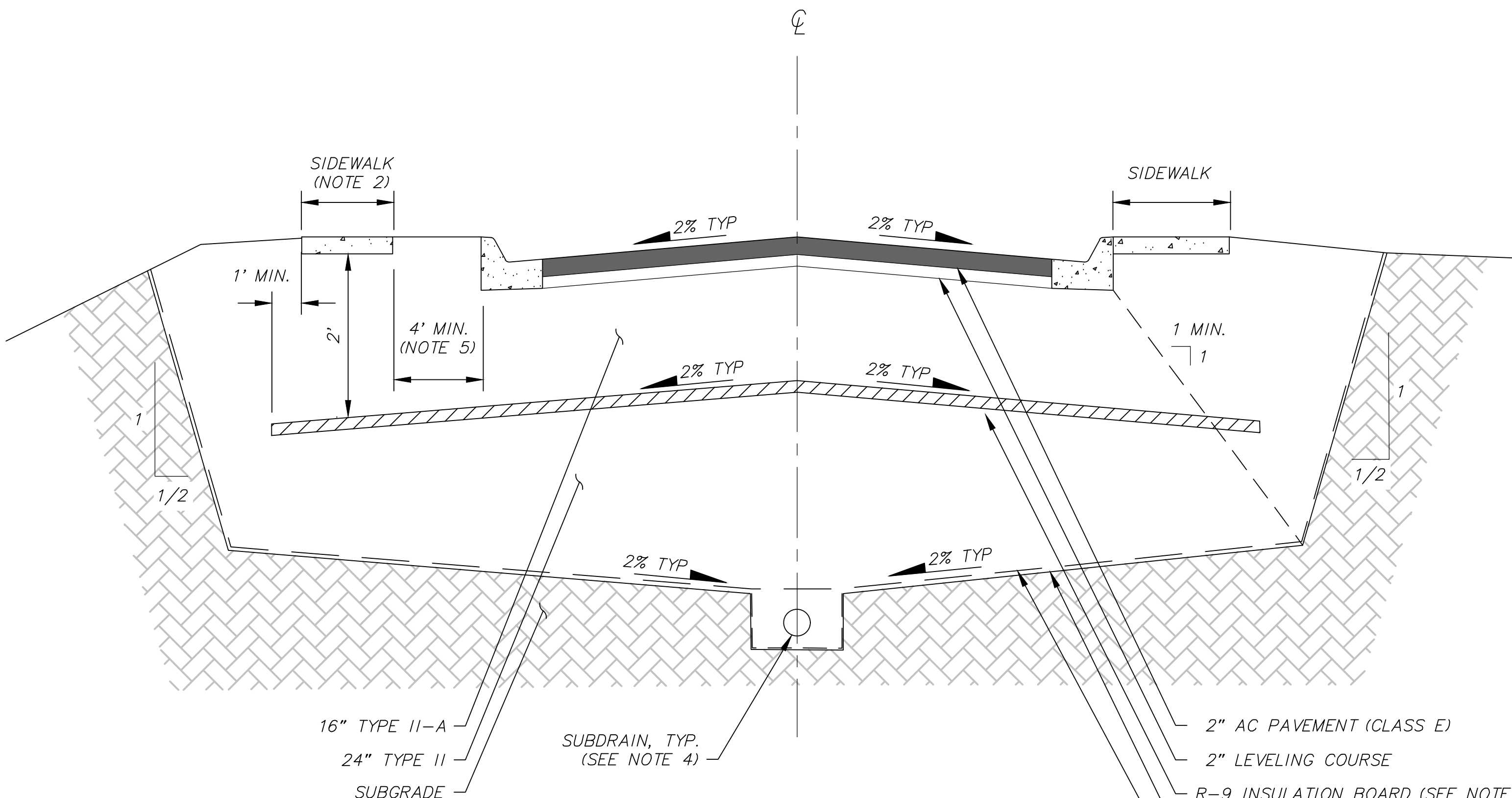
QUINHAGAK STREET RECONSTRUCTION
MOA PM&E PROJECT NUMBER 21-13

TYPICAL INSULATED SECTION
WITH EDGE SUBDRAINS

Project:	10155.00
Drawn By:	CRW
Scale:	NTS
Date:	**JAN 2023**
Figure:	3



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PHONE: (907) 562-3252
#AECL882-AK

QUINHAGAK STREET RECONSTRUCTION
MOA PM&E PROJECT NUMBER 21-13

TYPICAL INSULATED SECTION
WITH CENTER SUBDRAIN

Project:	10155.00
Drawn By:	CRW
Scale:	NTS
Date:	**JAN 2023**
Figure:	4

Appendix A

Borehole Logs

Included in this section:

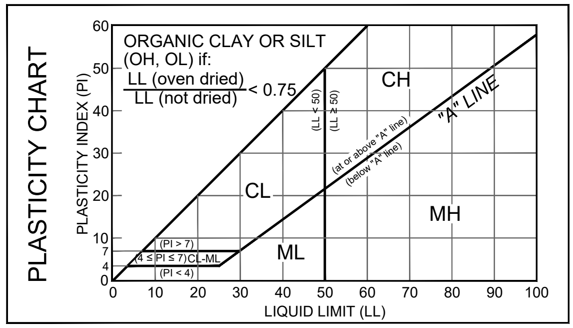
1) Borehole Log Legend
2) Borehole Logs (BH-01 through BH-06)

UNIFIED SOIL CLASSIFICATION (ASTM D 2487)

GROUP SYMBOL	SOIL GROUP NAMES & LEGEND	
GW	WELL-GRADED GRAVEL	if soil contains ≥ 15% sand, add "with sand"
GP	POORLY GRADED GRAVEL	
GM	SILTY GRAVEL	
GC	CLAYEY GRAVEL	
SW	WELL-GRADED SAND	if soil contains ≥ 15% gravel, add "with gravel"
SP	POORLY GRADED SAND	
SM	SILTY SAND	
SC	CLAYEY SAND	
CL	LEAN CLAY	if soil contains coarse-grained soil from 15% to 29%, add "with sand" or "with gravel" for whichever type is prominent, or for ≥ 30%, add "sandy" or "gravelly"
ML	SILT	
OL	ORGANIC CLAY OR SILT	
CH	FAT CLAY	
MH	ELASTIC SILT	
OH	ORGANIC CLAY OR SILT	
PT	PEAT	

Gravels or sands with 5% to 12 % fines require dual symbols (GW-GM, GW-GC, GP-GM, GP-GC, SW-SM, SW-SC, SP-SM, SP-SC) and add "with clay or "with silt" to group name. If fines classify as CL-ML for GM or SM, use dual symbol GC-GM or SC-SM.

Optional Abbreviations: Lower case "s" after USCS group symbol denotes either "sandy or "with sand" and "g" denotes either "gravelly" or "with gravel."



