CAMROSE DRIVE STORM DRAINAGE PROJECT

DESIGN STUDY REPORT / DRAFT

August 2022

MOA Project #20-27

Prepared for:

Municipality of Anchorage
Project Management & Engineering Department
632 West 6th Avenue
Anchorage, Alaska 99501

Prepared by:

CRW Engineering Group, LLC
3940 Arctic Boulevard, Suite 300
Anchorage, AK 99503

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1.0 Introduction and Background

MOA Project Management & Engineering (PM&E) has contracted with CRW Engineering Group, LLC (CRW) to provide professional engineering services to develop and evaluate alternatives to improve the drainage along Camrose Drive and along Derby Way (see FIGURE 1 for project location and vicinity map). The alternatives and recommendations are summarized in this Design Study Report (DSR).

Figure 1 - Project Location and Vicinity Map

1.1 Purpose and Need

A primary purpose of the project is to resolve the flooding that occurs each spring and during large rain events at the intersection of Camrose Drive and Derby Way (see photos on front cover). This is due to a failed storm drain system at the intersection. MOA Street Maintenance regularly uses their vac truck to remove the excess water, which is expensive. The vac truck is very noisy and can keep residents awake if the work is performed at night. Also, residents have complained of impacts to their properties, including heaving driveways, concerns about ground subsidence, and the inability to walk along the roadway.

Residents have also been impacted by ponding at the intersection of Camrose Drive and Kensington Drive. Flat grades and an old storm drain system at this intersection have contributed to the ponding issues, but has not required the use of a vac truck to remove the standing water.

There are two separate storm drain systems outfalls that discharge stormwater to the South Fork of Chester Creek. Both outfalls are constructed within a narrow easement between homes. Street Maintenance cannot gain access along these easements due to vegetation and fences. Both of these outfalls need to be permanently abandoned, and the proposed storm should be constructed within the ROW instead.

2.0 Existing Conditions

2.1 Area Context and Zoning

The entire project area is Zoned R-1, Single-Family Residential.

2.2 Roadway Characteristics and Conditions

Camrose Drive are classified as Secondary (local) Street: Urban Residential in the MOA PM&E Design Criteria Manual (DCM) and have a posted speed limit of 20 MPH. Most of Camrose Drive is very flat, with grades varying between 0.4% and 0.6%, with a steeper 2.0% grade near Baxter Road. There are low spots along the roadways where drainage can’t effectively drain to a catch basin, and during spring break-up or large rain events these areas form large ponds within the roadway. For example, both the intersection of Camrose/Derby and Camrose/Kensington experience ponding, compounded by deteriorated storm drain systems. Derby Way has roadway grades that vary from 0.4% to 6.3%.

The existing pavement conditions is in fair to poor conditions with cracking and settlement throughout many sections of the roadway. Rolled curb and gutter is present on both Camrose Drive and Derby Way. The existing roadway width along Camrose Drive and Derby Way is approximately 37 feet wide measured from back of curb.

East Northern Lights Boulevard is classified as a Major Arterial. It comprises of two lanes in each direction, a median/turn lane, pedestrian facilities on both sides, with barrier curbs, and has a posted speed limit of 45 MPH.

2.3 Right-of-Way and Easements

Camrose Drive and Derby Way have 60-foot ROW widths. East Northern Lights Boulevard has a ROW width of 90 feet.

2.4 Environmental

2.4.1 Wetlands / Creeks

According to the U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory mapper and the Municipality of Anchorage (MOA) Wetlands Atlas, the only waterway or wetlands near the project area is South Fork Chester Creek. As the project involves impacts (cut/fill) below ordinary high water of South Fork Chester Creek, a U.S. Army Corps of Engineers (USACE) Section 404 (wetlands) permit would be required. It is likely that the project would be authorized under Nationwide Permit (NWP) #43, Stormwater Management Facilities.

2.4.2 Water Use / Water Quality

Storm water within the proposed project area flows off the roadway and enters Anchorage's municipal separate storm sewer system (MS4) and then into South Fork Chester Creek. The proposed project involves abandonment of two existing storm drain outfalls between Camrose Drive to South Fork Chester Creek and may involve replacement of an existing storm drain outfall into the creek near Northern Lights Boulevard.

South Fork of Chester Creek is listed on the Alaska Department of Environmental Conservation's (ADEC) Impaired Waters 2020 list as a category 4a waterbody; indicating it has been designated as an impaired water with an approved Total Maximum Daily Load (TMDL). The creek is contaminated with fecal coliform bacteria from urban runoff and industrial pollutant sources. A TMDL has been established in accordance with Section 303 (d)(1)(C) of the Clean Water Act and the Environmental Protection Agency's regulation (40 CFR Part 130).

Any work planned within waters of the U.S. would require a Clean Water Act Section 401 Certification from ADEC; however, if the USACE finds that a NWP applies to this project, this certification would be covered through the NWP.

A Temporary Water Use Authorization from the Alaska Department of Natural Resources (ADNR) would also be required for any work in Chester Creek where creek diversion/dewatering is planned.

Temporary water quality impacts during construction would be minimized through coordination with resource agencies and use of Best Management Practices as identified in the Storm Water Pollution Prevention Plan that would be developed for the project if project ground-disturbing activities total more than one acre.

2.4.3 Fish and Anadromous Waters

According to the Alaska Department of Fish and Game (ADF&G) Anadromous Waters Catalog Interactive Mapper, the South Fork of Chester Creek is an anadromous waterbody supporting Coho and Sockeye Salmon, and Dolly Varden (Anadromous Waters Catalog #247-50-10050-2302-3010). At the project location, ADF&G reports Coho Salmon spawning. The project would remove and/or replace three storm drain outfalls that directly impact Chester Creek, and a Fish Habitat Permit from ADF&G would be required. If rerouting or dewatering of any section of the creek is required, an Aquatic Resource Permit from ADF&G would also be required to collect fish and remove them from the worksite.

2.4.4 Floodplain and Regulatory Floodway

A review of the Federal Emergency Management Agency's Flood Insurance Rate Map #0200050759D revealed that components of the project would be within the regulatory floodway, Zone AE (FIGURE 2). The rest of the project would be in either Zone X (shaded; indicating the 0.2-percent-annual-chance [or 500-year] flood zone), or Zone X (unshaded; outside the flood zone). Coordination with the MOA Flood Hazard Program would be required for any project impacts to the regulatory floodway (Zone AE) of South Fork Chester Creek. Any roadway regrading adjacent to the floodway in the Zone X (shaded; 0.2% zone) may also need consultation with the MOA Flood Hazard Program. An engineering analysis must be conducted to determine if the project would increase flood heights, and a no-rise certification would be completed for work in Zone AE and submitted prior to issuance of a Flood Hazard Permit from the MOA.

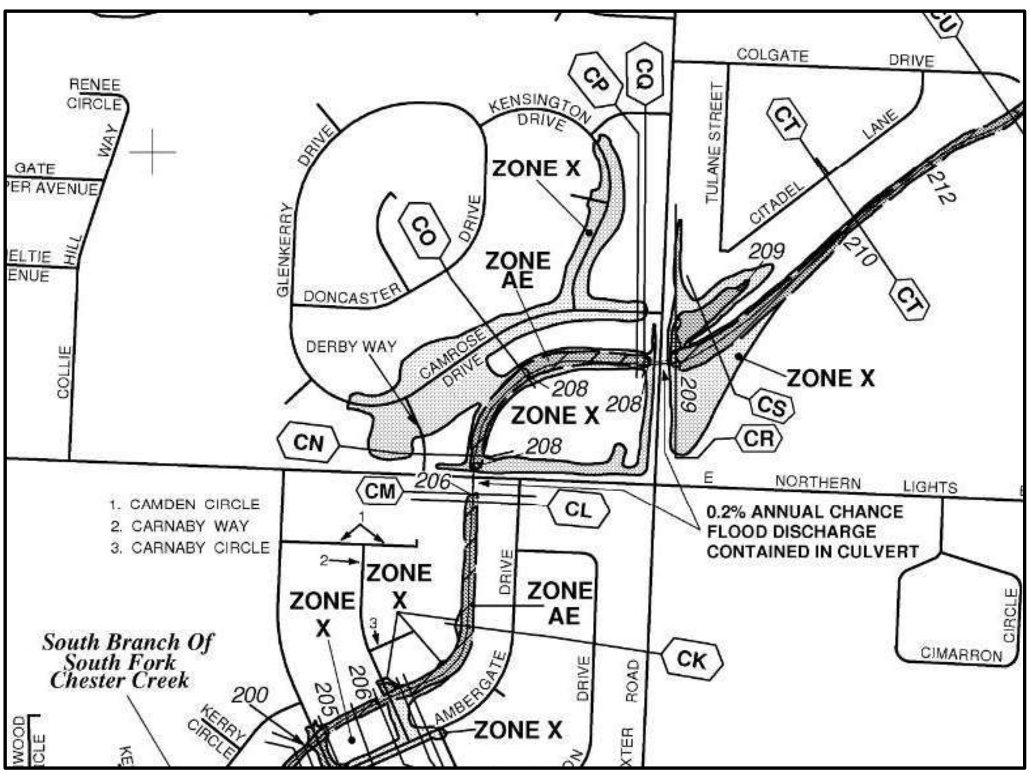


Figure 2 - Flood Insurance Rate Map (Project Area)

2.4.5 Migratory Birds and Eagles' Nests

According to the USFWS Information for Planning and Consulting Portal, several species of migratory birds may travel through the proposed project area and may be disturbed by vegetation clearing operations. The proposed clearing activities should occur outside of the recommended migratory bird nesting period window for the Southcentral Region (May 1 – July 15) outlined in the 2017 USFWS Region 7 Timing Recommendations for Land Disturbance and Vegetation Clearing.

According to the USFWS Bald Eagle Nest Sites Mapper, there are no documented eagle nests located near the project area. An eagle nest survey is recommended as suitable nesting habitat exists in the project area. If a nest is discovered to be active immediately prior to construction, an Eagle Take Permit may be required from USFWS.

2.4.6 Contaminated Sites

According to the ADEC Contaminated Sites Mapper, there are no contaminated sites within 0.25 mile of the proposed project area.

The likelihood of encountering contaminated soil or groundwater during the construction phase is low. If suspected contamination is encountered, construction activities would cease in the area, and ADEC would be contacted for direction on how to proceed.

2.4.7 Historic Properties, Archeological, and Cultural Resources

As part of the USACE wetlands permitting process, in accordance with Section 106 of the National Historic Preservation Act, the USACE would coordinate with consulting parties during their permitting process as needed to determine if there are any historic properties or cultural resources within the project area.

2.5 Drainage & Soils

Existing drainage conditions are discussed in Section 3.0 below, and the existing soil conditions are summarized in Section 4.0 below. A geotechnical investigation including 4 boreholes with piezometers is planned for the Fall of 2022. A full geotechnical report with recommendations is anticipated to be completed by December 2022.

2.6 Utilities

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

2.6.1 Water

Anchorage Water and Wastewater Utility (AWWU) owns and operates water mains, fire hydrants, and water services in the project area. All adjacent parcels are served by AWWU's public water system. An existing 8-inch ductile iron (DI) water main extends along the length of north side of Camrose Drive and the east side of Derby Way. The water main was installed in 1971 and is located approximately 12 feet from centerline. The water main ties into a 6” DI water main that runs along the east side of Kensington Drive and 12” DI water mains on East Northern Lights Boulevard and Baxter Road. The East Northern Lights Boulevard 12” DI water main was installed in 1970 and is located on the north side of the roadway within the inside westbound lane. The water mains have approximately 8-12 feet of cover based upon record drawing information. There are two fire hydrants within the project limits, each is offset approximately 20 feet from Camrose Drive centerline. Several water service keyboxes were not found during the field survey and are likely buried beneath grass or pavement. The missing keyboxes were approximated into the drawings based upon water connect cards provided by AWWU.

2.6.2 Sanitary Sewer

The project area is also entirely served by an AWWU owned and operated piped sewer system consisting of gravity sewer mains, manholes, and sewer services. An existing 8-inch AC sewer main extends along the south side of Camrose Drive, the west side of Derby Way, and the west side of Kingston Drive. The AC sewer main was installed in 1972 and its location varies between 2-12 feet from the roadway centerlines. There are 4 manholes and 1 cleanout within the project limits. Existing sewer service locations are approximated in the drawings based upon connect cards provided by AWWU.

2.6.3 Storm Drain

Storm drain facilities within the project area are discussed in SECTION 3.0 below.

2.6.4 Electric

CEA owns and operates overhead and underground electric lines, utility poles, and roadway lights within the project area. The underground single-phase primary conductor runs along the backside of the parcels within utility easements that serve residents on Derby Way, Camrose Drive, and Kensington Drive. The single-phase primary conductor crosses under Derby Way at the Northern Lights Intersection and under Camrose Drive at the Baxter Road Intersection. CEA also owns and operates an aerial transmission line and an underground three-phase primary conductor paralleling the south side of East Northern Lights Boulevard within the proposed project limits.

2.6.5 Telephone & Fiber Optic

Alaska Communications (ACS) owns and operates underground copper telecommunication lines in the project area. The underground lines serve customers on Derby Way, Camrose Drive, and Kensington Drive through utility easements located on the backside of the parcels. Underground copper lines run parallel and along both sides of East Northern Lights Boulevard and Baxter Road within the proposed project limits. ACS plans to install new fiber optic lines along the south side of E. Northern Lights Boulevard in the fall of 2022. The design team is coordinating with ACS to try and minimize future conflicts between the proposed storm drain and new fiber optic lines.

2.6.6 Cable & Fiber Optic

General Communications, Inc. (GCI) owns and operates underground coaxial cables within the project area. The underground lines serve customers on Derby Way, Camrose Drive, and Kensington Drive through utility easements located on the backside of the parcels. GCI has .750 and .500 coaxial cables perpendicularly crossing underneath Camrose Drive from the south between parcels 27 and 28 to the north between parcels 6 and 7. GCI operates .875 coaxial cables that parallel the north and south side of East Northern Lights Boulevard within the proposed project limits.

2.6.7 Natural Gas

ENSTAR Natural Gas Company (ENSTAR) owns and operates natural gas facilities within the project area. A 1 ¼-inch steel gas main parallels the south side of Camrose Drive from Baxter Road to Kensington Drive where it transitions to a 2-inch steel gas main. The 2-inch gas main tees and continues along the east side of Kensington Drive and the south side of Camrose Drive to Derby Way. At Derby Way the gas line tees and continues west on Camrose Drive with a 1 ¼-inch steel line and a 2-inch steel line continues south along the east side of Derby Way to E. Northern Lights Boulevard. At the intersection the 2-inch steel transitions into a 2-inch plastic line perpendicularly crosses East Northern Lights Boulevard and continues east along the south side of the road until it exits the proposed project area. There are also multiple ¾" and 1 ¼-inch steel service crossings along Camrose Drive to serve the residents on the north side of the road.

2.7 Private Improvements

Each property has a single mailbox in the ROW behind the curb, and a driveway that extends to the curb. There are also some landscaping and trees located behind the curb.

3.0 Drainage Analysis

This section of the DSR focuses on the design standards and requirements identified in the Anchorage Stormwater Manual (ASM) regarding drainage design and analysis, as well as addressing the components typically provided in a standalone Stormwater Management Report.

This project falls under the *Medium Project* category based on the definition provided in Section 3.3.1.3 of the ASM:

- Project will disturb 10,000 or more square feet of land.
- The fraction of impervious, lawn or other landscaping, and naturally vegetated landcover types present at pre-development of the project will not change by more than 5% as a result of the proposed improvements.

This report will summarize the drainage conditions within the project area for the pre- and post-development conditions and evaluate design alternatives to improve overall drainage in the project area. Refer to SECTION 7.0 for the post-development conditions.

3.1 Existing Conditions

The intersection of Camrose Drive and Derby Way floods seasonally during spring break-up and large rain events. The flooding at the intersection has gotten progressively worse each year. MOA Street Maintenance regularly uses their vac truck to remove the excess water. Residents have complained of impacts to their properties, including heaving driveways, concerns about ground subsidence, moisture in crawl spaces, and the inability to walk along the roadway.

Photo 1 – Typical Springtime Flooding (March 2022)

In addition to the flooding issue, Street Maintenance has identified several issues with the piped storm drain systems in the project area that are aging and in poor condition. Issues include failing inverts, collapsed pipe, debris in pipes causing blockages, and failures in the pavement due to damaged pipe. One of the outfall pipes that discharges into South Fork Chester Creek is also fully submerged under normal flow conditions in the creek.

3.1.1 Conveyance Systems

There are two separate storm drain systems within the project area. Both are located on Camrose Drive and will be referred to as the *east* and *west systems* for the purpose of this report (see FIGURE 3). Surface runoff in the project area generally flows north to south and is directed into Type 2 (rolled) curb and gutter along either side of the roadway. This runoff is then captured by catch basins associated with either the east or west system, which are described in more detail below.

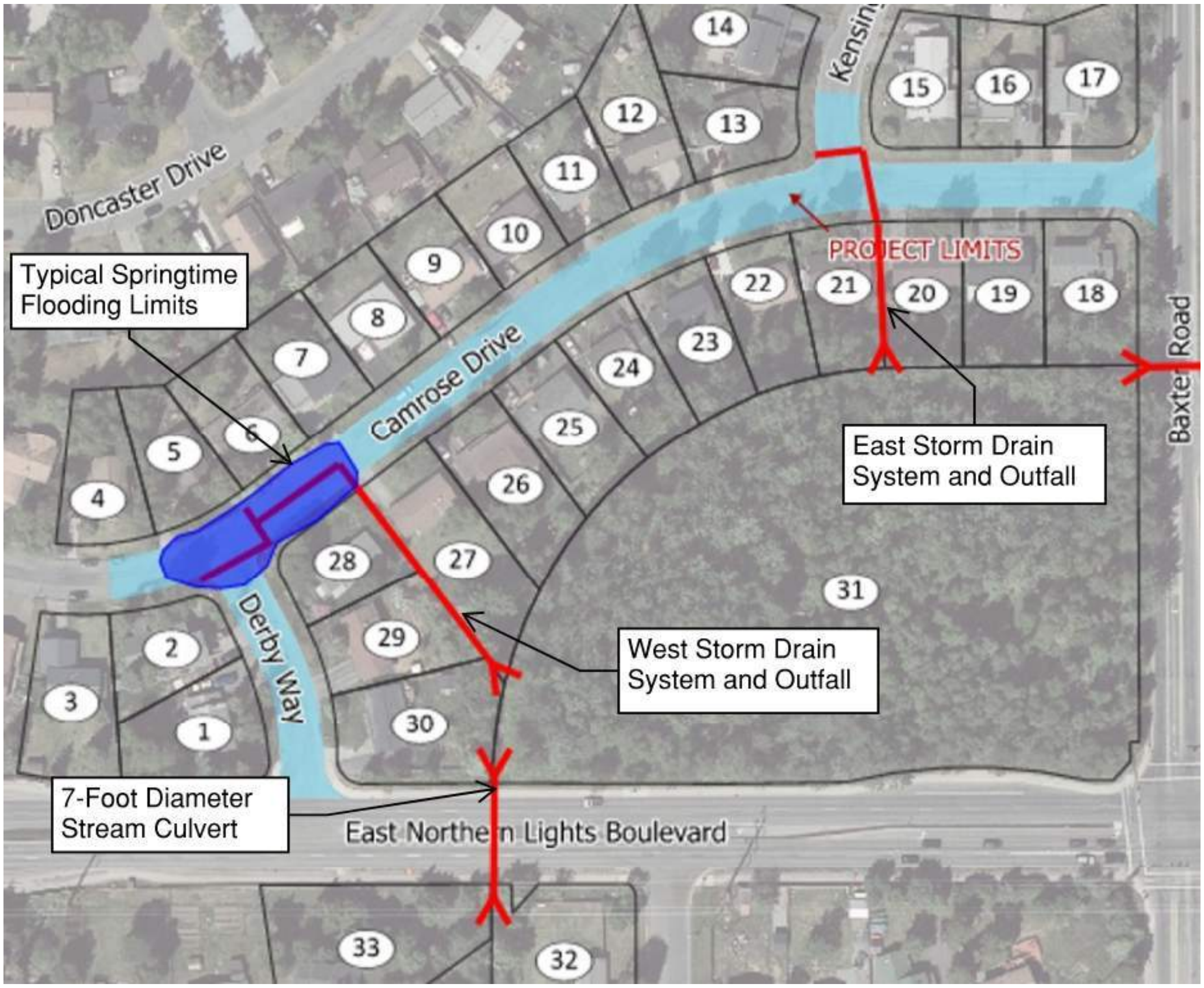


Figure 3 – Conveyance Systems Map

The west system consists of two catch basins and one catch basin manhole located at the intersection of Camrose Drive and Derby Way. These structures collect surface runoff via curb inlets from these two roadways, adjacent properties, and a significant contributing area from the subdivision to the north (Glenkerry Drive, Doncaster Drive, and Kilkenny Circle). The curb inlets direct flow into the piped system, which includes two additional storm drain manholes. The west system is routed northeast along Camrose Drive, then flows southeast along a 17.5-foot-wide utility easement between Parcels 27 & 28 and

Photo 2 – West System Outfall Pipe (Submerged)


Photo 3 – East System Outfall Pipe

discharges into South Fork Chester Creek. This outfall pipe is fully submerged with approximately 1-foot of water over the top of the 18-inch pipe during typical creek flows.

The east system consists of one catch basin and two catch basin manholes located at the intersection of Camrose Drive and Kensington Drive. Like the west system, the east system conveys runoff from these roadways and adjacent properties, as well as portions of the subdivision to the north (Colleen Circle, Dunbar Lane, Glenkerry Drive, and Doncaster Drive). The east system is routed south through a 15-foot-wide utility easement between Parcels 20 & 21 and outfalls into South Fork Chester Creek. The invert of this outfall pipe is located near the water surface of the creek during typical flows.

The storm drain pipe for the east and west systems ranges in size from 10-inch to 18-inch corrugated metal pipe (CMP). These systems were installed in 1972 as part of the College Gate East Subdivision Additional No. 3 improvements project, making the pipe and structures 50 years old. One segment of pipe from the east system was replaced with 18-inch corrugated polyethylene pipe (CPEP), likely because of a recent repair.


Photo 4 – Storm Drain with Debris

MOA Street Maintenance inspected each system to the extents possible. The inspection identified pipes with missing inverts, significant debris accumulation, crushed pipe, and surface degradation near storm drain structures due to failing pipe. The 50-year-old system is beyond its useful design life and is no longer operating effectively.

MOA Street Maintenance would like to eliminate the two outfall pipes (MOA GIS IDs 1158-117 & 1538-115) for the east and west systems. Each outfall pipe segment is routed through a utility easement between homes, making access extremely difficult with fencing, landscaping, and other shallow utilities.

MOA Street Maintenance performed a CCTV inspection of the existing storm drain systems within the project limits. Also, Stephl Engineering (Stephl) performed a inspection of the Chester Creek Culvert at Northern Lights Boulevard in August 2022, and it appears to be in relatively decent condition. See APPENDIX H for the Stephl's Cheser Creek Culvert Inspection Memo and for additional storm drain inspection photos along Camrose Drive and Derby Way. Note that photos of the west outfall were not taken due to the presence of standing water in the pipe and manhole.

Refer to APPENDIX A for an Existing Utilities Map that show the existing storm drain systems.

3.1.2 Drainage Basins

The project and contributing drainage area is situated within the Lower South Fork Chester Creek watershed and encompasses approximately 34 acres. The drainage area is located within the MOA Municipal Separate Storm System (MS4) and is identified by MOA Watershed Management (WMS) mapping as Sub-basin IDs 131 and 606.

The project site was delineated into 8 smaller catchment areas based on topography, land cover, and routing of runoff in the area. The drainage area primarily consists of a fully developed residential neighborhood with single family homes (zoned R-1), municipal roadways constructed with Type 2 (rolled) curb and gutter, and asphalt surfacing. As such, land cover generally consists of pervious areas such as lawns and forests, and impervious surfaces such as roadways and roofs. The runoff generated from the contributing area is intercepted by one of the two pipe storm drain systems described above, both of which outfall into South Fork Chester Creek.

The contributing drainage area and delineated catchment areas are illustrated in APPENDIX D.

3.1.3 Water Quality Treatment

Currently, no water quality treatment is being provided for stormwater discharging into South Fork Chester Creek for the east or west pipe storm drain systems beyond natural processes provided by lawns and vegetated areas. The storm drain structures in the project area are constructed with catches/sumps below the outgoing pipe, which help collect heavier sediments such as gravel and sand.

3.2 Hydrologic and Hydraulic Analysis

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

3.2.1 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 as provided in Appendix D of the ASM. The base design storm depth values are from Table 4.2-1 of the ASM. Based on the project location, the base storm depths were adjusted using an orographic factor of 1.2. Refer to the Anchorage Orographic Map in APPENDIX D showing the location of the project and the corresponding factor used for this analysis. The 10-year, 24-hour design storm was used to evaluate if the existing pipe is adequate to convey peak flows, as well as for sizing proposed piping and lift station design. The 10-year design storm has a base depth of 2.28 inches (Table 4.2-1, ASM) and was increased to 2.74 inches due to orographic effects. The 100-year, 24-hour design was modeled to evaluate flood bypass conditions. The 100-year design storm has a base depth of 3.39 inches (Table 4.2-1, ASM) and was increased to 4.31 inches to account for orographic effects.

3.2.2 Model Information

The Soil Conservation Service (SCS) TR-55 method was used for this drainage analysis. The drainage analysis was developed using 2019 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 design points, evaluate pipe sizing, and identify problems areas (e.g. flooding, surcharged pipes, etc.).

Precipitation losses were estimated using SCS Curve Numbers based on land cover type, slope, and the hydrologic soil group for the project area. Soil Type B was used for this drainage analysis effort based on the project location. Soil type was determined using the Web Soil Survey (WSS), an online tool operated by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). Refer to APPENDIX D for the hydrologic soil group report from the WSS.

The time of concentration (Tc) 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 dictation point of a watershed to the design point or point of interest.

3.2.3 Model Results

The results from the drainage modeling effort show that the existing storm drain pipe for both the east and west system is undersized to accommodate the 10-year, 24-hour design storm event. Each system experiences prolonged surcharging in pipes and structures during the peak of the storm. Structure 1538-006 & 1538-063 (west system) overtop during the peak of the 10-year storm, causing flooding into the Camrose Drive and Derby Way intersection. This is consistent with conditions reported by homeowners in the area during large rain events and spring break-up. In addition to Structures 1538-006 & 1538-063, Structure 1538-015 (east system) overtops during the 100-year event for a prolonged period. Structure 1538-063 overtops for a prolonged period of time (over 2 hours).

Peak flows are shown below for the east and west systems at the outfall for the 10-year and 100-year storm events. Note that peak flow results do not account for water that exits/overtops structures.

Table 1 - Peak Flows (Existing Conditions)

Design Point (MOA GIS ID)	Peak Runoff 10-yr, 24-hr Event (cfs)	Peak Runoff 100-yr, 24-hr Event (cfs)
East System Outfall (1538-117)	5.57*	8.20**
West System Outfall (1538-115)	10.27**	11.32**

* Surcharging in System
** Prolonged Overtopping/Flooding in System

Comprehensive drainage model results, input parameters, and other related data can be found in APPENDIX D. Additionally, profiles are provided for the east and west systems illustrating the hydraulic grade line (water surface elevation) during peak flow conditions.

Note that the naming convention used for the storm drain structures in the existing drainage model matches the GIS identification number provided on the MOA Stormwater Asset Map available online.

4.0 Geotechnical Analysis

A geotechnical investigation including 4 boreholes with piezometers is planned for the Fall of 2022. A full geotechnical report with recommendations is anticipated to be completed by December 2022.

4.1 Existing Conditions

Camrose Drive area has historic geotechnical borings that show predominantly sand and gravel with a low frost potential (see APPENDIX I - Historical Geotechnical Data). This is consistent with the general geological map of Anchorage. The groundwater was relatively deep considering the nearby stream, about 6 to 9 feet below ground surface (BGS).

A more detailed summary of the existing conditions based on the geotechnical investigation is planned for September 2022 will be included as part of the final DSR.

4.2 Preliminary Analysis and Recommendations

The use of 2-inches insulation over the storm drain with less than 4 feet of cover is recommended to reduce the risk of the storm drain freezing. Frost depths between insulated and uninsulated sections differ and can result in large differential surface manifestations, depending on the subgrade. With the anticipated sand and gravel, the differential surface manifestations are expected to be smaller compared to silt, assuming the entire roadway is insulated to minimize differential movement. Insulating just over the storm drain could introduce differential movement in the roadway. Three or four feet of insulation behind the curb is typically required for silty soils to prevent "curb rolling." For sand and gravel that are anticipated for Derby Way and Camrose Drive, the frost heave potential is considerably lower and therefore we could expect insulation extending 1 foot behind the curb to perform satisfactorily.

A more detailed analysis and recommendations based on the Geotechnical Report will be included as part of the final DSR.

5.0 Design Criteria and Standards

The ROW within the project area is owned by MOA and therefore, the design criteria for this project are based on the MOA Design Criteria Manual (DCM). See below for a summary of the requirements from the DCM for the drainage, lift station, and roadway improvements.

5.1 Drainage

A summary of the pertinent storm drain design criteria per the Anchorage Stormwater Manual (ASM) Volume 1 is provided below:

- Storm drain pipes shall be Type S corrugated polyethylene pipe (CPEP) or Type S pre-coated corrugated metal pipe (PCMP) due to corrosion issues in Anchorage area.
- Minimum diameter of storm drain pipe is 12 inches. Catch basin lead minimum size is 10-inch in diameter for the MOA.
- 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.
- Flared end sections or headwalls are required on all storm outfalls.
- Storm drain outfalls shall be one foot above the 100-year water surface elevation for regulated streams.

5.2 Lift Station Design Criteria

A summary of the lift station design criteria is summarized below:

Stormwater lift stations must be designed to accommodate the design storm event listed in Table 4.2-1 of the ASM Volume 1 which identifies a 10-year, 24-hour storm for conveyance design for a minor drainageway. The lift station must also accommodate a 5-year design storm event with one pump out of operation. A summary of selected storm drain lift station design criteria is provided below:

- Number of pumps per lift station — 2 (3 upon approval)
- Minimum force main diameter — 4 inches
- Minimum force main velocity — 3 ft/sec
- Maximum motor starts per pump — 6/hour

Additional lift station requirements are that pumps 5-horsepower and larger have three-phase motors. Solid state reduced voltage current-limits motor starter (soft starts) shall be provided if required by the electrical utility. Wet well ventilation is required and consists of schedule 40 steel gooseneck vent piping.

5.3 Roadway Design Criteria

Camrose Drive and Derby Way will be reconstructed the full width to replace curb and gutter that has met it’s useful life, and will replaced in the same horizontal location. The vertical location will generally be the same, but there may be some locations where it varies some due to settlement or flat grades.

The asbuilts show the roadway grades of 0.4% for approximately 700 feet along Camrose Drive and a portion of Derby Way. The minimum vertical grade for a street with curb and gutter is 0.5% (per DCM 1.9.D.2.a). Since this is a storm drain reconstruction project, is it anticipated that it will not be required to re-grade the roadway with high and low points to attain the minimum 0.5%, and as such a waiver will not be required.

The initial investigation shows that the driveway grades will not be changed significantly, and will be able to easily meet the Max residential driveway grade of ± 10%. The landing residential grade/length of ± 2% for 12 ft may not be attainable since the driveways are already established without landings. Since this is a storm drain reconstruction project, is it anticipated that it will not be required to re-grade the driveways to obtain a 2% landing, and as such a waiver will not be required.

6.0 General Design Considerations

6.1 Right-of-Way Acquisition and Temporary Construction Permits

A key element for the successful completion of any project is the acquisition of any required ROW, easements, and/or permits while providing fair and equitable treatment to all affected property owners, tenants and lessees. 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. Storm drain easements (DE) are required for drainage facilities installed on or near 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 or an existing easement to conduct the work.

6.2 Driveways

Driveways will typically be repaved 6 feet beyond the back of curb to accommodate the transition insulation, which extends 4 feet beyond the roadway insulation.

6.3 Mailboxes

Individual mailboxes at the single-family residences will be impacted by the proposed improvements. Some past projects have attempted to change mail delivery from individual mailboxes to cluster mailboxes. Previous communication with the United States Postal Service (USPS) indicates that to change from individual to cluster mailboxes the following must occur:

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

6.4 Private Improvements in Right-of-Way

Property owners who have personal improvements in the ROW, such as landscaping 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 and retaining walls within the roadway clear zone are usually not granted. Fences within the ROW for this project will be removed and reset onto the property line if impacted during construction. If an owner doesn't wish for the fence to be reset, it will be disposed.

7.0 Drainage Improvements

The primary goal for this project is to improve overall drainage in the project area, address flooding issues, upgrade aging and undersized drainage infrastructure, and improve maintenance access to the storm drain system. Refer to Section 3.0 that describes the existing storm drain system and the various issues associated with it.

7.1 Alternatives

Three alternatives were evaluated to meet these project goals, which will be discussed in more detail below. Each of these alternatives have pros and cons associated with them, as well as design challenges that will need to be considered as the project moves forward.

Due to the age and poor condition of the existing east and west storm drain systems, all alternatives recommend replacing the existing pipe and structures entirely. The exception is that the MOA has requested that the two storm drain outfalls between the houses be permanently eliminated because access is challenging or not possible due to the private improvements, such as fences and vegetation. The pipe can either be excavated and removed or abandoned in place and filled with a concrete slurry. The concrete slurry option (grout) is intended to minimize impacts to private improvements, shallow utilities, and the South Fork Chester Creek, which is a salmon-bearing stream. Abandoning will be further analyzed during the design phase. The alternatives below reflect the concrete slurry cost, assuming it is feasible. Vacating unused easements will be considered during the Design phase.

7.1.1 Alternative 1 (Gravity System to south side of Northern Lights Blvd.)

Alternative 1 consists of extending a continuous gravity storm drain system from the intersection of Kensington Drive and Camrose Drive to the west to Derby Way. The storm drain system would then be routed south and outfall on the south side of East Northern Light Boulevard into South Fork Chester Creek.

A combination of curb inlets and manholes are designed to collect stormwater runoff at low points and direct it to the gravity piped system. The pipe system would be constructed with corrosion resistant corrugated polyethylene pipe (CPEP) ranging in size from 12-inch (catch basin leads) to 18 and 24-inch (main line pipe).

An existing CMP storm drain system on East Northern Lights Boulevard extends west of Campbell Airstrip Road and is routed east past Derby Way and discharges on the south side of East Northern Lights Boulevard. To make this alternative a viable option, this existing system will need to be connected to the proposed system on the north side of Northern Lights Boulevard. Runoff from the existing and proposed systems will be combined and a new outfall will be constructed.

Photo 5 – Stream backwater north of Northern Lights Boulevard

One of the main benefits to constructing the outfall on the south side of Northern Lights Boulevard instead of on the north side is the additional relief gained. The creek bed and crossing culvert are approximately 1.2 feet lower on the south side of East Northern Lights Boulevard compared to the north end. The stream north of East Northern Lights Boulevard has filled in with sedimentation since installed. This is due to the stream backwater against the East Northern Lights Boulevard crossing, which is attributed to the

Photo 6 – 1.2' Grade Drop south of Northern Lights Boulevard

15-foot wide stream narrowing to a 7-foot wide culvert. The additional relief is also gained by extending the outfall further south away from the culvert outlet, as this segment of the creek has a steeper slope than the north side. Furthermore, discharging on the south side of the roadway will allow the outfall to be constructed more in-line with the flow of the creek, making it more hydraulically efficient. Whereas if it were installed on the north end, the outfall would likely be perpendicular to the flow of the creek, with a higher potential of causing creek bank and bed erosion.

Photo 7 – Submerged Outfall Example

The proposed outfall will be submerged approximately 0.5 feet during normal flow conditions. A similar solution was determined by installing a partially submerged outfall to Fish Creek for the Turnagain Boulevard project in 2017, and has been working fine (see photo this page).

Based on record drawings and survey data, a conflict exists with the proposed storm drain and the 12-inch ductile iron (DI) water main located in the west-bound lane of Northern Lights Boulevard. Coordination with Anchorage Water & Wastewater Utility (AWWU) will be required to relocate the water main at the storm drain crossing to provide sufficient vertical separation distance.

In order to construct Alternative 1, the proposed pipe will be installed with less than 4-feet of cover for a significant portion of the alignment from Derby Way to Kensington Drive. This segment of pipe will have approximately 3-feet of cover for most of the run. However, there are a couple locations where cover decreases to 2.5-feet for short segments. The cover concerns will be addressed in SECTION 7.2.3 below. The feasibility of storm drain footing services will be investigated during the design phase. The cost estimate for this proposed gravity alternative includes storm drain footing services for all properties that are adjacent to the storm drain.

The construction costs and overall maintenance for Alternative 1 are anticipated to be significantly lower than other viable options. Refer to APPENDIX E for project cost estimates.

Alternative 1 is shown on the Storm Drain Plan & Profile Sheets C1.1 – C1.4 in APPENDIX C.

7.1.2 Alternative 2 (Gravity System to west side of Baxter Road)

Alternative 2 analyzed the option of extending a gravity storm drain system from the intersection of Kensington Drive and Camrose Drive to the east to Baxter Road. The piped system would extend south and discharge on the west side of Baxter Road into the South Fork Chester Creek.

This option was determined not to be feasible as a gravity option. While maintaining the minimum amount of cover required to install the storm drain structures at the Kensington Drive and Camrose Drive intersection and running the main line pipe at minimum grade (0.30%), the outfall pipe does not daylight completely on the west side of Baxter Road into the South Fork Chester Creek. Therefore, this alternative was removed from consideration. As such, no project cost estimate was prepared for this alternative.

Alternative 2 is shown on the Storm Drain Plan & Profile Sheets C2.1 in APPENDIX C.

7.1.3 Alternative 3 (Lift Station System)

Alternative 3 consists of installing a gravity storm drain system from the intersection of Kensington Drive and Camrose Drive to the west to Derby Way, like Alternative 1. The gravity system then discharges into a new stormwater lift station at the intersection of Camrose Drive and Derby Way. Unlike Alternative 1, this segment of gravity system can be installed with the standard 4-feet of cover over the pipe. Catch basins will be installed on either side of the lift station to collect runoff, which also discharge into the lift station. The lift station will pump stormwater runoff via a force main from the wet well to the south along Derby Way and outfalls on the south side of East Northern Lights Boulevard into the South Fork Chester Creek.

A combination of curb inlets and manholes are designed to collect stormwater runoff at low points and direct it to the gravity piped system along Camrose Drive. The gravity pipe system will be constructed with corrosion resistant corrugated polyethylene pipe (CPEP) ranging in size from 12-inch (catch basin leads) to 18-inch (main line pipe). The force main will be a 10-inchy high-density polyethylene (HDPE) SDR11 pipe.

The lift station will be sized to accommodate a 5-year design storm event with one pump out of service. Together, all pumps in the lift station will accommodate 10-year, 24-hour storm flows. Sizing stormwater lift station pumps is an iterative process analyzed by adjusting pump outputs, wet well diameters, and pump operating depths. The goal is to avoid overly deep wet wells while minimalizing pump size to reduce electrical costs during smaller, more typical storms.

Using two pumps in the Camrose Drive lift station would require both pumps to produce 1,650 gpm (825 gpm per pump). With a three-pump configuration, the total out would need to increase to 1,830 gpm (approximately 610 gpm per pump). The increase in maximum flow rate for the three-pump configuration is due to the buildup of stored stormwater during the design event when only one (smaller) pump is operating. Both configurations will accommodate a 5-year design storm event.

Initial pump sizing indicates that the 825 gpm requires a 10 hp motor while the 610-gpm pump is available with 7.5 hp motor. Both motors require three phase power. Per CEA requirements, when only single-phase power is available, the maximum combined size of all motors running at one time is 40 hp so both two and three pump configurations will be allowable by the utility.

The required pump capacity will be dependent on the available storage volume within the wet well for storm flows. A very large pump will be required if storage volume is limited and, conversely, a relatively small pump could be allowable if wet well storage could accommodate a significant portion of the discharge from the storm event. Larger pumps with smaller operating volumes also typically have short run times and can require multiple starts and stops to pump a given volume. This can damage the pump and lead to premature failure. Therefore, sizing the pump and wet well is a balancing act to keep both within reasonable limits.

Photo 8 - Example Control Panel with VFDs Left Center

Because the lift station is located at the low point of the area and a stream is located nearby, groundwater could be 5 feet deep, and minimizing the depth of the wet well will be important. Limiting the depth means maximizing the diameter of the wet well to increase storage volumes. To avoid increased costs associated with cast-in-place structures, the diameter selected for wet well sizing was limited to 12 feet, which is the largest diameter available in pre-cast units.

APPENDIX G shows a summary of the spreadsheet that was developed to review the impacts of various pump outputs and wet well depths and optimize the system. The selected layout will place the lead pump sensor 1.5 feet above the pump shut-off sensor, and the lag pump sensor will be installed 6-inches above the lead pump sensor. If a third pump is used it would be triggered to turn on 6-inches above the lag pump. A high-water float will be installed 7.5 feet above the pump shut-off sensor to signal an alarm in the event of flooding. The wet well will have a total depth of 18 feet with the bottom foot reserved for sediment storage. A review of reducing the wet well diameter to 8-feet found that an additional 10-feet of depth would be required with similarly sized pumps.

The pumps were sized based on utilizing a 10-inch high-density polyethlyene (HDPE) SDR11 pipe to reduce head loss and allow smaller pumps to be installed.

Assuming a typical force main burial depth of 4-feet, the proposed force main outlet elevation initially appears to be slightly lower than the elevation at the lift station resulting in water draining from the force main each time the pumps turn off. If the pipeline is buried deeper or the elevation of the force main outlet pipe is raised, resulting in all or a segment of the pipeline to remain full, it may be necessary to insulate the pipe and install electric heat trace.

Check valves will be installed on the force main within a separate valve vault to prevent backflow of storm water into the lift station. Isolation valves will also be installed on each pump discharge pipe within the valve vault before they are combined to a single force main. The valve vault will be constructed from a pre-cast concrete manhole located approximately 10 feet southeast of the lift station.

A new control panel will be located behind curb in close proximity to the lift station. The control panel location will allow maintenance personnel to operate the pumps in hand mode while visibly checking operations. The lift station control cabinet will be a NEMA 4X stainless steel enclosure set on a concrete foundation and house the lift station control panel, enclosed pump breakers, heater, thermostat, exhaust fan with louver, receptacle, and lighting. The lift station control panel will operate the pumps in an alternating lead-lag configuration, the lead pump will start when the water level reaches the lead setpoint and the lag pump will start when water reaches the lag setpoint. The pumps will automatically alternate lead and lag after each start. It is anticipated that only the lead pump will run during normal conditions and the lag pump will only run during a 10-year weather event. A level probe in the lift station wet well will provide lead pump start, lag pump start, all pumps stop and high-level alarm signals.

Lift station alarms will consist of high levels, low temperature, power failure, pump failure, surge suppressor failure, and phase converter failure. An automatic alarm dialer can be installed if requested by MOA to identify the lift station to notify MOA Street Maintenance of an emergency.

Power for the lift station can come from the existing single-phase distribution system near the project area or a three-phase line extension from existing three-phase distribution on the south side of Northern Lights Blvd. CEA will need to determine if the existing single-phase distribution system can accommodate the lift station loads or if a three-phase line extension is required. If the service is single phase, VFDs will be used to make three-phase power for the pumps and reduce current inrush when a pump starts. If the service is three-phase, soft starts shall be used to reduce inrush when a pump starts. In either case, a new transformer will be required for the new service. A meter base with main breaker (meter main combo), transfer switch, generator inlet and distribution panel will be installed on the back side of the control cabinet for either type of service.

An analysis of the operational costs for both two and three pump configurations were evaluated to determine if the three pump configuration would be more efficient to operate on an annual basis due to smaller motor sizes. The analysis found that the larger pumps would be approximately the same electrical costs annually assuming average annual precipitation.

Since the gravity storm drain pipe within Camrose Drive is anticipated to have 4 feet of cover, storm drain footing services are expected to be feasible. The cost estimate for this alternative includes storm drain footing services for all properties that are adjacent to the storm drain.

The construction costs and overall maintenance for Alternative 3 are anticipated to be significantly higher than Alternative 1. Refer to APPENDIX E for project cost estimates.

Refer to APPENDIX G for additional lift station data and analysis information. Alternative 3 is shown on the Storm Drain Plan & Profile Sheets C3.1 – C3.4 in APPENDIX C.

7.1.4 Comparison of Alternatives

The table below compares the two viable alternatives, Alternative 1 verses Alternative 3.

Table 2 – Comparison of Alternatives 1 and 3

ALTERNATIVE 1 (GRAVITY)	ALTERNATIVE 3 (LIFT STATION)
PROS • Minimal maintenance • No conflicts with sewer services • Less cost than Pump Station	PROS • Standard depth of cover
CONS • Less than 4' of cover in locations • Partially submerged outfall • Heat Trace Considerations • Some Footing Service Drains may not be feasible due to shallow cover	CONS • Within the flood plain • Risk of flooding if pumps fail • High construction cost • Additional Maintenance Effort • Located within Camrose/Derby Intersection

Table 3 – Operating Cost Comparisons

Annual Operating Costs		
Category	**Alternative 1 (Gravity)**	**Alternative 3 (Lift station)**
*Heat Trace**	$6,000	$2,000
Lift station/Pumps	$0	$200
Pump Replacement (every 15 years)	$0	$3,000
Total Annual Operating Cost (rounded)	**$6,000**	**$5,200**

**All storm drain pipes and catch basin leads in Alt 1 will have heat trace. Lift station (Alt 3) will have heat trace.*

7.2 Proposed Conditions

7.2.1 Drainage Basins

The contributing area for the proposed condition remains largely unchanged from the existing conditions discussed in SECTION 3.1.2. One catchment near the Camrose Drive and Derby Way intersection was delineated into 2 catchments to better reflect the proposed storm drain inlets in this location (9 catchments total). Additionally, for Alternative 1, 6 new catchments were added to account for runoff from Northern Lights Boulevard. Flow from East Northern Lights Boulevard will be added to the proposed system prior to discharging into the South Fork Chester Creek. These 6 catchments are located within Sub-basin ID 557 as identified by WMS mapping.

In total, 15 catchments were defined for the proposed condition. Land cover and topography remain the same as defined in the existing conditions, except for catchments added along

Northern Lights Boulevard. This section of roadway consists of a significant amount of impervious area with four lanes of roadway, turn pockets, a separated pathway, and some grassed medians. The runoff generated from the contributing area will be intercepted by one of the proposed storm drain systems described above and discharged into the South Fork Chester Creek.

The contributing drainage area and delineated catchment areas are illustrated in Appendix D.

7.2.2 Water Quality Treatment

The right-of-way (ROW) width along Camrose Drive and Derby Way is 60 feet. This narrow roadway corridor does not provide sufficient room to implement Green Infrastructure (GI) for water quality treatment without significant impacts to private property. As such, traditional treatment, such as an oil and grit separator (OGS), will likely be utilized prior to discharging to the creek. This treatment approach is in compliance with Section 3.3.2.1 of the ASM.

As noted in Section 3.1.3, the project area currently does not have any water treatment mechanism in place for either the east or west system. This project will improve water quality entering the creek with the addition of an OGS at the end of the storm drain system by removing floatable pollutants such as oil and grease and by removing sediments with attached pollutants.

It should be noted that the proposed improvements for Alternative 1 will require removing the existing OGS from the East Northern Lights Boulevard system and replacing with a larger unit.

7.2.3 Freeze Protection

The proposed roadway section for for Alternative 1 includes installation of insulation board (R-9) extending one foot beyond back of curb for the width of the roadway. Additionally, heat trace will be installed for all storm drain segments for Alternative 1. Heat trace will be installed within the lift station manhole and outfall for Alternative 2, but roadway insulation is not required. These mitigation measures will be implemented to comply with the freeze protection and thaw system design criteria identified in Sections 5.3.3 and 5.3.4 of the ASM.

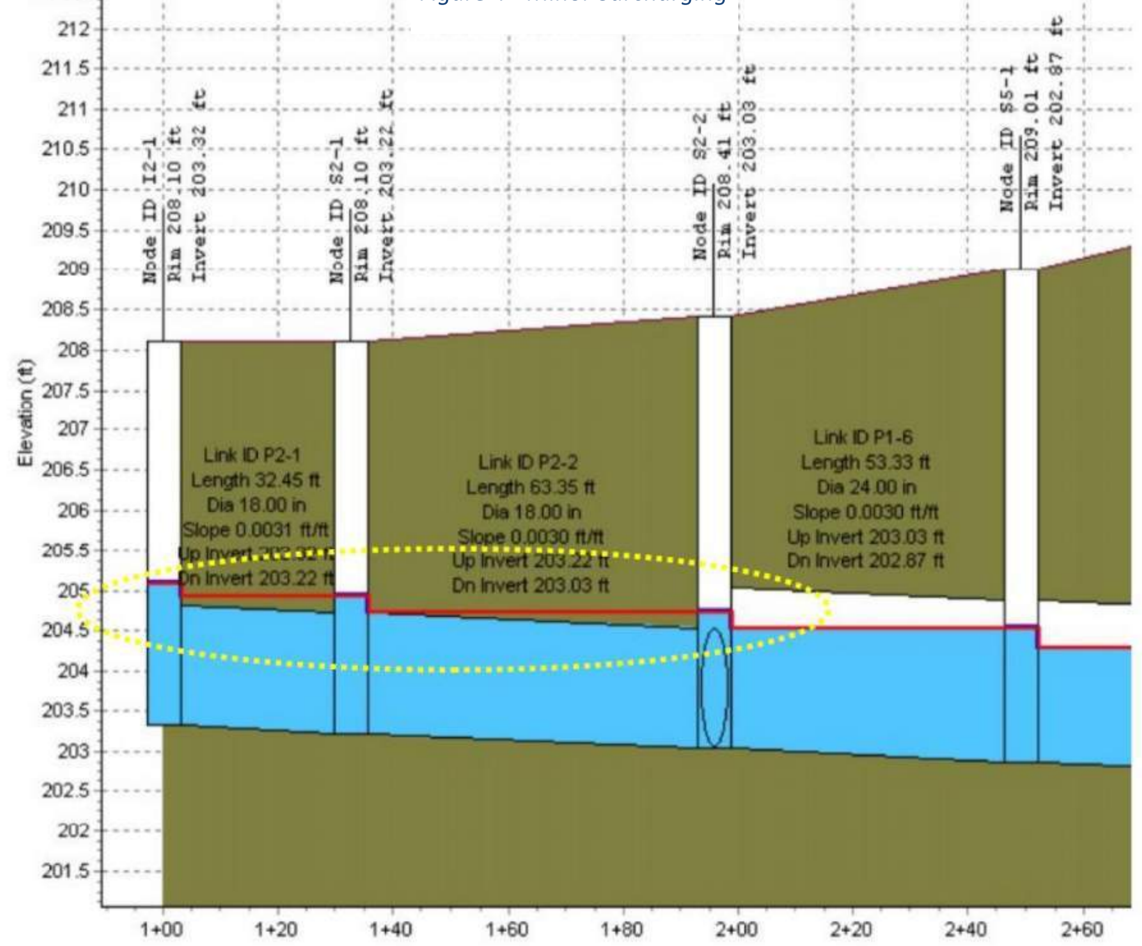
7.3 Hydrologic and Hydraulic Analysis

The hydrologic and hydraulic analysis methodology and approach for the proposed condition is the same as the existing condition. Refer to Section 3.2 for additional information.

7.3.1 Model Results (Alternative 1)

The proposed gravity storm drain system was designed to maximize conveyance capacity, while maintaining maximum cover over the pipe for freeze protection. The drainage model results for Alternative 1 show that the combination of 18 and 24-inch mainline CPEP pipe meet the design criteria and sizing requirements defined in Section 5.3.2 of the ASM with the exception of some minor surcharging that occurs in Pipes P2-1 and P2-2 (see Figure 4). A design waiver will be requested for this issue. No overtopping occurs within the gravity system during the 10-year, 24-hour design storm. Overtopping occurs at Structure I2-1, I2-2 & I4-1 for a brief period (approximately 30 minutes) during the 100-year storm event, otherwise no flooding occurs in the proposed system.

Figure 4 - Minor Surcharging



Peak flows are shown below for the east and west systems at the outfall for the 10-year and 100-year storm events.

Table 4 – Peak Flows (Proposed Condition - Alternative 1)

Design Point (MOA GIS ID)	Peak Runoff 10-yr, 24-hr Event (cfs)	Peak Runoff 100-yr, 24-hr Event (cfs)
N. Lights Blvd. Outfall (Pipe P1-1)	9.25*	17.50**

* Minor Surcharging in System

** Overtopping/Flooding in System

Comprehensive drainage model results, input parameters, and other related data can be found in APPENDIX D. Additionally, profiles are provided for the Alternative 1 storm drain system illustrating the hydraulic grade line (water surface elevation) during peak flow conditions.

Note that the naming convention used for the storm drain structures and pipe in the proposed drainage model matches the callouts provided on the Storm Drain Plan & Profile sheets C1.1 – C1.4 in APPENDIX D.

8.0 Right-of-Way Impacts

Preliminary estimated easement and permit requirements are summarized in **ERROR! REFERENCE SOURCE NOT FOUND.** below. As the planning and design of this project progresses, the required easements and temporary construction permits will be refined.

Table 5 – Estimated Right-of-Way Easements / Permits

Alternative	Public Use Easements (PUE)	Slope Easements (SE)	Drainage Easements (DE)	Temporary Construction Easements (TCE)	Temporary Construction Permits (TCP)
1	1	0	3	5	0
3	1	0	0	2	0

9.0 Utility Impacts

When reconstruction projects 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 the purpose of 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 will require relocation of the facility. In these locations the utilities will either require relocation or will require support in place for the contractor to work around the utility.

The utility relocation cost estimates for each Alternative and each utility company are shown in APPENDIX E. Additionally, an existing underground traffic line that runs along the north side of East Northern Lights Boulevard may be impacted by the storm drain improvements. Additional coordination with MOA Signal

Maintenance Department will be necessary to determine the extents of relocation or if the underground traffic line can be worked around and protected in place.

10.0 Permitting and Agency Approvals

Permits and agency approvals for the Camrose Drive Storm Drainage project required for construction of the proposed improvements are listed below. Because the roadway is classified as a secondary (local) urban residential 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 this project include:

- USACE Section 404 Nationwide Permit
- Construction General Permit (required from ADEC for any ground-disturbing activities over 1 acre where storm water runoff from the project discharges into a water of the U.S. or an MS4)
- ADEC Section 401 Clean Water Act Certification (likely covered by the USACE NWP)
- ADNR Temporary Water Use Authorization for dewatering
- ADF&G Fish Habitat Permit
- ADF&G Aquatic Resource Permit
- MOA Flood Hazard Permit and No-Rise Certification
- MOA Watershed Management Services Stormwater Plan Approval
- ADEC Approval to Construct Storm Drain Improvements and Separation Waivers

Refer to Section 2.4 for additional information regarding the permits listed above, as well as other Environmental considerations. Additional permits may be identified as the design develops.

11.0 Stakeholder Coordination/Public Involvement

Since this is a drainage project and not a transportation project, the CSS process was not followed but many elements of that process were incorporated into the public involvement and stakeholder coordination effort. See below for list of stakeholders.

Table 6 – List of Stakeholders

MOA Agencies	Other
Project Management & Engineering	Area property owners and residents
Maintenance and Operations	Northeast Community Council
Traffic Engineering	University Area Community Council
Watershed Management Services	Representative Ivy Spohnholz
Anchorage Water & Wastewater Utility	Senator Bill Wielechowski
Parks & Recreation	Alaska Communications Systems (ACS)

Anchorage Fire & Police Department Anchorage Assembly Member Pete Peterson Anchorage Assembly Member Forest Dunbar	General Communication Corp (GCI) Municipal Light and Power (ML&P) ENSTAR Natural Gas Company

Letters to notify utility companies of the proposed work will be sent during the Preliminary Design Phase.

11.1 Stakeholder and Public Involvement Activities

A summary of the outreach effort to inform stakeholder and solicit input can be found in APPENDIX F and are summarized below:

Table 7 – Stakeholder Coordination/Public Involvement Events

Date	Activity	Comments
February 1, 2022	Mailing List Developed	Over 50 stakeholders
February 4, 2022	Website Development	Launched Website
February 4, 2022	Online Questionnaire Posted & Questionnaire Mailed	Queried adjacent property owners regarding specific area issues and concerns
February 22, 2022	E-Newsletter #1	Project Update. Reminder questionnaire is due soon.
June 22, 2022	Meeting with MOA Maintenance and Operations	Review gravity and lift station alternatives and obtain feedback

Note that an attendance at the local community council has not been made, and a public open house has not been held yet. These may be held during the design or construction phases.

11.2 Project Website

The project website (www.camrosedrivedrainage.com) has been developed as a resource to learn about the scope of the project, to share the project schedule, and to provide contact information to encourage the public to provide comments. Website content includes a Home page, a Documents & Resources page, and a Comment page. The website content and schedule will be updated as the project progresses.

11.3 Summary of Public Comments Received

The comments were received from the questionnaire that was both posted online and mailed. The comments were compiled and are presented in APPENDIX F. Responses show strong support from the adjacent property owners for drainage improvements.

12.0 Quantity and Cost Estimates

A summary of estimated project costs for the proposed improvements is presented below for each alternative. Quantities and detailed cost estimates are presented in APPENDIX E.

Table 8 – Cost Comparison

Category	Alternative 1 (Recommended)	Alternative 3
Design & Management Total (estimated)	$727,000	$737,000
ROW Acquisition Total	$41,000	$20,000
Utility Relocation (15% Contingency) Total	$133,000	$36,000
A. Design, ROW Acquisition, Utility Relocation	**$901,000**	**$793,000**
Construction Drainage & Roadway Improvements	$1,792,000	$2,460,000
Construction Contingency (15%)	$269,000	$369,000
Construction Management / Inspection / Testing	$201,000	$266,000
B. Total Estimated Construction Cost (rounded)	**$2,262,000**	**$3,095,000**
C. Overhead / Grant Accounting	**$558,000**	**$686,000**
Total Estimated Project Cost (A + B + C)	**$3,721,000**	**$4,574,000**

13.0 Design Recommendations

See below for a discussion of the recommended alternative and proposed variances.

13.1 Recommendation – Alternative 1 (Gravity System to NLB)

Based on comments received from public, feedback from the MOA, the requirements of the DCM, the table in 7.1.4, and the construction costs, the recommended alternative is Alternative 1 (Gravity System to south side of Northern Lights Boulevard).

13.2 Proposed Variances from Design Criteria Manual

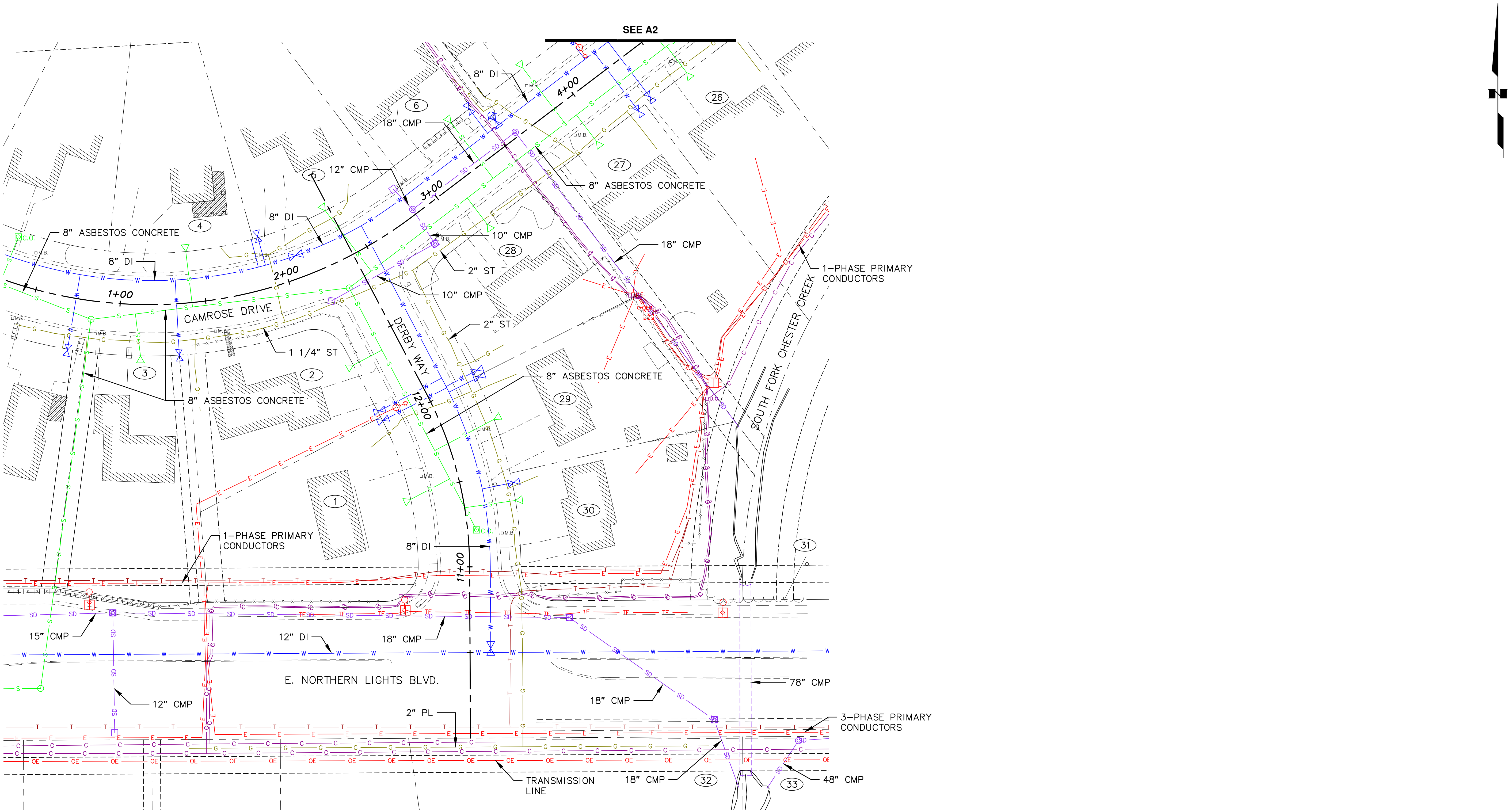
The proposed variances from the DCM include:

- Invert elevation difference across a manhole of 0.05 feet to be eliminated.
- Storm drain outfall of 1 foot above the 100-year flood event is not attainable. The proposed storm drain outfall will be partially submerged approximately 0.5 foot during normal flow conditions.
- Minor surcharging of one storm drain pipe.

****** End of Report ******

Existing Utilities Drawings

Appendix A



EXISTING UTILITY LEGEND

- SANITARY SEWER
- NATURAL GAS
- WATER
- STORM DRAIN
- FIBER OPTIC
- CABLE TELEVISION
- CABLE TELEVISION (OVERHEAD)
- TELEPHONE
- TELEPHONE (OVERHEAD)
- ELECTRIC
- ELECTRIC (OVERHEAD)
- ELECTRIC/CABLE (OVERHEAD)
- ELECTRIC/TELEPHONE/CABLE (OVERHEAD)
- TRAFFIC LINE
- CULVERT
- GRAVEL
- CURB & GUTTER
- EDGE OF PAVEMENT
- PROPERTY LINE
- EASMENT
- CONCRETE
- FENCE
- SANITARY SEWER MANHOLE
- SANITARY SEWER SERVICE
- SANITARY SEWER CLEANOUT
- KEY BOX / WATER VALVE
- FIRE HYDRANT
- WELL
- WATER VENT
- STORM DRAIN CATCH BASIN
- STORM DRAIN MANHOLE
- STORM DRAIN CATCH BASIN MANHOLE
- FIBER OPTIC VAULT
- CABLE PEDESTAL
- TELEPHONE PEDESTAL
- MAILBOX
- GAS METER
- FUEL VENT
- ELECTRIC JBOX
- ELECTRIC SWITCH CABINET
- LUMINAIRE
- LIGHT POLE
- POWERLINE POLE
- GUY WIRE
- LOAD CENTER
- JUNCTION BOX TYPE 1
- ELECTRIC MANHOLE
- ELECTRIC OUTLET
- PARCEL NUMBER

30' 0 30' 60'

PROJECT: 20-27

STATUS: DSR

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

MUNICIPALITY OF ANCHORAGE

CAMROSE DRIVE
STORM DRAINAGE PROJECT

EXISTING UTILITES MAP

DATE	JUNE 2022
SCALE	1"=30'
FIGURE	A1 OF A2

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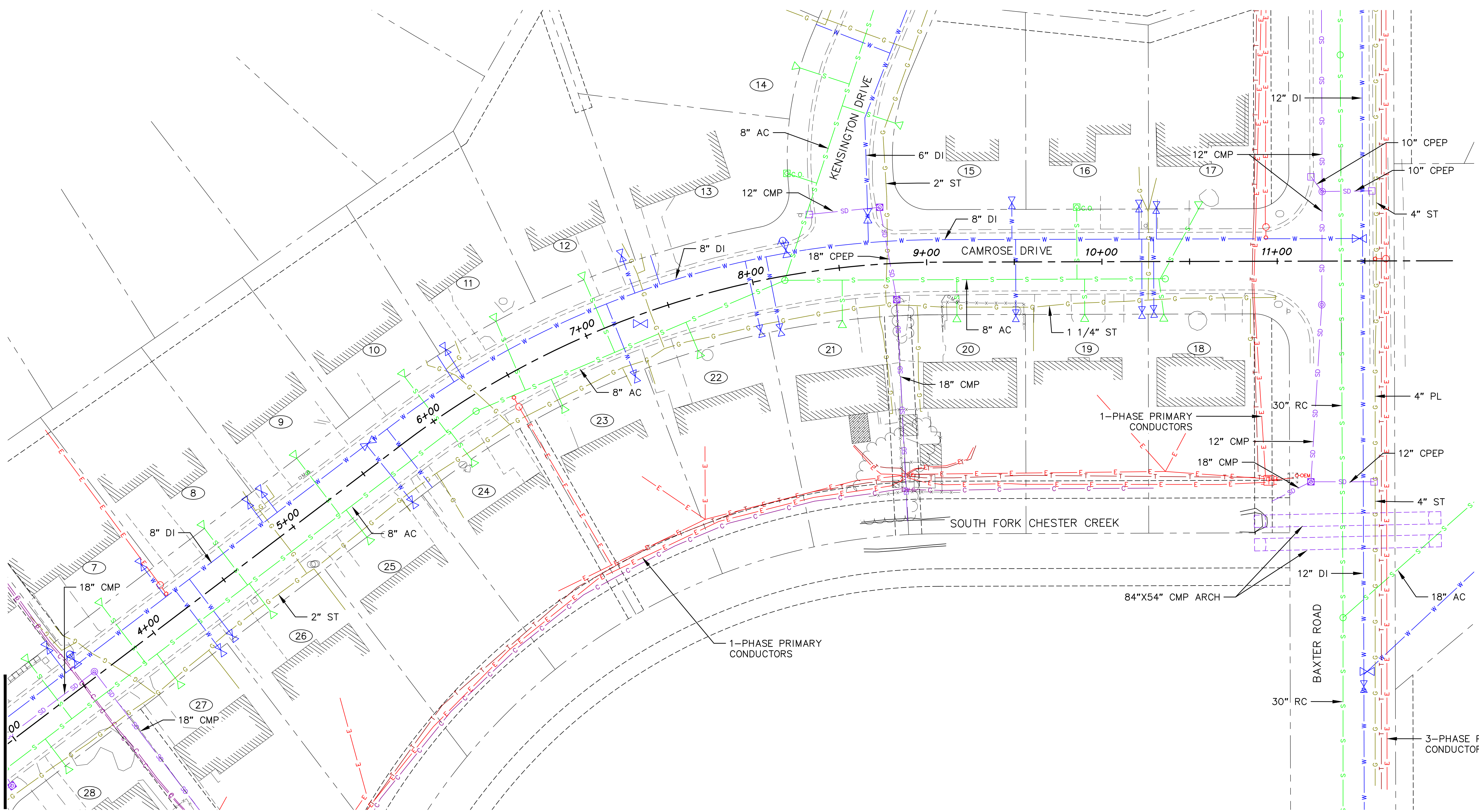

EXISTING UTILITY LEGEND

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

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

CABLE PEDESTAL
TELEPHONE PEDESTAL
MAILBOX
GAS METER
FUEL VENT
ELECTRIC JBOX
ELECTRIC SWITCH CABINET
LUMINAIRE
LIGHT POLE
POWERLINE POLE
GUY WIRE
LOAD CENTER
JUNCTION BOX TYPE 1
ELECTRIC MANHOLE
ELECTRIC OUTLET
PARCEL NUMBER

30' 0 30' 60'

PROJECT: 20-27
STATUS: DSR

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3940 ARCTIC BLVD. SUITE 300
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PHONE: (907) 562-3252
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MUNICIPALITY OF ANCHORAGE

CAMROSE DRIVE
STORM DRAINAGE PROJECT

EXISTING UTILITIES MAP

DATE: JUNE 2022
SCALE: 1"=30'
FIGURE: A2 OF A2

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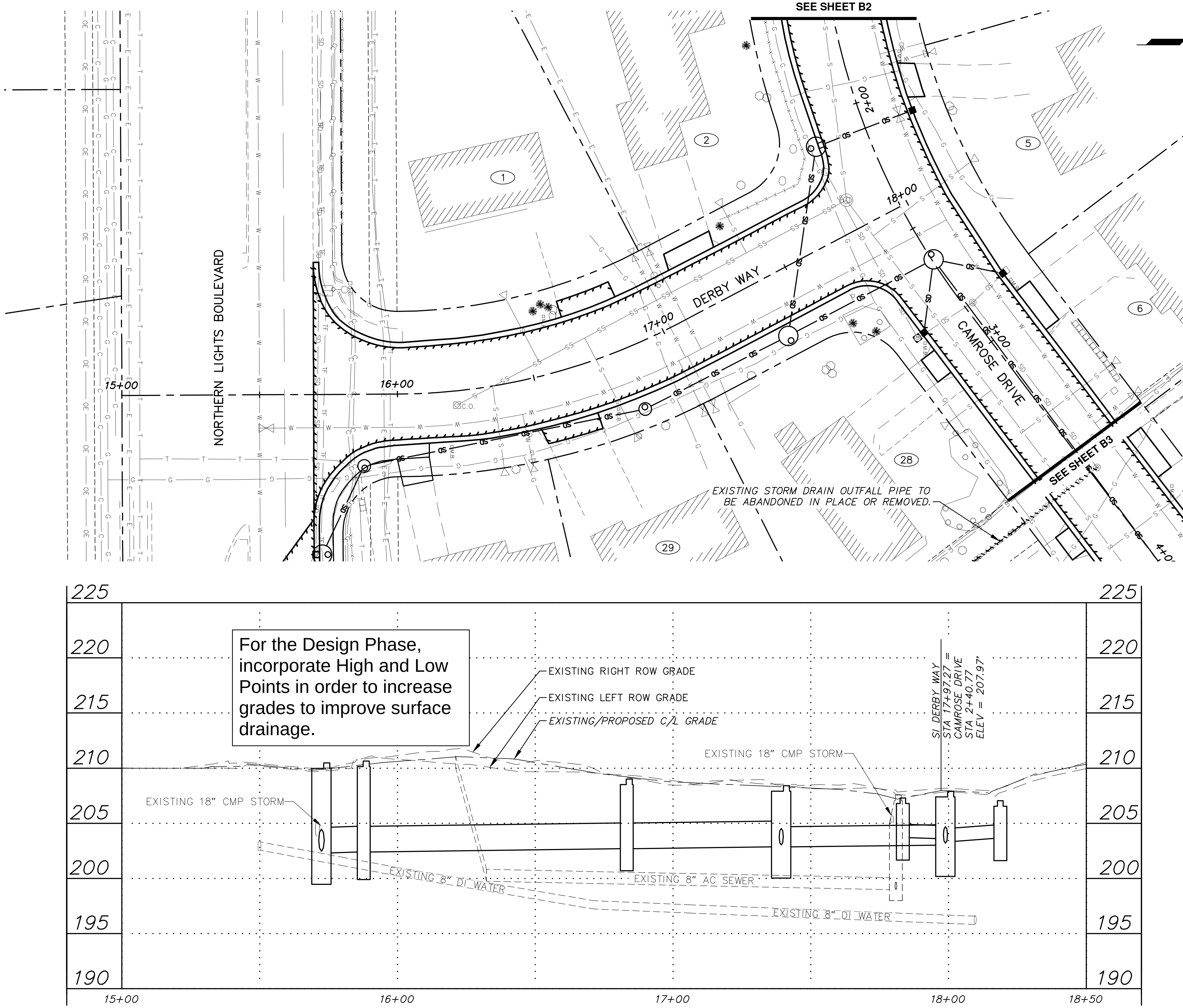
Roadway Plan & Profile Drawings

Appendix B



ALTERNATIVE #1
STORM DRAIN
SHOWN

RECORD DRAWING

1. DATA PROVIDED BY: ______ TITLE: ______
   THIS WILL SERVE TO CERTIFY THAT THESE RECORD DRAWINGS ARE A TRUE AND ACCURATE REPRESENTATION OF THE PROJECT AS CONSTRUCTED.
   CONTRACTOR: ______
   BY: ______ TITLE: ______ DATE: ______
2. DATA TRANSFERRED BY: ______ TITLE: ______
   COMPANY: ______ DATE: ______
3. BASED ON PERIODIC FIELD OBSERVATIONS BY THE ENGINEER (OR AN INDIVIDUAL UNDER HIS/HER DIRECT SUPERVISION), THE CONTRACTOR-PROVIDED DATA APPEARS TO REPRESENT THE PROJECT AS CONSTRUCTED.
   DATA TRANSFER CHECKED BY: ______ TITLE: ______
   COMPANY: ______ DATE: ______
   BY: ______

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 40 20 0 20 40 SCALE

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

CONSULTANT — SEAL

MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

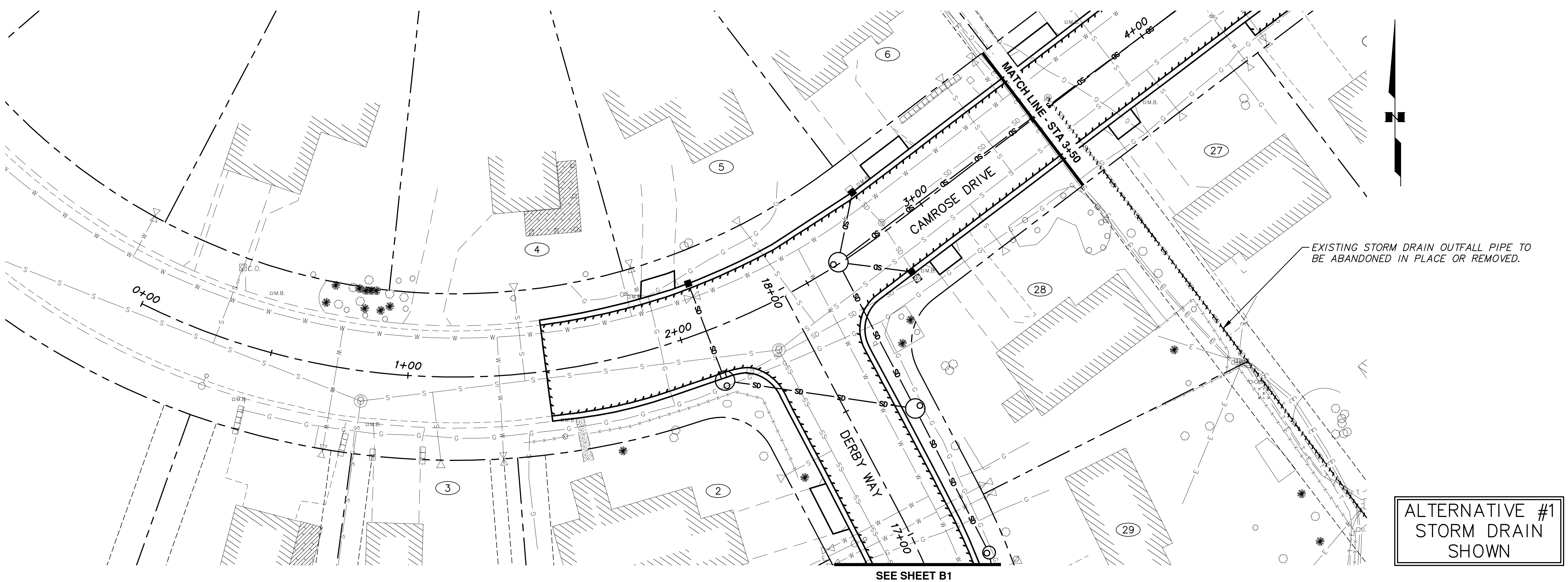
20-27 — CAMROSE DRIVE STORM DRAINAGE PROJECT — SCHED A

ROADWAY PLAN & PROFILE

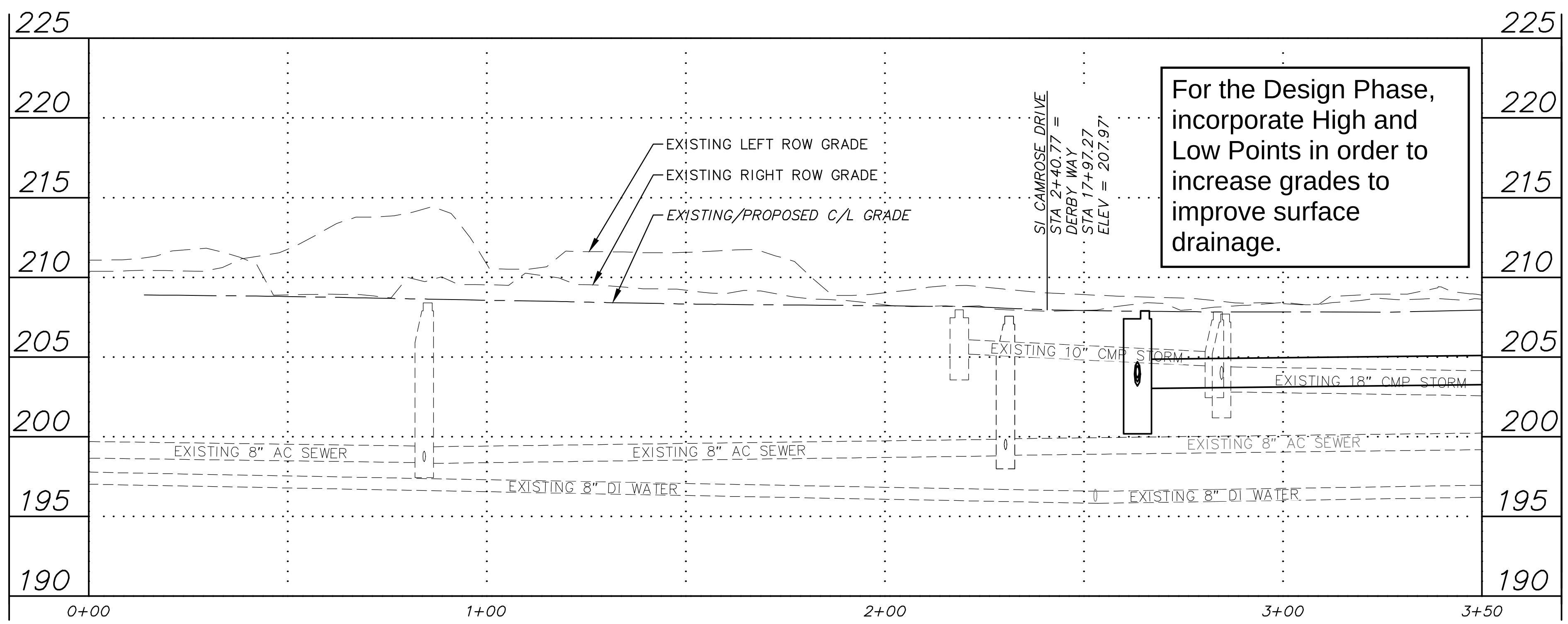
STA 15+00 TO STA 18+00

SCALE HOR. 1"=20' VER. 1"=5' | GRID SW1538, SW1638 | DATE AUG 2022 | STATUS DSR | SHEET B1 of B4

File:J:\JobsData\10152.00 Camrose Drive Storm Drainage\00 CADD 2019\01 Working Set\01 Civil\01 DSR\10152.00 Roadway - Plan & Profile.dwg



SEE SHEET B1



RECORD DRAWING

1. DATA PROVIDED BY: ______ TITLE: ______
   THIS WILL SERVE TO CERTIFY THAT THESE RECORD DRAWINGS ARE A TRUE AND ACCURATE REPRESENTATION OF THE PROJECT AS CONSTRUCTED.
   CONTRACTOR: ______
   BY: ______ TITLE: ______ DATE: ______
2. DATA TRANSFERRED BY: ______ TITLE: ______
   COMPANY: ______ DATE: ______
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   DATA TRANSFER CHECKED BY: ______ TITLE: ______
   COMPANY: ______ DATE: ______
   BY: ______

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

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

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MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

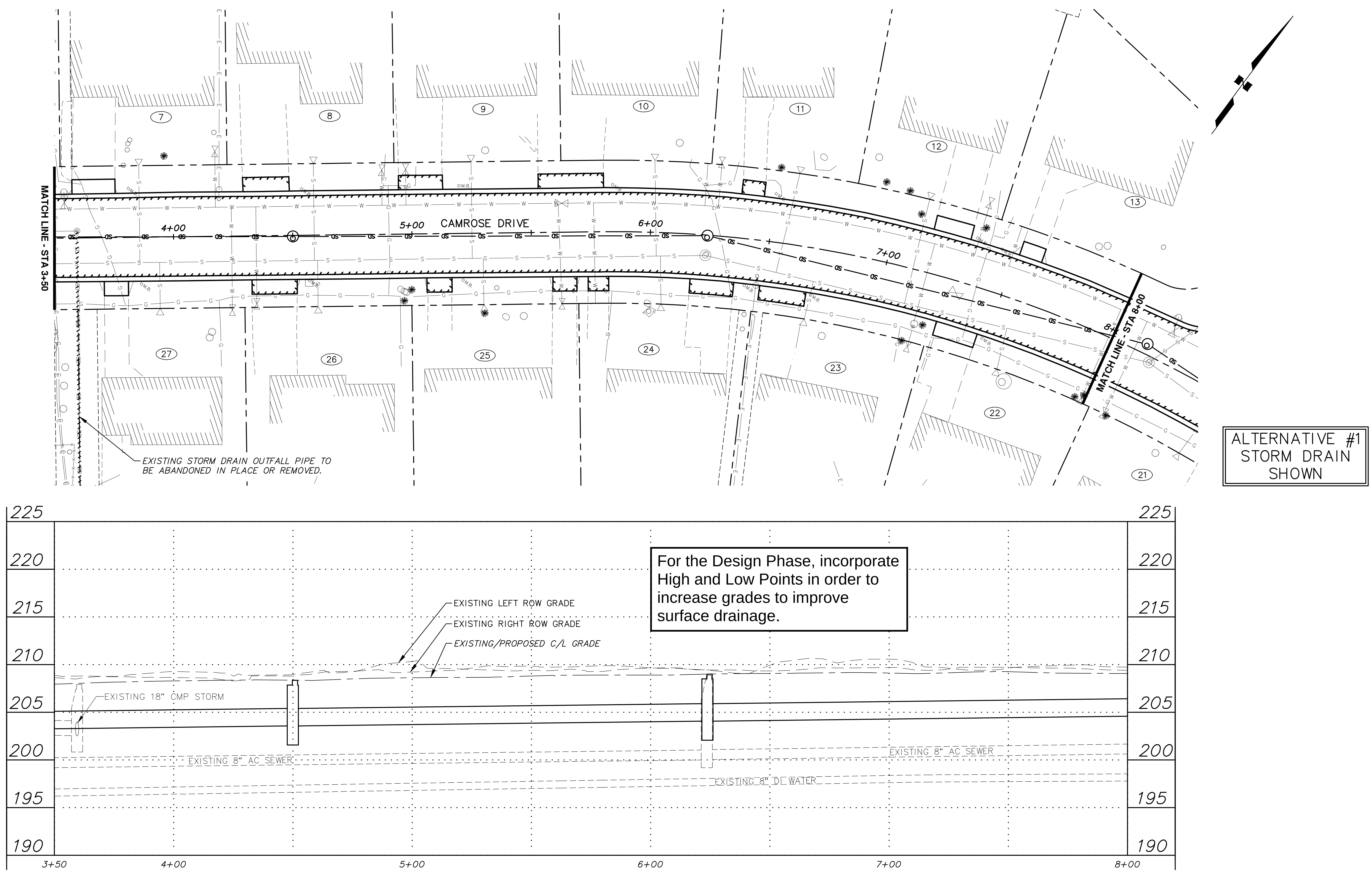
20-27 CAMROSE DRIVE STORM DRAINAGE PROJECT SCHED A

ROADWAY PLAN & PROFILE

STA 0+00 TO 3+50

SCALE HOR. 1"=20' VER. 1"=5' | GRID SW1538, SW1638 | DATE AUG 2022 | STATUS DSR | SHEET B2 of B4

File: L:\JobsData\10152.00 Camrose Drive Storm Drainage\00 CADD 2019\01 Working Set\01 Civil\01 DSR\10152.00 Roadway - Plan & Profile.dwg



RECORD DRAWING

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   DATA TRANSFER CHECKED BY: ______ TITLE: ______
   COMPANY: ______ DATE: ______
   BY: ______

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 40 20 0 20 40 SCALE

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

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PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

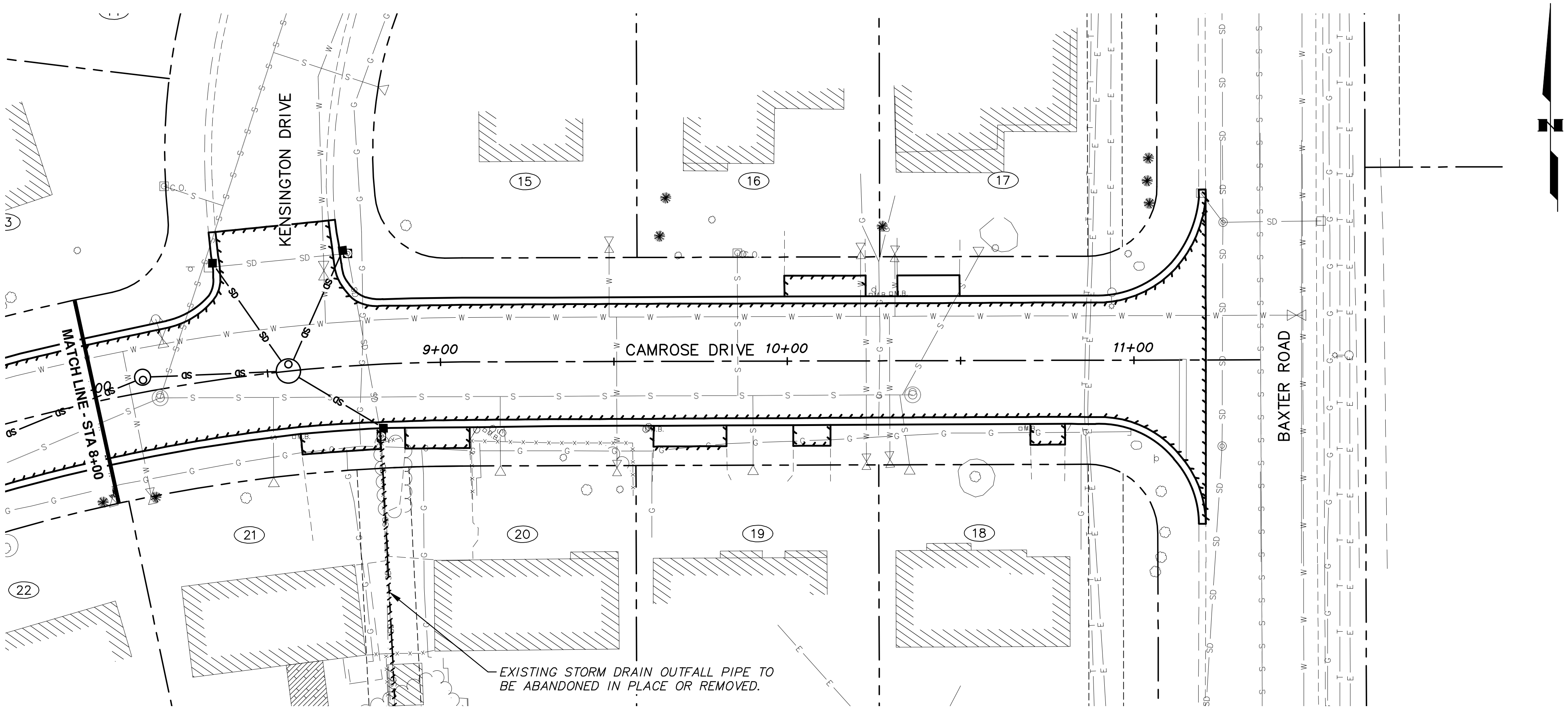
20-27 — CAMROSE DRIVE STORM DRAINAGE PROJECT — SCHED A

ROADWAY PLAN & PROFILE

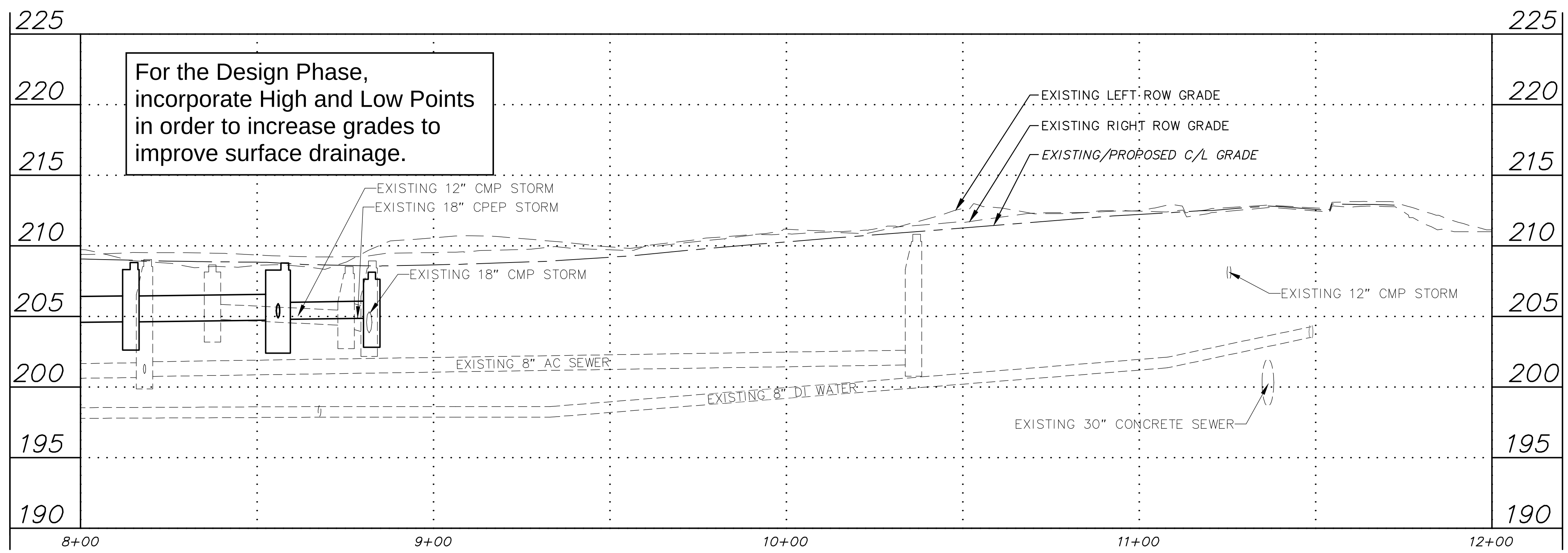
STA 3+50 TO 8+00

SCALE HOR. 1"=20' VER. 1"=5' | GRID SW1538, SW1638 | DATE AUG 2022 | STATUS DSR | SHEET B3 of B4

File: J:\JobsData\10152.00 Camrose Drive Storm Drainage\00 CADD 2019\01 Working Set\01 Civil\01 DSR\10152.00 Roadway - Plan & Profile.dwg



ALTERNATIVE #1
STORM DRAIN
SHOWN



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2. DATA TRANSFERRED BY: ______ TITLE: ______
   COMPANY: ______ DATE: ______
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   DATA TRANSFER CHECKED BY: ______ TITLE: ______
   COMPANY: ______ DATE: ______
   BY: ______

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

FIELD BOOKS	BM NO.	LOCATION	ELEV.	REV	DATE	DESCRIPTION	BY
DESIGN							
STAKING							
ASBUILT							
CONTRACTOR	BASIS OF THIS DATUM						
INSPECTOR							
CONSTRUCTION RECORD	VERTICAL DATUM			REVISIONS			

CRW ENGINEERING GROUP, LLC
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PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

20-27 CAMROSE DRIVE STORM DRAINAGE PROJECT SCHED A

ROADWAY PLAN & PROFILE

STA 8+00 TO EOP

SCALE HOR. 1"=20' VER. 1"=5'

GRID SW1538, SW1638

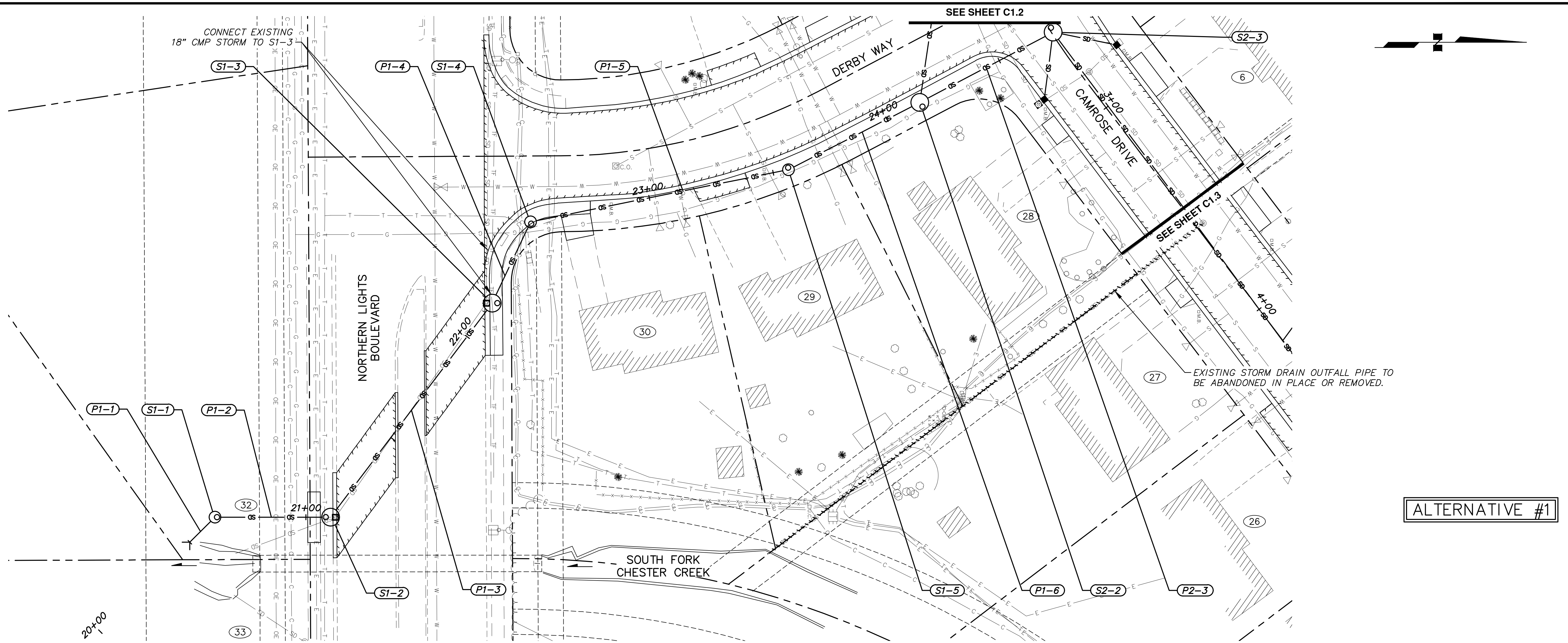
DATE AUG 2022 STATUS DSR

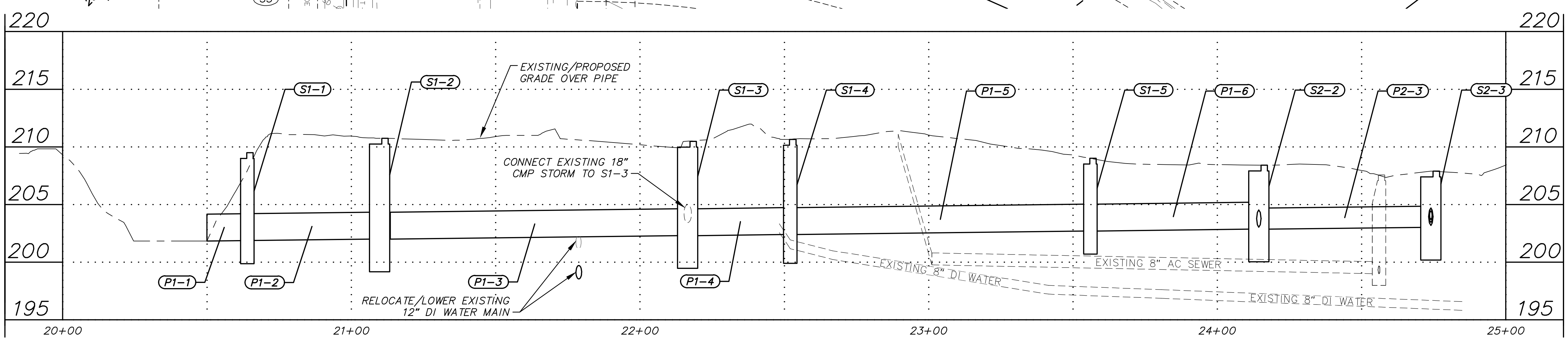
SHEET B4 of B4

File: J:\JobsData\10152.00 Camrose Drive Storm Drainage\00 CADD 2019\01 Working Set\01 Civil\01 DSR\10152.00 Roadway - Plan & Profile.dwg