COMPONENT DEFINITIONS BY GRADATION

COMPONENT	SIZE RANGE
BOULDERS	ABOVE 12 IN.
COBBLES	3 IN. TO 12 IN.
GRAVEL	3 IN. TO NO. 4 (4.76 mm)
COARSE GRAVEL	3 IN. TO 3/4 IN.
FINE GRAVEL	3/4 IN. TO NO. 4 (4.76 mm)
SAND	NO. 4 (4.76 mm) TO NO. 200 (0.074 mm)
COARSE SAND	NO. 4 (4.76 mm) TO NO. 10 (2.0 mm)
MEDIUM SAND	NO 10 (2.0 mm) TO NO. 40 (0.42 mm)
FINE SAND	NO. 40 (0.42 mm) TO NO. 200 (0.074 mm)
SILT AND CLAY	SMALLER THAN NO. 200 (0.074 mm)
SILT	0.074 mm TO 0.005 mm
CLAY	LESS THAN 0.005 mm

OTHER SYMBOLS

SYMBOL	NAMES & LEGEND	
BLDR	COBBLES AND BOULDERS	overlay
FILL	GRANULAR FILL	man-made or placed
WD	WOODY DEBRIS	
RAP	RECLAIMED ASPHALT PAVEMENT	

RELATIVE DENSITY / CONSISTENCY ESTIMATE USING STANDARD PENETRATION TEST (SPT) VALUES (FROM TERZAGHI & PECK 1996)

COHESIONLESS SOILS[a]		COHESIVE SOILS[b]		
RELATIVE DENSITY	N_{60} (BLOWS/FOOT)[c]	CONSISTENCY	N_{60} (BLOWS/FOOT)[c]	UNCONFINED COMPRESSIVE STRENGTH (TSF)[d]
VERY LOOSE	0 - 4	VERY SOFT	0 - 2	0 - 0.25
LOOSE	4 - 10	SOFT	2 - 4	0.25 - 0.50
MED DENSE	10 - 30	MEDIUM	4 - 8	0.50 - 1.0
DENSE	30 - 50	STIFF	8 - 15	1.0 - 2.0
VERY DENSE	OVER 50	VERY STIFF	15 - 30	2.0 - 4.0
		HARD	OVER 30	OVER 4.0

(a) Soils consisting of gravel, sand and silt, either separately or in combination possessing no characteristics of plasticity, and exhibiting drained behavior.
(b) Soils possessing the characteristics of plasticity, and exhibiting undrained behavior.
(c) Refer to ASTM D 1586-99 for a definition of N.
(d) Undrained shear strength, s_u = 1/2 unconfined compression strength, U_c. Note that Torvane measures s_u and Pocket Penetrometer measures U_c.

CRITERIA FOR DESCRIBING MOISTURE CONDITION (ASTM D 2488)

DRY	ABSENCE OF MOISTURE, DUSTY, DRY TO THE TOUCH
MOIST	DAMP BUT NO VISIBLE WATER
WET	VISIBLE FREE WATER, USUALLY SOIL IS BELOW WATER TABLE

SAMPLER ABBREVIATIONS

SS	SPT Sampler (2 in. OD, 140 lb hammer)	C	Core (Rock)
SSO	Oversize Spit Spoon (2.5 in. OD, 140 lb typ.)	TW	Thin Wall (Shelby Tube)
HD	Heavy Duty Split Spoon (3 in. OD, 300/340 lb typ.)	MS	Modified Shelby
BD	Bulk Drive (4 in. OD, 300/340 lb hammer typ.)	GP	Geoprobe
CA	Continuous Core (Soil in Hollow-Stem Auger)	AR	Air Rotary Cuttings
G	Grab Sample from surface / testpit	AG	Auger Cuttings

DESCRIPTIVE TERMINOLOGY FOR PERCENTAGES (ASTM D 2488)

DESCRIPTIVE TERMS	RANGE OF PROPORTION
TRACE	0 - 5%
FEW	5 - 10%
LITTLE	10 - 25%
SOME	30 - 45%
MOSTLY	50 - 100%

LABORATORY TEST ABBREVIATIONS

AL	Atterberg Limit	PI	Plastic Index	TS	Thaw Consolidation
Consol	Consolidation	PID	Photoionization Detector	TV	Torvane
LMA	Limited Mechanical Analysis	Proc	Proctor	TXCD	Consolidated Drained Triaxial
MA	Sieve and Hydrometer Analysis	PP	Pocket Penetrometer	TXCU	Consolidated Undrained Triaxial
MC	Moisture Content	P200	Percent Fines (Silt & Clay)	TXUU	Unconsolidated Undrained Triaxial
NP	Non-plastic	SA	Sieve Analysis	VS	Vane Shear
OLI	Organic Loss on Ignition	SpG	Specific Gravity	Ω	Soil Resistivity

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LEGEND: SOIL CLASSIFICATION AND ABBREVIATIONS

FILE NAME: M:\Engineering References\Tech Geotechnical\CRW Geotechnical Report Template\Borehole Log Legend\Geotech Borehole Legends.dwg

FROZEN SOIL CLASSIFICATION (ASTM D 4083)

1. DESCRIBE SOIL INDEPENDENT OF FROZEN STATE	CLASSIFY SOIL BY THE UNIFIED SOIL CLASSIFICATION SYSTEM				
	MAJOR GROUP		SUBGROUP		
	DESCRIPTION	DESIGNATION	DESCRIPTION		DESIGNATION
2. MODIFY SOIL DESCRIPTION BY DESCRIPTION OF FROZEN SOIL	Segregated ice not visible by eye	N	Poorly bonded of friable		N_f
			Well bonded	No excess ice	Nbn
				Excess ice	Nbe
	Segregated ice visible by eye (ice less than 25 mm thick)	V	Individual ice crystals or inclusions		V_x
			Ice coatings on particles		V_c
			Random or irregularly oriented ice formations		V_r
			Stratified or distinctly oriented ice formations		V_s
			Uniformly distributed ice		V_u
3. MODIFY SOIL DESCRIPTION BY DESCRIPTION OF SUBSTANTIAL ICE STRATA	Ice greater than 25 mm thick	ICE	Ice with soil inclusions		ICE+soil type
			Ice without soil inclusions		ICE

FROST DESIGN SOIL CLASSIFICATION(1)

FROST GROUP(2)	GENERAL SOIL TYPE	% FINER THAN 0.02 mm BY WEIGHT	TYPICAL USCS SOIL CLASS
NFS(3)	(a) Gravels Crushed stone Crushed rock	0 - 1.5	GW, GP
	(b) Sands	0 - 3	SW, SP
PFS(4) [MOA NFS] [FAA NFS]	(a) Gravels Crushed stone Crushed rock	1.5 - 3	GW, GP
[MOA F-2] [FAA FG-2]	(b) Sands	3 - 10	SW, SP
S1 [MOA F-1] [FAA FG-1]	Gravelly soils	3 - 6	GW, GP, GW-GM, GP-GM, GW-GC, GP-GC
S1 [MOA F-2] [FAA FG-2]	Sandy soils	3 - 6	SW, SP, SW-SM, SP-SM, SW-SC, SP-SC
F1(5) [MOA F-1] [FAA FG-1]	Gravelly soils	6 - 10	GM, GC, GM-GC, GW-GM, GP-GM, GW-GC, GP-GC
F2(5) [MOA F-2] [FAA FG-2]	(a) Gravelly soils	10 - 20	GW, GP, GW-GM, GP-GM, GW-GC, GP-GC
	(b) Sands	6 - 15	SM, SW-SM, SP-SM, SC, SW-SC, SP-SC, SM-SC
F3(5) [MOA F-3] [FAA FG-3]	(a) Gravelly soils	Over 20	GM, GC, GM-GC
	(b) Sands, except very fine silty sands	Over 15	SM, SC, SM-SC
	(c) Clays, PI>12	--	CL, CH
F4(5) [MOA F-4] [FAA FG-4]	(a) Silts	--	ML, MH, ML-CL
	(b) Very fine silty sands	Over 15	SM, SC, SM-SC
	(c) Clays, PI≤12	--	CL, ML-CL
	(d) Varved clays or other fine-grained banded sediments	--	CL or CH layered with ML, MH, ML-CL, SM, SC, or SM-SC

(1) From the U.S. Army Corps of Engineers (USACE), EM 1110-3-138, "Pavement Criteria for Seasonal Frost Conditions", April 1984
(2) USACE frost groups directly correspond to frost groups in Municipality of Anchorage (MOA) Design Criteria Manual (DCM). Federal Aviation Administration (FAA) frost groups come from Table 2-2 in Section 2.5.4 of Advisory Circular (AC) 150/5320-6G, Airport Pavement Design and Evaluation (June, 2021).
(3) Non-frost susceptible
(4) Possibly frost susceptible, requires lab test for void ratio to determine frost design classification.
(5) Consistent with MOA Definition.