Storm Drain Plan & Profile Drawings

Appendix C





RECORD DRAWING

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   COMPANY: ______ DATE: ______
   BY: ______

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

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
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PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

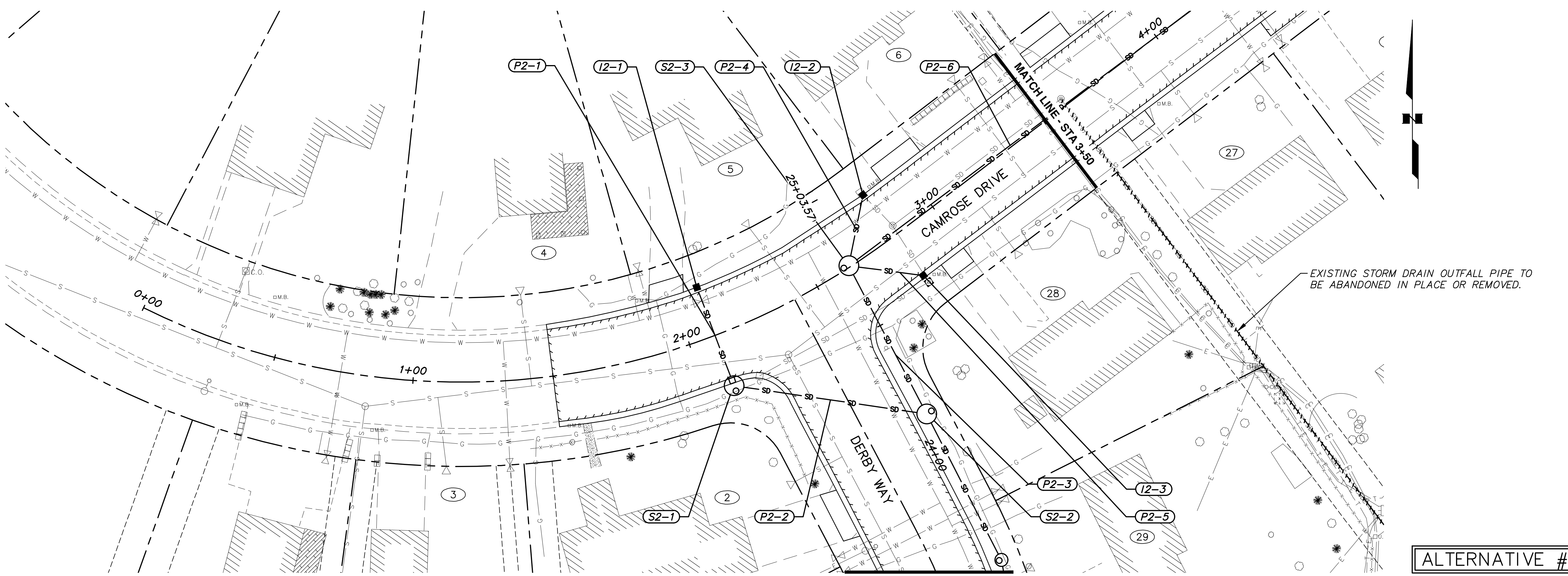
20–27 CAMROSE DRIVE STORM DRAINAGE PROJECT SCHED A

STORM DRAIN PLAN & PROFILE

BOP TO STA 13+50

SCALE HOR. 1"=20' VER. 1"=5' | GRID SW1538, SW1638 | DATE AUG 2022 | STATUS DSR | SHEET C1.1 of C1.4

File: J:\JobsData\10152.00 Camrose Drive Storm Drainage\00 CADD 2019\01 Working Set\01 Civil\01 DSR\10152.00 Storm Drain – Plan & Profile_Alt 1.dwg



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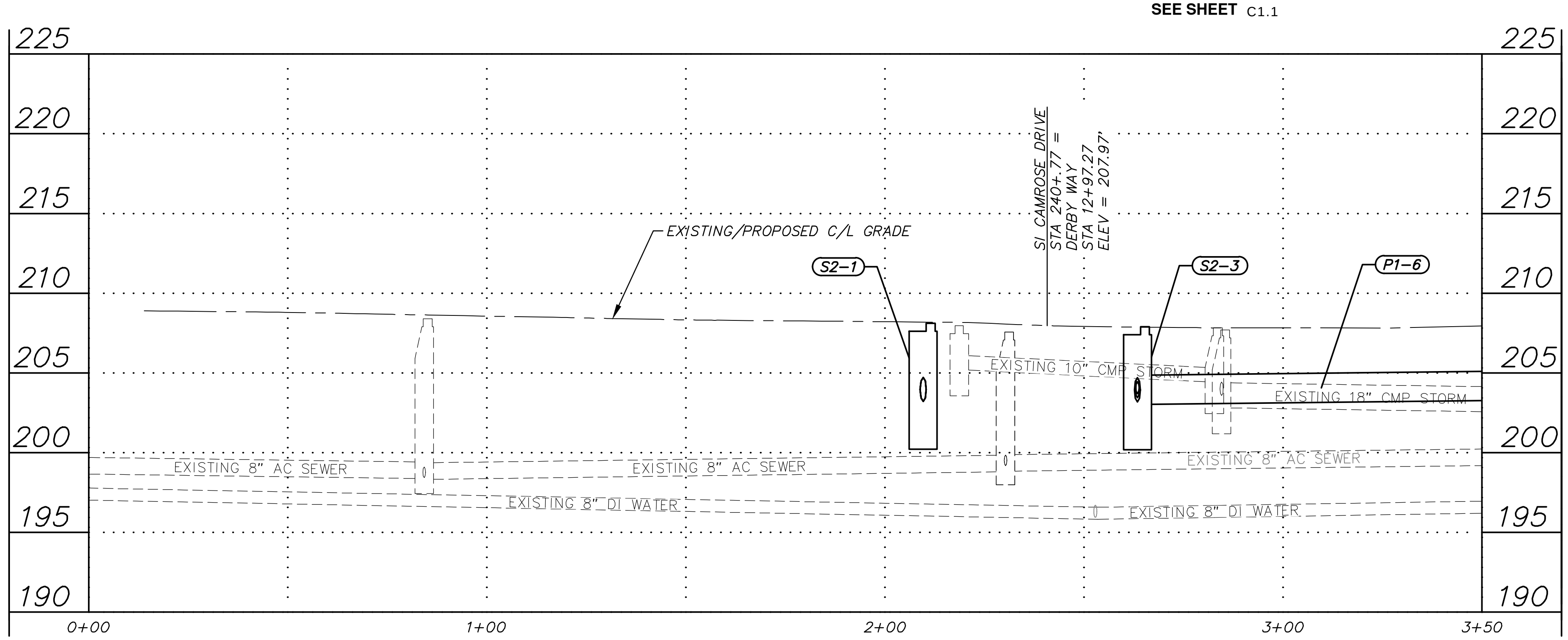

The feasibility and location of storm drain footing services will be analyzed during the design phase

RECORD DRAWING

1. DATA PROVIDED BY: ______ TITLE: ______
   THIS WILL SERVE TO CERTIFY THAT THESE RECORD DRAWINGS ARE A TRUE AND ACCURATE REPRESENTATION OF THE PROJECT AS CONSTRUCTED.
   CONTRACTOR: ______
   BY: ______ TITLE: ______ DATE: ______
2. DATA TRANSFERRED BY: ______ TITLE: ______
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   COMPANY: ______ DATE: ______
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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 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			

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

CONSULTANT

SEAL

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

20-27 CAMROSE DRIVE STORM DRAINAGE PROJECT SCHED A

STORM DRAIN PLAN & PROFILE

STA 1+50 TO STA 3+50

SCALE HOR. 1"=20' VER. 1"=5' | GRID SW1538, SW1638 | DATE AUG 2022 | STATUS DSR | SHEET C1.2 of C1.4

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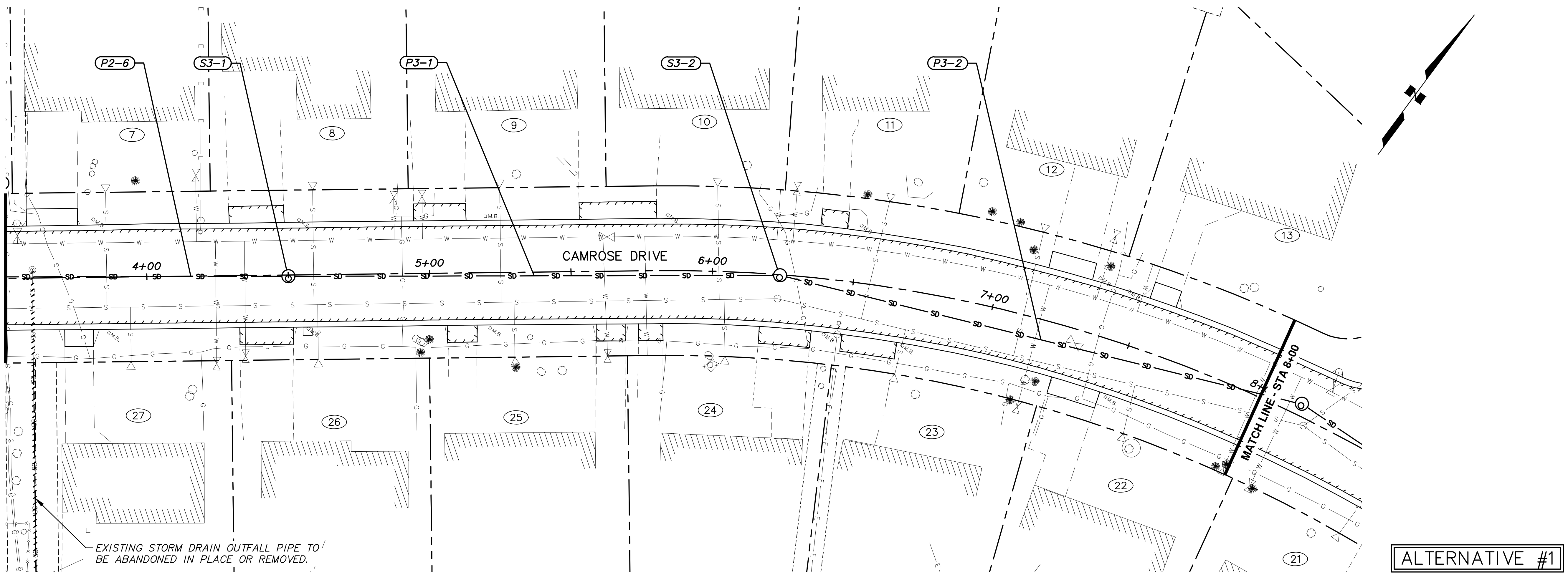

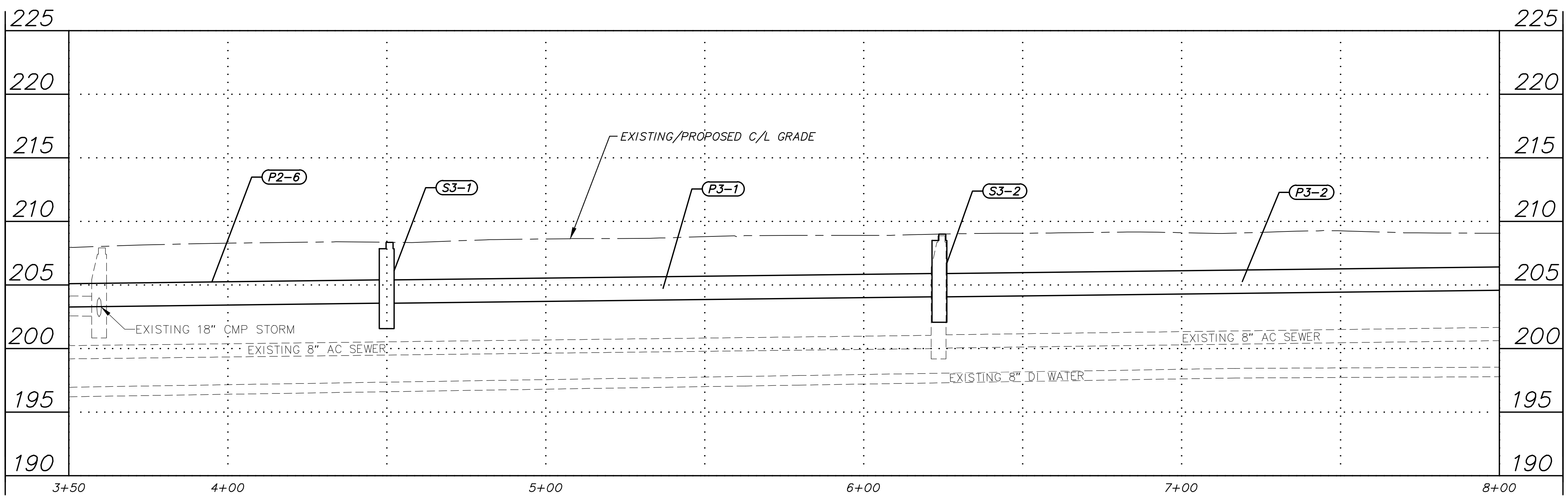

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   DATA TRANSFER CHECKED BY: ____ TITLE: ____
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   BY: ____

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 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

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD. SUITE 300
ANCHORAGE, ALASKA 99503
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PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

20-27 CAMROSE DRIVE STORM DRAINAGE PROJECT SCHED A

STORM DRAIN PLAN & PROFILE

STA 3+50 TO STA 8+00

SCALE HOR. 1"=20' VER. 1"=5'
GRID SW1538, SW1638
DATE AUG 2022
STATUS DSR
SHEET C1.3 of C1.4

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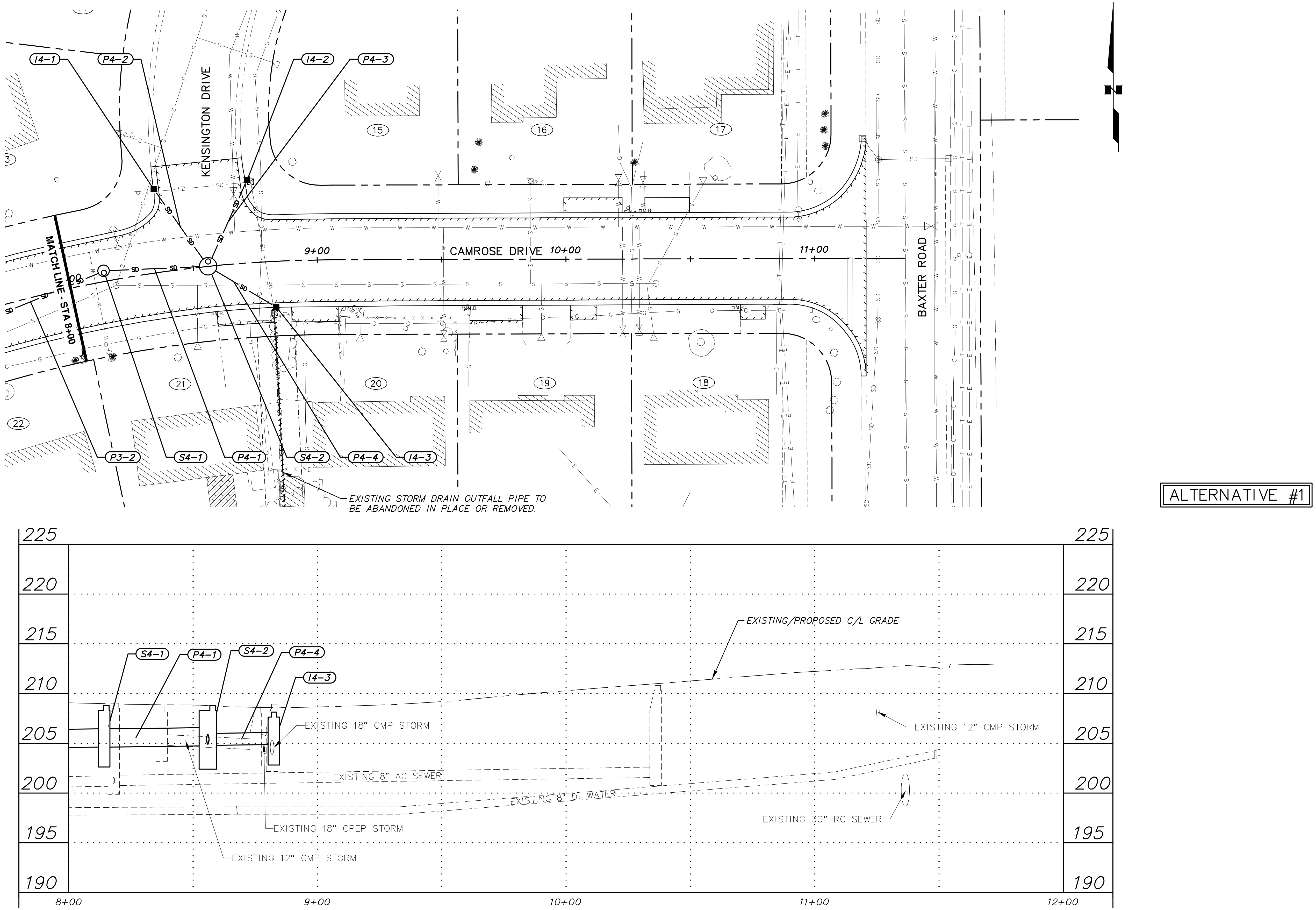
ALTERNATIVE #1



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   BY: ____________ TITLE: ____________ DATE: ____________
2. DATA TRANSFERRED BY: ____________ TITLE: ____________
   COMPANY: ____________ DATE: ____________
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   DATA TRANSFER CHECKED BY: ____________ TITLE: ____________
   COMPANY: ____________ DATE: ____________
   BY: ____________

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 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			

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD. SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 562-3252
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PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

20-27 CAMROSE DRIVE STORM DRAINAGE PROJECT SCHED A

STORM DRAIN PLAN & PROFILE

STA 8+00 TO EOP

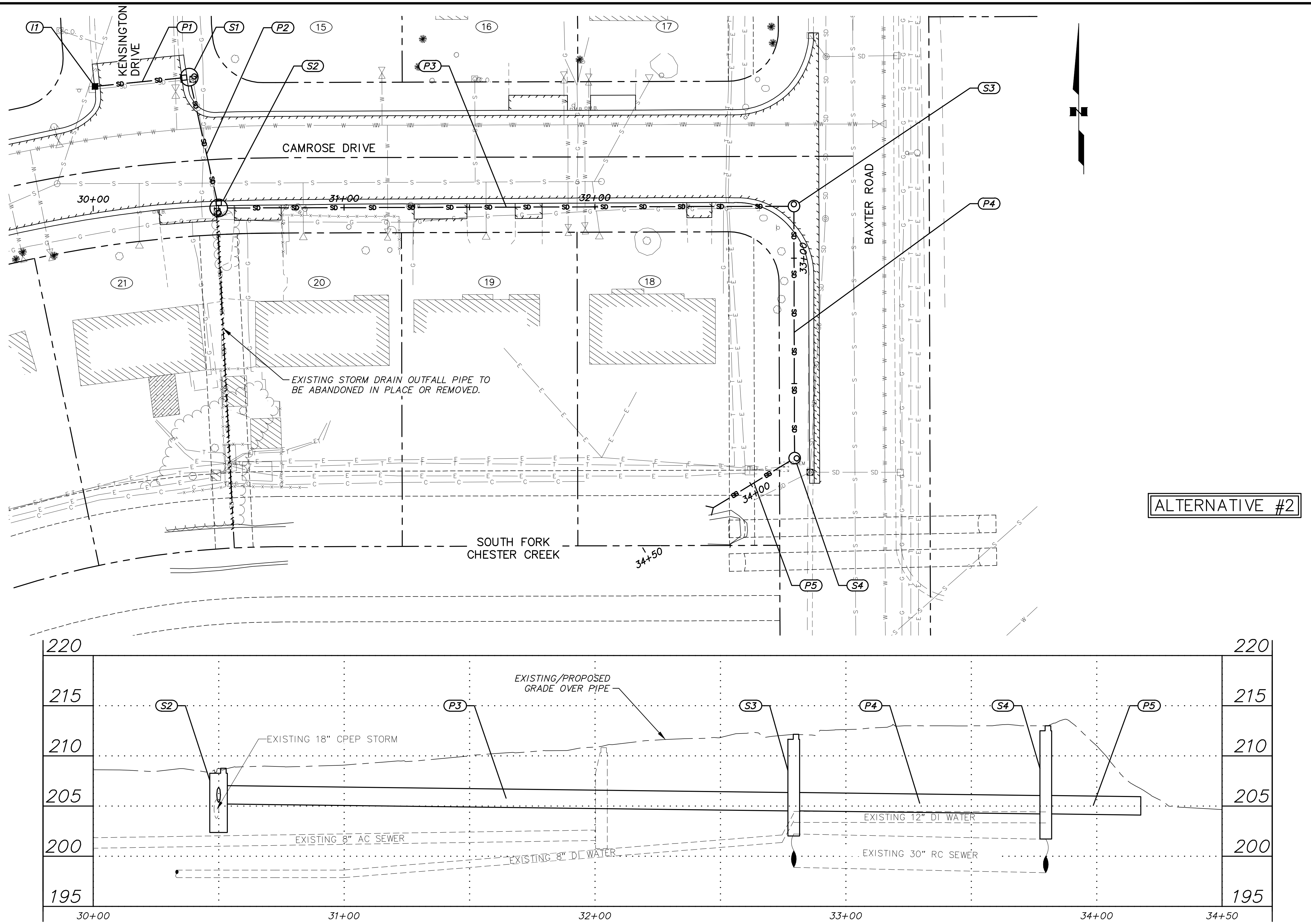
SCALE HOR. 1"=20' VER. 1"=5'

GRID SW1538, SW1638

DATE AUG 2022

STATUS DSR

SHEET C1.4 of C1.4



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RECORD DRAWING

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   THIS WILL SERVE TO CERTIFY THAT THESE RECORD DRAWINGS ARE A TRUE AND ACCURATE REPRESENTATION OF THE PROJECT AS CONSTRUCTED.
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   BY: ______ TITLE: ______ DATE: ______
2. DATA TRANSFERRED BY: ______ TITLE: ______
   COMPANY: ______ DATE: ______
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   DATA TRANSFER CHECKED BY: ______ TITLE: ______
   COMPANY: ______ DATE: ______
   BY: ______

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

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

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MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

20-27 | CAMROSE DRIVE STORM DRAINAGE PROJECT | SCHED A

STORM DRAIN PLAN & PROFILE

STA 30+00 TO STA 34+50

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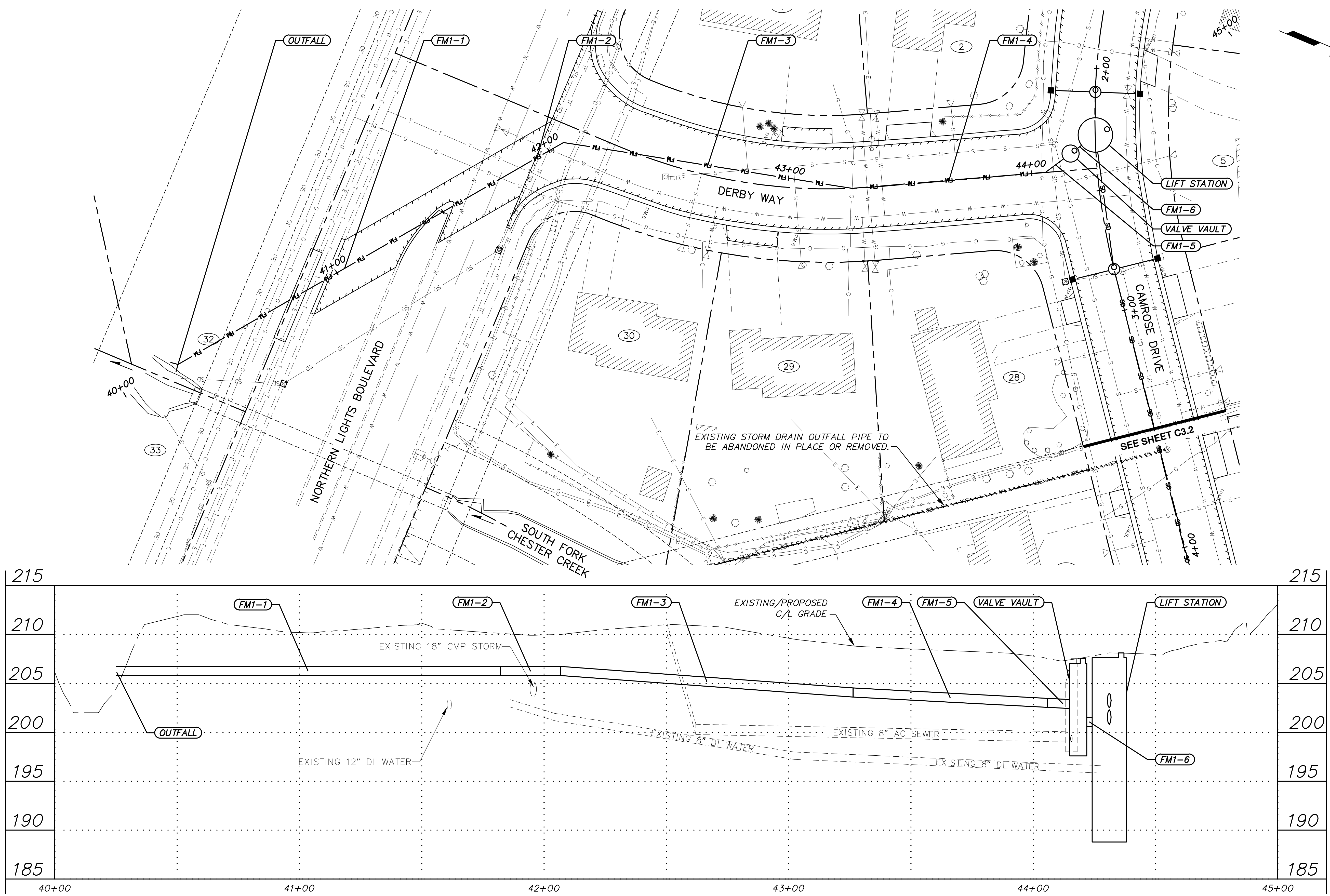

ALTERNATIVE #3

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   BY:______ TITLE:______ DATE:______
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3. BASED ON PERIODIC FIELD OBSERVATIONS BY THE ENGINEER (OR AN INDIVIDUAL UNDER HIS/HER DIRECT SUPERVISION), THE CONTRACTOR-PROVIDED DATA APPEARS TO REPRESENT THE PROJECT AS CONSTRUCTED.
   DATA TRANSFER CHECKED BY:______ TITLE:______
   COMPANY:______ DATE:______
   BY:______

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

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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MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

20-27 CAMROSE DRIVE STORM DRAINAGE PROJECT SCHED A

STORM DRAIN PLAN & PROFILE

BOP TO STA 13+50

SCALE HOR. 1"=20' VER. 1"=5' | GRID SW1538, SW1638 | DATE AUG 2022 | STATUS DSR | SHEET C3.1 of C3.4

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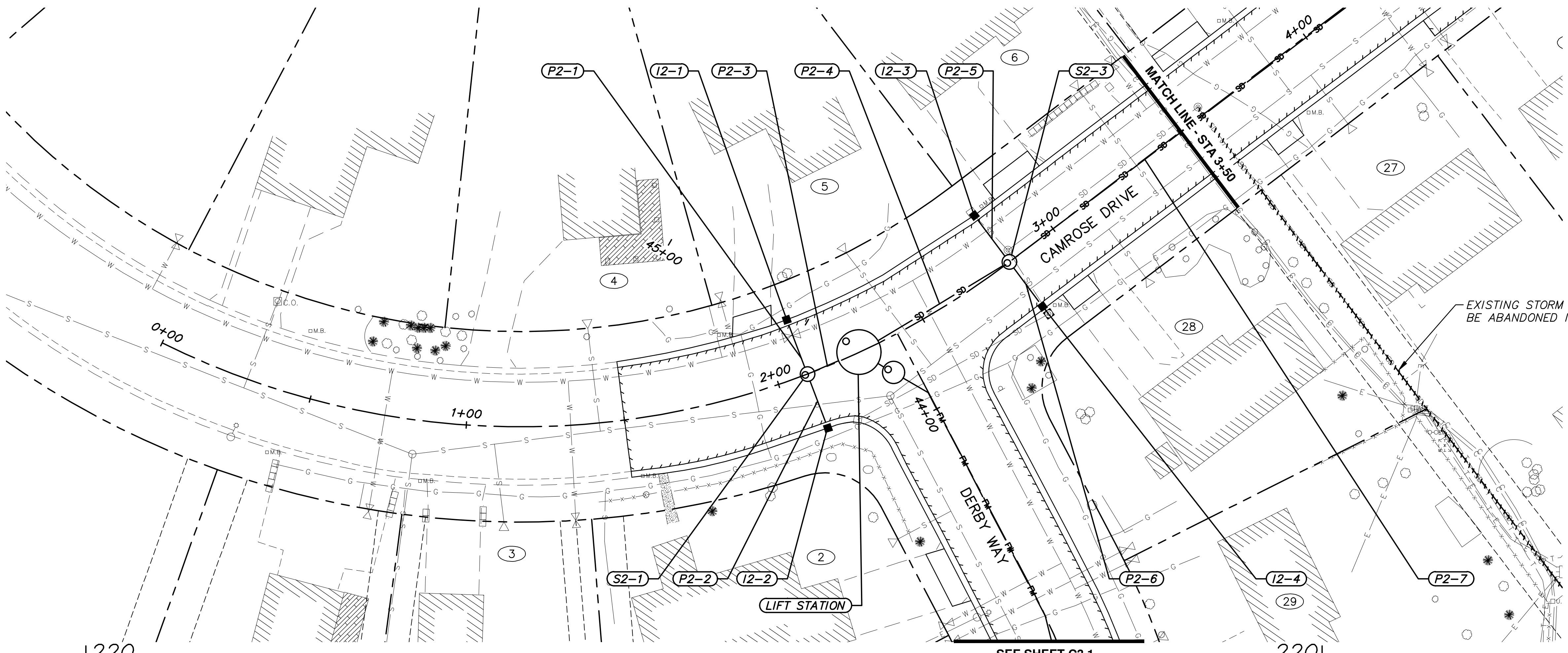

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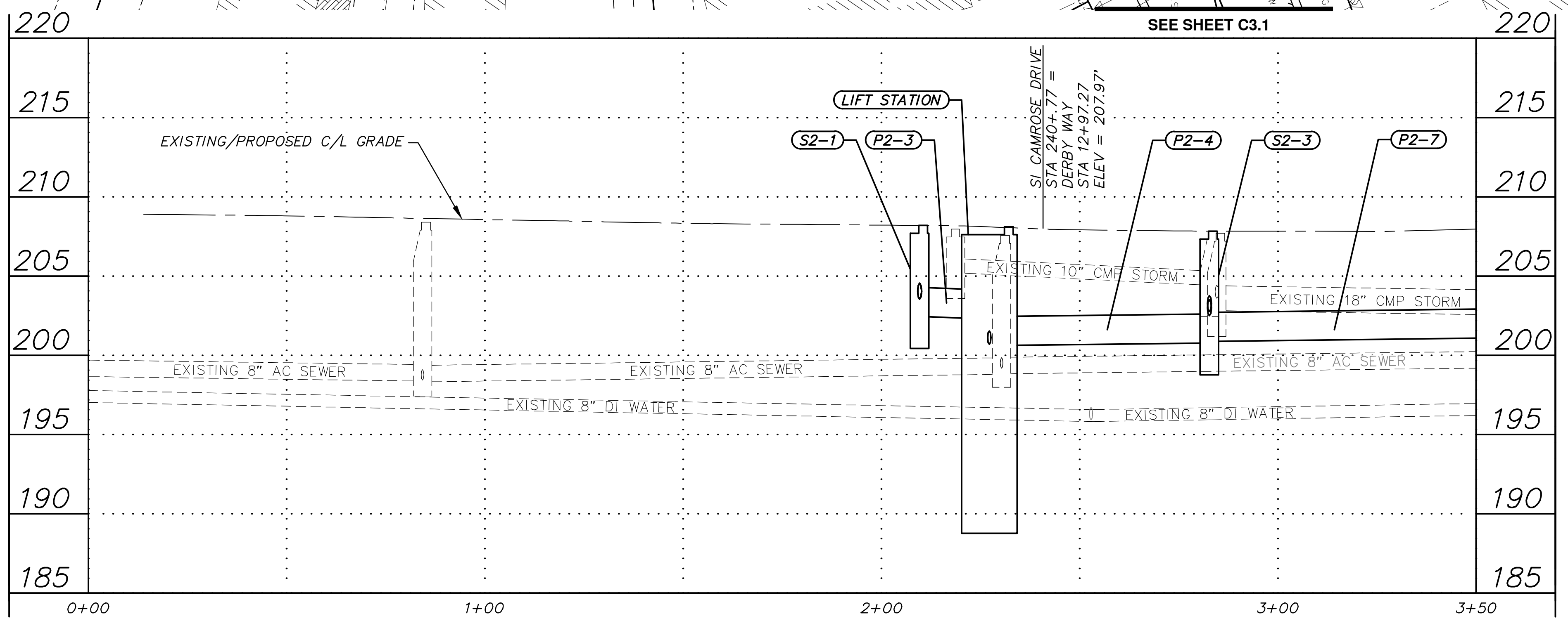

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RECORD DRAWING

1. DATA PROVIDED BY: ____________ TITLE: ____________
   THIS WILL SERVE TO CERTIFY THAT THESE RECORD DRAWINGS ARE A TRUE AND ACCURATE REPRESENTATION OF THE PROJECT AS CONSTRUCTED.
   CONTRACTOR: ____________
   BY: ____________ TITLE: ____________ DATE: ____________
2. DATA TRANSFERRED BY: ____________ TITLE: ____________
   COMPANY: ____________ DATE: ____________
3. BASED ON PERIODIC FIELD OBSERVATIONS BY THE ENGINEER (OR AN INDIVIDUAL UNDER HIS/HER DIRECT SUPERVISION), THE CONTRACTOR-PROVIDED DATA APPEARS TO REPRESENT THE PROJECT AS CONSTRUCTED.
   DATA TRANSFER CHECKED BY: ____________ TITLE: ____________
   COMPANY: ____________ DATE: ____________
   BY: ____________

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 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			

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

SEAL

MUNICIPALITY OF ANCHORAGE

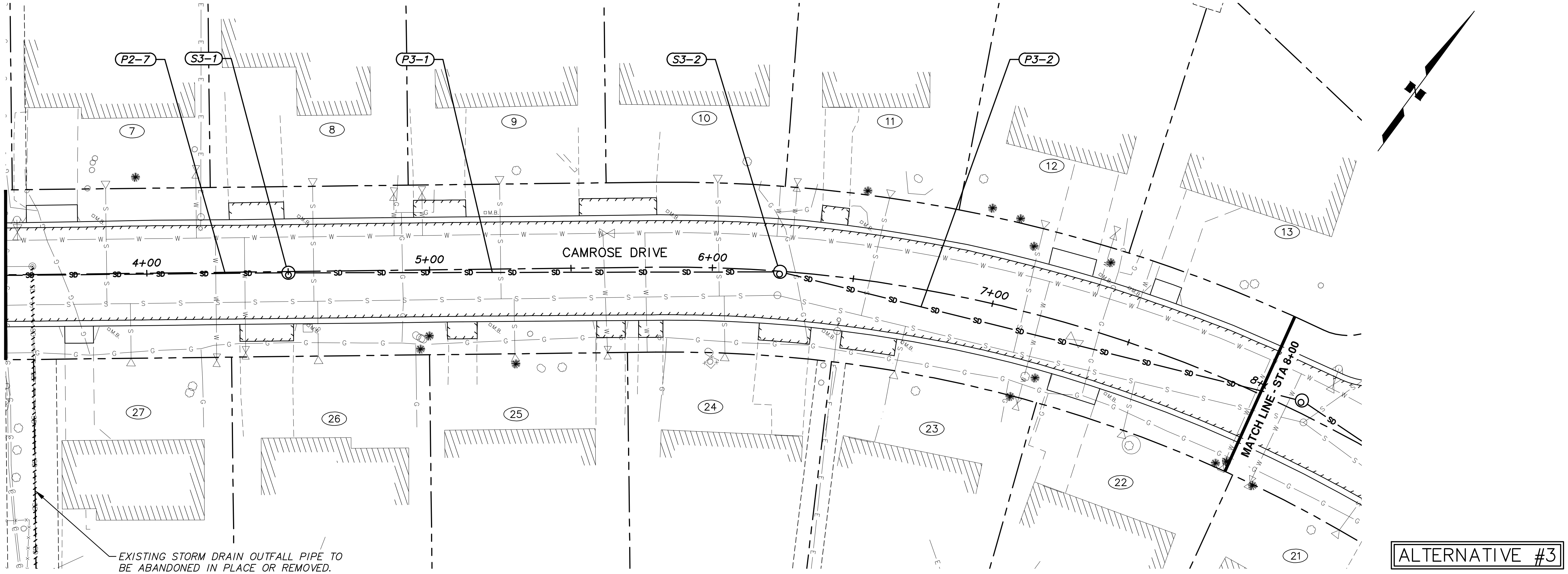
PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

20-27 CAMROSE DRIVE STORM DRAINAGE PROJECT SCHED A

STORM DRAIN PLAN & PROFILE

STA 1+50 TO STA 3+50

SCALE HOR. 1"=20' VER. 1"=5'
GRID SW1538, SW1638
DATE AUG 2022
STATUS DSR
SHEET C3.2 of C3.4



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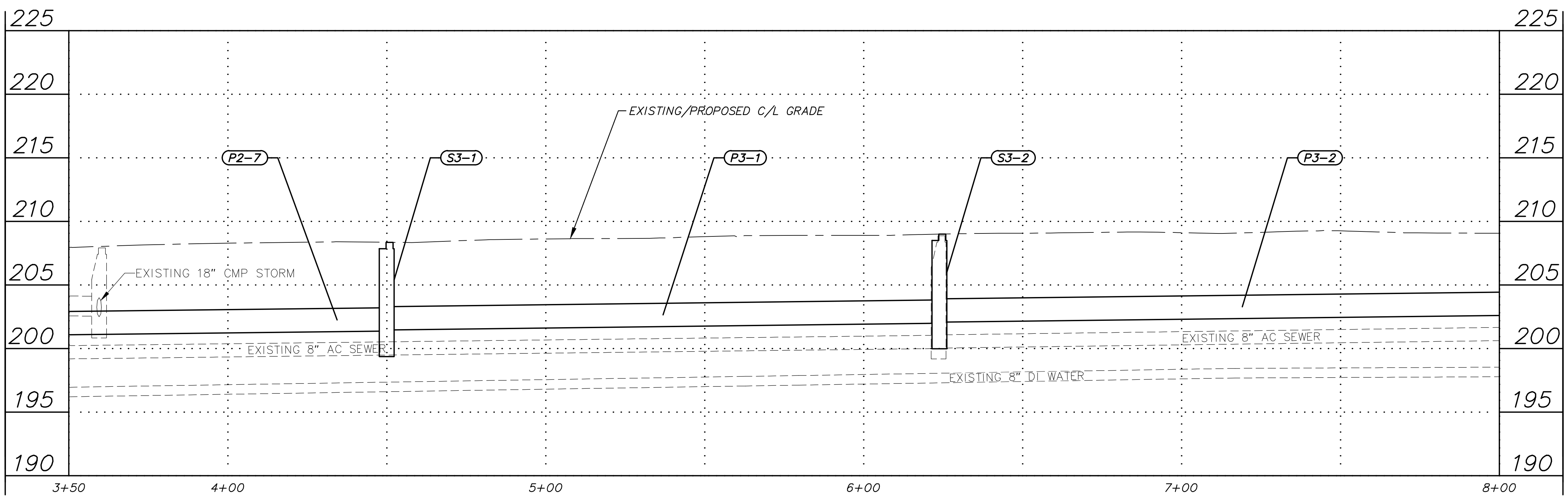

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RECORD DRAWING

1. DATA PROVIDED BY: ____________ TITLE: ____________
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   CONTRACTOR: ____________
   BY: ____________ TITLE: ____________ DATE: ____________
2. DATA TRANSFERRED BY: ____________ TITLE: ____________
   COMPANY: ____________ DATE: ____________
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   DATA TRANSFER CHECKED BY: ____________ TITLE: ____________
   COMPANY: ____________ DATE: ____________
   BY: ____________

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 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

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STORM DRAIN PLAN & PROFILE

STA 3+50 TO STA 8+00

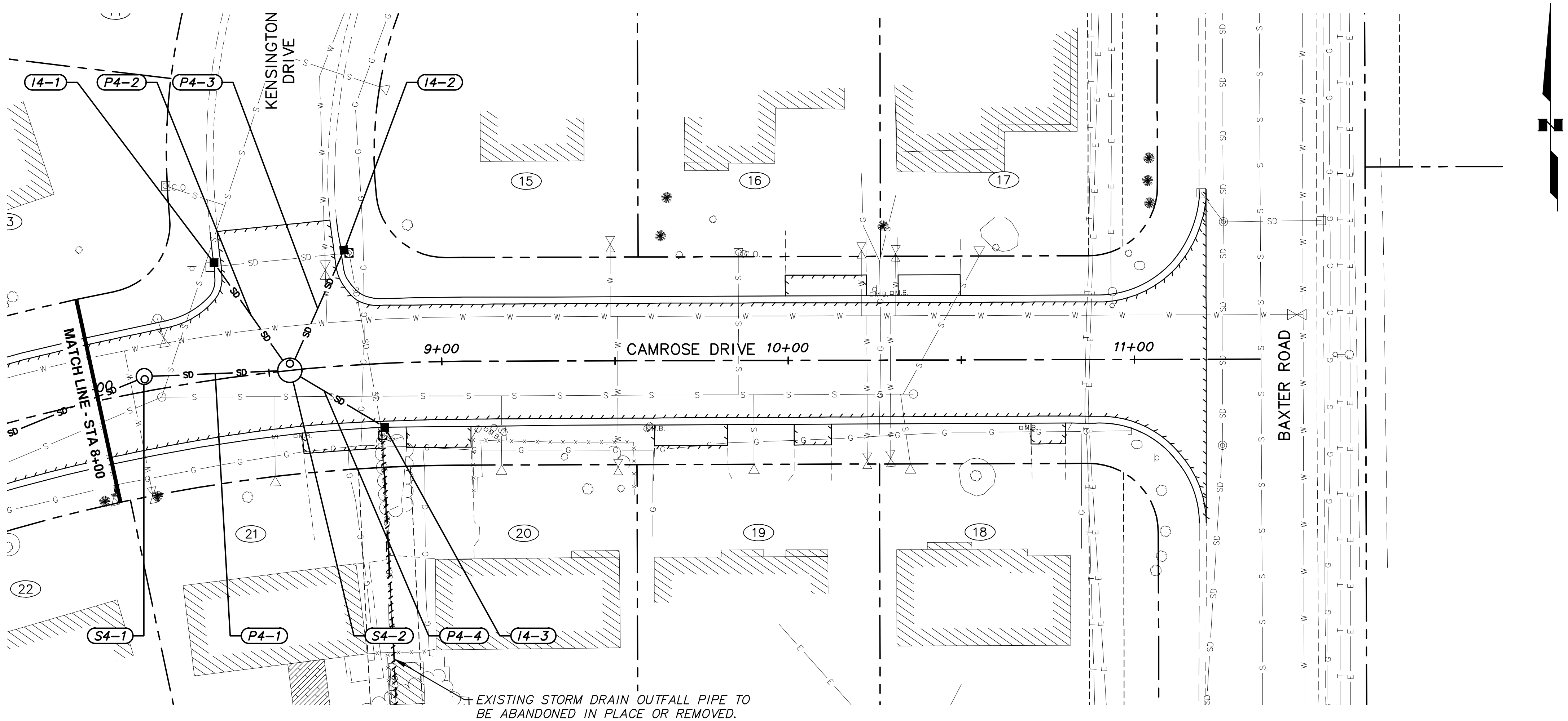
SCALE HOR. 1"=20' VER. 1"=5'

GRID SW1538, SW1638

DATE AUG 2022

STATUS DSR

SHEET C3.3 of C3.4



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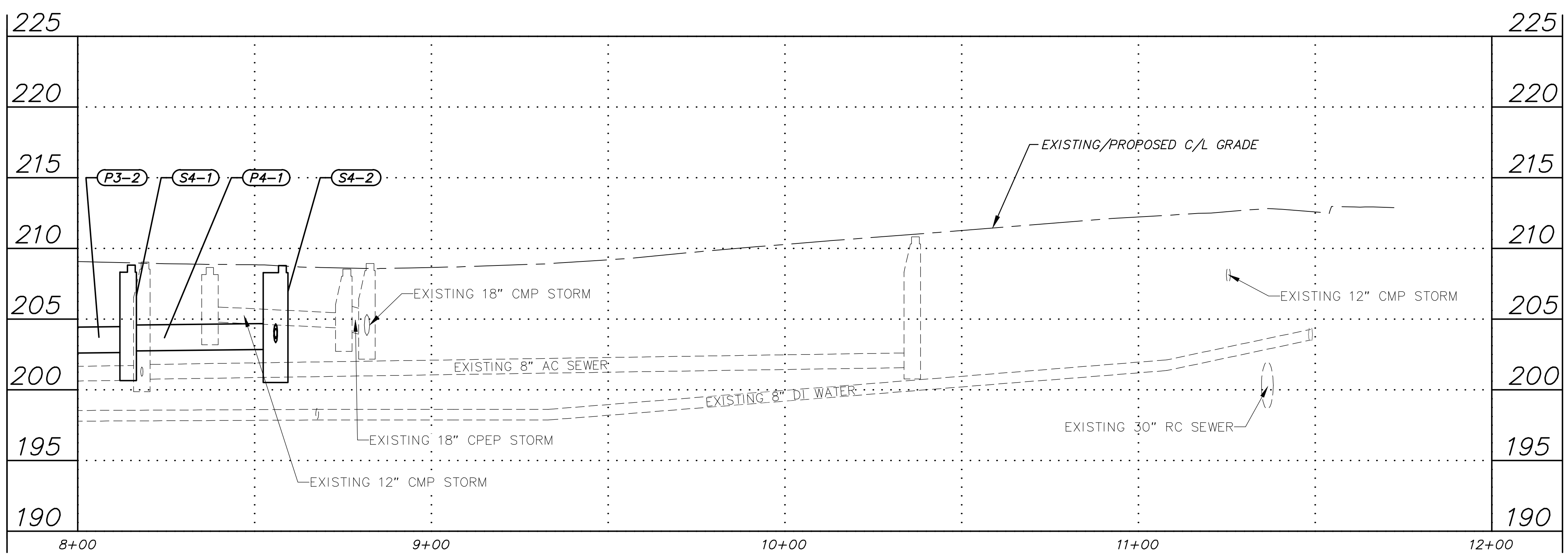

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   CONTRACTOR: ______
   BY: ______ TITLE: ______ DATE: ______
2. DATA TRANSFERRED BY: ______ TITLE: ______
   COMPANY: ______ DATE: ______
3. BASED ON PERIODIC FIELD OBSERVATIONS BY THE ENGINEER (OR AN INDIVIDUAL UNDER HIS/HER DIRECT SUPERVISION), THE CONTRACTOR-PROVIDED DATA APPEARS TO REPRESENT THE PROJECT AS CONSTRUCTED.
   DATA TRANSFER CHECKED BY: ______ TITLE: ______
   COMPANY: ______ DATE: ______
   BY: ______

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

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

CONSULTANT

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MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

20-27 CAMROSE DRIVE STORM DRAINAGE PROJECT SCHED A

STORM DRAIN PLAN & PROFILE

STA 8+00 TO EOP

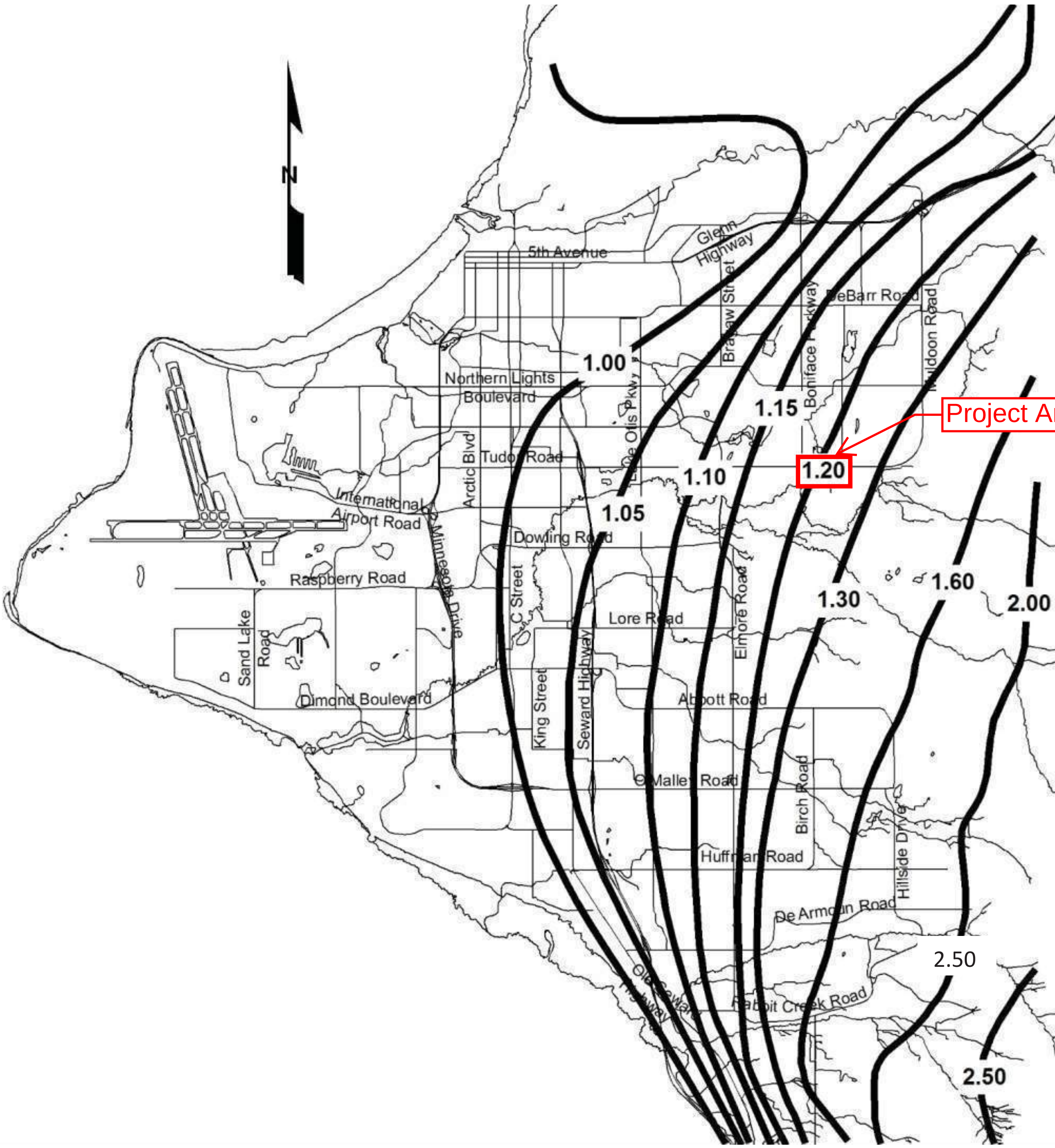
SCALE HOR. 1"=20' VER. 1"=5'
GRID SW1538, SW1638
DATE AUG 2022
STATUS DSR
SHEET C3.4 of C3.4

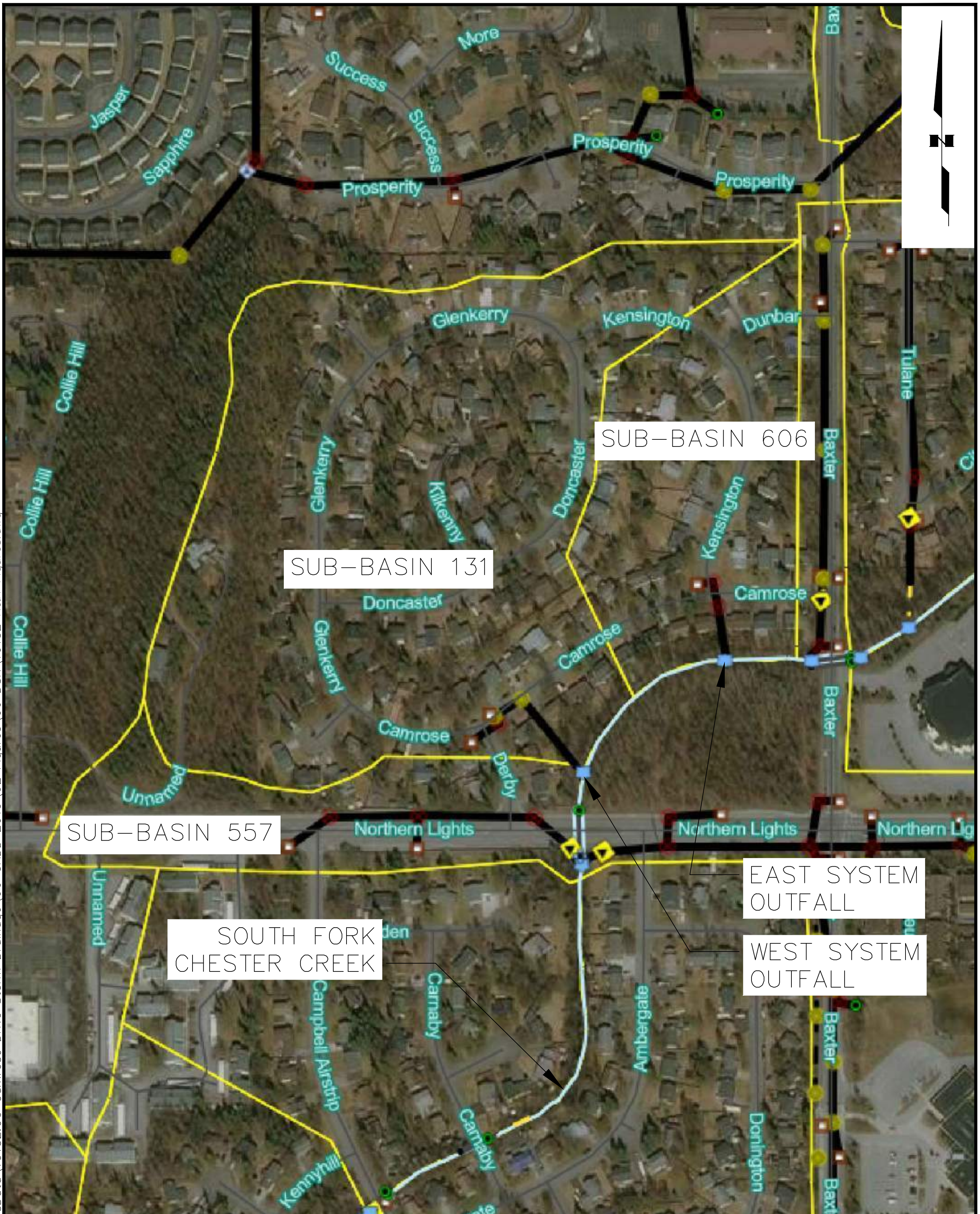
File: J:\JobsData\10152.00 Camrose Drive Storm Drainage\00 CADD 2019\01 Working Set\01 Civil\01 DSR\10152.00 Storm Drain - Plan & Profile_Alt 3.dwg

Hydrologic & Hydraulic Analysis Data

Appendix D

Figure 4.2-3: Orographic Factor Map (Anchorage)





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

DSR

CAMROSE DRIVE
STORM DRAIN PROJECT
MOA DRAINAGE SUB–BASIN MAP

Project No:	20.27
Drawn By:	JCH
Scale:	NTS
Date:	AUG 2022
Figure:	1

FILE NAME: J:\JobsData\10152.00 Camrose Drive Storm Drainage\00 CADD 2019\02 Figures\06 DSR\10152 H&H Figures.dwg

NOAA Atlas 14, Volume 7, Version 2 ANCHORAGE INTL AP
Station ID: 50-0280
Location name: Anchorage, Alaska, USA*
Latitude: 61.2°, Longitude: -150°
Elevation:
Elevation (station metadata): 132 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Douglas Kane, Sarah Dietz, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Svetlana Stuefer, Amy Tidwell, Carl Trypaluk, Dale Unruh, Michael Yekta, Erica Betts, Geoffrey Bonnin, Sarah Heim, Lillian Hiner, Elizabeth Lilly, Jayashree Narayanan, Fenglin Yan, Tan Zhao

NOAA, National Weather Service, Silver Spring, Maryland
and
University of Alaska Fairbanks, Water and Environmental Research Center

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.079 (0.060-0.110)	0.107 (0.080-0.150)	0.143 (0.105-0.205)	0.172 (0.124-0.250)	0.213 (0.151-0.317)	0.244 (0.170-0.368)	0.275 (0.188-0.422)	0.307 (0.207-0.478)	0.350 (0.230-0.556)	0.383 (0.248-0.618)
10-min	0.107 (0.081-0.149)	0.144 (0.108-0.202)	0.192 (0.141-0.275)	0.231 (0.167-0.336)	0.286 (0.202-0.425)	0.328 (0.228-0.495)	0.369 (0.252-0.566)	0.413 (0.278-0.643)	0.470 (0.310-0.747)	0.514 (0.333-0.830)
15-min	0.125 (0.095-0.174)	0.169 (0.127-0.238)	0.224 (0.165-0.321)	0.271 (0.196-0.394)	0.334 (0.236-0.496)	0.383 (0.266-0.578)	0.432 (0.296-0.663)	0.483 (0.325-0.752)	0.551 (0.363-0.876)	0.601 (0.389-0.970)
30-min	0.166 (0.126-0.231)	0.224 (0.168-0.315)	0.298 (0.219-0.427)	0.359 (0.260-0.522)	0.444 (0.314-0.660)	0.509 (0.354-0.769)	0.574 (0.393-0.880)	0.641 (0.431-0.999)	0.731 (0.481-1.16)	0.798 (0.517-1.29)
60-min	0.227 (0.173-0.315)	0.307 (0.231-0.432)	0.408 (0.300-0.585)	0.492 (0.356-0.716)	0.608 (0.430-0.904)	0.697 (0.485-1.05)	0.786 (0.538-1.21)	0.878 (0.591-1.37)	1.00 (0.659-1.59)	1.09 (0.708-1.76)
2-hr	0.294 (0.224-0.408)	0.397 (0.298-0.558)	0.528 (0.389-0.757)	0.636 (0.460-0.926)	0.786 (0.556-1.17)	0.901 (0.627-1.36)	1.02 (0.696-1.56)	1.14 (0.765-1.77)	1.29 (0.852-2.06)	1.41 (0.916-2.28)
3-hr	0.359 (0.273-0.499)	0.486 (0.365-0.683)	0.645 (0.475-0.924)	0.779 (0.564-1.13)	0.962 (0.681-1.43)	1.10 (0.767-1.67)	1.24 (0.851-1.91)	1.39 (0.935-2.17)	1.58 (1.04-2.52)	1.73 (1.12-2.79)
6-hr	0.524 (0.399-0.728)	0.709 (0.533-0.997)	0.943 (0.694-1.35)	1.14 (0.823-1.66)	1.40 (0.993-2.09)	1.61 (1.12-2.43)	1.82 (1.24-2.78)	2.03 (1.37-3.16)	2.31 (1.52-3.67)	2.52 (1.64-4.07)
12-hr	0.750 (0.571-1.04)	1.02 (0.765-1.43)	1.37 (1.01-1.96)	1.65 (1.19-2.39)	2.02 (1.43-3.01)	2.31 (1.61-3.49)	2.60 (1.78-3.99)	2.90 (1.95-4.52)	3.30 (2.17-5.25)	3.60 (2.33-5.81)
24-hr	1.04 (0.830-1.31)	1.40 (1.11-1.79)	1.90 (1.47-2.47)	2.28 (1.74-3.02)	2.79 (2.09-3.78)	3.19 (2.35-4.38)	3.59 (2.60-5.01)	4.02 (2.87-5.69)	4.58 (3.20-6.61)	5.00 (3.44-7.33)
2-day	1.28 (1.03-1.62)	1.68 (1.33-2.15)	2.24 (1.74-2.92)	2.69 (2.05-3.56)	3.32 (2.48-4.48)	3.83 (2.82-5.25)	4.36 (3.16-6.08)	4.97 (3.55-7.04)	5.78 (4.04-8.35)	6.39 (4.40-9.38)
3-day	1.44 (1.15-1.81)	1.85 (1.46-2.36)	2.44 (1.89-3.17)	2.92 (2.23-3.87)	3.62 (2.71-4.89)	4.20 (3.09-5.77)	4.82 (3.49-6.72)	5.57 (3.97-7.89)	6.56 (4.59-9.48)	7.31 (5.03-10.7)
4-day	1.57 (1.25-1.98)	1.99 (1.57-2.54)	2.61 (2.02-3.39)	3.12 (2.38-4.13)	3.87 (2.89-5.22)	4.49 (3.30-6.16)	5.16 (3.74-7.20)	5.97 (4.26-8.46)	7.05 (4.93-10.2)	7.86 (5.42-11.5)
7-day	1.95 (1.56-2.46)	2.45 (1.94-3.13)	3.16 (2.45-4.12)	3.75 (2.86-4.96)	4.58 (3.43-6.19)	5.26 (3.87-7.23)	5.98 (4.34-8.34)	6.82 (4.86-9.65)	7.92 (5.53-11.4)	8.75 (6.02-12.8)
10-day	2.26 (1.81-2.85)	2.83 (2.23-3.61)	3.62 (2.81-4.71)	4.25 (3.24-5.62)	5.13 (3.84-6.93)	5.83 (4.29-8.01)	6.57 (4.76-9.16)	7.39 (5.27-10.5)	8.47 (5.92-12.2)	9.29 (6.40-13.6)
20-day	3.15 (2.52-3.98)	3.90 (3.08-4.99)	4.91 (3.81-6.39)	5.68 (4.34-7.51)	6.71 (5.02-9.07)	7.51 (5.53-10.3)	8.31 (6.02-11.6)	9.13 (6.52-12.9)	10.2 (7.15-14.8)	11.1 (7.61-16.2)
30-day	3.98 (3.18-5.02)	4.90 (3.87-6.26)	6.10 (4.73-7.94)	7.00 (5.34-9.26)	8.17 (6.11-11.0)	9.05 (6.66-12.4)	9.91 (7.18-13.8)	10.7 (7.67-15.2)	11.8 (8.28-17.1)	12.7 (8.73-18.6)
45-day	4.99 (3.99-6.30)	6.12 (4.84-7.82)	7.55 (5.86-9.84)	8.60 (6.57-11.4)	9.93 (7.43-13.4)	10.9 (8.02-15.0)	11.8 (8.56-16.5)	12.7 (9.04-17.9)	13.8 (9.63-19.9)	14.6 (10.1-21.5)
60-day	5.59 (4.47-7.06)	6.84 (5.41-8.74)	8.39 (6.51-10.9)	9.50 (7.26-12.6)	10.9 (8.14-14.7)	11.9 (8.74-16.3)	12.8 (9.28-17.9)	13.7 (9.75-19.3)	14.8 (10.3-21.4)	15.6 (10.8-22.9)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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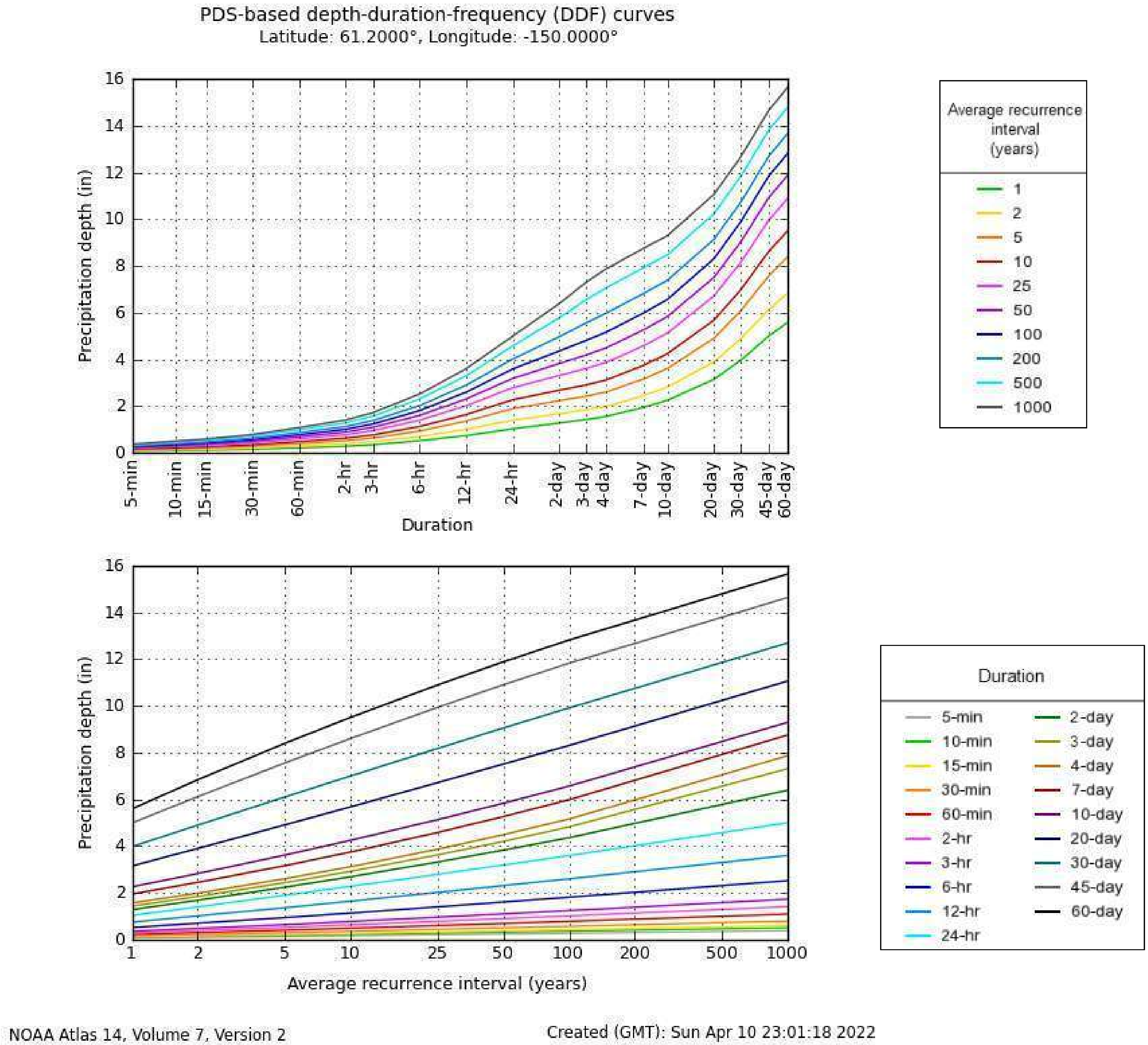
PF graphical



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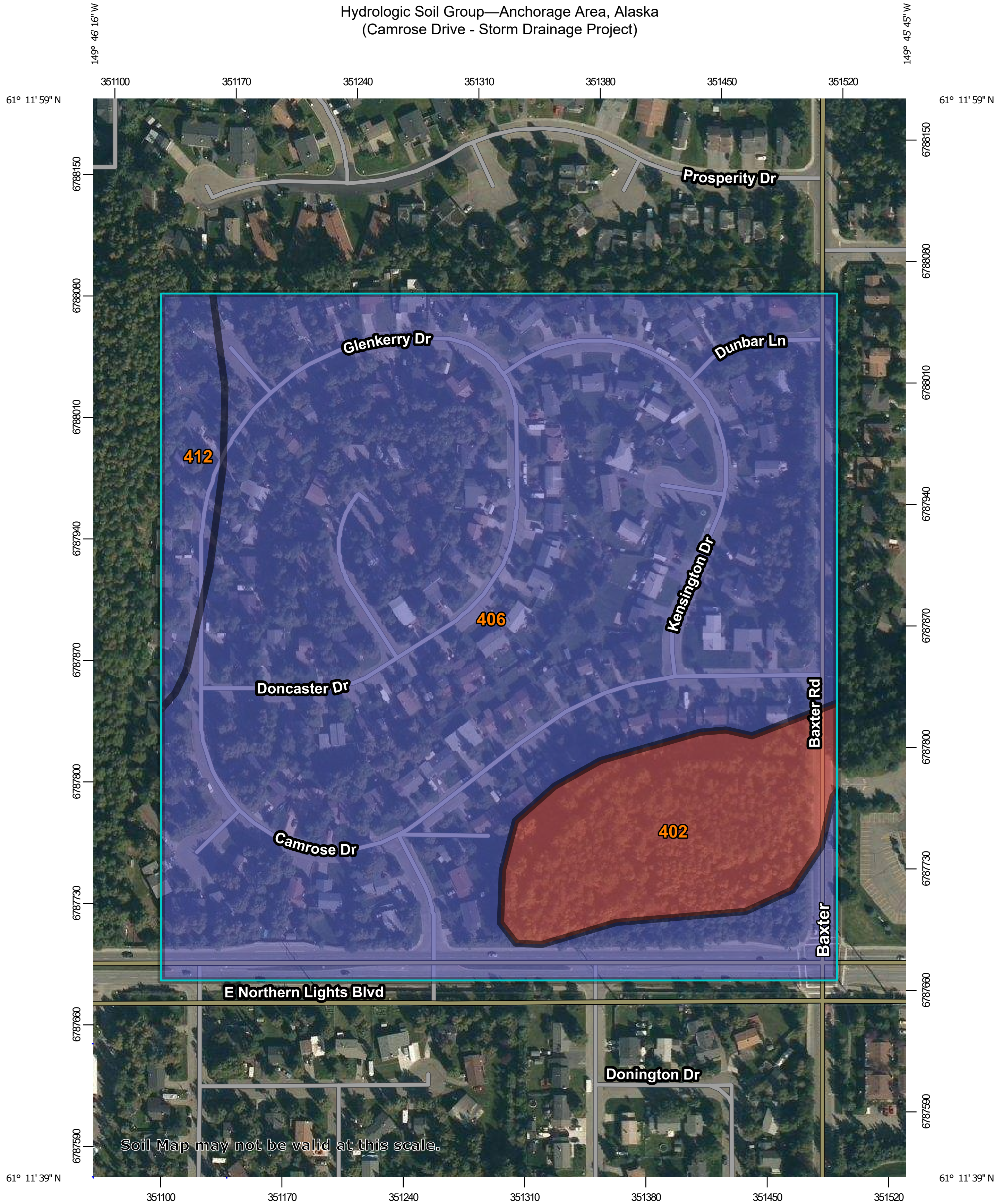
Maps & aerials

Small scale terrain

Anchorage and Eagle River 24-hour Rainfall Distribution in 6-minute (0.1 hour) increments

Time (hr)	Cumulative Fraction	Time (hr)	Cumulative Fraction	Time (hr)	Cumulative Fraction	Time (hr)	Cumulative Fraction	Time (hr)	Cumulative Fraction	Time (hr)	Cumulative Fraction
0.1	0.00189	4.6	0.10808	9.1	0.25631	13.6	0.68341	18.1	0.85354	22.6	0.97168
0.2	0.0038	4.7	0.11091	9.2	0.26074	13.7	0.68825	18.2	0.85661	22.7	0.97384
0.3	0.00573	4.8	0.11376	9.3	0.2652	13.8	0.69307	18.3	0.85967	22.8	0.97597
0.4	0.00768	4.9	0.11663	9.4	0.2697	13.9	0.69784	18.4	0.8627	22.9	0.97809
0.5	0.00965	5	0.11952	9.5	0.27423	14	0.70258	18.5	0.86571	23	0.98018
0.6	0.01165	5.1	0.12244	9.6	0.2788	14.1	0.70729	18.6	0.86871	23.1	0.98226
0.7	0.01366	5.2	0.12537	9.7	0.2834	14.2	0.71196	18.7	0.87168	23.2	0.98431
0.8	0.01569	5.3	0.12832	9.8	0.28804	14.3	0.7166	18.8	0.87463	23.3	0.98634
0.9	0.01774	5.4	0.13129	9.9	0.29271	14.4	0.7212	18.9	0.87756	23.4	0.98835
1	0.01982	5.5	0.13429	10	0.29742	14.5	0.72577	19	0.88048	23.5	0.99035
1.1	0.02191	5.6	0.1373	10.1	0.30216	14.6	0.7303	19.1	0.88337	23.6	0.99232
1.2	0.02403	5.7	0.14033	10.2	0.30693	14.7	0.7348	19.2	0.88624	23.7	0.99427
1.3	0.02616	5.8	0.14339	10.3	0.31175	14.8	0.73926	19.3	0.88909	23.8	0.9962
1.4	0.02832	5.9	0.14646	10.4	0.31659	14.9	0.74369	19.4	0.89192	23.9	0.99811
1.5	0.03049	6	0.14956	10.5	0.32148	15	0.74808	19.5	0.89473	24	1
1.6	0.03269	6.1	0.15267	10.6	0.32728	15.1	0.75179	19.6	0.89752		
1.7	0.03491	6.2	0.15581	10.7	0.33334	15.2	0.75547	19.7	0.90028		
1.8	0.03714	6.3	0.15897	10.8	0.33964	15.3	0.75914	19.8	0.90303		
1.9	0.0394	6.4	0.16214	10.9	0.34619	15.4	0.76279	19.9	0.90576		
2	0.04168	6.5	0.16534	11	0.35298	15.5	0.76642	20	0.90847		
2.1	0.04398	6.6	0.16856	11.1	0.36003	15.6	0.77002	20.1	0.91115		
2.2	0.0463	6.7	0.1718	11.2	0.36732	15.7	0.77361	20.2	0.91382		
2.3	0.04864	6.8	0.17506	11.3	0.37486	15.8	0.77717	20.3	0.91647		
2.4	0.051	6.9	0.17834	11.4	0.38265	15.9	0.78072	20.4	0.91909		
2.5	0.05338	7	0.18164	11.5	0.39068	16	0.78424	20.5	0.9217		
2.6	0.05578	7.1	0.18496	11.6	0.40026	16.1	0.78775	20.6	0.92428		
2.7	0.0582	7.2	0.1883	11.7	0.41117	16.2	0.79123	20.7	0.92685		
2.8	0.06064	7.3	0.19166	11.8	0.42585	16.3	0.79469	20.8	0.92939		
2.9	0.0631	7.4	0.19504	11.9	0.44681	16.4	0.79814	20.9	0.93191		
3	0.06558	7.5	0.19844	12	0.48521	16.5	0.80156	21	0.93442		
3.1	0.06809	7.6	0.20186	12.1	0.55319	16.6	0.80496	21.1	0.9369		
3.2	0.07061	7.7	0.20531	12.2	0.57415	16.7	0.80834	21.2	0.93936		
3.3	0.07315	7.8	0.20877	12.3	0.58883	16.8	0.8117	21.3	0.9418		
3.4	0.07572	7.9	0.21225	12.4	0.59974	16.9	0.81504	21.4	0.94422		
3.5	0.0783	8	0.21576	12.5	0.60932	17	0.81836	21.5	0.94662		
3.6	0.08091	8.1	0.21928	12.6	0.61735	17.1	0.82166	21.6	0.949		
3.7	0.08353	8.2	0.22283	12.7	0.62514	17.2	0.82494	21.7	0.95136		
3.8	0.08618	8.3	0.22639	12.8	0.63268	17.3	0.8282	21.8	0.9537		
3.9	0.08885	8.4	0.22998	12.9	0.63997	17.4	0.83144	21.9	0.95602		
4	0.09153	8.5	0.23358	13	0.64702	17.5	0.83466	22	0.95832		
4.1	0.09424	8.6	0.23721	13.1	0.65381	17.6	0.83786	22.1	0.9606		
4.2	0.09697	8.7	0.24086	13.2	0.66036	17.7	0.84103	22.2	0.96286		
4.3	0.09972	8.8	0.24453	13.3	0.66666	17.8	0.84419	22.3	0.96509		
4.4	0.10248	8.9	0.24821	13.4	0.67272	17.9	0.84733	22.4	0.96731		
4.5	0.10527	9	0.25192	13.5	0.67852	18	0.85044	22.5	0.96951		

Hydrologic Soil Group—Anchorage Area, Alaska
(Camrose Drive - Storm Drainage Project)



Map Scale: 1:3,020 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 40, 80, 160, 240

Feet: 0, 100, 200, 400, 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 6N WGS84

MAP LEGEND

Area of Interest (AOI)
Area of Interest (AOI)

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Anchorage Area, Alaska
Survey Area Data: Version 17, Sep 8, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 26, 2011—Aug 29, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
402	Clam Gulch silt loam, 0 to 7 percent slopes	D	4.4	11.6%
406	Cryorthents and Urban land, 0 to 5 percent slopes	B	32.2	84.0%
412	Deception-Estelle-Kichatna complex, 20 to 45 percent slopes	B	1.7	4.4%
Totals for Area of Interest			**38.3**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

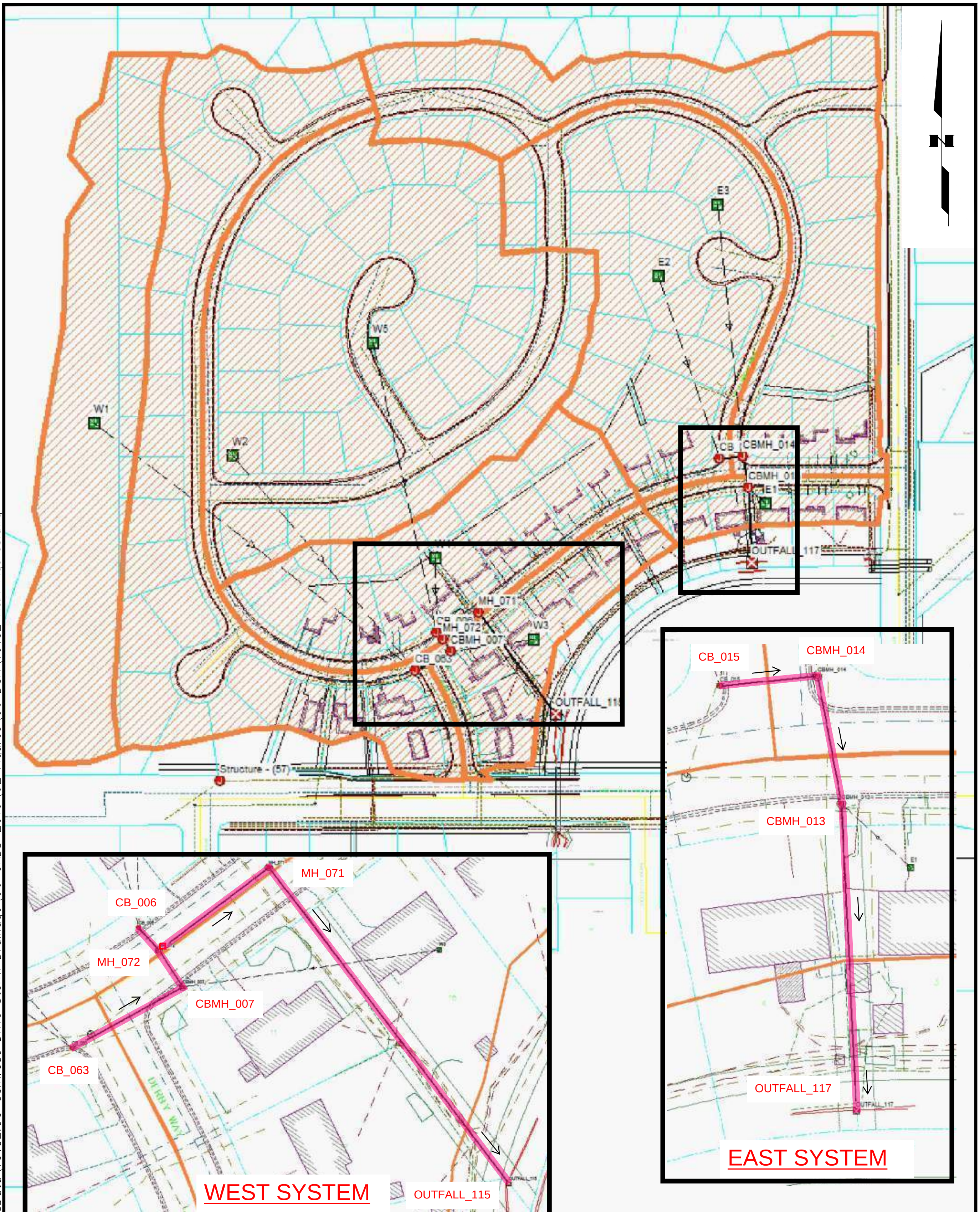
Rating Options

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Existing Conditions



FILE NAME: J:\JobsData\10152.00 Camrose Drive Storm Drainage\00 CADD 2019\02 Figures\06 DSR\10152 H&H Figures.dwg

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

DSR

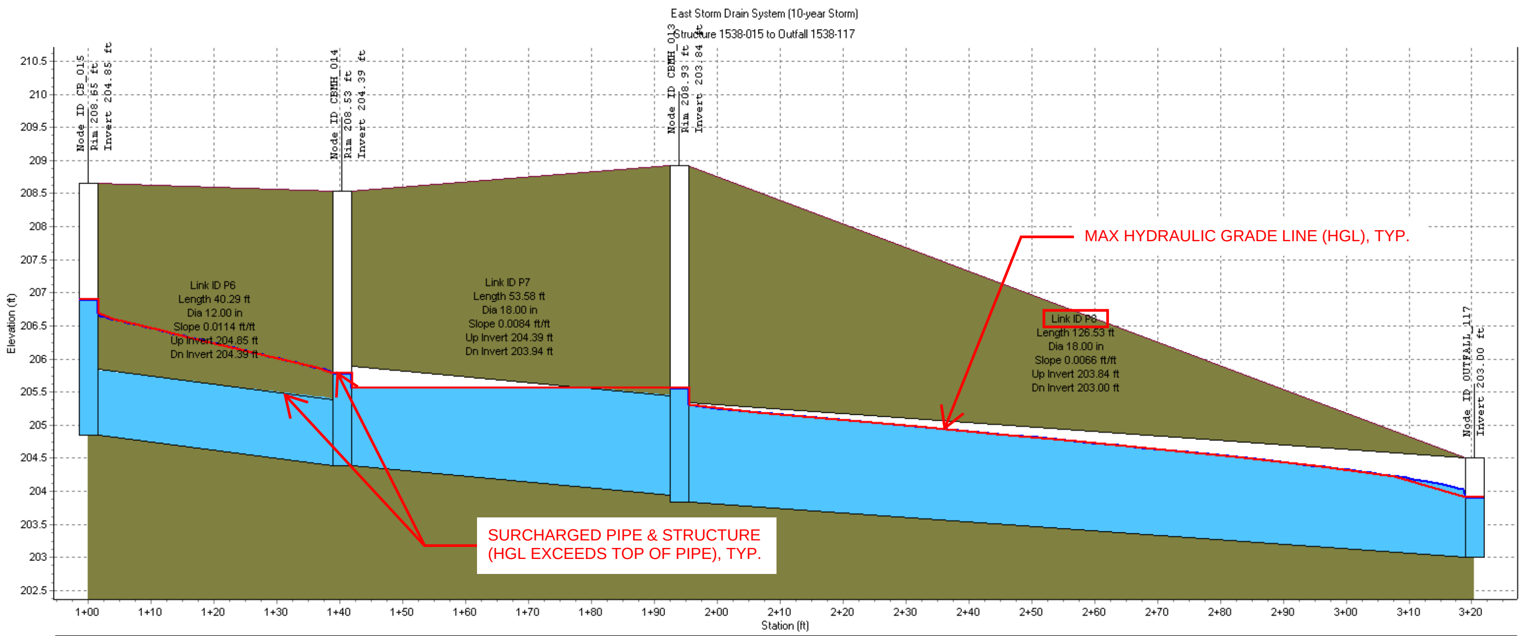
CAMROSE DRIVE
STORM DRAIN PROJECT
HYDROLOGIC & HYDRAULIC ANALYSIS

EXISTING CONDITIONS MODEL

Project No:	20-27
Drawn By:	JCH
Scale:	NTS
Date:	AUG 2022
Figure:	2

<u>EXISTING CONDITIONS</u>

EAST STORM DRAIN SYSTEM (10-YEAR STORM)
STRUCTURE 1538-015 TO OUTFALL 1538-117



Node ID:	CB_015	CBMH_014	CBMH_013	OUTFALL_117
Rim (ft):	208.65	208.53	208.93	
Invert (ft):	204.85	204.39	203.84	203.00
Min Pipe Cover (ft):	2.80	2.64	3.49	
Max HGL (ft):	206.93	205.78	205.56	203.91

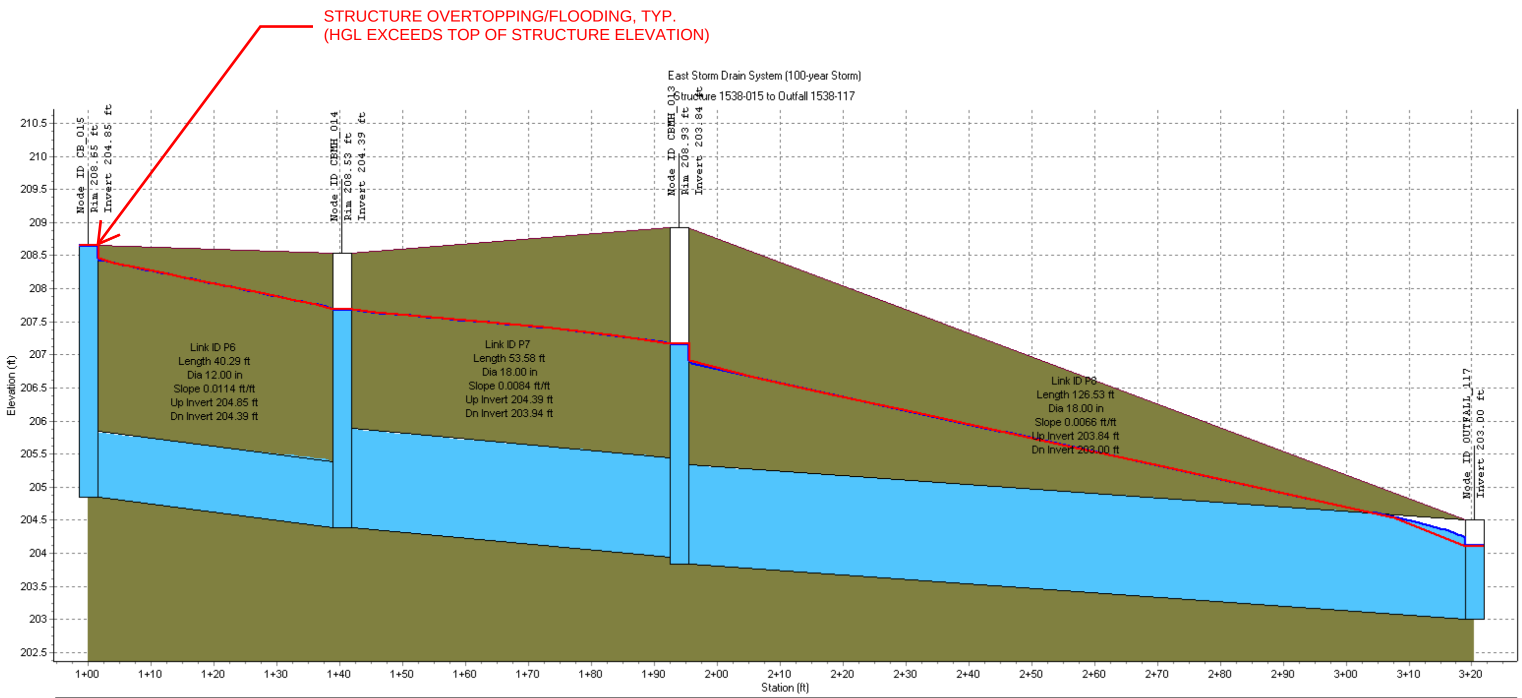
Link ID:	P6	P7	P8
Length (ft):	40.29	53.58	126.53
Dia (in):	12.00	18.00	18.00
Slope (ft/ft):	0.0114	0.0084	0.0066
Up Invert (ft):	204.85	204.39	203.84
Dn Invert (ft):	204.39	203.94	203.00
Max Q (cfs):	3.10	5.14	5.57
Max Vel (ft/s):	3.94	3.09	3.66
Max Depth (ft):	1.00	1.45	1.20

MAX FLOW RATE IN PIPE (E.G. P8)
DURING DESIGN STORM, TYP.