ICE BONDING SYMBOLS

No ice-bonded soil observed

Poorly bonded or friable

Well bonded

DEFINITIONS

Candled Ice is ice which has rotted or otherwise formed into long columnar crystals, very loosely bonded together.

Clear Ice is transparent and contains only a moderate number of air bubbles.

Cloudy Ice is translucent, but essentially sound and non-pervious.

Friable denotes a condition in which material is easily broken up under light to moderate pressure.

Granular Ice is composed of coarse, more or less equidimensional, ice crystals weakly bonded together.

Ice Coatings on particles are discernible layers of ice found on or below the larger soil particles in a frozen soil mass. They are sometimes associated with hoarfrost crystals, which have grown into voids produced by the freezing action.

Ice Crystal is a very small individual ice particle visible in the face of a soil mass. Crystals may be present alone or in a combination with other ice formations.

Ice Lenses are lenticular ice formations in soil occurring essentially parallel to each other, generally normal to the direction of heat loss and commonly in repeated layers.

Ice Segregation is the growth of ice as distinct lenses, layers, veins and masses in soils, commonly but not always oriented normal to direction of heat loss.

Massive Ice is a large mass of ice, typically nearly pure and relatively homogeneous.

Poorly-Bonded signifies that the soil particles are weakly held together by the ice and that the frozen soil consequently has poor resistance to chipping or breaking.

Porous Ice contains numerous void, usually interconnected and usually resulting from melting at air bubbles or along crystal interfaces from presence of salt or other materials in the water, or from the freezing of saturated snow. Though porous, the mass retains its structural unity.

Thaw-Stable frozen soils do not, on thawing, show loss of strength below normal, long-time thawed values nor produce detrimental settlement.

Thaw-Unstable frozen soils show on thawing, significant loss of strength below normal, long-time thawed values and/or significant settlement, as a direct result of the melting of the excess ice in the soil.

Well-Bonded signifies that the soil particles are strongly held together by the ice and that the frozen soil possesses relatively high resistance to chipping or breaking.

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LEGEND: FROZEN SOIL CLASSIFICATION

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BOREHOLE BH-01

CLIENT Municipality of Anchorage
PROJECT NAME Quinhagak Street Reconstruction
PROJECT NUMBER 10155.00
PROJECT LOCATION Quinhagak Street, Anchorage, Alaska
DATE STARTED 5/25/22 **COMPLETED** 5/25/22
GROUND ELEVATION
DRILLING CONTRACTOR Discovery Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow-Stem Auger, autohammer
▽ **AT TIME OF DRILLING** 5.00 ft
LOGGED BY DSN **CHECKED BY** AFS/SMH
▼ **AT END OF DRILLING** 5.35 ft
NOTES
▼ **AFTER DRILLING** 4.35 ft

DEPTH (ft)	U.S.C.S.	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	FIELD BLOW COUNTS (N VALUE)	POCKET PEN. (psf)	ICE BOND	PID (ppm)	OTHER TESTS
0	AC	ASPHALT CONCRETE, (AC)							
	SP-SM	POORLY GRADED SAND WITH SILT AND GRAVEL, (SP-SM) 44% gravel, 45% sand, 11% fines Brown/gray, moist. Subangular to subrounded gravel up to 3 inches. Frost class F2 (hydrometer).	SS S1	88	8-11-14-13 (25)			0.9	MA
		38% gravel, 56% sand, 6% fines Frost class F2 (estimated).	SS S2	63	7-9-6-5 (15)			1.2	LMA
5	GP-GM	POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) 51% gravel, 42% sand, 7% fines Brown, wet. Subangular gravel up to 2 inches. Frost class F1 (estimated).	SS S3A	75	4-7-7-5 (14)			1.5	SA
	ML	SILT WITH GRAVEL, (ML) 20% gravel, 0% sand, 80% fines Gray, moist. Subangular gravel up to 1 inch. Frost class F4 (estimated).	SS S3B					1.9	
	SM	SILTY SAND, (SM) 7% gravel, 63% sand, 30% fines Gray, wet. Fine sand. Frost class F3 (estimated).	SS S4	88	1-5-7-6 (12)			1	LMA
10			SS S5A	75	1-6-6-8 (12)			1.8	
	ML	SILT, (ML) 0% gravel, 5% sand, 95% fines Gray, wet.	SS S5B					0.9	
15	ML	GRAVELLY SILT, (ML) 30% gravel, 0% sand, 70% fines Gray, wet. Subrounded gravel up to 1.5 inches.	SS S6	100	17-50/5"			1	

▲ FIELD N VALUE ▲ 10 20 30 40
PL MC LL 10 20 30 40

Bottom of borehole at 16.0 feet.

Notes:
Completed as piezometer, 1" Sch40 PVC, glued slip connections, hand-slotted screen 4-16 ft BGS. Backfilled with cuttings. Steel flushmount monument with 1/2" bolts. Cold patched.

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BOREHOLE BH-02

CLIENT Municipality of Anchorage
PROJECT NAME Quinhagak Street Reconstruction
PROJECT NUMBER 10155.00
PROJECT LOCATION Quinhagak Street, Anchorage, Alaska
DATE STARTED 5/25/22 **COMPLETED** 5/25/22
GROUND ELEVATION
DRILLING CONTRACTOR Discovery Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow-Stem Auger, autohammer
AT TIME OF DRILLING 3.50 ft
LOGGED BY AFS **CHECKED BY** AFS/SMH
AT END OF DRILLING
NOTES
AFTER DRILLING

DEPTH (ft)	U.S.C.S.	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	FIELD BLOW COUNTS (N VALUE)	POCKET PEN. (psf)	ICE BOND	PID (ppm)	OTHER TESTS
0	AC	ASPHALT CONCRETE, (AC)							
	GP-GM	POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) 48% gravel, 40% sand, 12% fines Brown, moist to wet. Subangular to rounded gravel up to 2.5 inches with cobbles up to 4-5 inches (5% by volume). Frost class F1 (hydrometer).	SS S1	92	11-17-14-9 (31)			2.2	MA
	GP-GM	(GP-GM) 52% gravel, 38% sand, 10% fines Frost class F1 (estimated).	SS S2	63	3-6-4-5 (10)			2.4	LMA
5	GP	POORLY GRADED GRAVEL WITH SAND, (GP) 65% gravel, 30% sand, 5% fines Brown, moist to wet. Angular to subrounded gravel up to 2.5 inches. Frost class NFS (estimated).	SS S3	63	5-9-8-7 (17)			2.7	
	SMg	SILTY SAND WITH GRAVEL, (SMg) 28% gravel, 57% sand, 15% fines Dark gray to brown, moist to wet. Medium to coarse sand, subangular to subrounded gravel up to 1.5 inches. Frost class F2 (estimated).	SS S4	17	4-4-4-4 (8)			2.7	SA
10	ML	SILT WITH SAND, (ML) 12% gravel, 18% sand, 70% fines Gray, wet. Subrounded gravel up to 1.5 inches.	SS S5A / SS S5B	88	1-2-2-2 (4)			2.5 / 1.4	LMA
15	SP-SM	POORLY GRADED SAND WITH SILT, (SP-SM) 0% gravel, 92% sand, 8% fines Gray, wet. Fine sand.	SS S6A	100	7-14-11-7 (25)			1.3	LMA
	ML	SILT WITH SAND, (ML) 10% gravel, 10% sand, 80% fines Gray, moist. Fine sand, subrounded gravel up to 1.5 inches.	SS S6B					0.4	

Bottom of borehole at 17.0 feet.

Notes:
Backfilled with cuttings and topped with cold patch asphalt.

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BOREHOLE BH-03

CLIENT Municipality of Anchorage
PROJECT NAME Quinhagak Street Reconstruction
PROJECT NUMBER 10155.00
PROJECT LOCATION Quinhagak Street, Anchorage, Alaska
DATE STARTED 5/25/22 **COMPLETED** 5/25/22
GROUND ELEVATION
DRILLING CONTRACTOR Discovery Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow-Stem Auger, autohammer
AT TIME OF DRILLING 3.00 ft
LOGGED BY AFS **CHECKED BY** AFS/SMH
AT END OF DRILLING 3.65 ft
NOTES
AFTER DRILLING 2.33 ft

DEPTH (ft)	U.S.C.S.	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	FIELD BLOW COUNTS (N VALUE)	POCKET PEN. (psf)	ICE BOND	PID (ppm)	OTHER TESTS	FIELD N VALUE / PL MC LL
0	GP-GM	POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) 70% gravel, 20% sand, 10% fines Brown, moist. Rounded gravel up to 3.0 inches, one broken cobble 3.5 inches. Frost class F1 (estimated).	SS S1A	75	4-2-2-2 (4)			2.9		
	ML	ORGANIC SOIL, (ML) Dark brown, moist. Silt with organics. Frost class F4 (estimated).	SS S1B					3.1		164
	PT	PEAT, (PT) Dark brown, moist.								
	SP-SM	POORLY GRADED SAND WITH SILT AND GRAVEL, (SP-SM) 37% gravel, 53% sand, 10% fines Dark brown, moist. Subrounded to rounded gravel up to 1 inch. Frost class F2 (estimated).	SS S2A / SS S2B	75	3-4-5-5 (9)			3.2 / 2.6	LMA	
	GP-GM	POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) 70% gravel, 20% sand, 10% fines Brown, moist to wet. Subrounded to rounded gravel up to 2.5 inches. Frost class F1 (estimated).	SS S2C					2		
5	SP	POORLY GRADED SAND, (SP) 10% gravel, 86% sand, 4% fines Gray, wet. Medium sand, subrounded gravel up to 1.25 inches. Frost class F2 (estimated).	SS S3	88	3-4-5-5 (9)			4.9	LMA	
	SM	SILTY SAND, (SM) 0% gravel, 61% sand, 39% fines Gray, wet. Fine sand. Frost class F4 (estimated).	SS S4	63	2-6-7-6 (13)			3.2	LMA	
10	CL-ML	SILTY CLAY, (CL-ML) 0% gravel, 5% sand, 95% fines Gray, moist to wet, soft to medium, low to medium plasticity. Interbedded silt and clay below 15 ft BGS. VS (Humboldt) = 1045 psf.	SS S5A / SS S5B	88	1-1-3-3 (4)	4167		3.7 / 3.5		
15		0% gravel, 10% sand, 90% fines VS (Humboldt) = 1421 psf/42 psf residual.	SS S6A	88	1-1-3-8 (4)	4167		2.2		68
	MLs	SANDY SILT, (MLs) 0% gravel, 46% sand, 54% fines Gray, moist. Fine sand, one rounded piece of gravel 1.25 inches.	SS S6B					3.1	LMA	

Bottom of borehole at 17.0 feet.

Notes:
Completed as piezometer, 1" Sch40 PVC, glued slip connections, hand-slotted screen 2.75-16.75 ft BGS. Backfilled with cuttings. Steel flushmount monument with 1/2" bolts.

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BOREHOLE BH-04

CLIENT Municipality of Anchorage
PROJECT NAME Quinhagak Street Reconstruction
PROJECT NUMBER 10155.00
PROJECT LOCATION Quinhagak Street, Anchorage, Alaska
DATE STARTED 5/25/22 **COMPLETED** 5/25/22
GROUND ELEVATION
DRILLING CONTRACTOR Discovery Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow-Stem Auger, autohammer
AT TIME OF DRILLING
LOGGED BY AFS **CHECKED BY** AFS/SMH
AT END OF DRILLING
NOTES
AFTER DRILLING

DEPTH (ft)	U.S.C.S.	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	FIELD BLOW COUNTS (N VALUE)	POCKET PEN. (psf)	ICE BOND	PID (ppm)	OTHER TESTS
0	AC	ASPHALT CONCRETE, (AC)							
	GP	POORLY GRADED GRAVEL WITH SAND, (GP) 76% gravel, 22% sand, 2% fines Brown, moist. Cobbles up to 4 inches and likely larger (5-10% by volume). Frost class F1 (hydrometer). Split spoon sample considered most representative of grain size distribution and is presented here. Grab sample also analyzed, see lab report for results.	SS S1	75	7-12-11-9 (23)			9.7	MA LMA
			SS S2	0	7-6-4-7 (10)				
5	SM	SILTY SAND, (SM) 4% gravel, 55% sand, 41% fines Gray, moist. Angular gravel up to 1 inch. Trace organic laminae in top of sample. Frost class F4 (estimated). VS (Humboldt) = 2047 psf.	SS S3	54	2-1-3-4 (4)			3.5	LMA
	CL	LEAN CLAY, (CL) 0% gravel, 5% sand, 95% fines Gray, moist, stiff to medium. Frost class F4 (estimated). VS (Humboldt) = 2340 psf.	SS S4	75	2-2-3-4 (5)	6000		7.9	AL
10		VS (Humboldt) = 2507 psf.	SS S5	100	1-2-4-6 (6)	6467		0.8	
15	MLs	SANDY SILT, (MLs) 0% gravel, 45% sand, 55% fines Gray, moist. Fine sand	SS S6	50	3-4-6-6 (10)			1.6	

Bottom of borehole at 17.0 feet.

Notes:
Backfilled with cuttings and topped with cold patch asphalt.

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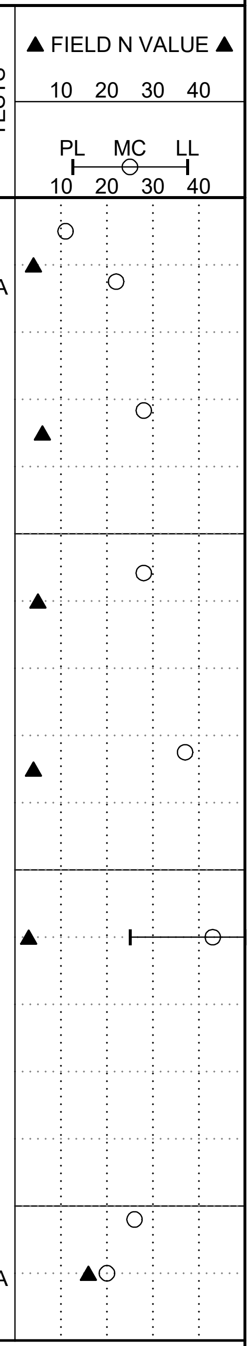
BOREHOLE BH-05

CLIENT Municipality of Anchorage
PROJECT NAME Quinhagak Street Reconstruction
PROJECT NUMBER 10155.00
PROJECT LOCATION Quinhagak Street, Anchorage, Alaska
DATE STARTED 5/25/22 **COMPLETED** 5/25/22
GROUND ELEVATION
DRILLING CONTRACTOR Discovery Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow-Stem Auger, autohammer
▽ **AT TIME OF DRILLING** 1.00 ft
LOGGED BY AFS **CHECKED BY** AFS/SMH
▼ **AT END OF DRILLING** 3.05 ft
NOTES
▼ **AFTER DRILLING** 1.98 ft