Autodesk Storm and Sanitary Analysis

<u>EXISTING CONDITIONS</u>

EAST STORM DRAIN SYSTEM (100-YEAR STORM)
STRUCTURE 1538-015 TO OUTFALL 1538-117



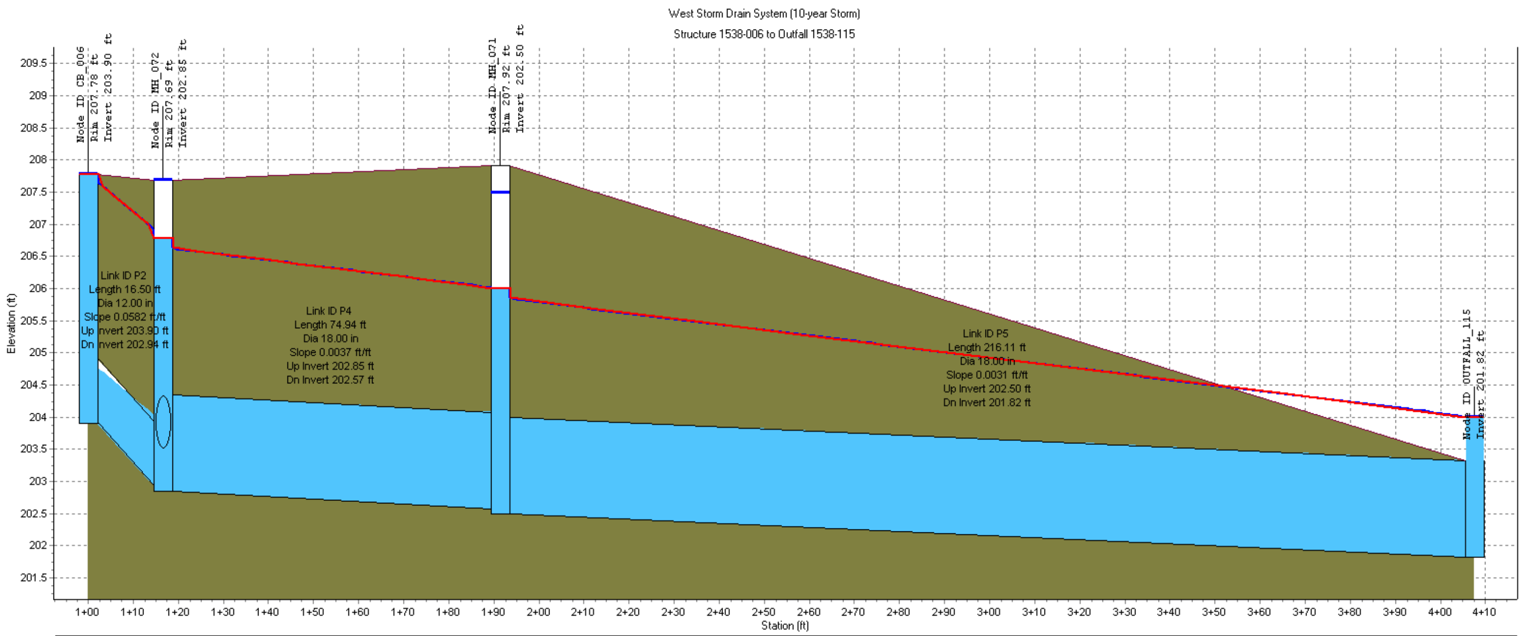
Node ID:	CB_015	CBMH_014	CBMH_013	OUTFALL_117
Rim (ft):	208.65	208.53	208.93	
Invert (ft):	204.85	204.39	203.84	203.00
Min Pipe Cover (ft):	2.80	2.64	3.49	
Max HGL (ft):	208.65	207.68	207.16	204.11

Link ID:	P6	P7	P8
Length (ft):	40.29	53.58	126.53
Dia (in):	12.00	18.00	18.00
Slope (ft/ft):	0.0114	0.0084	0.0066
Up Invert (ft):	204.85	204.39	203.84
Dn Invert (ft):	204.39	203.94	203.00
Max Q (cfs):	3.89	7.60	8.20
Max Vel (ft/s):	4.95	4.30	5.03
Max Depth (ft):	1.00	1.50	1.30

Autodesk Storm and Sanitary Analysis

<u>EXISTING CONDITIONS</u>

WEST STORM DRAIN SYSTEM (10-YEAR STORM)
STRUCTURE 1538-006 TO OUTFALL 1538-115



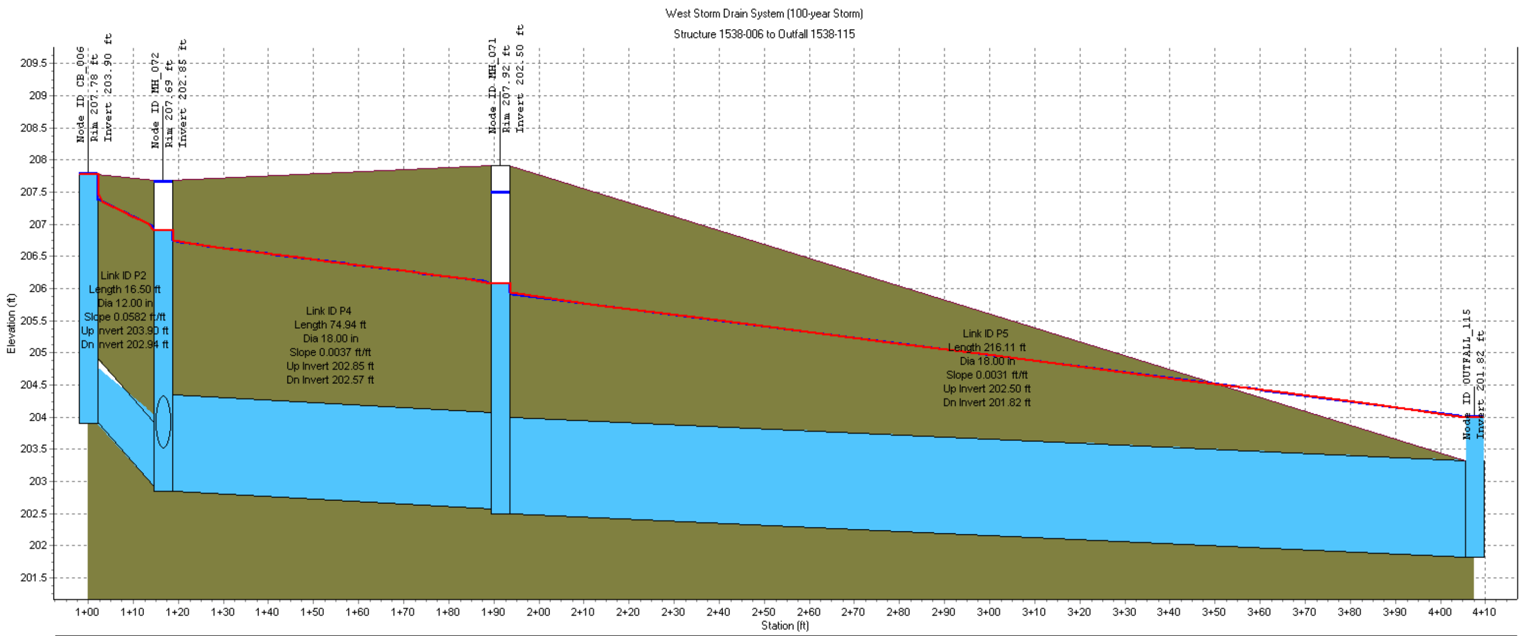
Node ID:	CB_006	MH_072	MH_071	OUTFALL_115
Rim (ft):	207.78	207.69	207.92	
Invert (ft):	203.90	202.85	202.50	201.82
Min Pipe Cover (ft):	2.88	3.34	3.85	
Max HGL (ft):	207.78	207.69	207.92	204.00

Link ID:	P2	P4	P5
Length (ft):	16.50	74.94	216.11
Dia (in):	12.00	18.00	18.00
Slope (ft/ft):	0.0582	0.0037	0.0031
Up Invert (ft):	203.90	202.85	202.50
Dn Invert (ft):	202.94	202.57	201.82
Max Q (cfs):	78.60	42.08	10.27
Max Vel (ft/s):	50.00	24.24	5.81
Max Depth (ft):	1.00	1.50	1.50

Autodesk Storm and Sanitary Analysis

<u>EXISTING CONDITIONS</u>

WEST STORM DRAIN SYSTEM (100-YEAR STORM)
STRUCTURE 1538-015 TO OUTFALL 1538-115



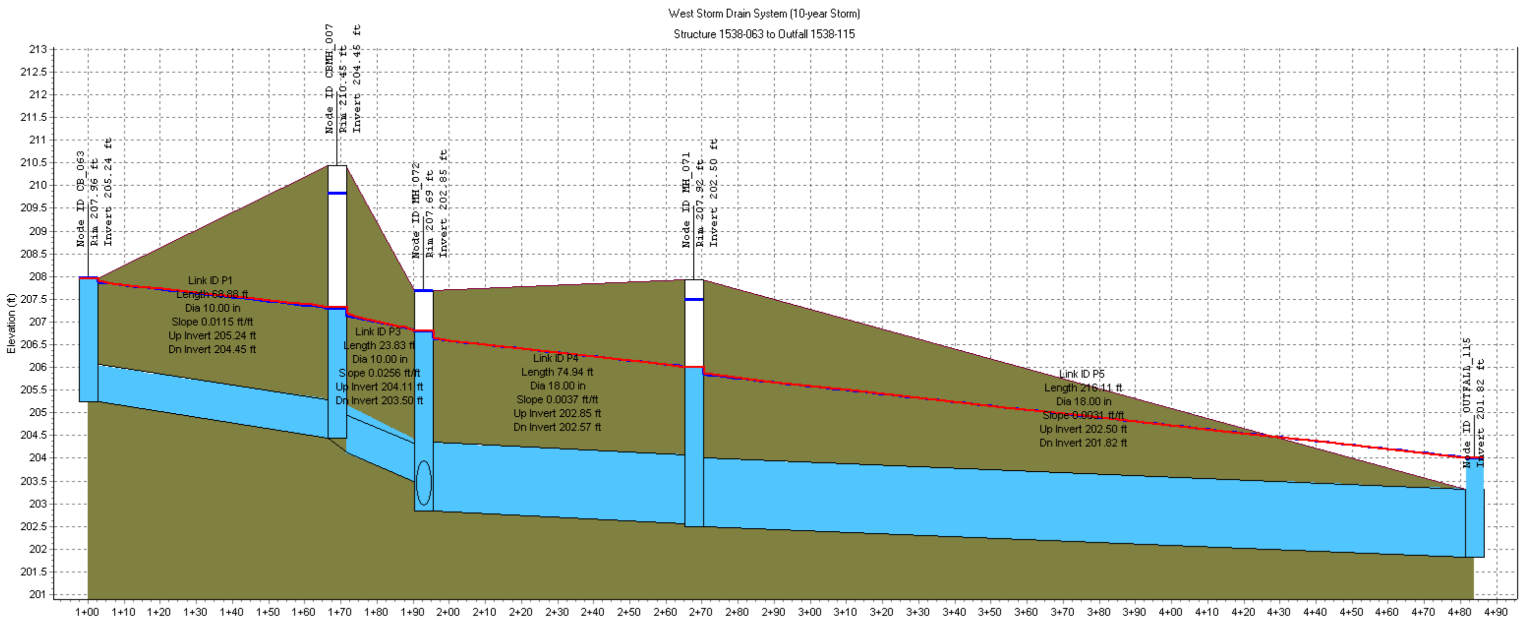
Node ID:	CB_006	MH_072	MH_071	OUTFALL_115
Rim (ft):	207.78	207.69	207.92	
Invert (ft):	203.90	202.85	202.50	201.82
Min Pipe Cover (ft):	2.88	3.34	3.85	
Max HGL (ft):	207.78	207.69	207.92	204.00

Link ID:	P2	P4	P5
Length (ft):	16.50	74.94	216.11
Dia (in):	12.00	18.00	18.00
Slope (ft/ft):	0.0582	0.0037	0.0031
Up Invert (ft):	203.90	202.85	202.50
Dn Invert (ft):	202.94	202.57	201.82
Max Q (cfs):	78.35	42.21	11.32
Max Vel (ft/s):	50.00	24.54	6.41
Max Depth (ft):	1.00	1.50	1.50

Autodesk Storm and Sanitary Analysis

EXISTING CONDITIONS

WEST STORM DRAIN SYSTEM (10-YEAR STORM)
STRUCTURE 1538-063 TO OUTFALL 1538-115

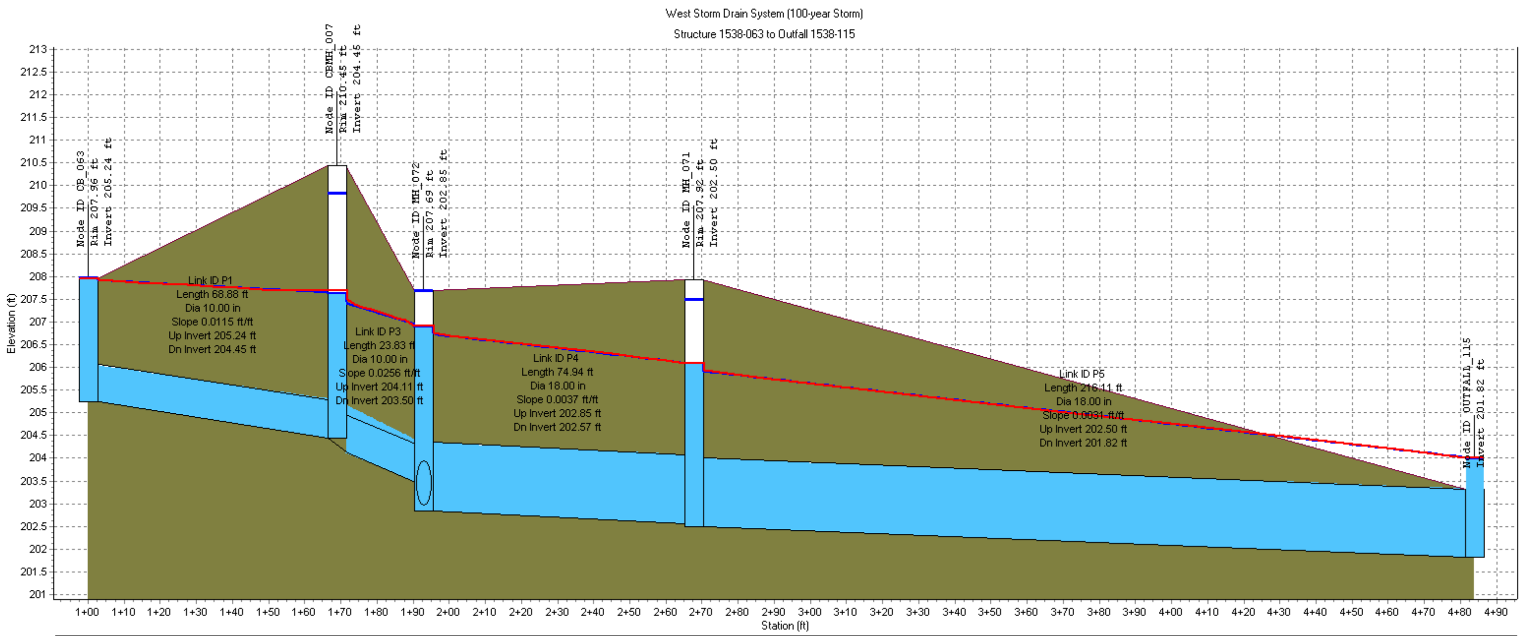


Node ID:	CB_063	CBMH_007	MH_072	MH_071	OUTFALL_115
Rim (ft):	207.96	210.45	207.69	207.92	
Invert (ft):	205.24	204.45	202.85	202.50	201.82
Min Pipe Cover (ft):	1.89	5.17	3.34	3.85	
Max HGL (ft):	207.96	210.45	207.69	207.92	204.00

Link ID:	P1	P3	P4	P5
Length (ft):	68.88	23.83	74.94	216.11
Dia (in):	10.00	10.00	18.00	18.00
Slope (ft/ft):	0.0115	0.0256	0.0037	0.0031
Up Invert (ft):	205.24	204.11	202.85	202.50
Dn Invert (ft):	204.45	203.50	202.57	201.82
Max Q (cfs):	8.83	56.45	42.08	10.27
Max Vel (ft/s):	30.86	50.00	24.24	5.81
Max Depth (ft):	0.83	0.83	1.50	1.50

EXISTING CONDITIONS

WEST STORM DRAIN SYSTEM (100-YEAR STORM)
STRUCTURE 1538-063 TO OUTFALL 1538-115



Node ID:	CB_063	CBMH_007	MH_072	MH_071	OUTFALL_115
Rim (ft):	207.96	210.45	207.69	207.92	
Invert (ft):	205.24	204.45	202.85	202.50	201.82
Min Pipe Cover (ft):	1.89	5.17	3.34	3.85	
Max HGL (ft):	207.96	210.45	207.69	207.92	204.00

Link ID:	P1	P3	P4	P5
Length (ft):	68.88	23.83	74.94	216.11
Dia (in):	10.00	10.00	18.00	18.00
Slope (ft/ft):	0.0115	0.0256	0.0037	0.0031
Up Invert (ft):	205.24	204.11	202.85	202.50
Dn Invert (ft):	204.45	203.50	202.57	201.82
Max Q (cfs):	11.21	56.45	42.21	11.32
Max Vel (ft/s):	29.27	50.00	24.54	6.41
Max Depth (ft):	0.83	0.83	1.50	1.50

Autodesk Storm and Sanitary Analysis

EXISTING CONDITION - SSA MODEL RESULTS
10-YEAR DESIGN STORM

```
Autodesk® Storm and Sanitary Analysis 2016 - Version 13.0.94 (Build 0)
-----------------------------------------------------------------------------------------

*******************
Project Description
*******************
File Name ................. 10152.00 Existing Condtions_SSA Model V2.SPF


****************
Analysis Options
****************
Flow Units ................ cfs
Subbasin Hydrograph Method. SCS TR-55
Time of Concentration...... SCS TR-55
Link Routing Method ....... Hydrodynamic
Storage Node Exfiltration.. None
Starting Date ............. MAR-29-2022 00:00:00
Ending Date ............... MAR-30-2022 00:00:00
Report Time Step .......... 00:05:00


*************
Element Count
*************
Number of rain gages ...... 1
Number of subbasins ....... 8
Number of nodes ........... 11
Number of links ........... 8


****************
Raingage Summary
****************
Gage                Data                Data       Recording
ID                  Source              Type        Interval
                                                         min
------------------------------------------------------------
ASM_1.2Factor       10-Year, 24-Hour StormCUMULATIVE      6.00


****************
Subbasin Summary
****************
Subbasin                  Total
                           Area
ID                        acres
------------------------------
E1                         0.77
E2                         4.89
E3                         5.24
W1                         4.12
W2                         5.59
W3                         1.64
W4                         3.14
W5                         8.40


************
Node Summary
************
Node                Element              Invert   Maximum    Ponded    External
ID                  Type              Elevation     Elev.      Area      Inflow
                                             ft        ft       ft²
-------------------------------------------------------------------------------
CB_006              JUNCTION             203.90    207.78      0.00
```

CB_015	JUNCTION	204.85	208.65	0.00
CB_063	JUNCTION	205.24	207.96	0.00
CBMH_007	JUNCTION	204.45	210.45	0.00
CBMH_013	JUNCTION	203.84	208.93	0.00
CBMH_014	JUNCTION	204.39	208.53	0.00
MH_071	JUNCTION	202.50	207.92	0.00
MH_072	JUNCTION	202.85	207.69	0.00
Structure - (57)	JUNCTION	206.85	211.10	0.00
OUTFALL_115	OUTFALL	201.82	203.32	0.00
OUTFALL_117	OUTFALL	203.00	204.50	0.00

****
Link Summary
****

Link ID	From Node	To Node	Element Type	Length ft	Slope %	Manning's Roughness
P1	CB_063	CBMH_007	CONDUIT	68.9	1.1469	0.0240
P2	CB_006	MH_072	CONDUIT	16.5	5.8173	0.0240
P3	CBMH_007	MH_072	CONDUIT	23.8	3.9866	0.0240
P4	MH_072	MH_071	CONDUIT	74.9	0.3736	0.0240
P5	MH_071	OUTFALL_115	CONDUIT	216.1	0.3147	0.0240
P6	CB_015	CBMH_014	CONDUIT	40.3	1.1416	0.0240
P7	CBMH_014	CBMH_013	CONDUIT	53.6	0.8399	0.0120
P8	CBMH_013	OUTFALL_117	CONDUIT	126.5	0.6639	0.0240

****
Cross Section Summary
****

Link ID	Shape	Depth/ Diameter ft	Width ft	No. of Barrels	Cross Sectional Area ft²	Full Flow Hydraulic Radius ft	Design Flow Capacity cfs
P1	CIRCULAR	0.83	0.83	1	0.55	0.21	1.27
P2	CIRCULAR	1.00	1.00	1	0.79	0.25	4.65
P3	CIRCULAR	0.83	0.83	1	0.55	0.21	2.37
P4	CIRCULAR	1.50	1.50	1	1.77	0.38	3.48
P5	CIRCULAR	1.50	1.50	1	1.77	0.38	3.19
P6	CIRCULAR	1.00	1.00	1	0.79	0.25	2.06
P7	CIRCULAR	1.50	1.50	1	1.77	0.38	10.43
P8	CIRCULAR	1.50	1.50	1	1.77	0.38	4.64

************************* Runoff Quantity Continuity *************************	Volume acre-ft	Depth inches
Total Precipitation	7.717	2.741
Surface Runoff	0.330	0.117
Continuity Error (%)	-0.001	

```
*************************        Volume       Volume
Flow Routing Continuity          acre-ft     Mgallons
*************************       ---------    ---------
External Inflow .........          0.078        0.025
External Outflow ........          3.971        1.294
Initial Stored Volume ....         0.004        0.001
Final Stored Volume ......         0.013        0.004
Continuity Error (%) .....        -0.309
```

```
******************************************
Composite Curve Number Computations Report
******************************************
```

Subbasin E1

Soil/Surface Description	Area (acres)	Soil Group	CN
1/8 acre lots, 65% impervious	0.77	B	85.00
Composite Area & Weighted CN	0.77		85.00

Subbasin E2

Soil/Surface Description	Area (acres)	Soil Group	CN
1/8 acre lots, 65% impervious	4.89	B	85.00
Composite Area & Weighted CN	4.89		85.00

Subbasin E3

Soil/Surface Description	Area (acres)	Soil Group	CN
1/8 acre lots, 65% impervious	5.24	B	85.00
Composite Area & Weighted CN	5.24		85.00

Subbasin W1

Soil/Surface Description	Area (acres)	Soil Group	CN
Woods, Good	4.12	B	55.00
Composite Area & Weighted CN	4.12		55.00

Subbasin W2

Soil/Surface Description	Area (acres)	Soil Group	CN
1/8 acre lots, 65% impervious	5.59	B	85.00
Composite Area & Weighted CN	5.59		85.00

Subbasin W3

Soil/Surface Description	Area (acres)	Soil Group	CN
1/4 acre lots, 38% impervious	1.64	B	75.00

Composite Area & Weighted CN	1.64	75.00

Subbasin W4

Soil/Surface Description	Area (acres)	Soil Group	CN
1/8 acre lots, 65% impervious	3.14	B	85.00
Composite Area & Weighted CN	3.14		85.00

Subbasin W5

Soil/Surface Description	Area (acres)	Soil Group	CN
1/8 acre lots, 65% impervious	8.40	B	85.00
Composite Area & Weighted CN	8.40		85.00

```
***************************************************
SCS TR-55 Time of Concentration Computations Report
***************************************************

Sheet Flow Equation
-------------------

        Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

        Where:

        Tc = Time of Concentration (hrs)
        n  = Manning's Roughness
        Lf = Flow Length (ft)
        P  = 2 yr, 24 hr Rainfall (inches)
        Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation
----------------------------------

        V  = 16.1345 * (Sf^0.5) (unpaved surface)
        V  = 20.3282 * (Sf^0.5) (paved surface)
        V  = 15.0 * (Sf^0.5) (grassed waterway surface)
        V  = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
        V  = 9.0 * (Sf^0.5) (cultivated straight rows surface)
        V  = 7.0 * (Sf^0.5) (short grass pasture surface)
        V  = 5.0 * (Sf^0.5) (woodland surface)
        V  = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
        Tc = (Lf / V) / (3600 sec/hr)

        Where:

        Tc = Time of Concentration (hrs)
        Lf = Flow Length (ft)
        V  = Velocity (ft/sec)
        Sf = Slope (ft/ft)

Channel Flow Equation
---------------------

        V  = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
        R  = Aq / Wp
        Tc = (Lf / V) / (3600 sec/hr)

        Where:
```

Tc = Time of Concentration (hrs)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft^2)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's Roughness

Subbasin E1

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.40	0.00	0.00
Flow Length (ft):	70.00	0.00	0.00
Slope (%):	3.30	0.00	0.00
2 yr, 24 hr Rainfall (in):	1.68	0.00	0.00
Velocity (ft/sec):	0.06	0.00	0.00
Computed Flow Time (minutes):	18.24	0.00	0.00

Channel Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.01	0.00	0.00
Flow Length (ft):	198.00	0.00	0.00
Channel Slope (%):	1.51	0.00	0.00
Cross Section Area (ft^2):	1.08	0.00	0.00
Wetted Perimeter (ft):	10.40	0.00	0.00
Velocity (ft/sec):	3.11	0.00	0.00
Computed Flow Time (minutes):	1.06	0.00	0.00

Total TOC (minutes): 19.30

Subbasin E2

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.40	0.00	0.00
Flow Length (ft):	38.00	0.00	0.00

	Subarea A	Subarea B	Subarea C
Slope (%):	2.63	0.00	0.00
2 yr, 24 hr Rainfall (in):	1.68	0.00	0.00
Velocity (ft/sec):	0.05	0.00	0.00
Computed Flow Time (minutes):	12.25	0.00	0.00

Channel Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.01	0.00	0.00
Flow Length (ft):	1093.00	0.00	0.00
Channel Slope (%):	0.52	0.00	0.00
Cross Section Area (ft^2):	1.08	0.00	0.00
Wetted Perimeter (ft):	10.40	0.00	0.00
Velocity (ft/sec):	1.83	0.00	0.00
Computed Flow Time (minutes):	9.98	0.00	0.00

==

Total TOC (minutes): 22.22

==

Subbasin E3

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.40	0.00	0.00
Flow Length (ft):	79.00	0.00	0.00
Slope (%):	1.41	0.00	0.00
2 yr, 24 hr Rainfall (in):	1.68	0.00	0.00
Velocity (ft/sec):	0.05	0.00	0.00
Computed Flow Time (minutes):	28.23	0.00	0.00

Channel Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.01	0.00	0.00
Flow Length (ft):	1266.00	0.00	0.00
Channel Slope (%):	0.52	0.00	0.00
Cross Section Area (ft^2):	1.08	0.00	0.00

	Subarea A	Subarea B	Subarea C
Wetted Perimeter (ft):	10.40	0.00	0.00
Velocity (ft/sec):	1.83	0.00	0.00
Computed Flow Time (minutes):	11.56	0.00	0.00

==

Total TOC (minutes): 39.78

==

Subbasin W1

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.80	0.00	0.00
Flow Length (ft):	105.00	0.00	0.00
Slope (%):	40.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	1.68	0.00	0.00
Velocity (ft/sec):	0.11	0.00	0.00
Computed Flow Time (minutes):	16.19	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	79.00	0.00	0.00
Slope (%):	2.60	0.00	0.00
Surface Type:	Grassed waterway	Unpaved	Unpaved
Velocity (ft/sec):	2.42	0.00	0.00
Computed Flow Time (minutes):	0.54	0.00	0.00

Channel Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.01	0.00	0.00
Flow Length (ft):	1332.00	0.00	0.00
Channel Slope (%):	6.70	0.00	0.00
Cross Section Area (ft²):	1.08	0.00	0.00
Wetted Perimeter (ft):	10.40	0.00	0.00
Velocity (ft/sec):	6.55	0.00	0.00
Computed Flow Time (minutes):	3.39	0.00	0.00

==

Total TOC (minutes): 20.12

==

Subbasin W2

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.40	0.00	0.00
Flow Length (ft):	73.00	0.00	0.00
Slope (%):	1.40	0.00	0.00
2 yr, 24 hr Rainfall (in):	1.68	0.00	0.00
Velocity (ft/sec):	0.05	0.00	0.00
Computed Flow Time (minutes):	26.57	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	98.00	0.00	0.00
Slope (%):	2.00	0.00	0.00
Surface Type:	Grassed waterway	Unpaved	Unpaved
Velocity (ft/sec):	2.12	0.00	0.00
Computed Flow Time (minutes):	0.77	0.00	0.00

Channel Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.01	0.00	0.00
Flow Length (ft):	1310.00	0.00	0.00
Channel Slope (%):	0.50	0.00	0.00
Cross Section Area (ft^2):	1.08	0.00	0.00
Wetted Perimeter (ft):	10.40	0.00	0.00
Velocity (ft/sec):	1.79	0.00	0.00
Computed Flow Time (minutes):	12.19	0.00	0.00

==

Total TOC (minutes): 39.54

==

Subbasin W3

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.40	0.00	0.00
Flow Length (ft):	82.00	0.00	0.00
Slope (%):	1.50	0.00	0.00
2 yr, 24 hr Rainfall (in):	1.68	0.00	0.00
Velocity (ft/sec):	0.05	0.00	0.00
Computed Flow Time (minutes):	28.37	0.00	0.00

Channel Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.01	0.00	0.00
Flow Length (ft):	360.00	0.00	0.00
Channel Slope (%):	0.40	0.00	0.00
Cross Section Area (ft^2):	1.08	0.00	0.00
Wetted Perimeter (ft):	10.40	0.00	0.00
Velocity (ft/sec):	1.60	0.00	0.00
Computed Flow Time (minutes):	3.75	0.00	0.00

==
Total TOC (minutes): 32.12
==

Subbasin W4

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.40	0.00	0.00
Flow Length (ft):	73.00	0.00	0.00
Slope (%):	2.74	0.00	0.00
2 yr, 24 hr Rainfall (in):	1.68	0.00	0.00
Velocity (ft/sec):	0.06	0.00	0.00
Computed Flow Time (minutes):	20.31	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	107.00	0.00	0.00
Slope (%):	2.62	0.00	0.00
Surface Type:	Grassed waterway	Unpaved	Unpaved
Velocity (ft/sec):	2.43	0.00	0.00
Computed Flow Time (minutes):	0.73	0.00	0.00

Channel Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.01	0.00	0.00
Flow Length (ft):	398.00	0.00	0.00
Channel Slope (%):	0.43	0.00	0.00
Cross Section Area (ft^2):	1.08	0.00	0.00
Wetted Perimeter (ft):	10.40	0.00	0.00
Velocity (ft/sec):	1.66	0.00	0.00
Computed Flow Time (minutes):	4.00	0.00	0.00

==

Total TOC (minutes): 25.04

==

Subbasin W5

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.40	0.00	0.00
Flow Length (ft):	73.00	0.00	0.00
Slope (%):	1.37	0.00	0.00
2 yr, 24 hr Rainfall (in):	1.68	0.00	0.00
Velocity (ft/sec):	0.05	0.00	0.00
Computed Flow Time (minutes):	26.80	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	98.00	0.00	

0.00
Slope (%): 2.04 0.00
0.00
Surface Type: Grassed waterway Unpaved
Unpaved
Velocity (ft/sec): 2.14 0.00
0.00
Computed Flow Time (minutes): 0.76 0.00
0.00

Channel Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.01	0.00	0.00
Flow Length (ft):	1310.00	0.00	0.00
Channel Slope (%):	5.00	0.00	0.00
Cross Section Area (ft^2):	1.06	0.00	0.00
Wetted Perimeter (ft):	10.40	0.00	0.00
Velocity (ft/sec):	5.59	0.00	0.00
Computed Flow Time (minutes):	3.90	0.00	0.00

==
Total TOC (minutes): 31.47
==

****
Subbasin Runoff Summary
****

Subbasin ID	Total Precip in	Total Runoff in	Peak Runoff cfs	Weighted Curve Number	Time of Concentration days	hh:mm:ss
E1	2.74	1.37	0.52	85.000	0	00:19:18
E2	2.74	1.37	3.12	85.000	0	00:22:13
E3	2.74	1.37	2.46	85.000	0	00:39:46
W1	2.74	0.13	0.06	55.000	0	00:20:07
W2	2.74	1.37	2.63	85.000	0	00:39:32
W3	2.74	0.79	0.46	75.000	0	00:32:07
W4	2.74	1.37	1.88	85.000	0	00:25:02
W5	2.74	1.37	4.46	85.000	0	00:31:28

****
Node Depth Summary
****

Node ID	Average Depth Attained ft	Maximum Depth Attained ft	Maximum HGL Attained ft	Time of Max Occurrence days	hh:mm	Total Flooded Volume acre-in	Total Time Flooded minutes	Retention Time hh:mm:ss
CB_006	0.42	3.88	207.78	0	00:24	1.39	39	0:00:00
CB_015	0.27	2.08	206.93	0	12:22	0	0	0:00:00

CB_063	0.41	2.72	207.96	0	00:07	1.18	64	0:00:00
CBMH_007	0.34	6.00	210.45	0	01:14	0.26	4	0:00:00
CBMH_013	0.42	1.72	205.56	0	12:25	0	0	0:00:00
CBMH_014	0.27	1.39	205.78	0	12:25	0	0	0:00:00
MH_071	1.68	5.42	207.92	0	00:04	0.50	4	0:00:00
MH_072	1.39	4.84	207.69	0	00:07	4.20	14	0:00:00
Structure - (57)	0.00	0.00	206.85	0	00:00	0	0	0:00:00
OUTFALL_115	2.18	2.18	204.00	0	00:00	0	0	0:00:00
OUTFALL_117	0.29	0.91	203.91	0	12:25	0	0	0:00:00

****
Node Flow Summary
****

Node ID	Element Type	Maximum Lateral Inflow cfs	Peak Inflow cfs	Time of Peak Inflow Occurrence days	hh:mm	Maximum Flooding Overflow cfs	Time of Peak Flooding Occurrence days	hh:mm
CB_006	JUNCTION	6.27	51.67	0	00:24	29.27	0	00:25
CB_015	JUNCTION	3.10	3.10	0	12:19	0.00		
CB_063	JUNCTION	2.61	8.83	0	05:48	6.87	0	05:48
CBMH_007	JUNCTION	0.45	19.94	0	06:58	5.70	0	05:07
CBMH_013	JUNCTION	0.52	5.58	0	12:25	0.00		
CBMH_014	JUNCTION	2.44	5.14	0	12:25	0.00		
MH_071	JUNCTION	0.00	42.08	0	04:15	19.73	0	03:36
MH_072	JUNCTION	0.00	81.05	0	04:43	40.52	0	04:43
Structure - (57)	JUNCTION	0.00	0.00	0	00:00	0.00		
OUTFALL_115	OUTFALL	0.00	10.27	0	03:21	0.00		
OUTFALL_117	OUTFALL	0.00	5.57	0	12:25	0.00		

****
Outfall Loading Summary
****

Outfall Node ID	Flow Frequency (%)	Average Flow cfs	Peak Inflow cfs
OUTFALL_115	100.00	1.40	10.27
OUTFALL_117	91.17	0.84	5.57
System	95.59	2.23	10.87

****
Link Flow Summary
****

Link ID	Element Type	Time of Peak Flow Occurrence days hh:mm	Maximum Velocity Attained ft/sec	Length Factor	Peak Flow during Analysis cfs	Design Flow Capacity cfs	Ratio of Maximum /Design Flow	Ratio of Maximum Flow Depth	Total Time Surcharged minutes	Reported Condition

```
  P1                  CONDUIT      0  05:48     30.86    1.00         8.83         1.27       6.94
1.00          94  SURCHARGED
  P2                  CONDUIT      0  04:43    >50.00    1.00        78.60         4.65      16.89
1.00         127  SURCHARGED
  P3                  CONDUIT      0  00:44    >50.00    1.00        56.45         2.37      23.82
1.00         102  SURCHARGED
  P4                  CONDUIT      0  04:15     24.24    1.00        42.08         3.48      12.10
1.00         198  SURCHARGED
  P5                  CONDUIT      0  03:21      5.81    1.00        10.27         3.19       3.22
1.00        1243  SURCHARGED
  P6                  CONDUIT      0  12:20      3.94    1.00         3.10         2.06       1.50
1.00          16  SURCHARGED
  P7                  CONDUIT      0  12:25      3.09    1.00         5.14        10.43       0.49
0.96           0  Calculated
  P8                  CONDUIT      0  12:25      3.66    1.00         5.57         4.64       1.20
0.80           0  > CAPACITY


  *******************************
  Highest Flow Instability Indexes
  *******************************
  Link P2 (4)
  Link P4 (4)
  Link P5 (2)
  Link P3 (1)
  Link P1 (1)

  WARNING 116 : Conduit inlet invert elevation defined for Conduit P3 is below upstream node
invert elevation.
                Assumed conduit inlet invert elevation equal to upstream node invert elevation.

  Analysis began on:  Tue Jul 26 15:05:53 2022
  Analysis ended on:  Tue Jul 26 15:05:55 2022
  Total elapsed time: 00:00:02
```

EXISTING CONDITION - SSA MODEL RESULTS
100-YEAR DESIGN STORM

```
Autodesk® Storm and Sanitary Analysis 2016 - Version 13.0.94 (Build 0)
-----------------------------------------------------------------------------------------

*******************
Project Description
*******************
File Name ................. 10152.00 Existing Condtions_SSA Model V2.SPF


****************
Analysis Options
****************
Flow Units ................ cfs
Subbasin Hydrograph Method. SCS TR-55
Time of Concentration...... SCS TR-55
Link Routing Method ....... Hydrodynamic
Storage Node Exfiltration.. None
Starting Date ............. MAR-29-2022 00:00:00
Ending Date ............... MAR-30-2022 00:00:00
Report Time Step .......... 00:05:00


*************
Element Count
*************
Number of rain gages ...... 1
Number of subbasins ....... 8
Number of nodes ........... 11
Number of links ........... 8


****************
Raingage Summary
****************
Gage                Data                Data       Recording
ID                  Source              Type        Interval
                                                        min
------------------------------------------------------------
ASM_1.2Factor       100-Year, 24-Hour StormCUMULATIVE      6.00


****************
Subbasin Summary
****************
Subbasin                 Total
                          Area
ID                       acres
------------------------------
E1                        0.77
E2                        4.89
E3                        5.24
W1                        4.12
W2                        5.59
W3                        1.64
W4                        3.14
W5                        8.40


************
Node Summary
************
Node                Element              Invert   Maximum    Ponded    External
ID                  Type              Elevation     Elev.      Area      Inflow
                                             ft        ft       ft²
-------------------------------------------------------------------------------
CB_006              JUNCTION             203.90    207.78      0.00
```

CB_015	JUNCTION	204.85	208.65	0.00
CB_063	JUNCTION	205.24	207.96	0.00
CBMH_007	JUNCTION	204.45	210.45	0.00
CBMH_013	JUNCTION	203.84	208.93	0.00
CBMH_014	JUNCTION	204.39	208.53	0.00
MH_071	JUNCTION	202.50	207.92	0.00
MH_072	JUNCTION	202.85	207.69	0.00
Structure - (57)	JUNCTION	206.85	211.10	0.00
OUTFALL_115	OUTFALL	201.82	203.32	0.00
OUTFALL_117	OUTFALL	203.00	204.50	0.00

****
Link Summary
****

Link ID	From Node	To Node	Element Type	Length ft	Slope %	Manning's Roughness
P1	CB_063	CBMH_007	CONDUIT	68.9	1.1469	0.0240
P2	CB_006	MH_072	CONDUIT	16.5	5.8173	0.0240
P3	CBMH_007	MH_072	CONDUIT	23.8	3.9866	0.0240
P4	MH_072	MH_071	CONDUIT	74.9	0.3736	0.0240
P5	MH_071	OUTFALL_115	CONDUIT	216.1	0.3147	0.0240
P6	CB_015	CBMH_014	CONDUIT	40.3	1.1416	0.0240
P7	CBMH_014	CBMH_013	CONDUIT	53.6	0.8399	0.0120
P8	CBMH_013	OUTFALL_117	CONDUIT	126.5	0.6639	0.0240

****
Cross Section Summary
****

Link ID	Shape	Depth/ Diameter ft	Width ft	No. of Barrels	Cross Sectional Area ft²	Full Flow Hydraulic Radius ft	Design Flow Capacity cfs
P1	CIRCULAR	0.83	0.83	1	0.55	0.21	1.27
P2	CIRCULAR	1.00	1.00	1	0.79	0.25	4.65
P3	CIRCULAR	0.83	0.83	1	0.55	0.21	2.37
P4	CIRCULAR	1.50	1.50	1	1.77	0.38	3.48
P5	CIRCULAR	1.50	1.50	1	1.77	0.38	3.19
P6	CIRCULAR	1.00	1.00	1	0.79	0.25	2.06
P7	CIRCULAR	1.50	1.50	1	1.77	0.38	10.43
P8	CIRCULAR	1.50	1.50	1	1.77	0.38	4.64

************************* Runoff Quantity Continuity *************************	Volume acre-ft	Depth inches
Total Precipitation	12.157	4.318
Surface Runoff	0.678	0.241
Continuity Error (%)	-0.001	

```
*************************           Volume         Volume
Flow Routing Continuity            acre-ft       Mgallons
*************************         ---------      ---------
External Inflow .........            0.057          0.019
External Outflow ........            6.584          2.145
Initial Stored Volume ....           0.004          0.001
Final Stored Volume ......           0.014          0.005
Continuity Error (%) .....          -0.114
```

```
******************************************
Composite Curve Number Computations Report
******************************************
```

Subbasin E1

Soil/Surface Description	Area (acres)	Soil Group	CN
1/8 acre lots, 65% impervious	0.77	B	85.00
Composite Area & Weighted CN	0.77		85.00

Subbasin E2

Soil/Surface Description	Area (acres)	Soil Group	CN
1/8 acre lots, 65% impervious	4.89	B	85.00
Composite Area & Weighted CN	4.89		85.00

Subbasin E3

Soil/Surface Description	Area (acres)	Soil Group	CN
1/8 acre lots, 65% impervious	5.24	B	85.00
Composite Area & Weighted CN	5.24		85.00

Subbasin W1

Soil/Surface Description	Area (acres)	Soil Group	CN
Woods, Good	4.12	B	55.00
Composite Area & Weighted CN	4.12		55.00

Subbasin W2

Soil/Surface Description	Area (acres)	Soil Group	CN
1/8 acre lots, 65% impervious	5.59	B	85.00
Composite Area & Weighted CN	5.59		85.00

Subbasin W3

Soil/Surface Description	Area (acres)	Soil Group	CN
1/4 acre lots, 38% impervious	1.64	B	75.00

Composite Area & Weighted CN	1.64		75.00

Subbasin W4

Soil/Surface Description	Area (acres)	Soil Group	CN
1/8 acre lots, 65% impervious	3.14	B	85.00
Composite Area & Weighted CN	3.14		85.00

Subbasin W5

Soil/Surface Description	Area (acres)	Soil Group	CN
1/8 acre lots, 65% impervious	8.40	B	85.00
Composite Area & Weighted CN	8.40		85.00

```
***************************************************
SCS TR-55 Time of Concentration Computations Report
***************************************************

Sheet Flow Equation
-------------------

        Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

        Where:

        Tc = Time of Concentration (hrs)
        n  = Manning's Roughness
        Lf = Flow Length (ft)
        P  = 2 yr, 24 hr Rainfall (inches)
        Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation
----------------------------------

        V  = 16.1345 * (Sf^0.5) (unpaved surface)
        V  = 20.3282 * (Sf^0.5) (paved surface)
        V  = 15.0 * (Sf^0.5) (grassed waterway surface)
        V  = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
        V  = 9.0 * (Sf^0.5) (cultivated straight rows surface)
        V  = 7.0 * (Sf^0.5) (short grass pasture surface)
        V  = 5.0 * (Sf^0.5) (woodland surface)
        V  = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
        Tc = (Lf / V) / (3600 sec/hr)

        Where:

        Tc = Time of Concentration (hrs)
        Lf = Flow Length (ft)
        V  = Velocity (ft/sec)
        Sf = Slope (ft/ft)

Channel Flow Equation
---------------------

        V  = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
        R  = Aq / Wp
        Tc = (Lf / V) / (3600 sec/hr)

        Where:
```

Tc = Time of Concentration (hrs)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's Roughness

Subbasin E1

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.40	0.00	0.00
Flow Length (ft):	70.00	0.00	0.00
Slope (%):	3.30	0.00	0.00
2 yr, 24 hr Rainfall (in):	1.68	0.00	0.00
Velocity (ft/sec):	0.06	0.00	0.00
Computed Flow Time (minutes):	18.24	0.00	0.00

Channel Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.01	0.00	0.00
Flow Length (ft):	198.00	0.00	0.00
Channel Slope (%):	1.51	0.00	0.00
Cross Section Area (ft²):	1.08	0.00	0.00
Wetted Perimeter (ft):	10.40	0.00	0.00
Velocity (ft/sec):	3.11	0.00	0.00
Computed Flow Time (minutes):	1.06	0.00	0.00

Total TOC (minutes): 19.30

Subbasin E2

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.40	0.00	0.00
Flow Length (ft):	38.00	0.00	0.00

```
        Slope (%):                              2.63            0.00
0.00
        2 yr, 24 hr Rainfall (in):              1.68            0.00
0.00
        Velocity (ft/sec):                      0.05            0.00
0.00
        Computed Flow Time (minutes):          12.25            0.00
0.00

  Channel Flow Computations
  -------------------------
                                           Subarea A       Subarea B       Subarea
C
        Manning's Roughness:                    0.01            0.00
0.00
        Flow Length (ft):                    1093.00            0.00
0.00
        Channel Slope (%):                      0.52            0.00
0.00
        Cross Section Area (ft²):               1.08            0.00
0.00
        Wetted Perimeter (ft):                 10.40            0.00
0.00
        Velocity (ft/sec):                      1.83            0.00
0.00
        Computed Flow Time (minutes):           9.98            0.00
0.00
================================================================================
        Total TOC (minutes):                   22.22
================================================================================


  --------------
  Subbasin E3
  --------------

  Sheet Flow Computations
  -----------------------
                                           Subarea A       Subarea B       Subarea
C
        Manning's Roughness:                    0.40            0.00
0.00
        Flow Length (ft):                      79.00            0.00
0.00
        Slope (%):                              1.41            0.00
0.00
        2 yr, 24 hr Rainfall (in):              1.68            0.00
0.00
        Velocity (ft/sec):                      0.05            0.00
0.00
        Computed Flow Time (minutes):          28.23            0.00
0.00

  Channel Flow Computations
  -------------------------
                                           Subarea A       Subarea B       Subarea
C
        Manning's Roughness:                    0.01            0.00
0.00
        Flow Length (ft):                    1266.00            0.00
0.00
        Channel Slope (%):                      0.52            0.00
0.00
        Cross Section Area (ft²):               1.08            0.00
0.00
```

	Subarea A	Subarea B	Subarea C
Wetted Perimeter (ft):	10.40	0.00	0.00
Velocity (ft/sec):	1.83	0.00	0.00
Computed Flow Time (minutes):	11.56	0.00	0.00

==

Total TOC (minutes): 39.78

==

Subbasin W1

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.80	0.00	0.00
Flow Length (ft):	105.00	0.00	0.00
Slope (%):	40.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	1.68	0.00	0.00
Velocity (ft/sec):	0.11	0.00	0.00
Computed Flow Time (minutes):	16.19	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	79.00	0.00	0.00
Slope (%):	2.60	0.00	0.00
Surface Type:	Grassed waterway	Unpaved	Unpaved
Velocity (ft/sec):	2.42	0.00	0.00
Computed Flow Time (minutes):	0.54	0.00	0.00

Channel Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.01	0.00	0.00
Flow Length (ft):	1332.00	0.00	0.00
Channel Slope (%):	6.70	0.00	0.00
Cross Section Area (ft^2):	1.08	0.00	0.00
Wetted Perimeter (ft):	10.40	0.00	0.00
Velocity (ft/sec):	6.55	0.00	0.00
Computed Flow Time (minutes):	3.39	0.00	0.00

==

Total TOC (minutes):	20.12

==

Subbasin W2

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.40	0.00	0.00
Flow Length (ft):	73.00	0.00	0.00
Slope (%):	1.40	0.00	0.00
2 yr, 24 hr Rainfall (in):	1.68	0.00	0.00
Velocity (ft/sec):	0.05	0.00	0.00
Computed Flow Time (minutes):	26.57	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	98.00	0.00	0.00
Slope (%):	2.00	0.00	0.00
Surface Type:	Grassed waterway	Unpaved	Unpaved
Velocity (ft/sec):	2.12	0.00	0.00
Computed Flow Time (minutes):	0.77	0.00	0.00

Channel Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.01	0.00	0.00
Flow Length (ft):	1310.00	0.00	0.00
Channel Slope (%):	0.50	0.00	0.00
Cross Section Area (ft^2):	1.08	0.00	0.00
Wetted Perimeter (ft):	10.40	0.00	0.00
Velocity (ft/sec):	1.79	0.00	0.00
Computed Flow Time (minutes):	12.19	0.00	0.00

==

Total TOC (minutes):	39.54

==

Subbasin W3

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.40	0.00	0.00
Flow Length (ft):	82.00	0.00	0.00
Slope (%):	1.50	0.00	0.00
2 yr, 24 hr Rainfall (in):	1.68	0.00	0.00
Velocity (ft/sec):	0.05	0.00	0.00
Computed Flow Time (minutes):	28.37	0.00	0.00

Channel Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.01	0.00	0.00
Flow Length (ft):	360.00	0.00	0.00
Channel Slope (%):	0.40	0.00	0.00
Cross Section Area (ft^2):	1.08	0.00	0.00
Wetted Perimeter (ft):	10.40	0.00	0.00
Velocity (ft/sec):	1.60	0.00	0.00
Computed Flow Time (minutes):	3.75	0.00	0.00

===
Total TOC (minutes): 32.12
===

Subbasin W4

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.40	0.00	0.00
Flow Length (ft):	73.00	0.00	0.00
Slope (%):	2.74	0.00	0.00
2 yr, 24 hr Rainfall (in):	1.68	0.00	0.00
Velocity (ft/sec):	0.06	0.00	0.00
Computed Flow Time (minutes):	20.31	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	107.00	0.00	0.00
Slope (%):	2.62	0.00	0.00
Surface Type:	Grassed waterway	Unpaved	Unpaved
Velocity (ft/sec):	2.43	0.00	0.00
Computed Flow Time (minutes):	0.73	0.00	0.00

Channel Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.01	0.00	0.00
Flow Length (ft):	398.00	0.00	0.00
Channel Slope (%):	0.43	0.00	0.00
Cross Section Area (ft^2):	1.08	0.00	0.00
Wetted Perimeter (ft):	10.40	0.00	0.00
Velocity (ft/sec):	1.66	0.00	0.00
Computed Flow Time (minutes):	4.00	0.00	0.00

Total TOC (minutes): 25.04

Subbasin W5

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.40	0.00	0.00
Flow Length (ft):	73.00	0.00	0.00
Slope (%):	1.37	0.00	0.00
2 yr, 24 hr Rainfall (in):	1.68	0.00	0.00
Velocity (ft/sec):	0.05	0.00	0.00
Computed Flow Time (minutes):	26.80	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	98.00	0.00	

0.00
Slope (%): 2.04 0.00
0.00
Surface Type: Grassed waterway Unpaved
Unpaved
Velocity (ft/sec): 2.14 0.00
0.00
Computed Flow Time (minutes): 0.76 0.00
0.00

Channel Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.01	0.00	0.00
Flow Length (ft):	1310.00	0.00	0.00
Channel Slope (%):	5.00	0.00	0.00
Cross Section Area (ft²):	1.06	0.00	0.00
Wetted Perimeter (ft):	10.40	0.00	0.00
Velocity (ft/sec):	5.59	0.00	0.00
Computed Flow Time (minutes):	3.90	0.00	0.00

==

Total TOC (minutes): 31.47

==

****
Subbasin Runoff Summary
****

Subbasin ID	Total Precip in	Total Runoff in	Peak Runoff cfs	Weighted Curve Number	Time of Concentration days	Time of Concentration hh:mm:ss
E1	4.31	2.73	1.04	85.000	0	00:19:18
E2	4.31	2.73	6.21	85.000	0	00:22:13
E3	4.31	2.73	4.90	85.000	0	00:39:46
W1	4.31	0.66	0.87	55.000	0	00:20:07
W2	4.31	2.73	5.23	85.000	0	00:39:32
W3	4.31	1.90	1.18	75.000	0	00:32:07
W4	4.31	2.73	3.74	85.000	0	00:25:02
W5	4.31	2.73	8.91	85.000	0	00:31:28

****
Node Depth Summary
****

Node ID	Average Depth Attained ft	Maximum Depth Attained ft	Maximum HGL Attained ft	Time of Max Occurrence days	Time of Max Occurrence hh:mm	Total Flooded Volume acre-in	Total Time Flooded minutes	Retention Time hh:mm:ss
CB_006	0.75	3.88	207.78	0	00:24	4.98	74	0:00:00
CB_015	0.37	3.80	208.65	0	12:11	0.81	27	0:00:00

CB_063	0.58	2.72	207.96	0	00:07	4.20	128	0:00:00
CBMH_007	0.48	6.00	210.45	0	01:14	0.11	2	0:00:00
CBMH_013	0.56	3.32	207.16	0	12:30	0	0	0:00:00
CBMH_014	0.36	3.29	207.68	0	12:30	0	0	0:00:00
MH_071	1.87	5.42	207.92	0	00:04	0.43	3	0:00:00
MH_072	1.67	4.84	207.69	0	00:07	3.22	12	0:00:00
Structure - (57)	0.00	0.00	206.85	0	00:00	0	0	0:00:00
OUTFALL_115	2.18	2.18	204.00	0	00:00	0	0	0:00:00
OUTFALL_117	0.38	1.11	204.11	0	12:30	0	0	0:00:00

****
Node Flow Summary
****

Node ID	Element Type	Maximum Lateral Inflow cfs	Peak Inflow cfs	Time of Peak Inflow Occurrence days	hh:mm	Maximum Flooding Overflow cfs	Time of Peak Flooding Occurrence days	hh:mm
CB_006	JUNCTION	12.49	51.67	0	00:24	29.27	0	00:25
CB_015	JUNCTION	6.18	6.18	0	12:20	3.05	0	12:20
CB_063	JUNCTION	5.90	11.22	0	04:14	7.62	0	04:14
CBMH_007	JUNCTION	1.17	19.75	0	04:28	7.90	0	04:09
CBMH_013	JUNCTION	1.03	8.21	0	12:30	0.00		
CBMH_014	JUNCTION	4.88	7.59	0	12:34	0.00		
MH_071	JUNCTION	0.00	42.21	0	04:14	19.73	0	03:36
MH_072	JUNCTION	0.00	78.35	0	00:43	39.20	0	00:17
Structure - (57)	JUNCTION	0.00	0.00	0	00:00	0.00		
OUTFALL_115	OUTFALL	0.00	11.32	0	04:44	0.00		
OUTFALL_117	OUTFALL	0.00	8.20	0	12:30	0.00		