DEPTH (ft)	U.S.C.S.	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	FIELD BLOW COUNTS (N VALUE)	POCKET PEN. (psf)	ICE BOND	PID (ppm)	OTHER TESTS
0	OL	SANDY ORGANIC SOIL, (OL)						0.6	
	GP-GM	POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) 50% gravel, 40% sand, 10% fines Gray to brown, moist to wet, subrounded to rounded gravel up to 1.25 inches. Frost class F1 (estimated).	SS S1A SS S1B	63	1-2-2-2 (4)			0.3	LMA
	SMg	SILTY SAND WITH GRAVEL, (SMg) 15% gravel, 42% sand, 43% fines Gray to red, moist. Rounded gravel up to 0.75 inches. Frost class F4 (estimated).							
	ML	SILT, (ML) 10% gravel, 0% sand, 90% fines Gray, moist, stiff, nonplastic. Rounded gravel up to 1.25 inches. Frost class F4 (estimated). VS (Humboldt) = 2256 psf.	SS S2	67	2-3-3-5 (6)	8133		0.4	
5	CH	FAT CLAY, (CH) 0% gravel, 0% sand, 100% fines Gray, moist, stiff. Frost class F3 (estimated). VS (Humboldt) = 2005 psf.	SS S3	58	1-2-3-4 (5)	7033		0.3	
		VS (Humboldt) = 2381 psf.	SS S4	75	2-2-2-3 (4)	5376		0.2	
10		VS (Humboldt) = 1421 psf.	SS S5	100	2-2-1-1 (3)	3733		0.3	AL
15	SM	SILTY SAND, (SM) 0% gravel, 64% sand, 36% fines Gray, moist to wet. Fine sand.	SS S6A SS S6B	67	3-7-9-13 (16)			0.3 0.2	LMA



Bottom of borehole at 17.0 feet.

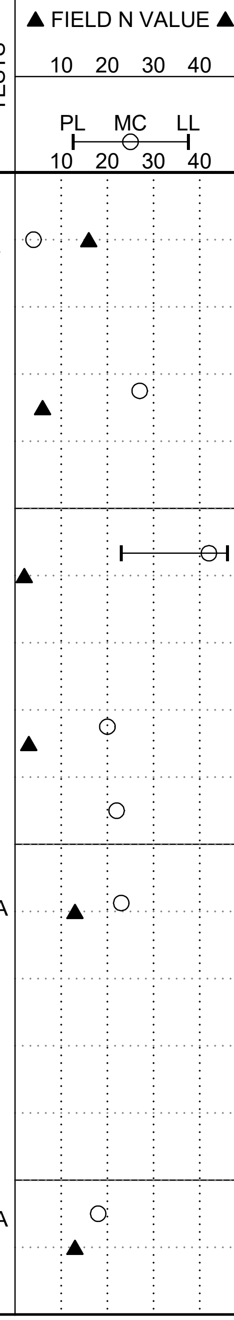
Notes:
Completed as piezometer, 1" Sch40 PVC, glued slip connections, hand-slotted screen 9.6-14.6 ft BGS. Backfilled with cuttings. Steel flushmount monument with 1/2" bolts.

CRW Engineering Group, Inc.
3940 Arctic Blvd Ste. 300
Anchorage, Alaska 99503
Telephone: (907) 562-3252

BOREHOLE BH-06

CLIENT Municipality of Anchorage
PROJECT NAME Quinhagak Street Reconstruction
PROJECT NUMBER 10155.00
PROJECT LOCATION Quinhagak Street, Anchorage, Alaska
DATE STARTED 5/25/22 **COMPLETED** 5/25/22
GROUND ELEVATION
DRILLING CONTRACTOR Discovery Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow-Stem Auger, autohammer
AT TIME OF DRILLING 10.00 ft
LOGGED BY AFS **CHECKED BY** AFS/SMH
AT END OF DRILLING
NOTES
AFTER DRILLING

DEPTH (ft)	U.S.C.S.	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	FIELD BLOW COUNTS (N VALUE)	POCKET PEN. (psf)	ICE BOND	PID (ppm)	OTHER TESTS
0	AC	ASPHALT CONCRETE, (AC)							
	GP	POORLY GRADED GRAVEL WITH SAND, (GP) 63% gravel, 32% sand, 5% fines Brown, moist. Subrounded to rounded gravel up to 3 inches, cobbles up to 4.5 inches (10-15% volume). Frost class F1 (estimated).	SS S1	75	6-10-6-4 (16)			0.3	SA
	CL	LEAN CLAY, (CL) 0% gravel, 5% sand, 95% fines Gray, moist, soft. Layers of sand up to 0.125 inches thick observed below 7.5 ft BGS. Frost class F4 (estimated). VS (Humboldt) = 2465 psf.	SS S2	75	2-3-3-3 (6)	7167		0	
5		VS (Humboldt) = 794 psf.	SS S3	67	1-1-1-1 (2)	1233		0.1	AL
		VS (Humboldt) = 752 psf.	SS S4A	100	1-1-2-5 (3)			0.1	
	SM	SILTY SAND, (SM) 0% gravel, 50% sand, 50% fines Gray, moist to wet. Fine sand. Frost class F4 (estimated).	SS S4B					0	
10		0% gravel, 72% sand, 28% fines	SS S5	88	6-6-7-6 (13)			0	LMA
15	ML	SILT WITH SAND, (ML) 0% gravel, 17% sand, 83% fines Gray, moist.	SS S6	63	2-4-9-9 (13)			0.1	LMA



Bottom of borehole at 17.0 feet.

Notes:
Backfilled with cuttings and topped with cold patch asphalt.

Appendix B

Laboratory Results

Included in this section:

1) Laboratory Results from Alaska Testlab

Alaska Testlab - Anchorage
4040 B Street, Suite 102
Anchorage, AK 99503
Phone: 907-205-1987
Fax: 907-782-4409
info@alaskatestlab.com

Material Test Report

Report No: ASM:22-1312
Issue No: 1

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
Anchorage, AK, 99503

Project Code: 220546

CC: CRW
Maria Kampsen

Project: Quinhagak St

10155.00

Reviewed By: Maria E Kampsen
Title: Senior Engineer
Date: 6/10/2022

Sample Details

Sample ID	22-1312-S01	22-1312-S02	22-1312-S03	22-1312-S04
Client Sample ID	BH-01 Sa1	BH-01 Sa2	BH-01 Sa3A	BH-01 Sa3B
Date Sampled				

Particle Size Distribution

Method:
ASTM D 422

Description:
Analysis of Particle Size Distribution in Soils. Sieving for Particles >75µm, Hydrometer

Drying By:

Washed:
Sample Washed

Sieve Size	% Passing	Limits
3in	100	
2in	100	
1½in	100	
1in	96	
¾in	82	
½in	74	
3/8in	68	
No.4	56	
No.10	41	
No.20	33	
No.40	24	
No.60	17	
No.100	14	
No.200	11	
Finer No.200 (75µm)	15.0	

Other Test Results

Description	Method	Results S01	Results S02	Results S03	Results S04	Limits
Dispersion device	ASTM D 422	Dispersant by hand				
Dispersion time (min)						
Shape						
Hardness						
Water Content (%)	ASTM D2216	4	4	10	10	
Date Tested		5/26/2022	5/26/2022	5/26/2022	5/26/2022	
Tested By		Karen Jackson	Karen Jackson	Karen Jackson	Karen Jackson	
Group Code	ASTM D2487	SP-SM		GP-GM		
Group Name		Poorly graded sand with silt and gravel		Poorly graded gravel with silt and sand		
Atterberg Limits Estimated		Yes		Yes		
Gravel (%)		44		51		
Sand (%)		45		42		
Fines (%)		11		7		
Tested By	ASTM D2487	John Platt		Frank Walters		
Percent Gravel	LMA (Internal Method)		38			
Percent Sand			56			
Percent Fines (Silt/Clay)			6			
Group Symbol			SP-SM			
Group Name			Poorly graded sand with silt and gravel			
Tested By			Frank Walters			

Comments

Soil Classification of Fines (-#200) in LMAs Assumed Unless Verified by Additional Testing

Alaska Testlab - Anchorage
4040 B Street, Suite 102
Anchorage, AK 99503
Phone: 907-205-1987
Fax: 907-782-4409
info@alaskatestlab.com

Material Test Report

Report No: ASM:22-1312
Issue No: 1

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
Anchorage, AK, 99503

Project Code: 220546

CC: CRW
Maria Kampsen

Project: Quinhagak St

10155.00

Reviewed By: Maria E Kampsen
Title: Senior Engineer
Date: 6/10/2022

Sample Details

Sample ID	22-1312-S01	22-1312-S02	22-1312-S03	22-1312-S04
Client Sample ID	BH-01 Sa1	BH-01 Sa2	BH-01 Sa3A	BH-01 Sa3B
Date Sampled				

Other Test Results

Description	Method	Results	Limits
Method	ASTM D6913	A	
Preparation Method		Oven Dry	
Composite Sieving?		Yes	
Separating Sieve(s)		No. 4	
Cu	ASTM D2487	35.20	
Cc		4.36	

Comments

Soil Classification of Fines (-#200) in LMAs Assumed Unless Verified by Additional Testing

Alaska Testlab - Anchorage
4040 B Street, Suite 102
Anchorage, AK 99503
Phone: 907-205-1987
Fax: 907-782-4409
info@alaskatestlab.com

Material Test Report

Report No: ASM:22-1312
Issue No: 1

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
Anchorage, AK, 99503

Project Code: 220546

CC: CRW
Maria Kampsen

Project: Quinhagak St

10155.00

Reviewed By: Maria E Kampsen
Title: Senior Engineer
Date: 6/10/2022

Sample Details

Sample ID	22-1312-S05	22-1312-S06	22-1312-S07	22-1312-S08
Client Sample ID	BH-01 Sa4	BH-01 Sa5A	BH-01 Sa5B	BH-01 Sa6
Date Sampled				

Other Test Results

Description	Method	Results				Limits
Water Content (%)	ASTM D2216	22	20	23	8	
Date Tested		5/26/2022	5/26/2022	5/26/2022	5/26/2022	
Tested By		Karen Jackson	Karen Jackson	Karen Jackson	Karen Jackson	
Percent Gravel	LMA (Internal Method)	7				
Percent Sand		63				
Percent Fines (Silt/Clay)		30				
Group Symbol		SM				
Group Name		Silty sand				
Tested By		Frank Walters				

Comments

Soil Classification of Fines (-#200) in LMAs Assumed Unless Verified by Additional Testing

Alaska Testlab - Anchorage
4040 B Street, Suite 102
Anchorage, AK 99503
Phone: 907-205-1987
Fax: 907-782-4409
info@alaskatestlab.com

Material Test Report

Report No: MAT:22-1312-S01
Issue No: 1

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
Anchorage, AK, 99503

Project Code: 220546

CC: CRW
Maria Kampsen

Project: Quinhagak St

10155.00

The results contained below pertain only to the items tested below. This report should not be reproduced, except in full, without the prior written approval of Alaska Testlab or the agency.

Reviewed By: Maria E Kampsen
Title: Senior Engineer
Date: 6/10/2022

Sample Details

Sample ID	22-1312-S01
Client Sample ID	BH-01 Sa1
Specification	Sieve SOILS

Other Test Results

Description	Method	Result	Limits
	ASTM D 422		
Dispersion device		Dispersant by hand	
Dispersion time (min)			
Shape			
Hardness			
Water Content (%)	ASTM D2216	4	
Date Tested		5/26/2022	
Tested By		Karen Jackson	
Group Code	ASTM D2487	SP-SM	
Group Name		Poorly graded sand with silt and gravel	
Atterberg Limits Estimated		Yes	
Gravel (%)		44	
Sand (%)		45	
Fines (%)		11	
Tested By	ASTM D2487	John Platt	
Date Tested		6/9/2022	

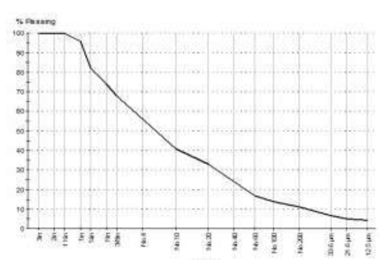
Particle Size Distribution

Method: ASTM D 422

Date Tested: 6/9/2022
Tested By: John Platt

Sieve Size	% Passing	Limits
3in	100	
2in	100	
1½in	100	
1in	96	
¾in	82	
½in	74	
3/8in	68	
No.4	56	
No.10	41	
No.20	33	
No.40	24	
No.60	17	
No.100	14	
No.200	11	
Finer No.200 (75µm)	15.0	
33.6 µm	6.6	
21.6 µm	5.0	
12.5 µm	4.4	

Chart



Comments

Soil Classification of Fines (-#200) in Sieve Analyses Assumed Unless Verified by Additional Testing
No Plasticity Index Test Performed

Alaska Testlab - Anchorage
4040 B Street, Suite 102
Anchorage, AK 99503
Phone: 907-205-1987
Fax: 907-782-4409
info@alaskatestlab.com

Material Test Report

Report No: MAT:22-1312-S03
Issue No: 1

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
Anchorage, AK, 99503

Project Code: 220546

CC: CRW
Maria Kampsen

Project: Quinhagak St

10155.00

Reviewed By: Maria E Kampsen
Title: Senior Engineer
Date: 6/10/2022

Sample Details

Sample ID 22-1312-S03
Client Sample ID BH-01 Sa3A

Other Test Results

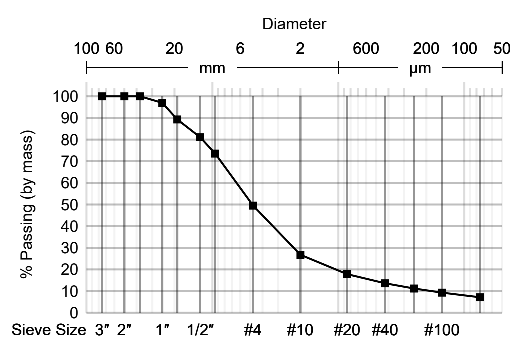
Description	Method	Result	Limits
Water Content (%)	ASTM D2216	10	
Date Tested		5/26/2022	
Tested By		Karen Jackson	
Group Code	ASTM D2487	GP-GM	
Group Name		Poorly graded gravel with silt and sand	
Atterberg Limits Estimated		Yes	
Gravel (%)		51	
Sand (%)		42	
Fines (%)		7	
	ASTM D2487		
Tested By		Frank Walters	
Date Tested		6/3/2022	
Method	ASTM D6913	A	
Preparation Method		Oven Dry	
Composite Sieving?		Yes	
Separating Sieve(s)		No. 4	
Cu	ASTM D2487	35.20	
Cc		4.36	
Date Tested		6/3/2022	

Particle Size Distribution

Method: ASTM D6913
Drying By: Oven
Date Tested: 6/3/2022
Tested By: Frank Walters

Sieve Size	% Passing	Limits
3in	100	
2in	100	
1½in	100	
1in	97	
¾in	89	
½in	81	
3/8in	74	
No.4	49.5	
No.10	27	
No.20	18	
No.40	14	
No.60	11	
No.100	9	
No.200	7	

Chart



Comments

Sample Size Does Not Meet ASTM Requirements
Soil Classification of Fines (-#200) in Sieve Analyses Assumed Unless Verified by Additional Testing
No Plasticity Index Test Performed

Alaska Testlab - Anchorage
4040 B Street, Suite 102
Anchorage, AK 99503
Phone: 907-205-1987
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info@alaskatestlab.com

Material Test Report

Report No: ASM:22-1313
Issue No: 1

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
Anchorage, AK, 99503

Project Code: 220546

CC: CRW
Maria Kampsen

Project: Quinhagak St

10155.00

Reviewed By: Maria E Kampsen
Title: Senior Engineer
Date: 6/10/2022

Sample Details

Sample ID	22-1313-S01	22-1313-S02	22-1313-S03	22-1313-S04
Client Sample ID	BH-02 Sa1	BH-02 Sa2	BH-02 Sa3	BH-02 Sa4
Date Sampled				