****
Outfall Loading Summary
****

Outfall Node ID	Flow Frequency (%)	Average Flow cfs	Peak Inflow cfs
OUTFALL_115	100.00	2.09	11.32
OUTFALL_117	94.81	1.25	8.20
System	97.40	3.34	13.61

****
Link Flow Summary
****

Link ID	Element Type	Time of Peak Flow Occurrence days hh:mm	Maximum Velocity Attained ft/sec	Length Factor	Peak Flow during Analysis cfs	Design Flow Capacity cfs	Ratio of Maximum /Design Flow	Ratio of Maximum Flow Depth	Total Time Surcharged minutes	Reported Condition

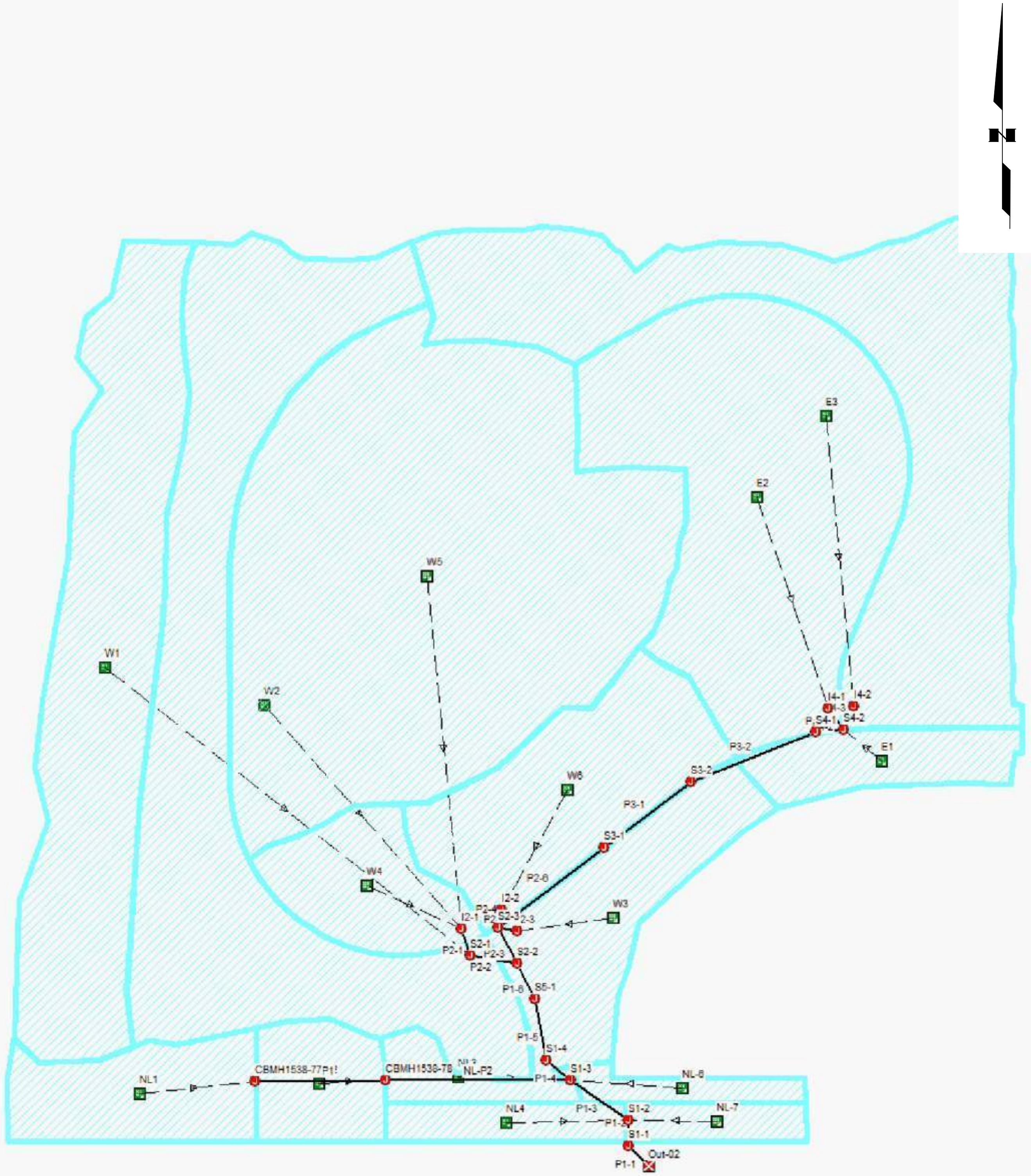
```
  P1                 CONDUIT      0  04:14      29.27     1.00        11.21         1.27       8.82
1.00         250  SURCHARGED
  P2                 CONDUIT      0  00:43    >50.00     1.00        78.35         4.65      16.83
1.00         332  SURCHARGED
  P3                 CONDUIT      0  00:44    >50.00     1.00        56.45         2.37      23.82
1.00         269  SURCHARGED
  P4                 CONDUIT      0  04:14      24.54     1.00        42.21         3.48      12.14
1.00         775  SURCHARGED
  P5                 CONDUIT      0  04:44       6.41     1.00        11.32         3.19       3.55
1.00        1307  SURCHARGED
  P6                 CONDUIT      0  12:11       4.95     1.00         3.89         2.06       1.88
1.00          48  SURCHARGED
  P7                 CONDUIT      0  12:35       4.30     1.00         7.60        10.43       0.73
1.00          40  SURCHARGED
  P8                 CONDUIT      0  12:30       5.03     1.00         8.20         4.64       1.77
0.87           0  > CAPACITY


  *********************************
  Highest Flow Instability Indexes
  *********************************
  Link P2 (2)
  Link P4 (2)
  Link P5 (1)

  WARNING 116 : Conduit inlet invert elevation defined for Conduit P3 is below upstream node
invert elevation.
                Assumed conduit inlet invert elevation equal to upstream node invert elevation.

  Analysis began on:  Tue Jul 26 15:00:14 2022
  Analysis ended on:  Tue Jul 26 15:00:17 2022
  Total elapsed time: 00:00:03
```

Proposed Conditions



FILE NAME: J:\JobsData\10152.00 Camrose Drive Storm Drainage\00 CADD 2019\02 Figures\06 DSR\10152 H&H Figures.dwg

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

DSR

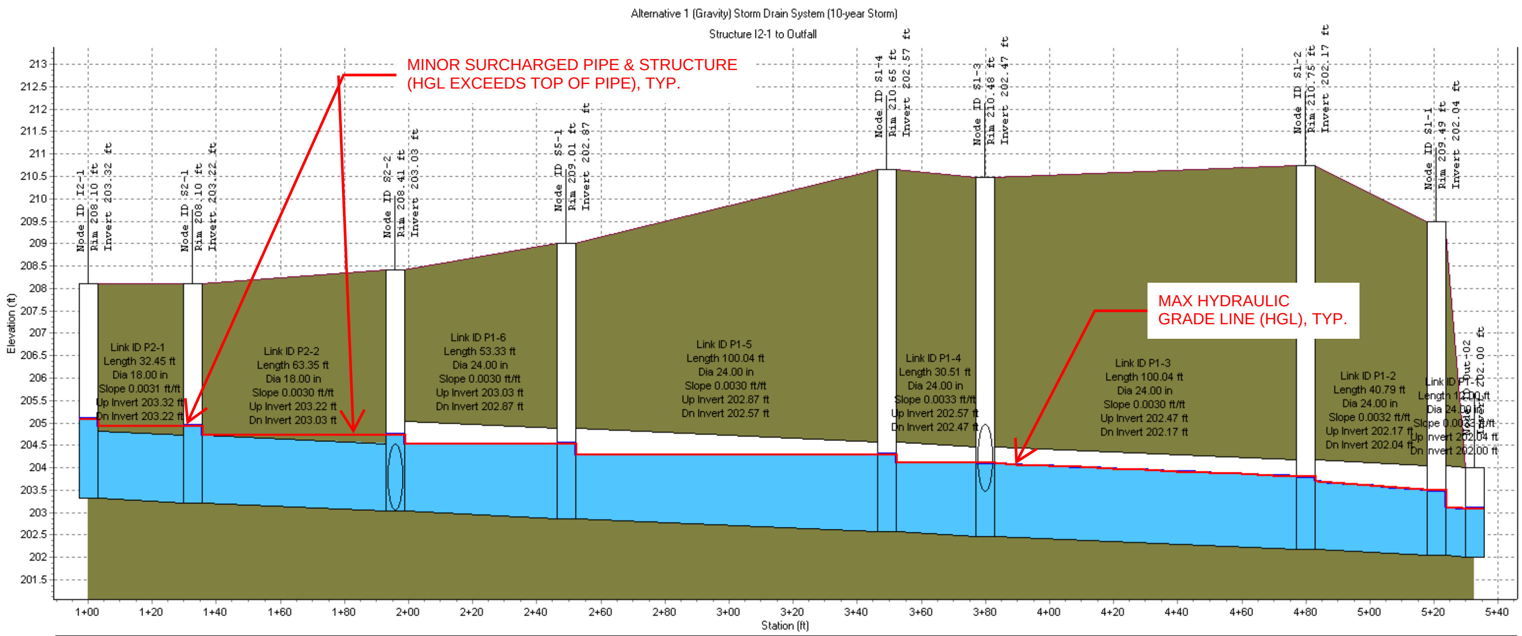
CAMROSE DRIVE
STORM DRAIN PROJECT
HYDROLOGIC & HYDRAULIC ANALYSIS

PROPOSED CONDITIONS MODEL (ALT. 1)

Project No:	20.27
Drawn By:	JCH
Scale:	NTS
Date:	AUG 2022
Figure:	3

PROPOSED CONDITIONS

ALTERNATIVE 1 (GRAVITY) STORM DRAIN SYSTEM (10-YEAR STORM)
STRUCTURE I2-1 TO OUTFALL



Node ID:	I2-1	S2-1	S2-2	S5-1	S1-4	S1-3	S1-2	S1-1	Out-02
Rim (ft):	208.10	208.10	208.41	209.01	210.65	210.48	210.75	209.49	
Invert (ft):	203.32	203.22	203.03	202.87	202.57	202.47	202.17	202.04	202.00
Min Pipe Cover (ft):	3.28	3.38	3.38	4.14	6.08	5.52	6.58	5.45	
Max HGL (ft):	205.10	204.94	204.74	204.54	204.30	204.11	203.81	203.50	203.09

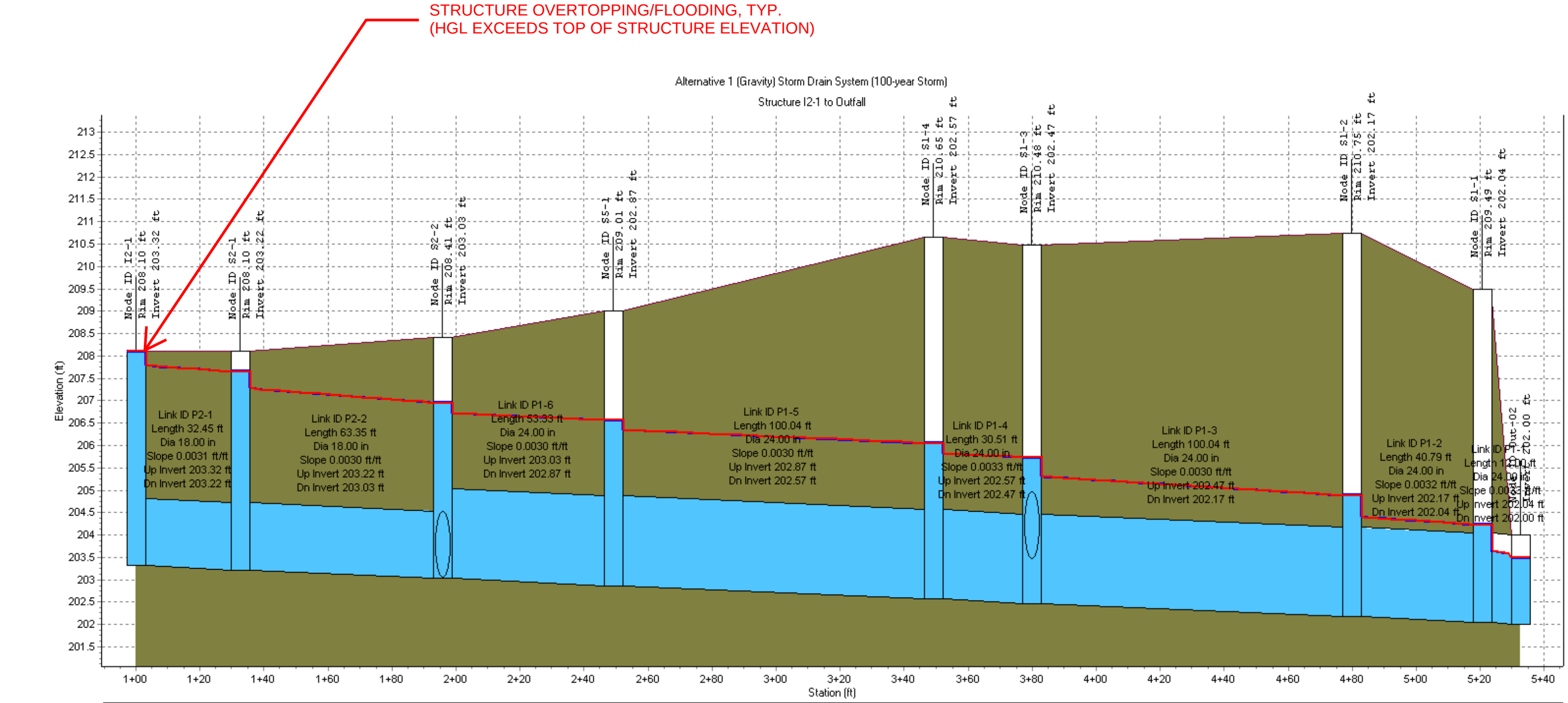
Link ID:	P2-1	P2-2	P1-6	P1-5	P1-4	P1-3	P1-2	P1-1
Length (ft):	32.45	63.35	53.33	100.04	30.51	100.04	40.79	12.00
Dia (in):	18.00	18.00	24.00	24.00	24.00	24.00	24.00	24.00
Slope (ft/ft):	0.0031	0.0030	0.0030	0.0030	0.0033	0.0030	0.0032	0.0033
Up Invert (ft):	203.32	203.22	203.03	202.87	202.57	202.47	202.17	202.04
Dn Invert (ft):	203.22	203.03	202.87	202.57	202.47	202.17	202.04	202.00
Max Q (cfs):	4.56	4.57	8.43	8.43	8.43	9.07	9.25	9.25
Max Vel (ft/s):	2.58	2.58	2.99	2.97	2.99	3.29	3.55	4.39
Max Depth (ft):	1.50	1.50	1.68	1.69	1.68	1.63	1.54	1.27

MAX FLOW RATE IN PIPE (E.G. P1-1) DURING DESIGN STORM, TYP.

Autodesk Storm and Sanitary Analysis

<u>PROPOSED CONDITIONS</u>

ALTERNATIVE 1 (GRAVITY) STORM DRAIN SYSTEM (100-YEAR STORM)
STRUCTURE I2-1 TO OUTFALL



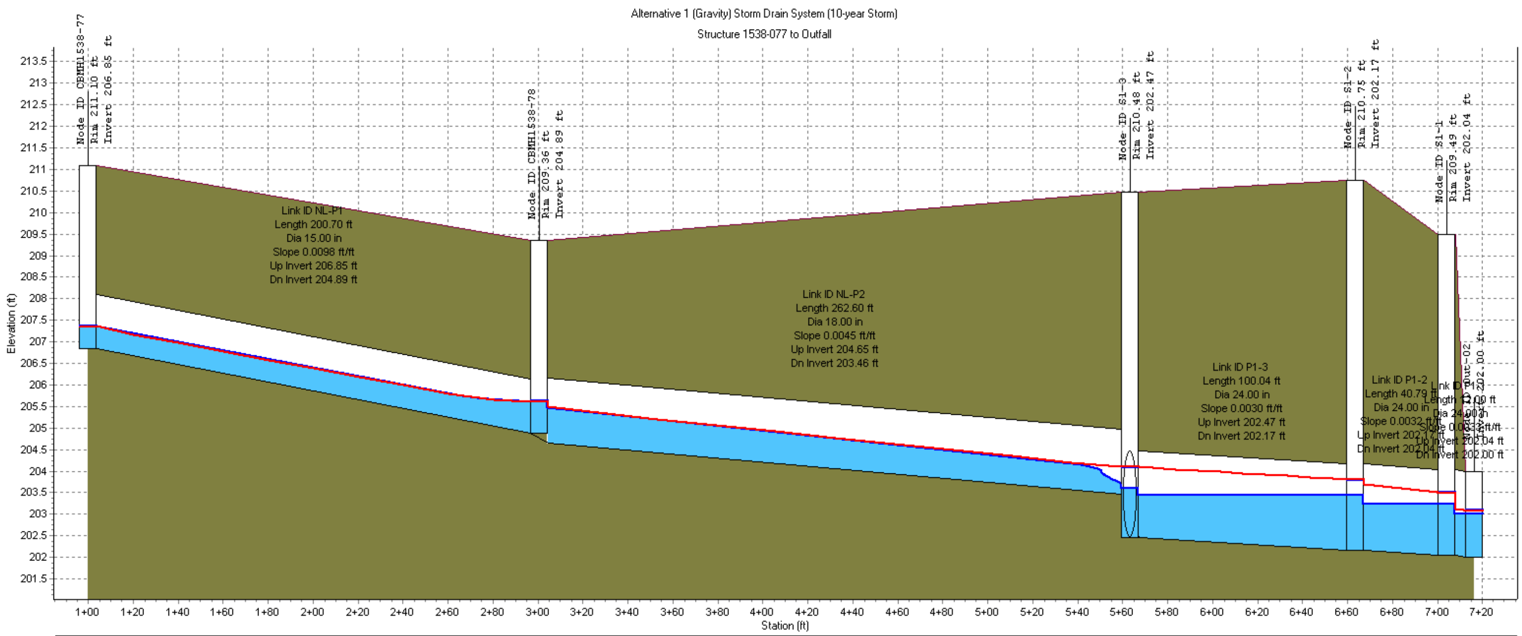
Node ID:	I2-1	S2-1	S2-2	S5-1	S1-4	S1-3	S1-2	S1-1	Out-02
Rim (ft):	208.10	208.10	208.41	209.01	210.65	210.48	210.75	209.49	
Invert (ft):	203.32	203.22	203.03	202.87	202.57	202.47	202.17	202.04	202.00
Min Pipe Cover (ft):	3.28	3.38	3.38	4.14	6.08	5.52	6.58	5.45	
Max HGL (ft):	208.10	207.65	206.99	206.66	206.23	205.99	204.99	204.27	203.51

Link ID:	P2-1	P2-2	P1-6	P1-5	P1-4	P1-3	P1-2	P1-1
Length (ft):	32.45	63.35	53.33	100.04	30.51	100.04	40.79	12.00
Dia (in):	18.00	18.00	24.00	24.00	24.00	24.00	24.00	24.00
Slope (ft/ft):	0.0031	0.0030	0.0030	0.0030	0.0033	0.0030	0.0032	0.0033
Up Invert (ft):	203.32	203.22	203.03	202.87	202.57	202.47	202.17	202.04
Dn Invert (ft):	203.22	203.03	202.87	202.57	202.47	202.17	202.04	202.00
Max Q (cfs):	8.40	8.83	14.07	14.07	14.07	16.28	17.50	17.50
Max Vel (ft/s):	4.75	5.00	4.48	4.48	4.48	5.18	5.57	6.00
Max Depth (ft):	1.50	1.50	2.00	2.00	2.00	2.00	2.00	1.74

Autodesk Storm and Sanitary Analysis

PROPOSED CONDITIONS

ALTERNATIVE 1 (GRAVITY) STORM DRAIN SYSTEM (10-YEAR STORM)
STRUCTURE 1538-077 TO OUTFALL



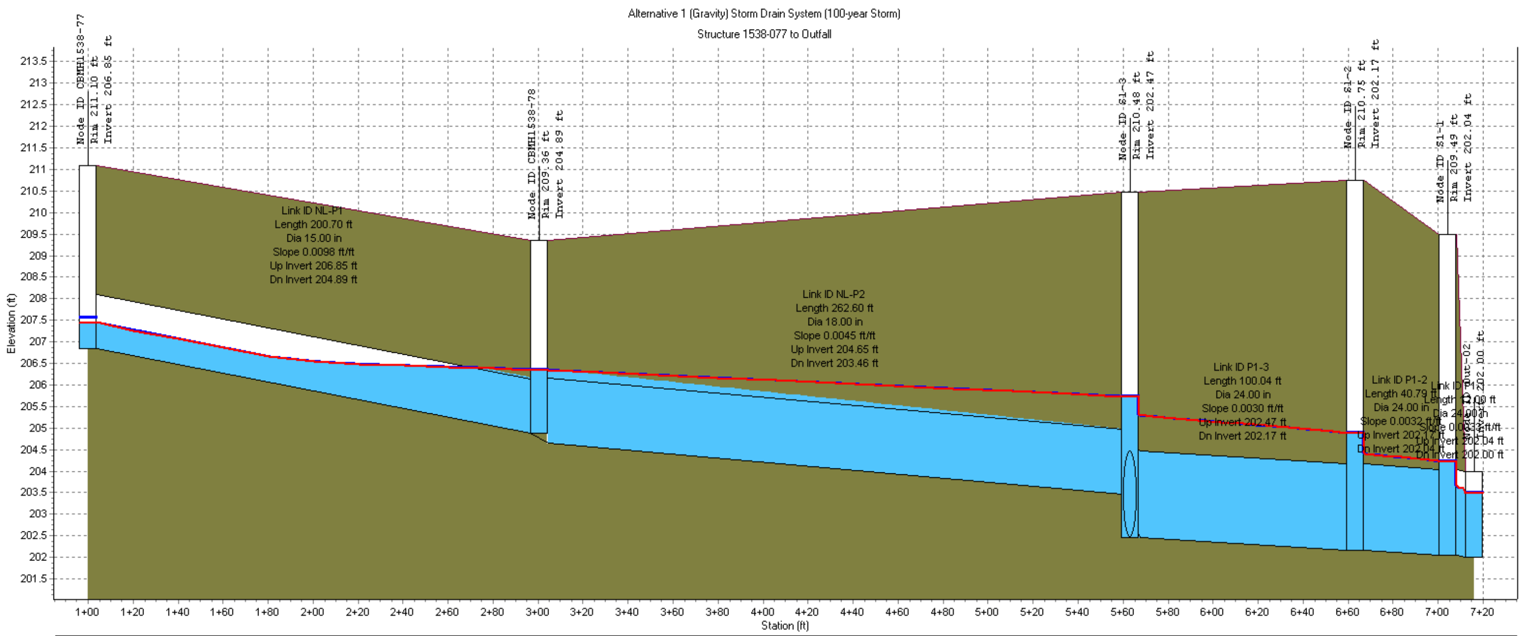
Node ID:	CBMH1538-77	CBMH1538-78	S1-3	S1-2	S1-1	Out-02
Rim (ft):	211.10	209.36	210.48	210.75	209.49	
Invert (ft):	206.85	204.89	202.47	202.17	202.04	202.00
Min Pipe Cover (ft):	3.00	3.21	5.52	6.58	5.45	
Max HGL (ft):	207.36	205.65	204.11	203.81	203.5[illegible]	203.09

Link ID:	NL-P1	NL-P2	P1-3	P1-2	P1-1
Length (ft):	200.70	262.60	100.04	40.79	12.00
Dia (in):	15.00	18.00	24.00	24.00	24.00
Slope (ft/ft):	0.0098	0.0045	0.0030	0.0032	0.0033
Up Invert (ft):	206.85	204.65	202.47	202.17	202.04
Dn Invert (ft):	204.89	203.46	202.17	202.04	202.00
Max Q (cfs):	1.19	1.67	9.07	9.25	9.25
Max Vel (ft/s):	1.98	2.40	3.29	3.55	4.39
Max Depth (ft):	0.61	0.59	1.63	1.54	1.27

Autodesk Storm and Sanitary Analysis

PROPOSED CONDITIONS

ALTERNATIVE 1 (GRAVITY) STORM DRAIN SYSTEM (100-YEAR STORM)
STRUCTURE 1538-077 TO OUTFALL



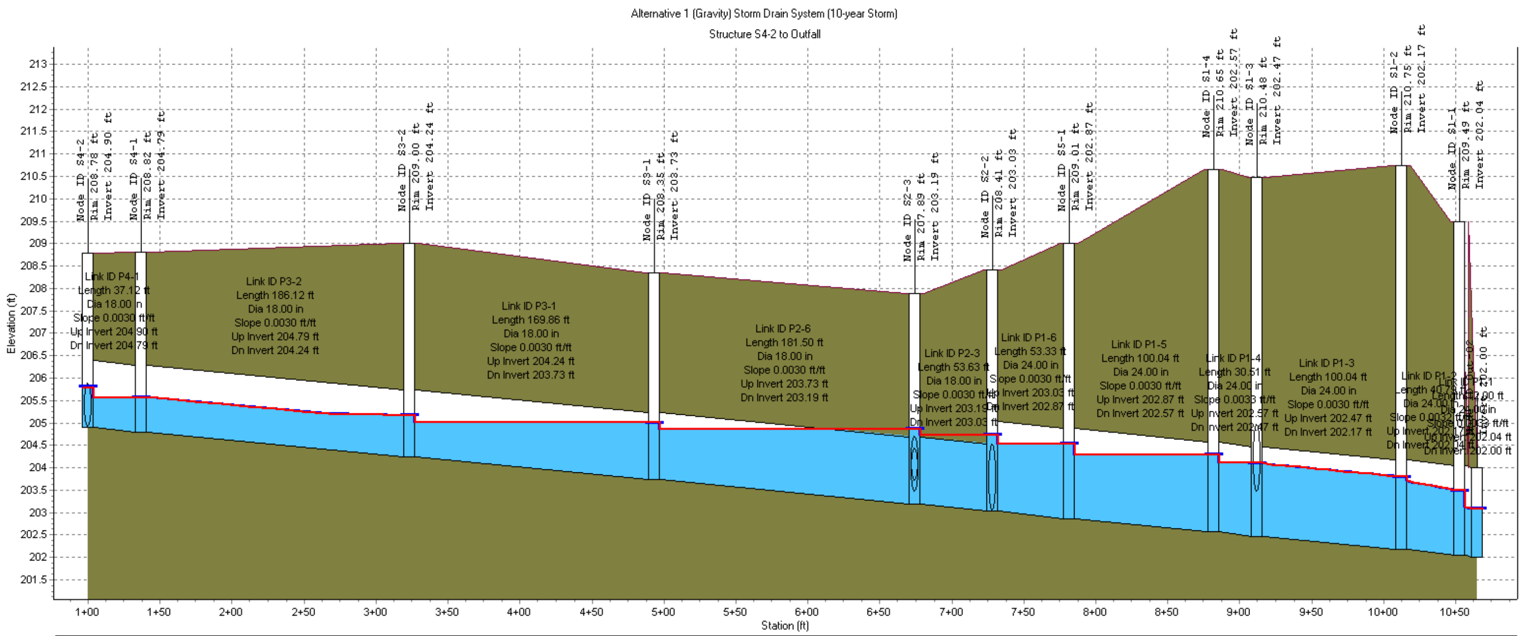
Node ID:	CBMH1538-77	CBMH1538-78	S1-3	S1-2	S1-1	Out-02
Rim (ft):	211.10	209.36	210.48	210.75	209.49	
Invert (ft):	206.85	204.89	202.47	202.17	202.04	202.00
Min Pipe Cover (ft):	3.00	3.21	5.52	6.58	5.45	
Max HGL (ft):	207.58	209.10	205.99	204.99	204.22	203.51

Link ID:	NL-P1	NL-P2	P1-3	P1-2	P1-1
Length (ft):	200.70	262.60	100.04	40.79	12.00
Dia (in):	15.00	18.00	24.00	24.00	24.00
Slope (ft/ft):	0.0098	0.0045	0.0030	0.0032	0.0033
Up Invert (ft):	206.85	204.65	202.47	202.17	202.04
Dn Invert (ft):	204.89	203.46	202.17	202.04	202.00
Max Q (cfs):	2.20	3.24	16.28	17.50	17.50
Max Vel (ft/s):	2.40	2.31	5.18	5.57	6.00
Max Depth (ft):	0.92	1.48	2.00	2.00	1.74

Autodesk Storm and Sanitary Analysis

<u>PROPOSED CONDITIONS</u>

ALTERNATIVE 1 (GRAVITY) STORM DRAIN SYSTEM (10-YEAR STORM)
STRUCTURE S4-2 TO OUTFALL



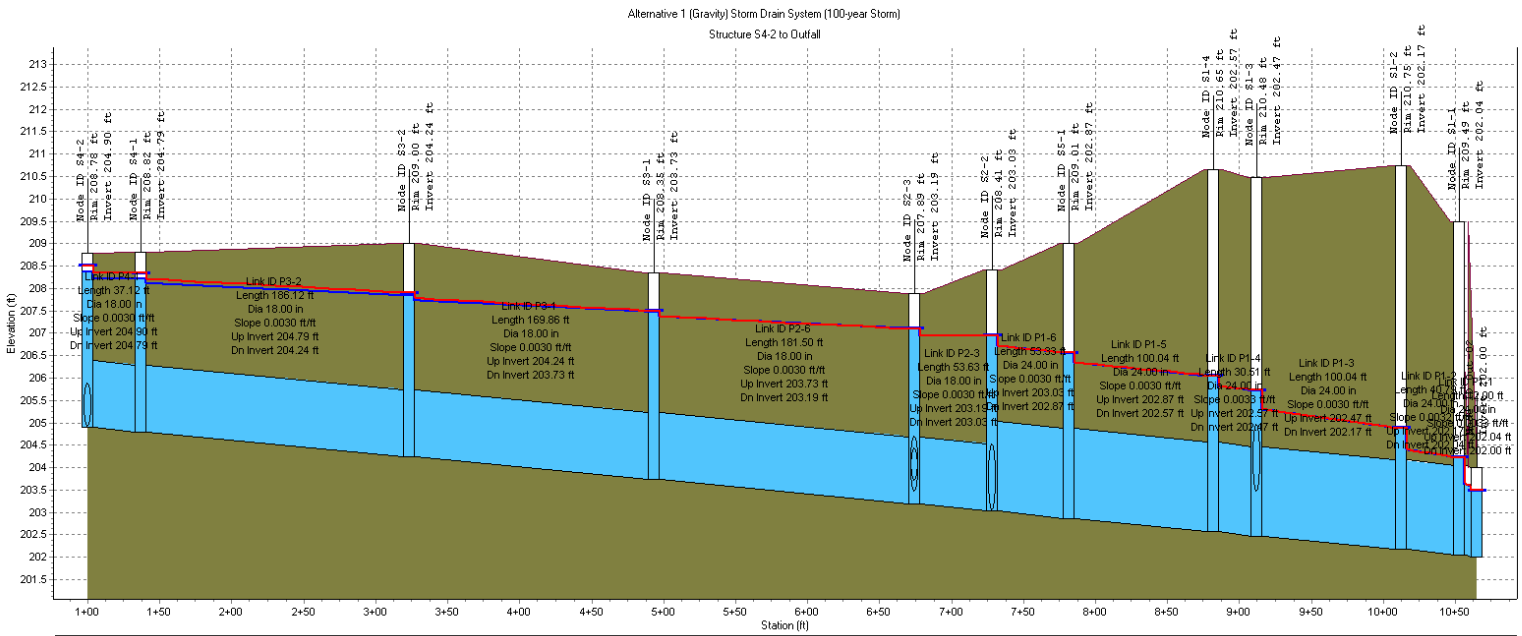
Node ID:	S4-2	S4-1	S3-2	S3-1	S2-3	S2-2	S5-1	S1-4	S1-3	S1-2	S1-1	Out-02
Rim (ft):	208.78	208.82	209.00	208.35	207.89	208.41	209.01	210.65	210.48	210.75	209.49	
Invert (ft):	204.90	204.79	204.24	203.73	203.19	203.03	202.87	202.57	202.47	202.17	202.04	202.00
Min Pipe Cover (ft):	2.38	2.53	3.26	3.12	3.19	3.38	4.14	6.08	5.52	6.58	5.45	
Max HGL (ft):	205.81	205.58	205.18	205.02	204.88	204.74	204.54	204.30	204.11	203.81	[illegible]	203.09

Link ID:	P4-1	P3-2	P3-1	P2-6	P2-3	P1-6	P1-5	P1-4	P1-3	P1-2	P1-1
Length (ft):	37.12	186.12	169.86	181.50	53.63	53.33	100.04	30.51	100.04	40.79	12.00
Dia (in):	18.00	18.00	18.00	18.00	18.00	24.00	24.00	24.00	24.00	24.00	24.00
Slope (ft/ft):	0.0030	0.0030	0.0030	0.0030	0.0030	0.0030	0.0030	0.0033	0.0030	0.0032	0.0033
Up Invert (ft):	204.90	204.79	204.24	203.73	203.19	203.03	202.87	202.57	202.47	202.17	202.04
Dn Invert (ft):	204.79	204.24	203.73	203.19	203.03	202.87	202.57	202.47	202.17	202.04	202.00
Max Q (cfs):	2.97	2.97	2.89	2.90	3.91	8.43	8.43	8.43	9.07	9.25	9.25
Max Vel (ft/s):	2.87	3.10	2.82	1.81	2.21	2.99	2.97	2.99	3.29	3.55	4.39
Max Depth (ft):	0.85	0.84	1.10	1.39	1.50	1.68	1.69	1.68	1.63	1.54	1.27

Autodesk Storm and Sanitary Analysis

PROPOSED CONDITIONS

ALTERNATIVE 1 (GRAVITY) STORM DRAIN SYSTEM (100-YEAR STORM)
STRUCTURE S4-2 TO OUTFALL



Node ID:	S4-2	S4-1	S3-2	S3-1	S2-3	S2-2	S5-1	S1-4	S1-3	S1-2	S1-1	Out-02
Rim (ft):	208.78	208.82	209.00	208.35	207.89	208.41	209.01	210.65	210.48	210.75	209.49	
Invert (ft):	204.90	204.79	204.24	203.73	203.19	203.03	202.87	202.57	202.47	202.17	202.04	202.00
Min Pipe Cover (ft):	2.38	2.53	3.26	3.12	3.19	3.38	4.14	6.08	5.52	6.58	5.45	
Max HGL (ft):	208.78	208.82	209.00	207.79	207.12	206.99	206.66	206.23	205.99	204.99	[illegible]	203.51

Link ID:	P4-1	P3-2	P3-1	P2-6	P2-3	P1-6	P1-5	P1-4	P1-3	P1-2	P1-1
Length (ft):	37.12	186.12	169.86	181.50	53.63	53.33	100.04	30.51	100.04	40.79	12.00
Dia (in):	18.00	18.00	18.00	18.00	18.00	24.00	24.00	24.00	24.00	24.00	24.00
Slope (ft/ft):	0.0030	0.0030	0.0030	0.0030	0.0030	0.0030	0.0030	0.0033	0.0030	0.0032	0.0033
Up Invert (ft):	204.90	204.79	204.24	203.73	203.19	203.03	202.87	202.57	202.47	202.17	202.04
Dn Invert (ft):	204.79	204.24	203.73	203.19	203.03	202.87	202.57	202.47	202.17	202.04	202.00
Max Q (cfs):	4.73	4.73	4.73	4.73	5.93	14.07	14.07	14.07	16.28	17.50	17.50
Max Vel (ft/s):	3.05	3.09	2.75	2.68	3.36	4.48	4.48	4.48	5.18	5.57	6.00
Max Depth (ft):	1.50	1.50	1.50	1.50	1.50	2.00	2.00	2.00	2.00	2.00	1.74

Autodesk Storm and Sanitary Analysis

PROPOSED CONDITION - ALTERNATIVE 1
SSA MODEL RESULTS
10-YEAR DESIGN STORM

Autodesk® Storm and Sanitary Analysis 2016 - Version 13.0.94 (Build 0)

****
Project Description
****

File Name .... 10152.00 Proposed Condtions_SSA Model (Alt 1)_R1.SPF

****
Analysis Options
****

Flow Units .... cfs
Subbasin Hydrograph Method. SCS TR-55
Time of Concentration...... SCS TR-55
Link Routing Method .... Hydrodynamic
Storage Node Exfiltration.. None
Starting Date MAR-29-2022 00:00:00
Ending Date MAR-30-2022 00:00:00
Report Time Step 00:05:00

****
Element Count
****

Number of rain gages 1
Number of subbasins 15
Number of nodes 20
Number of links 19

****
Subbasin Summary
****

Subbasin ID	Total Area acres
E1	0.77
E2	4.89
E3	5.24
NL1	1.01
NL2	0.75
NL3	0.35
NL4	0.34
NL-6	0.28
NL-7	0.22
W1	4.12
W2	5.59
W3	1.64
W4	3.14
W5	8.40
W6	2.07

****
Node Summary
****

Node ID	Element Type	Invert Elevation ft	Maximum Elev. ft	Ponded Area ft²	External Inflow
CBMH1538-77	JUNCTION	206.85	211.10	0.00	
CBMH1538-78	JUNCTION	204.89	209.36	0.00	
I2-1	JUNCTION	203.32	208.10	0.00	
I2-2	JUNCTION	203.75	207.05	0.00	

I2-3	JUNCTION	203.82	207.30	0.00
I4-1	JUNCTION	205.55	208.55	0.00
I4-2	JUNCTION	205.00	209.26	0.00
S1-1	JUNCTION	202.04	209.49	0.00
S1-2	JUNCTION	202.17	210.75	0.00
S1-3	JUNCTION	202.47	210.48	0.00
S1-4	JUNCTION	202.57	210.65	0.00
S2-1	JUNCTION	203.22	208.10	0.00
S2-2	JUNCTION	203.03	208.41	0.00
S2-3	JUNCTION	203.19	207.89	0.00
S3-1	JUNCTION	203.73	208.35	0.00
S3-2	JUNCTION	204.24	209.00	0.00
S4-1	JUNCTION	204.79	208.82	0.00
S4-2	JUNCTION	204.90	208.78	0.00
S5-1	JUNCTION	202.87	209.01	0.00
Out-02	OUTFALL	202.00	204.00	0.00

****
Link Summary
****

Link ID	From Node	To Node	Element Type	Length ft	Slope %	Manning's Roughness
NL-P1	CBMH1538-77	CBMH1538-78	CONDUIT	200.7	0.9766	0.0240
NL-P2	CBMH1538-78	S1-3	CONDUIT	262.6	0.5446	0.0240
P1-1	S1-1	Out-02	CONDUIT	12.0	0.3333	0.0120
P1-2	S1-2	S1-1	CONDUIT	40.8	0.3187	0.0120
P1-3	S1-3	S1-2	CONDUIT	100.0	0.2999	0.0120
P1-4	S1-4	S1-3	CONDUIT	30.5	0.3278	0.0120
P1-5	S5-1	S1-4	CONDUIT	100.0	0.2999	0.0120
P1-6	S2-2	S5-1	CONDUIT	53.3	0.3000	0.0120
P2-1	I2-1	S2-1	CONDUIT	32.5	0.3082	0.0120
P2-2	S2-1	S2-2	CONDUIT	63.4	0.2999	0.0120
P2-3	S2-3	S2-2	CONDUIT	53.6	0.2983	0.0120
P2-4	I2-2	S2-3	CONDUIT	20.8	1.4458	0.0120
P2-5	I2-3	S2-3	CONDUIT	23.9	0.5027	0.0120
P2-6	S3-1	S2-3	CONDUIT	181.5	0.2975	0.0120
P3-1	S3-2	S3-1	CONDUIT	169.9	0.3002	0.0120
P3-2	S4-1	S3-2	CONDUIT	186.1	0.2955	0.0120
P4-1	S4-2	S4-1	CONDUIT	37.1	0.2963	0.0120
P4-2	I4-1	S4-2	CONDUIT	33.0	1.9673	0.0120
P4-3	I4-2	S4-2	CONDUIT	33.2	0.3016	0.0120

****
Cross Section Summary
****

Link ID	Shape	Depth/ Diameter ft	Width ft	No. of Barrels	Cross Sectional Area ft²	Full Flow Hydraulic Radius ft	Design Flow Capacity cfs
NL-P1	CIRCULAR	1.25	1.25	1	1.23	0.31	3.46
NL-P2	CIRCULAR	1.50	1.50	1	1.77	0.38	4.20
P1-1	CIRCULAR	2.00	2.00	1	3.14	0.50	14.15
P1-2	CIRCULAR	2.00	2.00	1	3.14	0.50	13.84

P1-3	CIRCULAR	2.00	2.00	1	3.14	0.50	13.42
P1-4	CIRCULAR	2.00	2.00	1	3.14	0.50	14.03
P1-5	CIRCULAR	2.00	2.00	1	3.14	0.50	13.42
P1-6	CIRCULAR	2.00	2.00	1	3.14	0.50	13.42
P2-1	CIRCULAR	1.50	1.50	1	1.77	0.38	6.32
P2-2	CIRCULAR	1.50	1.50	1	1.77	0.38	6.23
P2-3	CIRCULAR	1.50	1.50	1	1.77	0.38	6.22
P2-4	CIRCULAR	1.00	1.00	1	0.79	0.25	4.64
P2-5	CIRCULAR	1.00	1.00	1	0.79	0.25	2.74
P2-6	CIRCULAR	1.50	1.50	1	1.77	0.38	6.21
P3-1	CIRCULAR	1.50	1.50	1	1.77	0.38	6.24
P3-2	CIRCULAR	1.50	1.50	1	1.77	0.38	6.19
P4-1	CIRCULAR	1.50	1.50	1	1.77	0.38	6.19
P4-2	CIRCULAR	1.00	1.00	1	0.79	0.25	5.41
P4-3	CIRCULAR	1.00	1.00	1	0.79	0.25	2.12

```
**************************        Volume         Depth
Runoff Quantity Continuity       acre-ft        inches
**************************     ---------       -------
Total Precipitation ......         8.864         2.741
Surface Runoff ...........         0.042         0.013
Continuity Error (%) .....        -0.001

**************************        Volume        Volume
Flow Routing Continuity          acre-ft      Mgallons
**************************     ---------     ---------
External Inflow ..........         0.008         0.002
External Outflow .........         2.503         0.816
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.012         0.004
Continuity Error (%) .....         0.001

******************************************
Composite Curve Number Computations Report
******************************************

--------------
Subbasin E1
--------------
                                                          Area         Soil
Soil/Surface Description                                (acres)        Group          CN
----------------------------------------------------------------------------------------
1/4 acre lots, 38% impervious                              0.77            B       75.00
Composite Area & Weighted CN                               0.77                    75.00

--------------
Subbasin E2
--------------
                                                          Area         Soil
```

Soil/Surface Description	(acres)	Group	CN
1/4 acre lots, 38% impervious	4.89	B	75.00
Composite Area & Weighted CN	4.89		75.00

Subbasin E3

Soil/Surface Description	Area (acres)	Soil Group	CN
1/4 acre lots, 38% impervious	5.24	B	75.00
Composite Area & Weighted CN	5.24		75.00

Subbasin NL1

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.76	B	98.00
> 75% grass cover, Good	0.25	B	61.00
Composite Area & Weighted CN	1.01		88.75

Subbasin NL2

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.45	B	98.00
> 75% grass cover, Good	0.30	B	61.00
Composite Area & Weighted CN	0.75		83.20

Subbasin NL3

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.21	B	98.00
> 75% grass cover, Good	0.14	B	61.00
Composite Area & Weighted CN	0.35		83.20

Subbasin NL4

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.32	B	98.00
> 75% grass cover, Good	0.02	B	61.00
Composite Area & Weighted CN	0.34		96.15

Subbasin NL-6

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.27	B	98.00
> 75% grass cover, Good	0.01	B	61.00
Composite Area & Weighted CN	0.28		96.15

Subbasin NL-7

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.21	B	98.00
> 75% grass cover, Good	0.01	B	61.00
Composite Area & Weighted CN	0.22		96.15

Subbasin W1

Soil/Surface Description	Area (acres)	Soil Group	CN
Woods, Good	4.12	B	55.00
Composite Area & Weighted CN	4.12		55.00

Subbasin W2

Soil/Surface Description	Area (acres)	Soil Group	CN
1/4 acre lots, 38% impervious	5.59	B	75.00
Composite Area & Weighted CN	5.59		75.00

Subbasin W3

Soil/Surface Description	Area (acres)	Soil Group	CN
1/4 acre lots, 38% impervious	1.64	B	75.00
Composite Area & Weighted CN	1.64		75.00

Subbasin W4

Soil/Surface Description	Area (acres)	Soil Group	CN
1/4 acre lots, 38% impervious	3.14	B	75.00
Composite Area & Weighted CN	3.14		75.00

Subbasin W5

Soil/Surface Description	Area (acres)	Soil Group	CN
1/4 acre lots, 38% impervious	8.40	B	75.00
Composite Area & Weighted CN	8.40		75.00

Subbasin W6

Soil/Surface Description	Area (acres)	Soil Group	CN
1/4 acre lots, 38% impervious	2.07	B	75.00
Composite Area & Weighted CN	2.07		75.00

****
SCS TR-55 Time of Concentration Computations Report
****

Sheet Flow Equation

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where:

Tc = Time of Concentration (hrs)
n = Manning's Roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hrs)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hrs)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft^2)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's Roughness

Subbasin E1

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.40	0.00	0.00
Flow Length (ft):	70.00	0.00	0.00
Slope (%):	3.30	0.00	0.00
2 yr, 24 hr Rainfall (in):	1.68	0.00	0.00
Velocity (ft/sec):	0.06	0.00	

```
0.00
         Computed Flow Time (minutes):             18.24                0.00
0.00

  Channel Flow Computations
  ------------------------
                                                Subarea A           Subarea B           Subarea
C
         Manning's Roughness:                       0.01                0.00
0.00
         Flow Length (ft):                        198.00                0.00
0.00
         Channel Slope (%):                         1.51                0.00
0.00
         Cross Section Area (ft²):                  1.08                0.00
0.00
         Wetted Perimeter (ft):                    10.40                0.00
0.00
         Velocity (ft/sec):                         3.11                0.00
0.00
         Computed Flow Time (minutes):              1.06                0.00
0.00

===============================================================================================
         Total TOC (minutes):                      19.30

===============================================================================================


  --------------
  Subbasin E2
  --------------

  Sheet Flow Computations
  -----------------------
                                                Subarea A           Subarea B           Subarea
C
         Manning's Roughness:                       0.40                0.00
0.00
         Flow Length (ft):                         38.00                0.00
0.00
         Slope (%):                                 2.63                0.00
0.00
         2 yr, 24 hr Rainfall (in):                 1.68                0.00
0.00
         Velocity (ft/sec):                         0.05                0.00
0.00
         Computed Flow Time (minutes):             12.25                0.00
0.00

  Channel Flow Computations
  ------------------------
                                                Subarea A           Subarea B           Subarea
C
         Manning's Roughness:                       0.01                0.00
0.00
         Flow Length (ft):                       1093.00                0.00
0.00
         Channel Slope (%):                         0.52                0.00
0.00
         Cross Section Area (ft²):                  1.08                0.00
0.00
         Wetted Perimeter (ft):                    10.40                0.00
0.00
         Velocity (ft/sec):                         1.83                0.00
0.00
         Computed Flow Time (minutes):              9.98                0.00
```

0.00

===
          Total TOC (minutes):   22.22

===

  Subbasin E3

  Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.40	0.00	0.00
Flow Length (ft):	79.00	0.00	0.00
Slope (%):	1.41	0.00	0.00
2 yr, 24 hr Rainfall (in):	1.68	0.00	0.00
Velocity (ft/sec):	0.05	0.00	0.00
Computed Flow Time (minutes):	28.23	0.00	0.00

  Channel Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.01	0.00	0.00
Flow Length (ft):	1266.00	0.00	0.00
Channel Slope (%):	0.52	0.00	0.00
Cross Section Area (ft²):	1.08	0.00	0.00
Wetted Perimeter (ft):	10.40	0.00	0.00
Velocity (ft/sec):	1.83	0.00	0.00
Computed Flow Time (minutes):	11.56	0.00	0.00