Particle Size Distribution

Method:
ASTM D 422

Description:
Analysis of Particle Size Distribution in Soils. Sieving for Particles >75µm, Hydrometer

Drying By:

Washed:
Sample Washed

Sieve Size	% Passing	Limits
3in	100	
2in	100	
1½in	98	
1in	94	
¾in	88	
½in	76	
3/8in	69	
No.4	52	
No.10	36	
No.20	28	
No.40	20	
No.60	17	
No.100	14	
No.200	12	
Finer No.200 (75µm)	15.6	

Other Test Results

Description	Method	Results				Limits
Dispersion device	ASTM D 422	Dispersant by hand				
Dispersion time (min)						
Shape						
Hardness						
Water Content (%)	ASTM D2216	3	5	6	9	
Date Tested		5/26/2022	5/26/2022	5/26/2022	5/26/2022	
Tested By		Karen Jackson	Karen Jackson	Karen Jackson	Karen Jackson	
Group Code	ASTM D2487	GP-GM			SM	
Group Name		Poorly graded gravel with silt and sand			Silty sand with gravel	
Atterberg Limits Estimated		Yes			Yes	
Gravel (%)		48			28	
Sand (%)		40			57	
Fines (%)		12			15	
Tested By	ASTM D2487	Quinton Goodman			Frank Walters	
Percent Gravel	LMA (Internal Method)		52			
Percent Sand			38			
Percent Fines (Silt/Clay)			10			
Group Symbol			GP-GM			
Group Name			Poorly graded gravel with silt and sand			
Tested By			Frank Walters			

Comments

Soil Classification of Fines (-#200) in LMAs Assumed Unless Verified by Additional Testing

Alaska Testlab - Anchorage
4040 B Street, Suite 102
Anchorage, AK 99503
Phone: 907-205-1987
Fax: 907-782-4409
info@alaskatestlab.com

Material Test Report

Report No: ASM:22-1313
Issue No: 1

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
Anchorage, AK, 99503

Project Code: 220546

CC: CRW
Maria Kampsen

Project: Quinhagak St

10155.00

Reviewed By: Maria E Kampsen
Title: Senior Engineer
Date: 6/10/2022

Sample Details

Sample ID	22-1313-S01	22-1313-S02	22-1313-S03	22-1313-S04
Client Sample ID	BH-02 Sa1	BH-02 Sa2	BH-02 Sa3	BH-02 Sa4
Date Sampled				

Other Test Results

Description	Method	Results	Limits
Method	ASTM D6913	A	
Preparation Method		Oven Dry	
Composite Sieving?		Yes	
Separating Sieve(s)		No. 4	
Cu	ASTM D2487		
Cc			

Comments

Soil Classification of Fines (-#200) in LMAs Assumed Unless Verified by Additional Testing

Alaska Testlab - Anchorage
4040 B Street, Suite 102
Anchorage, AK 99503
Phone: 907-205-1987
Fax: 907-782-4409
info@alaskatestlab.com

Material Test Report

Report No: ASM:22-1313
Issue No: 1

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
Anchorage, AK, 99503

Project Code: 220546

CC: CRW
Maria Kampsen

Project: Quinhagak St

10155.00

Reviewed By: Maria E Kampsen
Title: Senior Engineer
Date: 6/10/2022

Sample Details

Sample ID	22-1313-S05	22-1313-S06	22-1313-S07	22-1313-S08
Client Sample ID	BH-02 Sa5A	BH-02 Sa5B	BH-02 Sa6A	BH-02 Sa6B
Date Sampled				

Other Test Results

Description	Method	Results				Limits
Water Content (%)	ASTM D2216	11	9	25	22	
Date Tested		5/26/2022	5/26/2022	5/26/2022	5/26/2022	
Tested By		Karen Jackson	Karen Jackson	Karen Jackson	Karen Jackson	
Percent Gravel	LMA (Internal Method)		12	0		
Percent Sand			18	92		
Percent Fines (Silt/Clay)			70	8		
Group Symbol			ML	SP-SM		
Group Name			Sandy silt	Poorly graded sand with silt		
Tested By			Frank Walters	Frank Walters		

Comments

Soil Classification of Fines (-#200) in LMAs Assumed Unless Verified by Additional Testing

Alaska Testlab - Anchorage
4040 B Street, Suite 102
Anchorage, AK 99503
Phone: 907-205-1987
Fax: 907-782-4409
info@alaskatestlab.com

Material Test Report

Report No: MAT:22-1313-S01
Issue No: 1

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
Anchorage, AK, 99503

Project Code: 220546

CC: CRW
Maria Kampsen

Project: Quinhagak St

10155.00

Reviewed By: Maria E Kampsen
Title: Senior Engineer
Date: 6/10/2022

Sample Details

Sample ID 22-1313-S01
Client Sample ID BH-02 Sa1
Specification Sieve SOILS

Other Test Results

Description	Method	Result	Limits
	ASTM D 422		
Dispersion device		Dispersant by hand	
Dispersion time (min)			
Shape			
Hardness			
Water Content (%)	ASTM D2216	3	
Date Tested		5/26/2022	
Tested By		Karen Jackson	
Group Code	ASTM D2487	GP-GM	
Group Name		Poorly graded gravel with silt and sand	
Atterberg Limits Estimated		Yes	
Gravel (%)		48	
Sand (%)		40	
Fines (%)		12	
	ASTM D2487		
Tested By		Quinton Goodman	
Date Tested		6/9/2022	

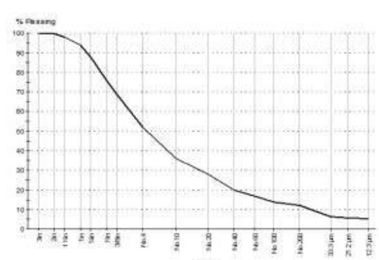
Particle Size Distribution

Method: ASTM D 422

Date Tested: 6/9/2022
Tested By: Quinton Goodman

Sieve Size	% Passing	Limits
3in	100	
2in	100	
1½in	98	
1in	94	
¾in	88	
½in	76	
3/8in	69	
No.4	52	
No.10	36	
No.20	28	
No.40	20	
No.60	17	
No.100	14	
No.200	12	
Finer No.200 (75μm)	15.6	
33.3 μm	6.3	
21.2 μm	5.8	
12.3 μm	5.3	

Chart



Comments

Soil Classification of Fines (-#200) in Sieve Analyses Assumed Unless Verified by Additional Testing
No Plasticity Index Test Performed

Alaska Testlab - Anchorage
4040 B Street, Suite 102
Anchorage, AK 99503
Phone: 907-205-1987
Fax: 907-782-4409
info@alaskatestlab.com

Material Test Report

Report No: MAT:22-1313-S04
Issue No: 1

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
Anchorage, AK, 99503

Project Code: 220546

CC: CRW
Maria Kampsen

Project: Quinhagak St

10155.00

Reviewed By: Maria E Kampsen
Title: Senior Engineer
Date: 6/10/2022

Sample Details

Sample ID 22-1313-S04
Client Sample ID BH-02 Sa4

Other Test Results

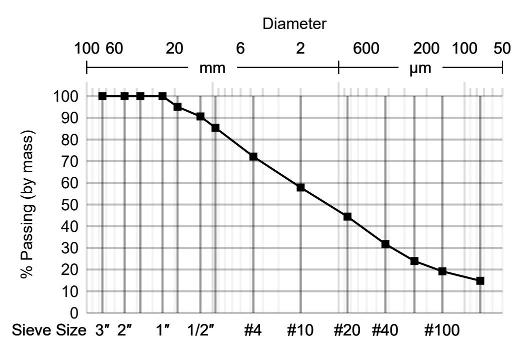
Description	Method	Result	Limits
Water Content (%)	ASTM D2216	9	
Date Tested		5/26/2022	
Tested By		Karen Jackson	
Group Code	ASTM D2487	SM	
Group Name		Silty sand with gravel	
Atterberg Limits Estimated		Yes	
Gravel (%)		28	
Sand (%)		57	
Fines (%)		15	
	ASTM D2487		
Tested By		Frank Walters	
Date Tested		6/3/2022	
Method	ASTM D6913	A	
Preparation Method		Oven Dry	
Composite Sieving?		Yes	
Separating Sieve(s)		No. 4	
Cu	ASTM D2487		
Cc			
Date Tested		6/3/2022	

Particle Size Distribution

Method: ASTM D6913
Drying By: Oven
Date Tested: 6/3/2022
Tested By: Frank Walters

Sieve Size	% Passing	Limits
3in	100	
2in	100	
1½in	100	
1in	100	
¾in	95	
½in	91	
3/8in	85	
No.4	72.1	
No.10	58	
No.20	44	
No.40	32	
No.60	24	
No.100	19	
No.200	15	

Chart



Comments

Sample Size Does Not Meet ASTM Requirements
Soil Classification of Fines (-#200) in Sieve Analyses Assumed Unless Verified by Additional Testing
No Plasticity Index Test Performed

Alaska Testlab - Anchorage
4040 B Street, Suite 102
Anchorage, AK 99503
Phone: 907-205-1987
Fax: 907-782-4409
info@alaskatestlab.com

Material Test Report

Report No: ASM:22-1314
Issue No: 1

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
Anchorage, AK, 99503

Project Code: 220546

CC: CRW
Maria Kampsen

Project: Quinhagak St

10155.00

Reviewed By: Maria E Kampsen
Title: Senior Engineer
Date: 6/10/2022

Sample Details

Sample ID	22-1314-S01	22-1314-S02	22-1314-S03	22-1314-S04
Client Sample ID	BH-03 Sa1A	BH-03 Sa1B	BH-03 Sa2A	BH-03 Sa2B
Date Sampled				

Other Test Results

Description	Method	Results				Limits
Water Content (%)	ASTM D2216	37	164	14	12	
Date Tested		5/26/2022	5/26/2022	5/26/2022	5/26/2022	
Tested By		Karen Jackson	Karen Jackson	Karen Jackson	Karen Jackson	
Percent Gravel	LMA (Internal Method)				37	
Percent Sand					53	
Percent Fines (Silt/Clay)					10	
Group Symbol					SP-SM	
Group Name					Poorly graded sand with silt and gravel	
Tested By					Frank Walters	

Comments

Soil Classification of Fines (-#200) in LMAs Assumed Unless Verified by Additional Testing

Alaska Testlab - Anchorage
4040 B Street, Suite 102
Anchorage, AK 99503
Phone: 907-205-1987
Fax: 907-782-4409
info@alaskatestlab.com

Material Test Report

Report No: ASM:22-1314
Issue No: 1

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
Anchorage, AK, 99503

Project Code: 220546

CC: CRW
Maria Kampsen

Project: Quinhagak St

10155.00

Reviewed By: Maria E Kampsen
Title: Senior Engineer
Date: 6/10/2022

Sample Details

Sample ID	22-1314-S05	22-1314-S06	22-1314-S07	22-1314-S08
Client Sample ID	BH-03 Sa2C	BH-03 Sa3	BH-03 Sa4	BH-03 Sa5A
Date Sampled				

Other Test Results

Description	Method	Results				Limits
Water Content (%)	ASTM D2216	11	18	22	26	
Date Tested		5/26/2022	5/26/2022	5/26/2022	5/26/2022	
Tested By		Karen Jackson	Karen Jackson	Karen Jackson	Cindy Zickefoose	
Percent Gravel	LMA (Internal Method)		10	0		
Percent Sand			86	61		
Percent Fines (Silt/Clay)			4	39		
Group Symbol			SP	SM		
Group Name			Poorly graded sand	Silty sand		
Tested By			Frank Walters	Frank Walters		

Comments

Soil Classification of Fines (-#200) in LMAs Assumed Unless Verified by Additional Testing

Alaska Testlab - Anchorage
4040 B Street, Suite 102
Anchorage, AK 99503
Phone: 907-205-1987
Fax: 907-782-4409
info@alaskatestlab.com

Material Test Report

Report No: ASM:22-1314
Issue No: 1

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
Anchorage, AK, 99503

Project Code: 220546

CC: CRW
Maria Kampsen

Project: Quinhagak St

10155.00

Reviewed By: Maria E Kampsen
Title: Senior Engineer
Date: 6/10/2022

Sample Details

Sample ID	22-1314-S09	22-1314-S10	22-1314-S11
Client Sample ID	BH-03 Sa5B	BH-03 Sa6A	BH-03 Sa6B
Date Sampled			

Other Test Results

Description	Method	Results			Limits
Water Content (%)	ASTM D2216	32	68	20	
Date Tested		5/26/2022	5/26/2022	5/26/2022	
Tested By		Karen Jackson	Karen Jackson	Karen Jackson	
Percent Gravel	LMA (Internal Method)			0	
Percent Sand				46	
Percent Fines (Silt/Clay)				54	
Group Symbol				ML	
Group Name				Sandy silt	
Tested By				Frank Walters	

Comments

Soil Classification of Fines (-#200) in LMAs Assumed Unless Verified by Additional Testing

Alaska Testlab - Anchorage
4040 B Street, Suite 102
Anchorage, AK 99503
Phone: 907-205-1987
Fax: 907-782-4409
info@alaskatestlab.com

Material Test Report

Report No: ASM:22-1315
Issue No: 1

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
Anchorage, AK, 99503

Project Code: 220546

CC: CRW
Maria Kampsen

Project: Quinhagak St

10155.00

Reviewed By: Maria E Kampsen
Title: Senior Engineer
Date: 6/10/2022

Sample Details

Sample ID	22-1315-S01	22-1315-S02	22-1315-S03
Client Sample ID	BH-04 Sa1S	BH-04 Sa1G	BH-04 Sa3
Date Sampled			

Particle Size Distribution

Method:
ASTM D 422

Description:
Analysis of Particle Size Distribution in Soils. Sieving for Particles >75µm, Hydrometer

Drying By:

Washed:
Sample Washed

Sieve Size	% Passing			Limits
3in	100			
2in	100			
1½in	90			
1in	81			
¾in	78			
½in	69			
3/8in	64			
No.4	51			
No.10	35			
No.20	26			
No.40	18			
No.60	13			
No.100	10			
No.200	8.5			
Finer No.200 (75µm)	12.5			

Other Test Results

Description	Method	Results			Limits
Dispersion device	ASTM D 422	Dispersant by hand			
Dispersion time (min)					
Shape					
Hardness					
Water Content (%)	ASTM D2216	5	3	20	
Date Tested		5/26/2022	5/26/2022	5/26/2022	
Tested By		Karen Jackson	Karen Jackson	Karen Jackson	
Group Code	ASTM D2487	GP-GM			
Group Name		Poorly graded gravel with silt and sand			
Atterberg Limits Estimated		Yes			
Gravel (%)		49			
Sand (%)		42			
Fines (%)		9			
Tested By	ASTM D2487	Nathan Wilson			
Percent Gravel	LMA (Internal Method)		76	4	
Percent Sand			22	55	
Percent Fines (Silt/Clay)			2	41	
Group Symbol			GP	SM	
Group Name			Poorly graded gravel with sand	Silty sand	
Tested By			Frank Walters	Frank Walters	

Comments

Soil Classification of Fines (-#200) in LMAs Assumed Unless Verified by Additional Testing