===
          Total TOC (minutes):   39.78

===

  Subbasin NL1

          User-Defined TOC override (minutes):   5.00

  Subbasin NL2

          User-Defined TOC override (minutes):   5.00

Subbasin NL3

User-Defined TOC override (minutes): 5.00

Subbasin NL4

User-Defined TOC override (minutes): 5.00

Subbasin NL-6

User-Defined TOC override (minutes): 5.00

Subbasin NL-7

User-Defined TOC override (minutes): 5.00

Subbasin W1

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.80	0.00	0.00
Flow Length (ft):	105.00	0.00	0.00
Slope (%):	40.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	1.68	0.00	0.00
Velocity (ft/sec):	0.11	0.00	0.00
Computed Flow Time (minutes):	16.19	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	79.00	0.00	0.00
Slope (%):	2.60	0.00	0.00
Surface Type:	Grassed waterway	Unpaved	Unpaved
Velocity (ft/sec):	2.42	0.00	0.00
Computed Flow Time (minutes):	0.54	0.00	0.00

Channel Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.01	0.00	0.00
Flow Length (ft):	1332.00	0.00	0.00

	Subarea A	Subarea B	Subarea C
Channel Slope (%):	6.70	0.00	0.00
Cross Section Area (ft²):	1.08	0.00	0.00
Wetted Perimeter (ft):	10.40	0.00	0.00
Velocity (ft/sec):	6.55	0.00	0.00
Computed Flow Time (minutes):	3.39	0.00	0.00

==

Total TOC (minutes): 20.12

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Subbasin W2

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.40	0.00	0.00
Flow Length (ft):	73.00	0.00	0.00
Slope (%):	1.40	0.00	0.00
2 yr, 24 hr Rainfall (in):	1.68	0.00	0.00
Velocity (ft/sec):	0.05	0.00	0.00
Computed Flow Time (minutes):	26.57	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	98.00	0.00	0.00
Slope (%):	2.00	0.00	0.00
Surface Type:	Grassed waterway	Unpaved	Unpaved
Velocity (ft/sec):	2.12	0.00	0.00
Computed Flow Time (minutes):	0.77	0.00	0.00

Channel Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.01	0.00	0.00
Flow Length (ft):	1310.00	0.00	0.00
Channel Slope (%):	0.50	0.00	0.00
Cross Section Area (ft²):	1.08	0.00	0.00
Wetted Perimeter (ft):	10.40	0.00	0.00

```
         Velocity (ft/sec):                        1.79              0.00
0.00
         Computed Flow Time (minutes):            12.19              0.00
0.00

================================================================================================
         Total TOC (minutes):                     39.54

================================================================================================


  --------------
  Subbasin W3
  --------------

  Sheet Flow Computations
  -----------------------
                                              Subarea A         Subarea B           Subarea
C
         Manning's Roughness:                      0.40              0.00
0.00
         Flow Length (ft):                        82.00              0.00
0.00
         Slope (%):                                1.50              0.00
0.00
         2 yr, 24 hr Rainfall (in):                1.68              0.00
0.00
         Velocity (ft/sec):                        0.05              0.00
0.00
         Computed Flow Time (minutes):            28.37              0.00
0.00

  Channel Flow Computations
  -------------------------
                                              Subarea A         Subarea B           Subarea
C
         Manning's Roughness:                      0.01              0.00
0.00
         Flow Length (ft):                       360.00              0.00
0.00
         Channel Slope (%):                        0.40              0.00
0.00
         Cross Section Area (ft²):                 1.08              0.00
0.00
         Wetted Perimeter (ft):                   10.40              0.00
0.00
         Velocity (ft/sec):                        1.60              0.00
0.00
         Computed Flow Time (minutes):             3.75              0.00
0.00

================================================================================================
         Total TOC (minutes):                     32.12

================================================================================================


  --------------
  Subbasin W4
  --------------

         User-Defined TOC override (minutes):     20.00

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  Subbasin W5
  --------------
```

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.40	0.00	0.00
Flow Length (ft):	73.00	0.00	0.00
Slope (%):	1.37	0.00	0.00
2 yr, 24 hr Rainfall (in):	1.68	0.00	0.00
Velocity (ft/sec):	0.05	0.00	0.00
Computed Flow Time (minutes):	26.80	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	98.00	0.00	0.00
Slope (%):	2.04	0.00	0.00
Surface Type:	Grassed waterway	Unpaved	Unpaved
Velocity (ft/sec):	2.14	0.00	0.00
Computed Flow Time (minutes):	0.76	0.00	0.00

Channel Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.01	0.00	0.00
Flow Length (ft):	1310.00	0.00	0.00
Channel Slope (%):	5.00	0.00	0.00
Cross Section Area (ft²):	1.06	0.00	0.00
Wetted Perimeter (ft):	10.40	0.00	0.00
Velocity (ft/sec):	5.59	0.00	0.00
Computed Flow Time (minutes):	3.90	0.00	0.00

===

Total TOC (minutes): 31.47

===

Subbasin W6

User-Defined TOC override (minutes): 20.00

****

Subbasin Runoff Summary

****

Subbasin ID	Total Precip in	Total Runoff in	Peak Runoff cfs	Weighted Curve Number	Time of Concentration days	Time of Concentration hh:mm:ss
E1	2.74	0.79	0.28	75.000	0	00:19:18
E2	2.74	0.79	1.66	75.000	0	00:22:13
E3	2.74	0.79	1.30	75.000	0	00:39:46
NL1	2.74	1.64	1.31	88.750	0	00:05:00
NL2	2.74	1.25	0.74	83.200	0	00:05:00
NL3	2.74	1.25	0.35	83.200	0	00:05:00
NL4	2.74	2.31	0.57	96.150	0	00:05:00
NL-6	2.74	2.31	0.47	96.150	0	00:05:00
NL-7	2.74	2.31	0.37	96.150	0	00:05:00
W1	2.74	0.13	0.06	55.000	0	00:20:07
W2	2.74	0.79	1.39	75.000	0	00:39:32
W3	2.74	0.79	0.46	75.000	0	00:32:07
W4	2.74	0.79	1.12	75.000	0	00:20:00
W5	2.74	0.79	2.37	75.000	0	00:31:28
W6	2.74	0.79	0.74	75.000	0	00:20:00

****
Node Depth Summary
****

Node ID	Average Depth Attained ft	Maximum Depth Attained ft	Maximum HGL Attained ft	Time of Max Occurrence days	Time of Max Occurrence hh:mm	Total Flooded Volume acre-in	Total Time Flooded minutes	Retention Time hh:mm:ss
CBMH1538-77	0.13	0.51	207.36	0	12:10	0	0	0:00:00
CBMH1538-78	0.21	0.76	205.65	0	12:12	0	0	0:00:00
I2-1	0.44	1.78	205.10	0	12:27	0	0	0:00:00
I2-2	0.14	1.14	204.89	0	12:27	0	0	0:00:00
I2-3	0.15	1.07	204.89	0	12:27	0	0	0:00:00
I4-1	0.13	0.43	205.98	0	12:20	0	0	0:00:00
I4-2	0.27	0.87	205.87	0	12:25	0	0	0:00:00
S1-1	1.01	1.46	203.50	0	12:28	0	0	0:00:00
S1-2	0.92	1.64	203.81	0	12:28	0	0	0:00:00
S1-3	0.69	1.64	204.11	0	12:27	0	0	0:00:00
S1-4	0.66	1.73	204.30	0	12:28	0	0	0:00:00
S2-1	0.44	1.72	204.94	0	12:27	0	0	0:00:00
S2-2	0.51	1.71	204.74	0	12:27	0	0	0:00:00
S2-3	0.43	1.69	204.88	0	12:27	0	0	0:00:00
S3-1	0.29	1.29	205.02	0	12:27	0	0	0:00:00
S3-2	0.28	0.94	205.18	0	12:27	0	0	0:00:00
S4-1	0.28	0.79	205.58	0	12:25	0	0	0:00:00
S4-2	0.31	0.91	205.81	0	12:25	0	0	0:00:00
S5-1	0.51	1.67	204.54	0	12:28	0	0	0:00:00
Out-02	1.00	1.09	203.09	0	12:28	0	0	0:00:00

****
Node Flow Summary
****

Node ID	Element Type	Maximum Lateral Inflow cfs	Peak Inflow cfs	Time of Peak Inflow Occurrence days	Time of Peak Inflow Occurrence hh:mm	Maximum Flooding Overflow cfs	Time of Peak Flooding Occurrence days	Time of Peak Flooding Occurrence hh:mm
CBMH1538-77	JUNCTION	1.22	1.22	0	12:10	0.00		
CBMH1538-78	JUNCTION	0.69	1.87	0	12:10	0.00		

I2-1	JUNCTION	4.56	4.56	0	12:25	0.00
I2-2	JUNCTION	0.74	0.74	0	12:20	0.00
I2-3	JUNCTION	0.45	0.45	0	12:30	0.00
I4-1	JUNCTION	1.64	1.64	0	12:20	0.00
I4-2	JUNCTION	1.29	1.29	0	12:35	0.00
S1-1	JUNCTION	0.00	9.25	0	12:28	0.00
S1-2	JUNCTION	0.89	9.26	0	12:27	0.00
S1-3	JUNCTION	0.77	9.08	0	12:27	0.00
S1-4	JUNCTION	0.00	8.43	0	12:28	0.00
S2-1	JUNCTION	0.06	4.56	0	12:25	0.00
S2-2	JUNCTION	0.00	8.43	0	12:27	0.00
S2-3	JUNCTION	0.00	3.91	0	12:27	0.00
S3-1	JUNCTION	0.00	2.89	0	12:27	0.00
S3-2	JUNCTION	0.00	2.97	0	12:25	0.00
S4-1	JUNCTION	0.00	2.97	0	12:25	0.00
S4-2	JUNCTION	0.28	2.97	0	12:25	0.00
S5-1	JUNCTION	0.00	8.43	0	12:27	0.00
Out-02	OUTFALL	0.00	9.25	0	12:28	0.00

****
Outfall Loading Summary
****

Outfall Node ID	Flow Frequency (%)	Average Flow cfs	Peak Inflow cfs
Out-02	99.85	2.00	9.25
System	99.85	2.00	9.25

****
Link Flow Summary
****

Link ID	Element Type	Time of Peak Flow Occurrence days hh:mm	Maximum Velocity Attained ft/sec	Length Factor	Peak Flow during Analysis cfs	Design Flow Capacity cfs	Ratio of Maximum /Design Flow	Ratio of Maximum Flow Depth	Total Time Surcharged minutes	Reported Condition
NL-P1	CONDUIT	0 12:10	1.98	1.00	1.19	3.46	0.34	0.50	0	Calculated
NL-P2	CONDUIT	0 12:12	2.40	1.00	1.67	4.20	0.40	0.42	0	Calculated
P1-1	CONDUIT	0 12:28	4.39	1.00	9.25	14.15	0.65	0.64	0	Calculated
P1-2	CONDUIT	0 12:28	3.55	1.00	9.25	13.84	0.67	0.77	0	Calculated
P1-3	CONDUIT	0 12:28	3.29	1.00	9.07	13.42	0.68	0.82	0	Calculated
P1-4	CONDUIT	0 12:28	2.99	1.00	8.43	14.03	0.60	0.84	0	Calculated
P1-5	CONDUIT	0 12:28	2.97	1.00	8.43	13.42	0.63	0.85	0	Calculated
P1-6	CONDUIT	0 12:27	2.99	1.00	8.43	13.42	0.63			

```
0.84          0  Calculated
  P2-1                 CONDUIT      0  12:25       2.58    1.00         4.56         6.32       0.72
1.00         16  SURCHARGED
  P2-2                 CONDUIT      0  12:25       2.58    1.00         4.57         6.23       0.73
1.00         16  SURCHARGED
  P2-3                 CONDUIT      0  12:27       2.21    1.00         3.91         6.22       0.63
1.00         16  SURCHARGED
  P2-4                 CONDUIT      0  12:20       2.19    1.00         0.72         4.64       0.16
1.00         13  SURCHARGED
  P2-5                 CONDUIT      0  12:30       1.75    1.00         0.45         2.74       0.17
1.00          9  SURCHARGED
  P2-6                 CONDUIT      0  12:29       1.81    1.00         2.90         6.21       0.47
0.93          0  Calculated
  P3-1                 CONDUIT      0  12:27       2.82    1.00         2.89         6.24       0.46
0.74          0  Calculated
  P3-2                 CONDUIT      0  12:25       3.10    1.00         2.97         6.19       0.48
0.57          0  Calculated
  P4-1                 CONDUIT      0  12:25       2.87    1.00         2.97         6.19       0.48
0.57          0  Calculated
  P4-2                 CONDUIT      0  12:20       3.03    1.00         1.64         5.41       0.30
0.66          0  Calculated
  P4-3                 CONDUIT      0  12:35       1.94    1.00         1.30         2.12       0.61
0.89          0  Calculated


  ********************************
  Highest Flow Instability Indexes
  ********************************
  All links are stable.

  WARNING 107 : Initial water surface elevation defined for Junction CBMH1538-77 is below
junction invert elevation.
                Assumed initial water surface elevation equal to invert elevation.
  WARNING 108 : Surcharge elevation defined for Junction CBMH1538-77 is below junction maximum
elevation. Assumed surcharge elevation equal to maximum elevation.
  WARNING 107 : Initial water surface elevation defined for Junction CBMH1538-78 is below
junction invert elevation.
                Assumed initial water surface elevation equal to invert elevation.
  WARNING 108 : Surcharge elevation defined for Junction CBMH1538-78 is below junction maximum
elevation. Assumed surcharge elevation equal to maximum elevation.
  WARNING 108 : Surcharge elevation defined for Junction I4-1 is below junction maximum
elevation. Assumed surcharge elevation equal to maximum elevation.
  WARNING 116 : Conduit inlet invert elevation defined for Conduit NL-P2 is below upstream node
invert elevation.
                Assumed conduit inlet invert elevation equal to upstream node invert elevation.
  WARNING 116 : Conduit inlet invert elevation defined for Conduit P4-2 is below upstream node
invert elevation.
                Assumed conduit inlet invert elevation equal to upstream node invert elevation.

  Analysis began on:  Wed Jul 27 13:24:42 2022
  Analysis ended on:  Wed Jul 27 13:24:45 2022
  Total elapsed time: 00:00:03
```

PROPOSED CONDITION - ALTERNATIVE 1
SSA MODEL RESULTS
10-YEAR DESIGN STORM

```
Autodesk® Storm and Sanitary Analysis 2016 - Version 13.0.94 (Build 0)
-----------------------------------------------------------------------------------------

*******************
Project Description
*******************
File Name ................ 10152.00 Proposed Condtions_SSA Model (Alt 1)_R1.SPF


****************
Analysis Options
****************
Flow Units ............... cfs
Subbasin Hydrograph Method. SCS TR-55
Time of Concentration...... SCS TR-55
Link Routing Method ....... Hydrodynamic
Storage Node Exfiltration.. None
Starting Date ............. MAR-29-2022 00:00:00
Ending Date ............... MAR-30-2022 00:00:00
Report Time Step .......... 00:05:00


*************
Element Count
*************
Number of rain gages ...... 1
Number of subbasins ....... 15
Number of nodes ........... 20
Number of links ........... 19


****************
Subbasin Summary
****************
Subbasin                 Total
                          Area
ID                       acres
------------------------------
E1                        0.77
E2                        4.89
E3                        5.24
NL1                       1.01
NL2                       0.75
NL3                       0.35
NL4                       0.34
NL-6                      0.28
NL-7                      0.22
W1                        4.12
W2                        5.59
W3                        1.64
W4                        3.14
W5                        8.40
W6                        2.07


************
Node Summary
************
Node                Element              Invert   Maximum    Ponded    External
ID                  Type              Elevation     Elev.      Area      Inflow
                                             ft        ft       ft²
-------------------------------------------------------------------------------
CBMH1538-77         JUNCTION             206.85    211.10      0.00
CBMH1538-78         JUNCTION             204.89    209.36      0.00
I2-1                JUNCTION             203.32    208.10      0.00
I2-2                JUNCTION             203.75    207.05      0.00
```

I2-3	JUNCTION	203.82	207.30	0.00
I4-1	JUNCTION	205.55	208.55	0.00
I4-2	JUNCTION	205.00	209.26	0.00
S1-1	JUNCTION	202.04	209.49	0.00
S1-2	JUNCTION	202.17	210.75	0.00
S1-3	JUNCTION	202.47	210.48	0.00
S1-4	JUNCTION	202.57	210.65	0.00
S2-1	JUNCTION	203.22	208.10	0.00
S2-2	JUNCTION	203.03	208.41	0.00
S2-3	JUNCTION	203.19	207.89	0.00
S3-1	JUNCTION	203.73	208.35	0.00
S3-2	JUNCTION	204.24	209.00	0.00
S4-1	JUNCTION	204.79	208.82	0.00
S4-2	JUNCTION	204.90	208.78	0.00
S5-1	JUNCTION	202.87	209.01	0.00
Out-02	OUTFALL	202.00	204.00	0.00

****
Link Summary
****

Link ID	From Node	To Node	Element Type	Length ft	Slope %	Manning's Roughness
NL-P1	CBMH1538-77	CBMH1538-78	CONDUIT	200.7	0.9766	0.0240
NL-P2	CBMH1538-78	S1-3	CONDUIT	262.6	0.5446	0.0240
P1-1	S1-1	Out-02	CONDUIT	12.0	0.3333	0.0120
P1-2	S1-2	S1-1	CONDUIT	40.8	0.3187	0.0120
P1-3	S1-3	S1-2	CONDUIT	100.0	0.2999	0.0120
P1-4	S1-4	S1-3	CONDUIT	30.5	0.3278	0.0120
P1-5	S5-1	S1-4	CONDUIT	100.0	0.2999	0.0120
P1-6	S2-2	S5-1	CONDUIT	53.3	0.3000	0.0120
P2-1	I2-1	S2-1	CONDUIT	32.5	0.3082	0.0120
P2-2	S2-1	S2-2	CONDUIT	63.4	0.2999	0.0120
P2-3	S2-3	S2-2	CONDUIT	53.6	0.2983	0.0120
P2-4	I2-2	S2-3	CONDUIT	20.8	1.4458	0.0120
P2-5	I2-3	S2-3	CONDUIT	23.9	0.5027	0.0120
P2-6	S3-1	S2-3	CONDUIT	181.5	0.2975	0.0120
P3-1	S3-2	S3-1	CONDUIT	169.9	0.3002	0.0120
P3-2	S4-1	S3-2	CONDUIT	186.1	0.2955	0.0120
P4-1	S4-2	S4-1	CONDUIT	37.1	0.2963	0.0120
P4-2	I4-1	S4-2	CONDUIT	33.0	1.9673	0.0120
P4-3	I4-2	S4-2	CONDUIT	33.2	0.3016	0.0120

****
Cross Section Summary
****

Link ID	Shape	Depth/ Diameter ft	Width ft	No. of Barrels	Cross Sectional Area ft²	Full Flow Hydraulic Radius ft	Design Flow Capacity cfs
NL-P1	CIRCULAR	1.25	1.25	1	1.23	0.31	3.46
NL-P2	CIRCULAR	1.50	1.50	1	1.77	0.38	4.20
P1-1	CIRCULAR	2.00	2.00	1	3.14	0.50	14.15
P1-2	CIRCULAR	2.00	2.00	1	3.14	0.50	13.84

P1-3	CIRCULAR	2.00	2.00	1	3.14	0.50	13.42
P1-4	CIRCULAR	2.00	2.00	1	3.14	0.50	14.03
P1-5	CIRCULAR	2.00	2.00	1	3.14	0.50	13.42
P1-6	CIRCULAR	2.00	2.00	1	3.14	0.50	13.42
P2-1	CIRCULAR	1.50	1.50	1	1.77	0.38	6.32
P2-2	CIRCULAR	1.50	1.50	1	1.77	0.38	6.23
P2-3	CIRCULAR	1.50	1.50	1	1.77	0.38	6.22
P2-4	CIRCULAR	1.00	1.00	1	0.79	0.25	4.64
P2-5	CIRCULAR	1.00	1.00	1	0.79	0.25	2.74
P2-6	CIRCULAR	1.50	1.50	1	1.77	0.38	6.21
P3-1	CIRCULAR	1.50	1.50	1	1.77	0.38	6.24
P3-2	CIRCULAR	1.50	1.50	1	1.77	0.38	6.19
P4-1	CIRCULAR	1.50	1.50	1	1.77	0.38	6.19
P4-2	CIRCULAR	1.00	1.00	1	0.79	0.25	5.41
P4-3	CIRCULAR	1.00	1.00	1	0.79	0.25	2.12

```
**************************        Volume         Depth
Runoff Quantity Continuity       acre-ft        inches
**************************     ---------       -------
Total Precipitation ......        13.964         4.318
Surface Runoff ...........         0.099         0.031
Continuity Error (%) .....        -0.001

**************************        Volume        Volume
Flow Routing Continuity          acre-ft      Mgallons
**************************     ---------     ---------
External Inflow ..........         0.007         0.002
External Outflow .........         5.652         1.842
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.018         0.006
Continuity Error (%) .....         0.000

******************************************
Composite Curve Number Computations Report
******************************************

--------------
Subbasin E1
--------------
                                                      Area         Soil
Soil/Surface Description                            (acres)        Group           CN
-----------------------------------------------------------------------------------------
1/4 acre lots, 38% impervious                          0.77            B        75.00
Composite Area & Weighted CN                           0.77                     75.00

--------------
Subbasin E2
--------------
                                                      Area         Soil
```

Soil/Surface Description	(acres)	Group	CN
1/4 acre lots, 38% impervious	4.89	B	75.00
Composite Area & Weighted CN	4.89		75.00

Subbasin E3

Soil/Surface Description	Area (acres)	Soil Group	CN
1/4 acre lots, 38% impervious	5.24	B	75.00
Composite Area & Weighted CN	5.24		75.00

Subbasin NL1

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.76	B	98.00
> 75% grass cover, Good	0.25	B	61.00
Composite Area & Weighted CN	1.01		88.75

Subbasin NL2

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.45	B	98.00
> 75% grass cover, Good	0.30	B	61.00
Composite Area & Weighted CN	0.75		83.20

Subbasin NL3

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.21	B	98.00
> 75% grass cover, Good	0.14	B	61.00
Composite Area & Weighted CN	0.35		83.20

Subbasin NL4

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.32	B	98.00
> 75% grass cover, Good	0.02	B	61.00
Composite Area & Weighted CN	0.34		96.15

Subbasin NL-6

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.27	B	98.00
> 75% grass cover, Good	0.01	B	61.00
Composite Area & Weighted CN	0.28		96.15

Subbasin NL-7

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.21	B	98.00
> 75% grass cover, Good	0.01	B	61.00
Composite Area & Weighted CN	0.22		96.15

Subbasin W1

Soil/Surface Description	Area (acres)	Soil Group	CN
Woods, Good	4.12	B	55.00
Composite Area & Weighted CN	4.12		55.00

Subbasin W2

Soil/Surface Description	Area (acres)	Soil Group	CN
1/4 acre lots, 38% impervious	5.59	B	75.00
Composite Area & Weighted CN	5.59		75.00

Subbasin W3

Soil/Surface Description	Area (acres)	Soil Group	CN
1/4 acre lots, 38% impervious	1.64	B	75.00
Composite Area & Weighted CN	1.64		75.00

Subbasin W4

Soil/Surface Description	Area (acres)	Soil Group	CN
1/4 acre lots, 38% impervious	3.14	B	75.00
Composite Area & Weighted CN	3.14		75.00

Subbasin W5

Soil/Surface Description	Area (acres)	Soil Group	CN
1/4 acre lots, 38% impervious	8.40	B	75.00
Composite Area & Weighted CN	8.40		75.00

Subbasin W6

Soil/Surface Description	Area (acres)	Soil Group	CN
1/4 acre lots, 38% impervious	2.07	B	75.00
Composite Area & Weighted CN	2.07		75.00

****
SCS TR-55 Time of Concentration Computations Report
****

Sheet Flow Equation

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where:

Tc = Time of Concentration (hrs)
n = Manning's Roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hrs)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hrs)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's Roughness

Subbasin E1

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.40	0.00	0.00
Flow Length (ft):	70.00	0.00	0.00
Slope (%):	3.30	0.00	0.00
2 yr, 24 hr Rainfall (in):	1.68	0.00	0.00
Velocity (ft/sec):	0.06	0.00	

0.00
Computed Flow Time (minutes): 18.24 0.00
0.00

Channel Flow Computations

Subarea A Subarea B Subarea
C
Manning's Roughness: 0.01 0.00
0.00
Flow Length (ft): 198.00 0.00
0.00
Channel Slope (%): 1.51 0.00
0.00
Cross Section Area (ft^2): 1.08 0.00
0.00
Wetted Perimeter (ft): 10.40 0.00
0.00
Velocity (ft/sec): 3.11 0.00
0.00
Computed Flow Time (minutes): 1.06 0.00
0.00

==
Total TOC (minutes): 19.30

==

Subbasin E2

Sheet Flow Computations

Subarea A Subarea B Subarea
C
Manning's Roughness: 0.40 0.00
0.00
Flow Length (ft): 38.00 0.00
0.00
Slope (%): 2.63 0.00
0.00
2 yr, 24 hr Rainfall (in): 1.68 0.00
0.00
Velocity (ft/sec): 0.05 0.00
0.00
Computed Flow Time (minutes): 12.25 0.00
0.00

Channel Flow Computations

Subarea A Subarea B Subarea
C
Manning's Roughness: 0.01 0.00
0.00
Flow Length (ft): 1093.00 0.00
0.00
Channel Slope (%): 0.52 0.00
0.00
Cross Section Area (ft^2): 1.08 0.00
0.00
Wetted Perimeter (ft): 10.40 0.00
0.00
Velocity (ft/sec): 1.83 0.00
0.00
Computed Flow Time (minutes): 9.98 0.00

0.00

==
Total TOC (minutes): 22.22

==

Subbasin E3

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.40	0.00	0.00
Flow Length (ft):	79.00	0.00	0.00
Slope (%):	1.41	0.00	0.00
2 yr, 24 hr Rainfall (in):	1.68	0.00	0.00
Velocity (ft/sec):	0.05	0.00	0.00
Computed Flow Time (minutes):	28.23	0.00	0.00

Channel Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.01	0.00	0.00
Flow Length (ft):	1266.00	0.00	0.00
Channel Slope (%):	0.52	0.00	0.00
Cross Section Area (ft^2):	1.08	0.00	0.00
Wetted Perimeter (ft):	10.40	0.00	0.00
Velocity (ft/sec):	1.83	0.00	0.00
Computed Flow Time (minutes):	11.56	0.00	0.00

==
Total TOC (minutes): 39.78

==

Subbasin NL1

User-Defined TOC override (minutes): 5.00

Subbasin NL2

User-Defined TOC override (minutes): 5.00

Subbasin NL3

User-Defined TOC override (minutes): 5.00

Subbasin NL4

User-Defined TOC override (minutes): 5.00

Subbasin NL-6

User-Defined TOC override (minutes): 5.00

Subbasin NL-7

User-Defined TOC override (minutes): 5.00

Subbasin W1

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.80	0.00	0.00
Flow Length (ft):	105.00	0.00	0.00
Slope (%):	40.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	1.68	0.00	0.00
Velocity (ft/sec):	0.11	0.00	0.00
Computed Flow Time (minutes):	16.19	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	79.00	0.00	0.00
Slope (%):	2.60	0.00	0.00
Surface Type:	Grassed waterway	Unpaved	Unpaved
Velocity (ft/sec):	2.42	0.00	0.00
Computed Flow Time (minutes):	0.54	0.00	0.00

Channel Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.01	0.00	0.00
Flow Length (ft):	1332.00	0.00	0.00

	Subarea A	Subarea B	Subarea C
Channel Slope (%):	6.70	0.00	0.00
Cross Section Area (ft²):	1.08	0.00	0.00
Wetted Perimeter (ft):	10.40	0.00	0.00
Velocity (ft/sec):	6.55	0.00	0.00
Computed Flow Time (minutes):	3.39	0.00	0.00

==

Total TOC (minutes): 20.12

==

Subbasin W2

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.40	0.00	0.00
Flow Length (ft):	73.00	0.00	0.00
Slope (%):	1.40	0.00	0.00
2 yr, 24 hr Rainfall (in):	1.68	0.00	0.00
Velocity (ft/sec):	0.05	0.00	0.00
Computed Flow Time (minutes):	26.57	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	98.00	0.00	0.00
Slope (%):	2.00	0.00	0.00
Surface Type:	Grassed waterway	Unpaved	Unpaved
Velocity (ft/sec):	2.12	0.00	0.00
Computed Flow Time (minutes):	0.77	0.00	0.00

Channel Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.01	0.00	0.00
Flow Length (ft):	1310.00	0.00	0.00
Channel Slope (%):	0.50	0.00	0.00
Cross Section Area (ft²):	1.08	0.00	0.00
Wetted Perimeter (ft):	10.40	0.00	0.00

	Subarea A	Subarea B	Subarea C
Velocity (ft/sec):	1.79	0.00	0.00
Computed Flow Time (minutes):	12.19	0.00	0.00

==

Total TOC (minutes): 39.54

==

Subbasin W3

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.40	0.00	0.00
Flow Length (ft):	82.00	0.00	0.00
Slope (%):	1.50	0.00	0.00
2 yr, 24 hr Rainfall (in):	1.68	0.00	0.00
Velocity (ft/sec):	0.05	0.00	0.00
Computed Flow Time (minutes):	28.37	0.00	0.00

Channel Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.01	0.00	0.00
Flow Length (ft):	360.00	0.00	0.00
Channel Slope (%):	0.40	0.00	0.00
Cross Section Area (ft^2):	1.08	0.00	0.00
Wetted Perimeter (ft):	10.40	0.00	0.00
Velocity (ft/sec):	1.60	0.00	0.00
Computed Flow Time (minutes):	3.75	0.00	0.00

==

Total TOC (minutes): 32.12

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Subbasin W4

User-Defined TOC override (minutes): 20.00

Subbasin W5

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.40	0.00	0.00
Flow Length (ft):	73.00	0.00	0.00
Slope (%):	1.37	0.00	0.00
2 yr, 24 hr Rainfall (in):	1.68	0.00	0.00
Velocity (ft/sec):	0.05	0.00	0.00
Computed Flow Time (minutes):	26.80	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	98.00	0.00	0.00
Slope (%):	2.04	0.00	0.00
Surface Type:	Grassed waterway	Unpaved	Unpaved
Velocity (ft/sec):	2.14	0.00	0.00
Computed Flow Time (minutes):	0.76	0.00	0.00

Channel Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.01	0.00	0.00
Flow Length (ft):	1310.00	0.00	0.00
Channel Slope (%):	5.00	0.00	0.00
Cross Section Area (ft²):	1.06	0.00	0.00
Wetted Perimeter (ft):	10.40	0.00	0.00
Velocity (ft/sec):	5.59	0.00	0.00
Computed Flow Time (minutes):	3.90	0.00	0.00

==

Total TOC (minutes): 31.47

==

Subbasin W6

User-Defined TOC override (minutes): 20.00

****
Subbasin Runoff Summary
****

Subbasin ID	Total Precip in	Total Runoff in	Peak Runoff cfs	Weighted Curve Number	Time of Concentration days	Time of Concentration hh:mm:ss
E1	4.31	1.90	0.72	75.000	0	00:19:18
E2	4.31	1.90	4.29	75.000	0	00:22:13
E3	4.31	1.90	3.38	75.000	0	00:39:46
NL1	4.31	3.09	2.40	88.750	0	00:05:00
NL2	4.31	2.57	1.52	83.200	0	00:05:00
NL3	4.31	2.57	0.71	83.200	0	00:05:00
NL4	4.31	3.86	0.93	96.150	0	00:05:00
NL-6	4.31	3.86	0.77	96.150	0	00:05:00
NL-7	4.31	3.86	0.59	96.150	0	00:05:00
W1	4.31	0.66	0.87	55.000	0	00:20:07
W2	4.31	1.90	3.61	75.000	0	00:39:32
W3	4.31	1.90	1.18	75.000	0	00:32:07
W4	4.31	1.90	2.89	75.000	0	00:20:00
W5	4.31	1.90	6.16	75.000	0	00:31:28
W6	4.31	1.90	1.91	75.000	0	00:20:00

****
Node Depth Summary
****

Node ID	Average Depth Attained ft	Maximum Depth Attained ft	Maximum HGL Attained ft	Time of Max Occurrence days	Time of Max Occurrence hh:mm	Total Flooded Volume acre-in	Total Time Flooded minutes	Retention Time hh:mm:ss
CBMH1538-77	0.18	0.73	207.58	0	12:10	0	0	0:00:00
CBMH1538-78	0.30	4.21	209.10	0	12:11	0	0	0:00:00
I2-1	0.98	4.78	208.10	0	12:13	1.10	28	0:00:00
I2-2	0.46	3.30	207.05	0	12:09	1.12	35	0:00:00
I2-3	0.45	3.33	207.15	0	12:12	0	0	0:00:00
I4-1	0.38	3.00	208.55	0	12:09	0.97	35	0:00:00
I4-2	0.65	4.26	209.26	0	12:09	0.00	0	0:00:00
S1-1	1.15	2.23	204.27	0	12:12	0	0	0:00:00
S1-2	1.15	2.82	204.99	0	12:12	0	0	0:00:00
S1-3	1.03	3.52	205.99	0	12:12	0	0	0:00:00
S1-4	1.05	3.66	206.23	0	12:12	0	0	0:00:00
S2-1	0.96	4.43	207.65	0	12:13	0	0	0:00:00
S2-2	0.99	3.96	206.99	0	12:12	0	0	0:00:00
S2-3	0.91	3.93	207.12	0	12:12	0	0	0:00:00
S3-1	0.66	4.06	207.79	0	12:09	0	0	0:00:00
S3-2	0.64	4.76	209.00	0	12:09	0.00	0	0:00:00
S4-1	0.62	4.03	208.82	0	12:09	0.00	0	0:00:00
S4-2	0.67	3.88	208.78	0	12:09	0.00	0	0:00:00
S5-1	0.96	3.79	206.66	0	12:12	0	0	0:00:00
Out-02	1.04	1.51	203.51	0	12:12	0	0	0:00:00

****
Node Flow Summary
****

Node ID	Element Type	Maximum Lateral Inflow cfs	Peak Inflow cfs	Time of Peak Inflow Occurrence days	Time of Peak Inflow Occurrence hh:mm	Maximum Flooding Overflow cfs	Time of Peak Flooding Occurrence days	Time of Peak Flooding Occurrence hh:mm
CBMH1538-77	JUNCTION	2.26	2.26	0	12:10	0.00		
CBMH1538-78	JUNCTION	1.42	3.60	0	12:10	0.00		

I2-1	JUNCTION	11.91	11.91	0	12:25	3.93	0	12:25
I2-2	JUNCTION	1.91	2.92	0	12:20	2.92	0	12:20
I2-3	JUNCTION	1.17	1.17	0	12:25	0.00		
I4-1	JUNCTION	4.26	4.26	0	12:20	2.98	0	12:25
I4-2	JUNCTION	3.34	3.34	0	12:30	0.09	0	12:09
S1-1	JUNCTION	0.00	17.50	0	12:12	0.00		
S1-2	JUNCTION	1.44	17.50	0	12:12	0.00		
S1-3	JUNCTION	1.39	16.28	0	12:12	0.00		
S1-4	JUNCTION	0.00	14.07	0	12:41	0.00		
S2-1	JUNCTION	0.85	8.83	0	12:41	0.00		
S2-2	JUNCTION	0.00	14.07	0	12:41	0.00		
S2-3	JUNCTION	0.00	5.93	0	12:45	0.00		
S3-1	JUNCTION	0.00	4.73	0	12:31	0.00		
S3-2	JUNCTION	0.00	4.73	0	12:31	0.75	0	12:09
S4-1	JUNCTION	0.00	4.73	0	12:31	0.45	0	12:09
S4-2	JUNCTION	0.72	4.73	0	12:31	0.64	0	12:09
S5-1	JUNCTION	0.00	14.07	0	12:41	0.00		
Out-02	OUTFALL	0.00	17.50	0	12:12	0.00		

****
Outfall Loading Summary
****

Outfall Node ID	Flow Frequency (%)	Average Flow cfs	Peak Inflow cfs
Out-02	99.96	4.40	17.50
System	99.96	4.40	17.50

****
Link Flow Summary
****

Link ID	Element Type	Time of Peak Flow Occurrence days hh:mm	Maximum Velocity Attained ft/sec	Length Factor	Peak Flow during Analysis cfs	Design Flow Capacity cfs	Ratio of Maximum /Design Flow	Ratio of Maximum Flow Depth	Total Time Surcharged minutes	Reported Condition
NL-P1	CONDUIT	0 12:10	2.40	1.00	2.20	3.46	0.64	0.79	0	Calculated
NL-P2	CONDUIT	0 12:12	2.31	1.00	3.24	4.20	0.77	1.00	3	SURCHARGED
P1-1	CONDUIT	0 12:12	6.00	1.00	17.50	14.15	1.24	0.88	0	> CAPACITY
P1-2	CONDUIT	0 12:12	5.57	1.00	17.50	13.84	1.27	1.00	33	SURCHARGED
P1-3	CONDUIT	0 12:12	5.18	1.00	16.28	13.42	1.21	1.00	44	SURCHARGED
P1-4	CONDUIT	0 12:41	4.48	1.00	14.07	14.03	1.00	1.00	48	SURCHARGED
P1-5	CONDUIT	0 12:41	4.48	1.00	14.07	13.42	1.05	1.00	51	SURCHARGED
P1-6	CONDUIT	0 12:41	4.48	1.00	14.07	13.42	1.05			

```
1.00          51  SURCHARGED
  P2-1                 CONDUIT      0  12:41      4.75    1.00         8.40         6.32       1.33
1.00          73  SURCHARGED
  P2-2                 CONDUIT      0  12:41      5.00    1.00         8.83         6.23       1.42
1.00          73  SURCHARGED
  P2-3                 CONDUIT      0  12:45      3.36    1.00         5.93         6.22       0.95
1.00          71  SURCHARGED
  P2-4                 CONDUIT      0  12:15      2.16    1.00         1.13         4.64       0.24
1.00          68  SURCHARGED
  P2-5                 CONDUIT      0  12:25      1.74    1.00         1.17         2.74       0.43
1.00          65  SURCHARGED
  P2-6                 CONDUIT      0  12:31      2.68    1.00         4.73         6.21       0.76
1.00          56  SURCHARGED
  P3-1                 CONDUIT      0  12:31      2.75    1.00         4.73         6.24       0.76
1.00          50  SURCHARGED
  P3-2                 CONDUIT      0  12:31      3.09    1.00         4.73         6.19       0.77
1.00          45  SURCHARGED
  P4-1                 CONDUIT      0  12:31      3.05    1.00         4.73         6.19       0.76
1.00          45  SURCHARGED
  P4-2                 CONDUIT      0  12:10      3.16    1.00         2.42         5.41       0.45
1.00          44  SURCHARGED
  P4-3                 CONDUIT      0  12:30      4.26    1.00         3.34         2.12       1.58
1.00          53  SURCHARGED


  ********************************
  Highest Flow Instability Indexes
  ********************************
  All links are stable.

  WARNING 107 : Initial water surface elevation defined for Junction CBMH1538-77 is below
junction invert elevation.
                Assumed initial water surface elevation equal to invert elevation.
  WARNING 108 : Surcharge elevation defined for Junction CBMH1538-77 is below junction maximum
elevation. Assumed surcharge elevation equal to maximum elevation.
  WARNING 107 : Initial water surface elevation defined for Junction CBMH1538-78 is below
junction invert elevation.
                Assumed initial water surface elevation equal to invert elevation.
  WARNING 108 : Surcharge elevation defined for Junction CBMH1538-78 is below junction maximum
elevation. Assumed surcharge elevation equal to maximum elevation.
  WARNING 108 : Surcharge elevation defined for Junction I4-1 is below junction maximum
elevation. Assumed surcharge elevation equal to maximum elevation.
  WARNING 116 : Conduit inlet invert elevation defined for Conduit NL-P2 is below upstream node
invert elevation.
                Assumed conduit inlet invert elevation equal to upstream node invert elevation.
  WARNING 116 : Conduit inlet invert elevation defined for Conduit P4-2 is below upstream node
invert elevation.
                Assumed conduit inlet invert elevation equal to upstream node invert elevation.

  Analysis began on:  Wed Jul 27 13:12:34 2022
  Analysis ended on:  Wed Jul 27 13:12:38 2022
  Total elapsed time: 00:00:04
```

Project Cost Estimates

Appendix E

Camrose Drive Storm Drain Project
MOA Project No. 20-27

ENGINEER'S ESTIMATE - DRAFT DSR - ALTERNATIVE 1 (GRAVITY SYSTEM)

ITEM No.	MASS No.	ITEM DESCRIPTION	UNIT	CALC. QUANT	CONT. FACTOR	ROUND FACTOR	EST QUANT	UNIT PRICE	TOTAL COST
Schedule A - Drainage & Roadway Improvements									
A-1	20.02	Storm Water Pollution Prevention Plan (Type 3)	LS	1	1.00	0	1	$26,000	$26,000
A-2	20.04	Clearing and Grubbing	LS	1	1.00	1	1	$23,000	$23,000
A-3	20.07	Remove Sidewalk or Concrete Apron	SY	58	1.00	0	58	$25	$1,450
A-4	20.08	Remove Curb and Gutter	LF	2,507	1.00	0	2,507	$10	$25,070
A-5	20.09	Remove Pavement	SY	4,746	1.00	0	4,746	$3	$14,238
A-6	20.13	Trench Dewatering	LS	1	1.00	0	1	$40,000	$40,000
A-7	20.13	Trench Excavation and Backfill (Various Depths)	LF	1,233	1.00	0	1,233	$40	$49,320
A-8	20.15	Furnish Trench Backfill (Type II)	Ton	480	1.20	-2	600	$18	$10,800
A-9	20.15	Furnish Trench Backfill (Type II-A)	Ton	5,217	1.20	-2	6,300	$26	$163,800
A-10	20.16	Bedding Material (Class D)	LF	1,233	1.00	0	1,233	$30	$36,990
A-11	20.22	Leveling Course	Ton	522	1.05	-1	550	$35	$19,250
A-12	20.26	Insulation Board (R-9)	SF	48,158	1.05	0	50,566	$3	$151,698
A-13	20.27	Disposal of Unusable or Surplus Material	CY	3,700	1.20	0	4,440	$20	$88,800
A-14	20.28	Reconstruct Driveway (All Types)	EA	24	1.00	0	24	$2,500	$60,000
A-15	30.02	P.C.C. Curb and Gutter (All Types)	LF	2,507	1.00	0	2,507	$35	$87,745
A-16	30.03	P.C.C. Sidewalk (4" Thick, Standard Finish)	SY	58	1.00	0	58	$72	$4,176
A-17	30.04	P.C.C. Curb Ramp (All Types)	EA	1	1.00	0	1	$4,000	$4,000
A-18	30.04	Detectable Warnings	SF	11	1.00	0	11	$100	$1,100
A-19	40.06	A.C. Pavement (Class E)	Ton	583	1.05	-1	610	$150	$91,500
A-20	55.02	Furnish, Install, and Televise Pipe (12-Inch, Type S, CPEP)	LF	138	1.00	0	138	$60	$8,280
A-21	55.02	Furnish, Install, and Televise Pipe (18-Inch, Type S, CPEP)	LF	731	1.00	0	731	$75	$54,825
A-22	55.02	Furnish, Install, and Televise Pipe (24-Inch, Type S, CPEP)	LF	364	1.00	0	364	$90	$32,760
A-23	55.04	Connect to Existing Storm Drain System	EA	1	1.00	0	1	$3,000	$3,000
A-24	55.05	Construct (Type I) Manhole	EA	6	1.00	0	6	$7,000	$42,000
A-25	55.05	Construct (Type II) Manhole	EA	3	1.00	0	3	$11,000	$33,000
A-26	55.05	Construct (Type II) Catch Basin Manhole	EA	3	1.00	0	3	$11,500	$34,500
A-27	55.05	Construct (Type II) Bypass Manhole	EA	1	1.00	0	1	$30,000	$30,000
A-28	55.09	Construct Catch Basin	EA	6	1.00	0	6	$5,500	$33,000
A-29	55.11	Remove Manhole	EA	7	1.00	0	7	$1,300	$9,100
A-30	55.11	Remove Catch Basin	EA	3	1.00	0	3	$1,100	$3,300
A-31	55.13	Abandon Storm Drain Pipe with Flowable Grout	LF	388	1.00	0	388	$70	$27,160
A-32	55.18	Construct Footing Drain Service (6-Inch, Type S, CPEP)	EA	23	1.00	0	23	$2,000	$46,000
A-33	55.22	Oil and Grit Separator	EA	1	1.00	0	1	$30,000	$30,000
A-34	55.23	Heat Trace	LF	1,420	1.10	0	1,562	$52	$81,224
A-35	55.27	Storm Drain Bypass System	LS	1	1.00	0	1	$30,000	$30,000
A-36	60.02	Raise or Lower Water Main (12-Inch Ductile Iron)	EA	1	1.00	0	1	$15,000	$15,000
A-37	60.05	Adjust Key Box	EA	5	1.00	0	5	$600	$3,000
A-38	65.02	Construction Survey Measurement	LS	1	1.00	0	1	$33,000	$33,000
A-39	65.02	Two-Person Survey Crew	Hour	40	1.00	0	40	$225	$9,000
A-40	70.07	Remove Pipe	LF	424	1.00	0	424	$15	$6,360
A-41	70.10	Traffic Markings (All Types)	LS	1	1.00	0	1	$5,000	$5,000
A-42	70.11	Standard Sign	LS	1	1.00	0	1	$5,000	$5,000
A-43	70.12	Traffic Maintenance	LS	1	1.00	0	1	$120,000	$120,000
A-44	70.17	Relocate Mailbox	EA	26	1.00	0	26	$800	$20,800
A-45	75.03	Topsoil (4-inch depth)	MSF	16	1.25	0	20	$1,000	$20,000
A-46	75.04	Seeding, Schedule A Mowable Seed Mix	MSF	16	1.25	0	20	$600	$12,000
A-47	80.02	Trench and Backfill (2'W x 3.5'D)	LF	885	1.10	1	974	$20	$19,470
A-48	80.04	Load Center Foundation (Type 1A)	EA	1	1.00	0	1	$6,770	$6,770
A-49	80.07	Liquid-Tight Flexible Metal Conduit (1-1/2 inch)	LF	610	1.05	0	641	$32	$20,512
A-50	80.07	Steel Conduit (1-1/2 inch)	LF	2,260	1.05	0	2,373	$16	$37,968
A-51	80.07	Steel Conduit (2 inch)	LF	10	1.05	0	11	$18	$195
A-52	80.08	Junction Box (Type 1A)	EA	5	1.00	0	5	$1,170	$5,850
A-53	80.08	Junction Box (Type 2)	EA	1	1.00	0	1	$2,100	$2,100
A-54	80.10	Conductor, 1C #8 AWG XHHW-2 Cable	LF	4,700	1.10	1	5,170	$8	$38,775
A-55	80.14	Single-Meter Pad-Mount Load Center, Type 1A, with Heat Trace Control	EA	1	1.00	0	1	$14,250	$14,250
								TOTAL	**$1,792,136**

Schedule A - Drainage & Roadway Improvements $1,792,136

Camrose Drive Storm Drain Project
MOA Project No. 20-27

ENGINEER'S ESTIMATE - DRAFT DSR - ALTERNATIVE 3 (LIFT STATION SYSTEM)

ITEM No.	MASS No.	ITEM DESCRIPTION	UNIT	CALC. QUANT	CONT. FACTOR	ROUND FACTOR	EST QUANT	UNIT PRICE	TOTAL COST
Schedule A - Drainage & Roadway Improvements									
A-1	20.02	Storm Water Pollution Prevention Plan (Type 3)	LS	1	1.00	0	1	$36,000	$36,000
A-2	20.04	Clearing and Grubbing	LS	1	1.00	1	1	$32,000	$32,000
A-3	20.08	Remove Curb and Gutter	LF	2,451	1.00	0	2,451	$10	$24,510
A-4	20.09	Remove Pavement	SY	4,774	1.00	0	4,774	$3	$14,322
A-5	20.13	Trench Dewatering	LS	1	1.00	0	1	$40,000	$40,000
A-6	20.13	Trench Excavation and Backfill (Various Depths)	LF	1,268	1.00	0	1,268	$40	$50,720
A-7	20.15	Furnish Trench Backfill (Type II)	Ton	780	1.20	-2	900	$18	$16,200
A-8	20.15	Furnish Trench Backfill (Type II-A)	Ton	5,208	1.20	-2	6,200	$26	$161,200
A-9	20.16	Bedding Material (Class D)	LF	1,268	1.00	0	1,268	$30	$38,040
A-10	20.22	Leveling Course	Ton	525	1.05	-1	550	$35	$19,250
A-11	20.26	Insulation Board (R-9)	SF	48,071	1.05	-1	50,470	$3	$151,410
A-12	20.27	Disposal of Unusable or Surplus Material	CY	3,710	1.20	0	4,452	$20	$89,040
A-13	20.28	Reconstruct Driveway (All Types)	EA	24	1.00	0	24	$2,500	$60,000
A-14	30.02	P.C.C. Curb and Gutter (All Types)	LF	2,451	1.00	0	2,451	$35	$85,785
A-15	40.06	A.C. Pavement (Class E)	Ton	592	1.05	-1	620	$150	$93,000
A-16	55.02	Furnish, Install, and Televise Pipe (12-Inch, Type S, CPEP)	LF	180	1.00	0	180	$60	$10,800
A-17	55.02	Furnish, Install, and Televise Pipe (18-Inch, Type S, CPEP)	LF	646	1.00	0	646	$75	$48,450
A-18	55.02	Furnish, Install Pipe (8-Inch, Type S, CPEP)	LF	51	1.00	0	51	$50	$2,550
A-19	55.02	Furnish, Install Pipe (10-Inch, Force Main, DIP)	LF	390	1.00	0	390	$110	$42,900
A-20	55.02	Furnish, Install (10"x16.75") Arctic Pipe	LF	390	1.00	0	390	$125	$48,750
A-21	55.05	Construct (Type I) Manhole	EA	5	1.00	0	5	$7,000	$35,000
A-22	55.05	Construct (Type II) Manhole	EA	1	1.00	0	1	$11,000	$11,000
A-23	55.05	Construct (Type II) Bypass Manhole	EA	1	1.00	0	1	$30,000	$30,000
A-24	55.09	Construct Catch Basin	EA	7	1.00	0	7	$5,500	$38,500
A-25	55.11	Remove Manhole	EA	4	1.00	0	4	$1,300	$5,200
A-26	55.11	Remove Catch Basin	EA	3	1.00	0	3	$1,100	$3,300
A-27	55.13	Abandon Storm Drain Pipe with Flowable Grout	LF	388	1.00	0	388	$70	$27,160
A-28	55.18	Construct Footing Drain Service (6-Inch, Type S, CPEP)	EA	23	1.00	0	23	$2,000	$46,000
A-29	55.22	Oil and Grit Separator	EA	1	1.00	0	1	$30,000	$30,000
A-30	55.23	Heat Trace	LF	400	1.10	0	440	$52	$22,880
A-31	55.27	Storm Drain Bypass System	LS	1	1.00	0	1	$30,000	$30,000
A-32	55.29	Furnish, Install Camrose Lift Station	LS	1	1.00	0	1	$785,400	$785,400
A-33	60.05	Adjust Key Box	EA	5	1.00	0	5	$600	$3,000
A-34	65.02	Construction Survey Measurement	LS	1	1.00	0	1	$46,000	$46,000
A-35	65.02	Two-Person Survey Crew	Hour	40	1.00	0	40	$225	$9,000
A-36	70.07	Remove Pipe	LF	278	1.00	0	278	$15	$4,170
A-37	70.10	Traffic Markings (All Types)	LS	1	1.00	0	1	$5,000	$5,000
A-38	70.11	Standard Sign	LS	1	1.00	0	1	$5,000	$5,000
A-39	70.12	Traffic Maintenance	LS	1	1.00	0	1	$170,000	$170,000
A-40	70.17	Relocate Mailbox	EA	26	1.00	0	26	$800	$20,800
A-41	75.03	Topsoil (4-inch depth)	MSF	16	1.25	0	20	$1,000	$20,000
A-42	75.04	Seeding, Schedule A Mowable Seed Mix	MSF	16	1.25	0	20	$600	$12,000
A-43	80.02	Trench and Backfill (2'W x 3.5'D)	LF	200	1.10	1	220	$20	$4,400
A-44	80.04	Load Center Foundation (Type 1A)	EA	1	1.00	0	1	$6,770	$6,770
A-45	80.07	Liquid-Tight Flexible Metal Conduit (1-1/2 inch)	LF	10	1.05	0	11	$32	$352
A-46	80.07	Steel Conduit (1-1/2 inch)	LF	200	1.05	0	210	$16	$3,360
A-47	80.07	Steel Conduit (2 inch)	LF	10	1.05	0	11	$18	$195
A-48	80.08	Junction Box (Type 1A)	EA	1	1.00	0	1	$1,170	$1,170
A-49	80.08	Junction Box (Type 2)	EA	1	1.00	0	1	$2,100	$2,100
A-50	80.10	Conductor, 1C #8 AWG XHHW-2 Cable	LF	400	1.10	1	440	$8	$3,300
A-51	80.14	Single-Meter Pad-Mount Load Center, Type 1A, with Heat Trace Control	EA	1	1.00	0	1	$14,250	$14,250
								TOTAL	**$2,460,234**

Schedule A - Drainage & Roadway Improvements $2,460,234

Camrose Drive Storm Drainage Project
MOA Project No. 20-27

Utility Relocation Cost Estimate Summary Alternative 1	
Electric (CEA)	$13,000
Telephone (ACS)	$21,000
Cable Television (GCI)	$30,000
Natural Gas (Enstar)	$52,000
Subtotal:	*$116,000*
Construction Contingency (15%)	*$17,000*
Total Utility Relocation Cost:	**$133,000**

Camrose Drive Storm Drainage Project
MOA Project No. 20-27
Alternative 1
CEA Utility Relocation Cost Estimate Summary

Id No.	APPROX. STATION	OFFSET	UTILITY CONFLICT	DESCRIPTION OF CONFLICT	RECOMMENDED ACTION	AMOUNT	UNIT	UNIT PRICE	COST	COMMENTS
CEA-1	21+00	CL	Underground Three-Phase Conductor	Storm Drain Pipe	Verify Depth, Relocate as Needed	50	LF	$108	$5,418	
CEA-2	22+56	CL	Underground Single-Phase Primary Conductor	Storm Drain Pipe	Verify Depth, Relocate as Needed	50	LF	$88	$4,386	
								Construction Costs:	$9,804	
								Engineering/Administration (30%):	$2,941	
								Total:	**$13,000**	

Camrose Drive Storm Drainage Project
MOA Project No. 20-27
Alternative 1
ACS Utility Relocation Cost Estimate Summary

Id No.	APPROX. STATION	OFFSET	UTILITY CONFLICT	DESCRIPTION OF CONFLICT	RECOMMENDED ACTION	AMOUNT	UNIT	UNIT PRICE	COST	COMMENTS
ACS-1	21+04	CL	Underground Copper Telecommunications	Storm Drain Pipe	Verify Depth, Relocate as Needed	50	LF	$108	$5,418	
ACS-2	22+43	CL	Underground Copper Telecommunications	Storm Drain Pipe	Verify Depth, Relocate as Needed	50	LF	$108	$5,418	
ACS-3	22+58	CL	Underground Copper Telecommunications	Storm Drain Pipe	Verify Depth, Relocate as Needed	50	LF	$108	$5,418	
								Construction Costs:	$16,254	
								Engineering/Administration (30%):	$4,876	
								Total:	**$21,000**	

Camrose Drive Storm Drainage Project
MOA Project No. 20-27
Alternative 1
GCI Utility Relocation Cost Estimate Summary

Id No.	APPROX. STATION	OFFSET	UTILITY CONFLICT	DESCRIPTION OF CONFLICT	RECOMMENDED ACTION	AMOUNT	UNIT	UNIT PRICE	COST	COMMENTS
GCI-1	3+50	CL	2 Underground Crossings, .875 and .750 Coaxial Cables	Storm Drain Pipe	Relocate as needed	50	LF	$117	$5,838	
GCI-2	20+89	CL	Underground .875 Coaxial Cable	Storm Drain Pipe	Verify Depth, Relocate as Needed	50	LF	$117	$5,838	
GCI-3	22+39	CL	2 Underground .875 Coaxial Calbe Crossings	Storm Drain Pipe	Verify Depth, Relocate as Needed	100	LF	$117	$11,675	
								Construction Costs:	$23,350	
								Engineering/Administration (30%)	$7,005	
								Total:	**$30,000**	

Camrose Drive Storm Drainage Project
MOA Project No. 20-27
Alternative 1
ENSTAR Utility Relocation Cost Estimate Summary

Id No.	APPROX. STATION	OFFSET	UTILITY CONFLICT	DESCRIPTION OF CONFLICT	RECOMMENDED ACTION	AMOUNT	UNIT	UNIT PRICE	COST	COMMENTS
Enstar-1	2+10	RT	1 1/4-inch Steel	Storm Drain Manhole	Relocate as needed	30	LF	$129	$3,870	
Enstar-2	2+60	RT	1 1/4-inch Steel, 2-inch Steel, Pipe Tee	Storm Drain Pipe	Relocate as needed	30	LF	$148	$4,451	Assume the Pipe Tee will need to be relocated if there is a conflict.
Enstar-3	3+70	CL	3/4-inch Steel Service Crossing	Storm Drain Pipe	Relocate as needed	1	EA	$2,709	$2,709	Assume Enstar will replace the steel service line with a 3/4-inch plastic line.
Enstar-4	4+90	CL	3/4-inch Steel Service Crossing	Storm Drain Pipe	Relocate as needed	1	EA	$2,709	$2,709	Assume Enstar will replace the steel service line with a 3/4-inch plastic line.
Enstar-5	6+30	RT	3/4-inch Steel Service Crossing	Storm Drain Pipe	Relocate as needed	1	EA	$2,709	$2,709	Assume Enstar will replace the steel service line with a 3/4-inch plastic line.
Enstar-6	7+40	RT	3/4-inch Steel Service Crossing	Storm Drain Pipe	Relocate as needed	1	EA	$2,709	$2,709	Assume Enstar will replace the steel service line with a 3/4-inch plastic line.
Enstar-7	8+75	RT	2-inch Steel	Storm Drain Pipe	Relocate as needed	20	LF	$148	$2,967	
Enstar-8	22+44	CL	2-inch Steel	Storm Drain Pipe	Verify Depth, Relocate as Needed	50	LF	$148	$7,418	
Enstar-9	23+46 - 24+18	RT	2-inch Steel	Storm Drain Manholes and Pipe	Relocate as needed	72	LF	$148	$10,681	
								Construction Costs:	$40,222	
								Engineering/Administration (30%)	$12,067	
								Total:	**$52,000**	

Camrose Drive Storm Drainage Project
MOA Project No. 20-27

Utility Relocation Cost Estimate Summary Alternative 3	
Electric (CEA)	$0
Telephone (ACS)	$0
Cable Television (GCI)	$8,000
Natural Gas (Enstar)	$23,000
Subtotal:	*$31,000*
Construction Contingency (15%)	*$5,000*
Total Utility Relocation Cost:	**$36,000**

Camrose Drive Storm Drainage Project
MOA Project No. 20-27
Alternative 3
GCI Utility Relocation Cost Estimate Summary

Id No.	APPROX. STATION	OFFSET	UTILITY CONFLICT	DESCRIPTION OF CONFLICT	RECOMMENDED ACTION	AMOUNT	UNIT	UNIT PRICE	COST	COMMENTS
GCI-1	3+50	CL	2Underground Crossings, .875 and .750 Coaxial Cables	Storm Drain Pipe	Relocate as needed	50	LF	$117	$5,838	
								Construction Costs:	$5,838	
								Engineering/Administration (30%)	$1,751	
								Total:	**$8,000**	

Camrose Drive Storm Drainage Project
MOA Project No. 20-27
Alternative 3
ENSTAR Utility Relocation Cost Estimate Summary

Id No.	APPROX. STATION	OFFSET	UTILITY CONFLICT	DESCRIPTION OF CONFLICT	RECOMMENDED ACTION	AMOUNT	UNIT	UNIT PRICE	COST	COMMENTS
Enstar-1	2+10	RT	1 1/4-inch Steel	Storm Drain Manhole	Relocate as needed	30	LF	$129	$3,870	
Enstar-2	3+70	CL	3/4-inch Steel Service Crossing	Storm Drain Pipe	Relocate as needed	1	EA	$2,709	$2,709	Assume Enstar will replace the steel service line with a 3/4-inch plastic line.
Enstar-3	4+90	CL	3/4-inch Steel Service Crossing	Storm Drain Pipe	Relocate as needed	1	EA	$2,709	$2,709	Assume Enstar will replace the steel service line with a 3/4-inch plastic line.
Enstar-4	6+30	RT	3/4-inch Steel Service Crossing	Storm Drain Pipe	Relocate as needed	1	EA	$2,709	$2,709	Assume Enstar will replace the steel service line with a 3/4-inch plastic line.
Enstar-5	7+40	RT	3/4-inch Steel Service Crossing	Storm Drain Pipe	Relocate as needed	1	EA	$2,709	$2,709	Assume Enstar will replace the steel service line with a 3/4-inch plastic line.
Enstar-6	8+75	RT	2-inch Steel	Storm Drain Pipe	Relocate as needed	20	LF	$148	$2,967	
								Construction Costs:	$17,673	
								Engineering/Administration (30%)	$5,302	
								Total:	**$23,000**	

Public Involvement

Appendix F

February 2022

Project Background

The Municipality of Anchorage Project Management & Engineering Department (MOA PM&E) is planning to upgrade the storm drain system along Camrose Drive (see map to the right).

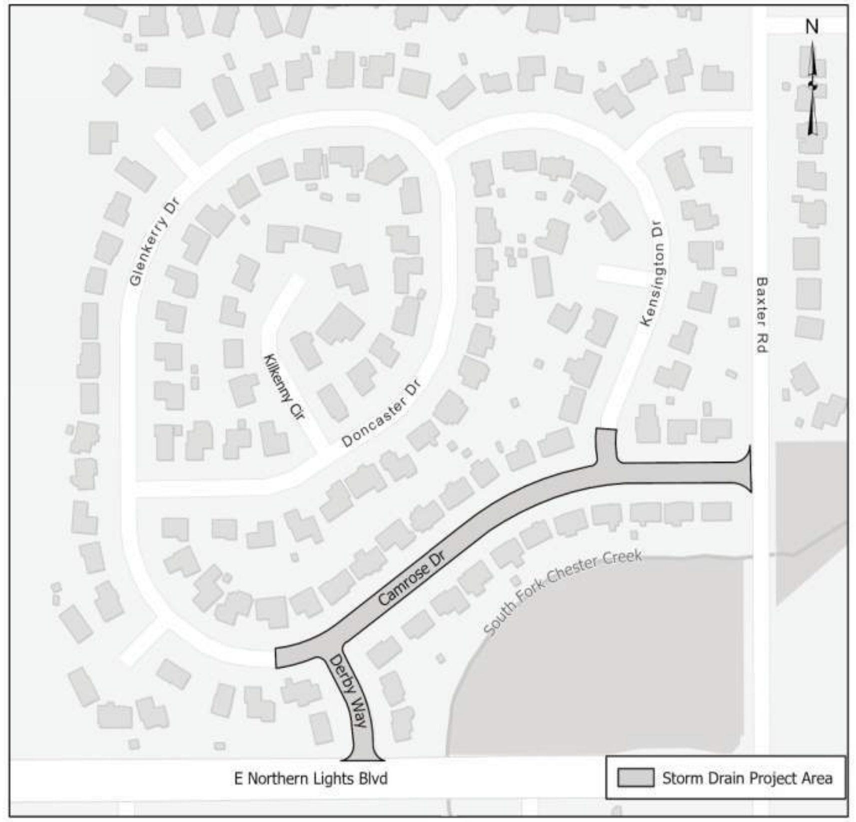
Improvements may include:

- New storm drain system
- New storm water lift station
- New road foundation
- New asphalt pavement

MOA PM&E has contracted with CRW Engineering Group, LLC (CRW) to provide preliminary engineering and design services. CRW will evaluate alternatives to improve the drainage and roadways and provide recommendations in a Design Study Report (DSR).

The project is funded only through the DSR and design phases. No funding for construction has been received at this time.

Project Map



Ways to Participate:

1 Complete and Return the Project Questionnaire by February 28, 2022

Online

By visiting the website listed below, scanning the QR code below using your smart phone camera, or go to www.surveymonkey.com/r/Camrose.

OR

By Mail

Complete the questionnaire and return it by mail. Tear off the last page, fold, and secure with the prepaid postage visible.

OR

By E-Mail

Fill out, scan, and email your completed questionnaire to holly@huddleak.com.

2 Sign up for email updates on the website

3 Contact us with questions:

Holly Spoth-Torres, Huddle AK
P: (907) 223-0136 E: holly@huddleak.com

www.CamroseDriveDrainage.com

Please cut or tear along the dotted line to return questionnaire

Camrose Drive Storm Drainage Questionnaire

Name: ______________________________

Physical Address: ______________________________ Mailing Address (if different): ______________________________

Email (optional): ______________________________ Would you like to receive email updates (circle one): YES / NO

Phone Number (optional): ______________________________

Your comments are important to us. We will use this information to aid in designing the improvements.

1. Do you own the property? Please circle one: YES / NO
2. Are you aware of any drainage problems within the Camrose Drive storm drain project area that need to be corrected? Please circle one: YES / NO
If yes, please explain: ______________________________
3. Are there any special conditions on your property that you feel the design team should be aware of when designing the project? Please circle one: YES / NO
If yes, please explain: ______________________________
4. Have you ever experienced groundwater problems in your crawl space or basement? Please circle one: YES / NO
If yes, please explain: ______________________________
5. Do you have a foundation drain or sump pump? Please circle one: YES / NO
If yes, how many? ________
Where are they located? ______________________________
Where does it drain? ______________________________
How often does the pump run? (e.g. All year, spring, fall, after storms, etc.) ______________________________
6. Is your driveway heated or constructed with concrete? Please circle one answer for each:
Heated: YES / NO
Concrete: YES / NO
7. Please include any other comments: ______________________________

Thank you. We appreciate your input.

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QUESTIONNAIRE WITHIN

Huddle AK
605 W. 2nd Ave
Anchorage, AK 99501

www.CamroseDriveDrainage.com

NAME
ADDRESS
ANCHORAGE, AK

Please fold along the dotted line to return questionnaire

Please secure here before returning

Huddle AK
605 W. 2nd Ave
Anchorage, AK 99501

Please secure here before returning

HELLO, CAMROSE DRIVE NEIGHBORS!

This packet contains important information regarding an upcoming project in your neighborhood. It also contains a project questionnaire designed to gather more information about the current conditions of the project area.

Follow these steps to get the most out of this process:

REVIEW the information in this packet.

COMPLETE AND RETURN the questionnaire by February 28, 2022.

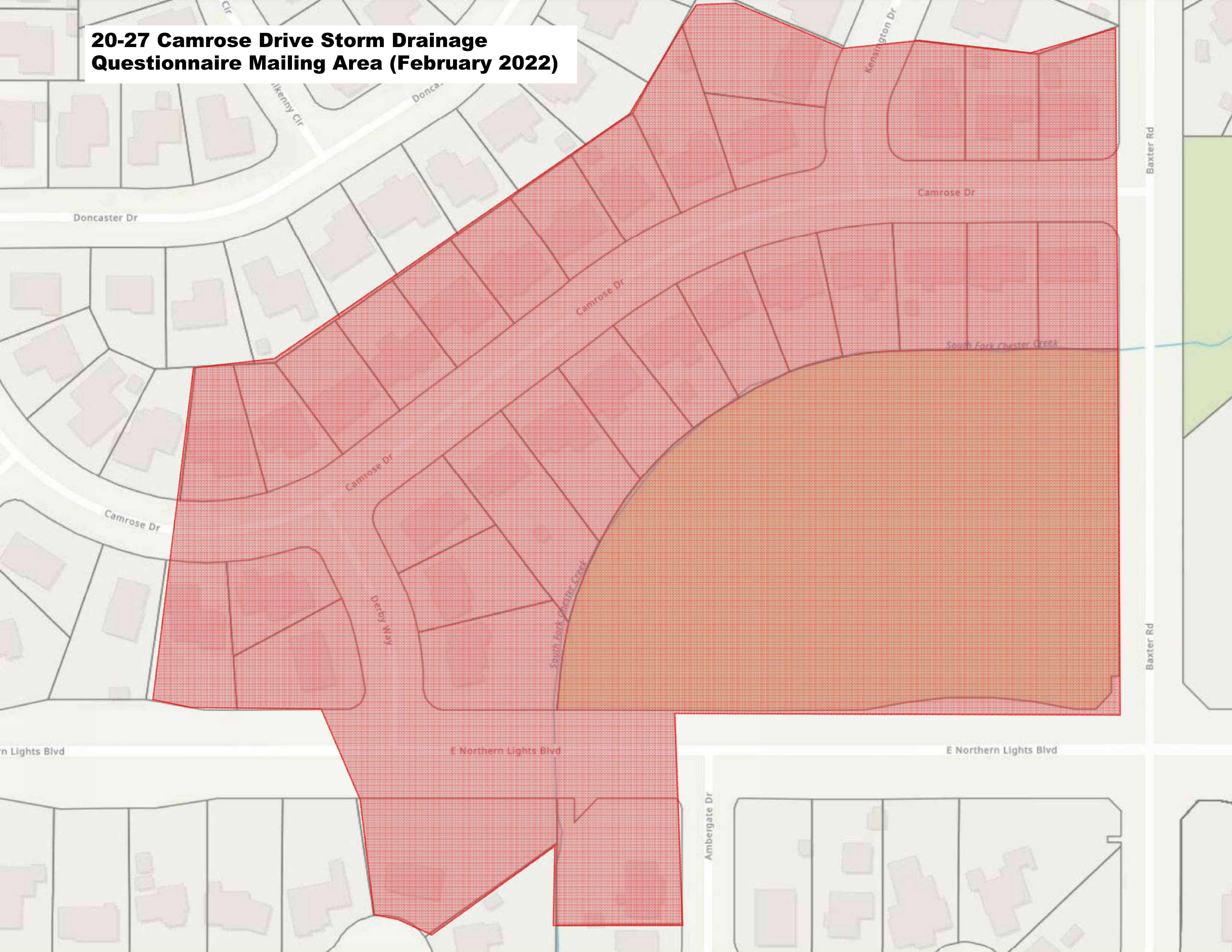
VISIT THE PROJECT WEBSITE to sign up for email updates and stay up to date.

CONTACT US
If you have questions or concerns, or would like to provide feedback to project staff, please contact us or visit the project website!

Call: Holly Spoth-Torres at (907) 223-0136
Email: holly@huddleak.com

www.CamroseDriveDrainage.com

20-27 Camrose Drive Storm Drainage Questionnaire Mailing Area (February 2022)



Questionnaire Results Summary

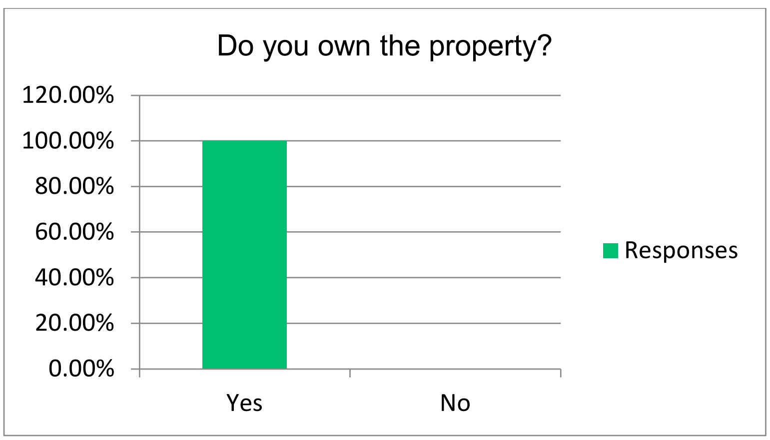
Date: March 7, 2022
Prepared By: Michelle Fehribach, Huddle AK
Project: Camrose Drive Storm Drainage Project
PM&E #20-27

Summary

A project questionnaire for the Camrose Drive Storm Drainage Project was created by the project team using SurveyMonkey and the questionnaire was open for responses from February 10 through March 7, 2022. Forty-eight paper questionnaires were mailed to the project area, with return postage included. A total of 10 people completed the questionnaire. Below is a summary of the answers to each question, including the open-ended responses.

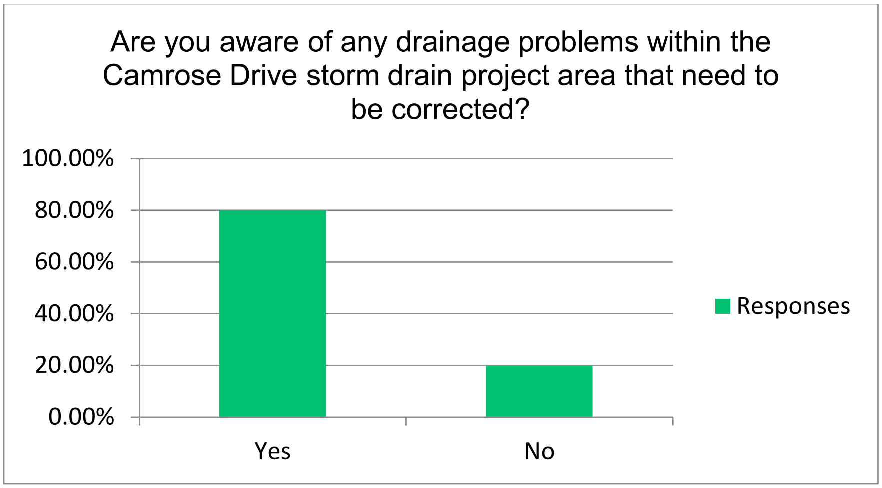
Question: Do you own the property?

Answered: 10 Skipped:0
Yes: 10 (100%) No: 0 (0%)



Question: Are you aware of any drainage problems within the Camrose Drive storm drain project area that need to be corrected?

Answered: 10 Skipped: 0
Yes: 8 (80%) No: 2 (20%)



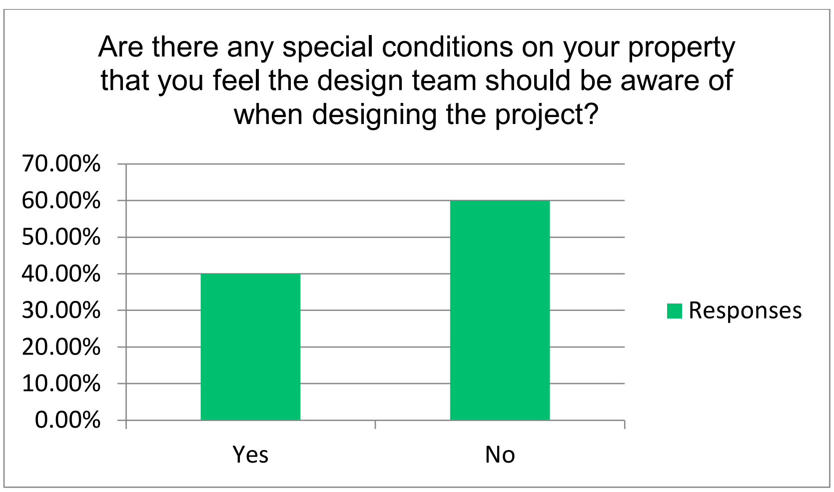
The individual responses for the people who said “yes” are listed below:

If yes, please explain:	Name	Address	Parcel Number
Floods frequently	Verrill and Phyllis Linnean	6019 Camrose	7
For 28 years we have seen water covering the roadway each spring. Too much water; too few drains/sewers. Spring 2020 and 2021 we also had three (3) sinkholes on the roadway of Camrose Drive and water up to the west end of our property.	Thomas J. and LouAnn S. Balensiefer	6029 Camrose Dr.	8
Every spring and even sometimes when it gets warm in the winter or when we have lots of rain in the summer the drains do not work very well.	Darrel and Patti Kincade	6030 Camrose Dr	26
Corner of Derby and Camrose floods every spring and heavy rains. Kensington and Camrose sometimes	Nancy Nelson	2544 Kensington Dr	14
In general, I understand the entire SD system is in need of replacement due to eroded pipes and the outlet to Chester Creek is non-existent. In addition, the road subsurface is ""spongy"" during the spring thaw, which in turn leads to numerous potholes/uneven road surface. Additionally, the intersection of Derby/Camrose becomes a large pond during spring thaw, again due	Tanya Hickok	5939 Camrose Drive	5

to the non-existent outlet to Chester Creek.			
Mayor water accumulation at the intersection of Derby dr and Camrose specially during spring when snow is melting up to 18” of water in some areas. Sink holes forming around manholes	Jesus Chavira	6005 Camrose Dr	6
Drainage issue between my driveway and next house. Persistent sink hole in road despite frequent patching. My driveway was also sagging (replaced 2021). Corner of Derby and Camrose AWFUL in spring.	Alyssa Tacke	6200 Camrose Dr	21
They explained it to me and said they would be digging up my drive and side yard.	Calvin Graham and Michelle Jones	6206 Camrose Dr	20

Question: Are there any special conditions on your property that you feel the design team should be aware of when designing the project?

Answered: 10 Skipped: 0
Yes: 4 (40%) No: 6 (60%)

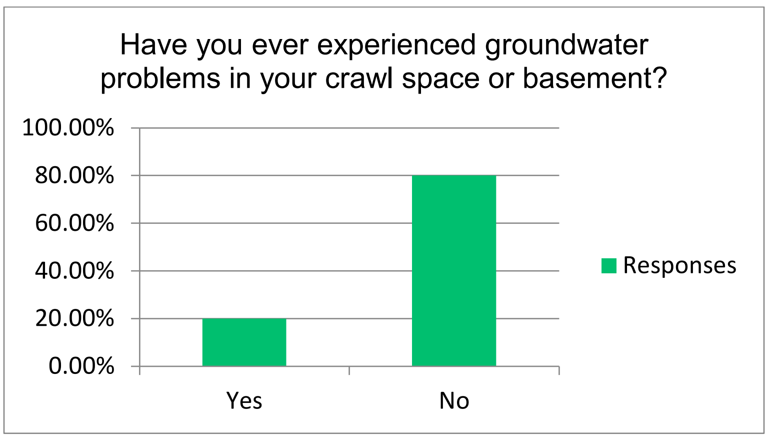


If yes, please explain:	Name	Address	Parcel Number
Fire plug light pole - drive way	Verrill and Phyllis Linnean	6019 Camrose	7
We have two (2) areas of our front lawn that keep sinking. Also, directly in front of our property are	Thomas J. and LouAnn S. Balensiefer	6029 Camrose Dr.	8

a crack and a dip in the asphalt on the roadway that collects water.			
Curb in front of my home buckled causing water back up during heavy rain	Nancy Nelson	2544 Kensington Dr	14
My driveway, neighbors driveway JUST replaced. Create slope so water runs into drain instead of pooling in front?	Alyssa Tacke	6200 Camrose Dr	21

Question: Have you ever experienced groundwater problems in your crawl space or basement?

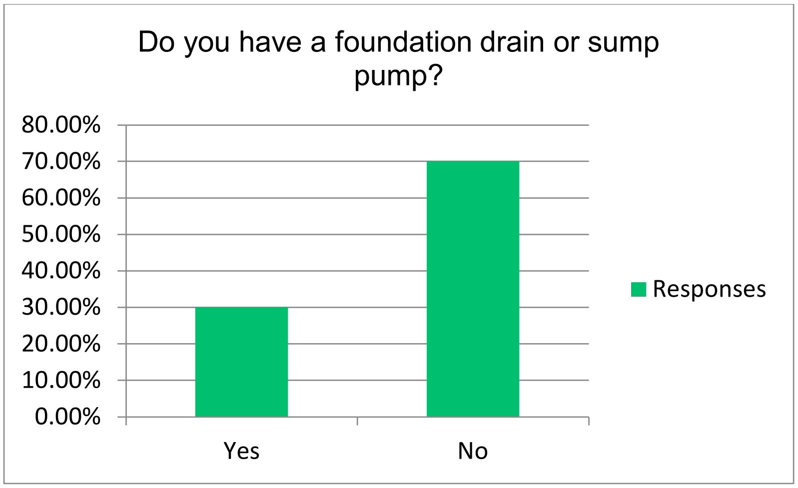
Answered: 10 Skipped: 0
Yes: 2 (20%) No: 8 (80%)



If yes, please explain:	Name	Address	Parcel Number
Basement has flooded	Nancy Nelson	2544 Kensington Dr	14
Water pooling in downstairs every spring.	Alyssa Tacke	6200 Camrose Dr	21

Question: Do you have a foundation drain or sump pump?

Answered: 10 Skipped: 0
Yes: 3 (30%) No: 7 (70%)

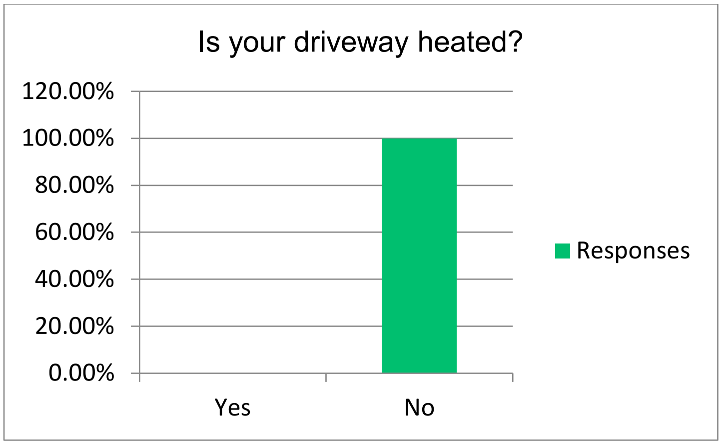


If someone answered "yes", they were prompted to answer more detailed questions about its location and when it runs. The answers for those who answered "yes" are below:

#	Location	Where it drains	How often it runs	Name	Address	Parcel Number
1	Garage	?	(skipped)	Verrill and Phyllis Linnean	6019 Camrose	7
1	Southwest corner of house in backyard	Towards Kensington	Manual turned on when needed	Nancy Nelson	2544 Kensington Dr	14
1	near utilities on back of house	end of property, backside of house	As needed. Float mechanism.	Alyssa Tacke	6200 Camrose Dr	21

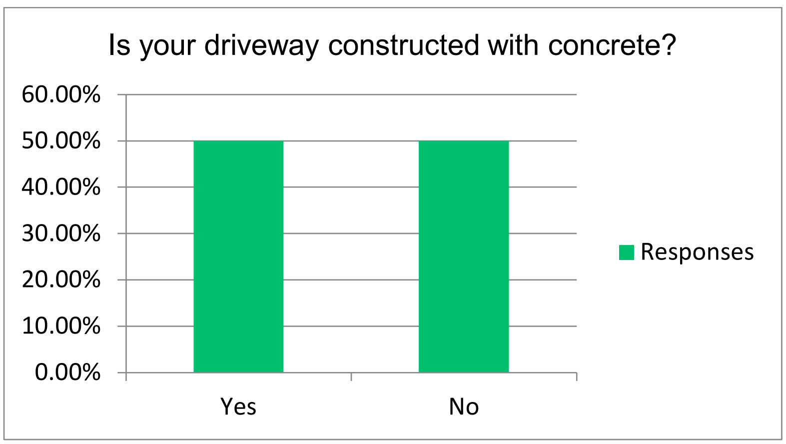
Question: Is your driveway heated?

Answered: 10 Skipped: 0
Yes: 0 (0%) No: 10 (100%)



Question: Is your driveway constructed with concrete?

Answered: 10 Skipped: 0
Yes: 5 (50%) No: 5 (50%)



The names and addresses for those who answered "yes" to this question are below:

Name	Address	Parcel Number
Verrill and Phyllis Linnean	6019 Camrose	7
Patricia Hudspeth - M & H Properties	2715 Derby Way	29
Tanya Hickok	5939 Camrose Drive	5
Jesus Chavira	6005 Camrose Dr	6
Alyssa Tacke	6200 Camrose Dr	21

Question: Please include any other comments.

Answered: 8 Skipped: 2

Responses	Name	Address	Parcel Number
We have lived here 29 years. Most of those years we have had water that can't drain to the west of our property.	Thomas J. and LouAnn S. Balensiefer	6029 Camrose Dr.	8
When it does back up the water will go past my driveway. My house is 3 houses from the corner of Derby Way.	Darrel and Patti Kincade	6030 Camrose Dr	26
Homes on both sides of me have sump pumps as well	Nancy Nelson	2544 Kensington Dr	14
Are there any considerations of adding sidewalks to the subdivision?	Tanya Hickok	5939 Camrose Drive	5
All the driveways on 6005, 6019, 6006, 6020 are sunken and cracked extremely due to the water accumulation mainly in that area	Jesus Chavira	6005 Camrose Dr	6
What can we expect and when?	Chamberlain David	2000 W Marston Dr	25
I'm a big proponent of repair. I called several times when I was replacing my driveway to discuss a potential repair of drainage system. It was extremely difficult for me to find the right person to talk to. I think his name was Bob.	Alyssa Tacke	6200 Camrose Dr	21
We just want everything put back like it was if you have to dig up our driveway, yard, trees, and fence.	Calvin Graham and Michelle Jones	6206 Camrose Dr	20

From: CRW Engineering Group LLC <comments@crweng.com> <comments@crweng.com>
Sent: Tuesday, February 22, 2022 12:01 PM
To: Bill Johnson<bjohnson@crweng.com> <bjohnson@crweng.com>
Subject: Camrose Drive Drainage: Project Intro & Questionnaire

PROJECT INTRODUCTION

The Municipality of Anchorage Project Management & Engineering Department (MOA PM&E) is planning to upgrade the storm drainage system along Camrose Drive.

Improvements may include:

- New storm drain system
- New storm water lift station
- New road foundation
- New asphalt pavement

MOA PM&E has contracted with CRW Engineering Group, LLC (CRW) to provide preliminary engineering and design services. CRW will evaluate alternatives to improve the drainage and roadways and provide recommendations in a Design Study Report (DSR). The project is funded only through the DSR and design phases. No funding for construction has been received at this time.

How to Get Involved:

1. Complete the project questionnaire online or by completing and returning the paper version, which was mailed to residents/owners along the storm drain project area in early February 2022. Complete the questionnaire by February 28, 2022.

2. Contact us anytime with comments or questions at holly@huddleak.com.

PROJECT WEBSITE

PROJECT AREA

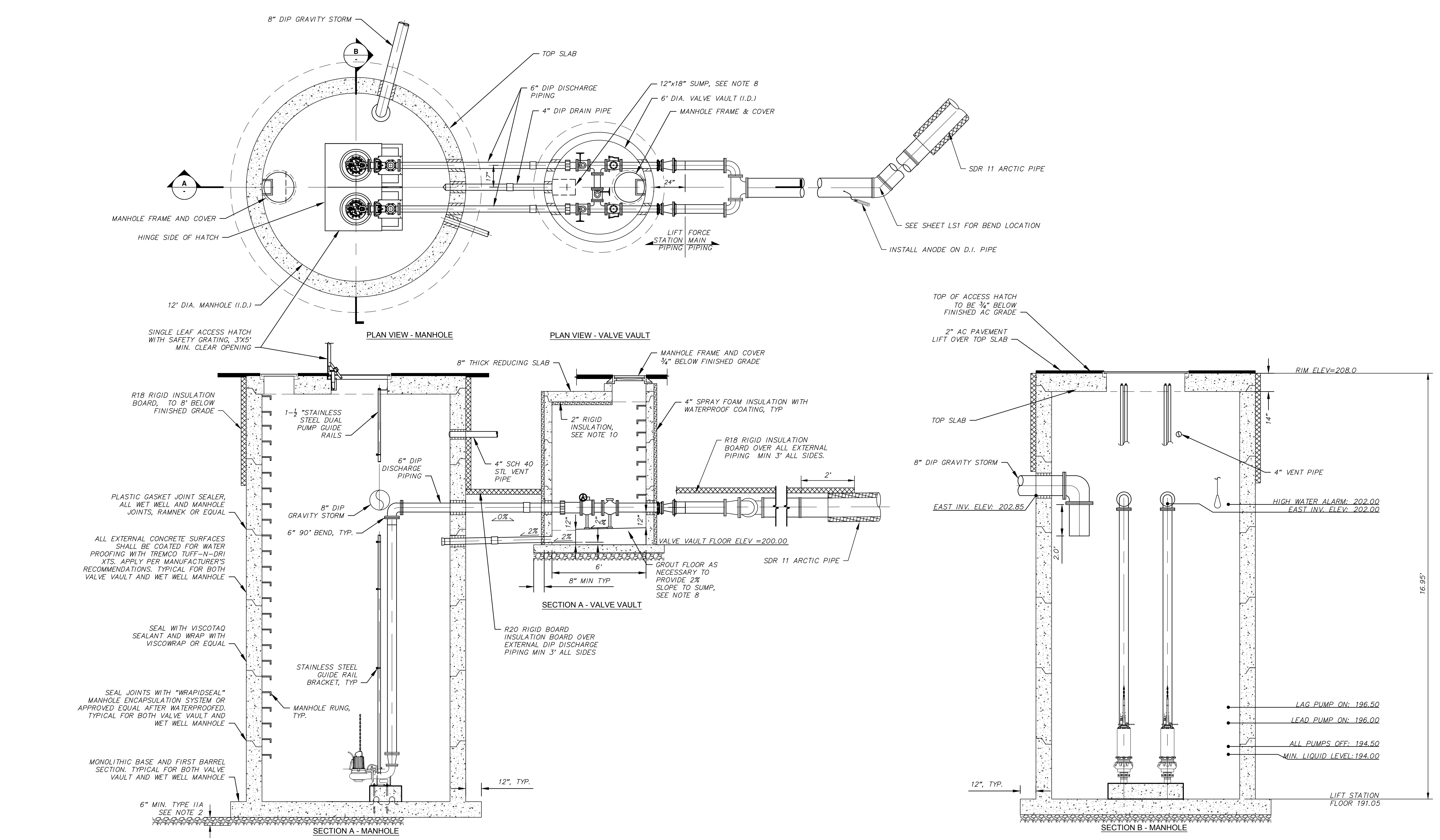
For more information, contact project staff or visit the project website.

Email the project team.

PM&E
PROJECT MANAGEMENT & ENGINEERING

Lift Station Information

Appendix G



RECORD DRAWING

THIS WILL SERVE TO CERTIFY THAT THESE RECORD DRAWINGS ARE A TRUE AND ACCURATE REPRESENTATION OF THE PROJECT AS CONSTRUCTED.

CONTRACTOR: ____________

BY: ____________

TITLE: ____________

DATE: ____________

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

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

14-49 CAMROSE DRIVE DRAINAGE IMPROVEMENTS SCHED. A

DETAILS – LIFT STATION PLAN & SECTION

SCALE HOR. NTS VER. NTS | GRID SW2025, SW2125 | DATE MAY 2018 | STATUS FINAL | SHEET of

File: J:\JobsData\10152.00 Camrose Drive Storm Drainage\00 CADD 2019\01 Working Set\01 Civil\01 DSR\10152.00 LS - Details.dwg

10152.00 Camrose Drive Lift Station

2145

Lift Station Input:

Pipe	8	in DIP
Pipe Inside Diameter	8.55	in
Pipe Length	9	ft
Kinematic Viscosity	1.66E-05	ft^2/s
Roughness (e)	0.06	in
Flow Range, Lower Limit	0	gpm
Flow Range, Upper Limit	2250	gpm
Lift Station Pump Off Elevation	0	ft
LS Invert Out Elevation	8.67	ft
Pump Efficiency	65	%
Motor Efficiency	80	%

Minor Losses - Lift Station:

Number of Fittings	Type of Fitting	Head-loss Coefficient (K)	Total per type of fitting (K)
1	45 Degree Elbow	0.24	0.24
1	Check Valve	1.5	1.5
1	90 Degree Elbow	0.45	0.45
1	Plug Valve	0.25	0.25
1	Tee Branch	0.84	0.84
Total system minor head-loss coefficient (K):			3.28

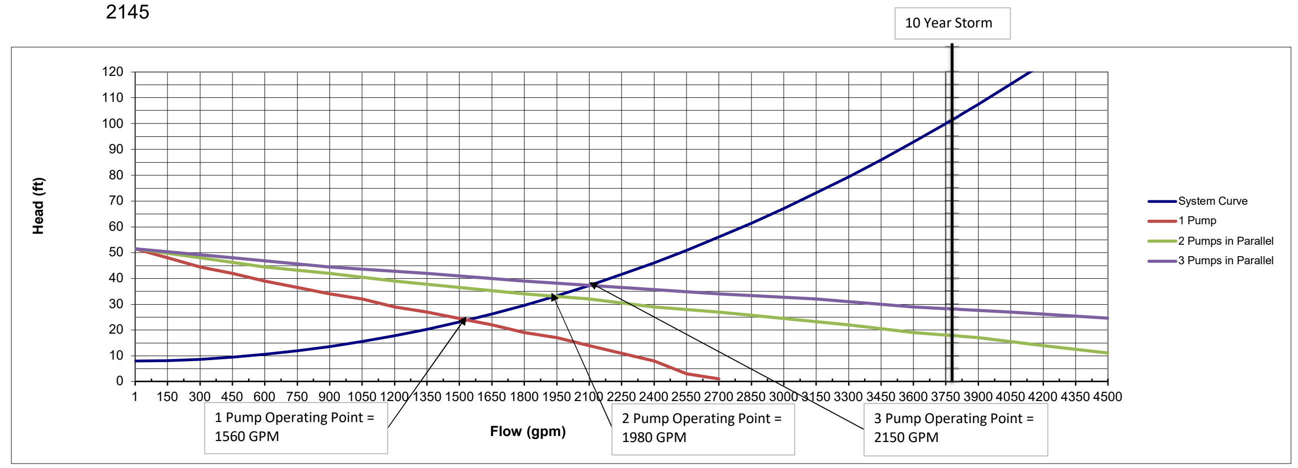
Force Main Input:

Pipe	10	in HDPE
Pipe Inside Diameter	8.68	in
Pipe Length (5% Contingency)	395	ft
Kinematic Viscosity	1.66E-05	ft^2/s
Roughness (e)	0.005	in
LS Invert Out Elevation	8.67	ft
Discharge Invert	8	ft

Minor Losses - Force Main

Number of Fittings	Type of Fitting	Head-loss Coefficient (K)	Total per type of fitting (K)
6	22.5 Bend	0.11	0.66
0	3 Bend	0.05	0
Total system minor head-loss coefficient (K):			0.66

Entered
From other cell
Calculated
Fixed



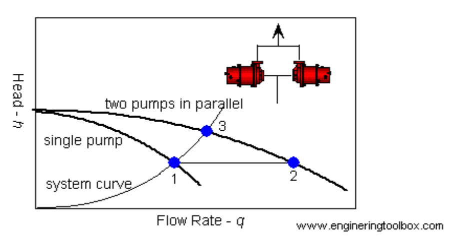
Output:

Flow Rate (gpm)	Flow Rate (ft^3/s)	Velocity in lift station (ft/s)	Velocity in force main (ft/s)	Reynold's # Lift Station	Reynold's # Force Main	Ratio (e/D) Lift Station	Ratio (e/D) Force Main	f (Swamee & Jain) Lift Station	f (Swamee & Jain) Force Main	Frictional Headloss (ft)	Frictional Headloss (psi)	Fittings Frictional Headloss (ft)	Fittings Frictional Headloss (psi)	Total Frictional Head Loss (ft)	Total Frictional Head Loss (psi)	Total Head Loss (psi)	Total Head Loss (ft)	Pump 1 (ft)	2 Pumps	3 pumps	Time in Pipe (Minutes)
1	0.002	0.01	0.01	2.39E+02	2.36E+02	0.00702	0.00058	0.134629233	0.1323060	0.0	0	0.00	0.00	0.0	0.00	3.5	8.0	51.5	51.5	51.5	1239.99
150	0.334	0.84	0.81	3.59E+04	3.54E+04	0.00702	0.00058	0.036188454	0.0242813	0.1	0	0.04	0.02	0.2	0.08	3.5	8.2	48			8.27
300	0.668	1.68	1.63	7.18E+04	7.07E+04	0.00702	0.00058	0.035086031	0.0217028	0.5	0.2	0.17	0.07	0.7	0.29	3.8	8.7	44.5	48.0		4.13
450	1.003	2.51	2.44	1.08E+05	1.06E+05	0.00702	0.00058	0.03468363	0.0205919	1.1	0.5	0.38	0.17	1.5	0.63	4.1	9.5	42		48.0	2.76
600	1.337	3.35	3.25	1.44E+05	1.41E+05	0.00702	0.00058	0.034472254	0.0199523	1.9	0.8	0.68	0.30	2.5	1.10	4.6	10.5	39	44.5		2.07
750	1.671	4.19	4.07	1.79E+05	1.77E+05	0.00702	0.00058	0.034341076	0.0195307	2.9	1.2	1.06	0.46	3.9	1.70	5.2	11.9	36.5			1.65
900	2.005	5.03	4.88	2.15E+05	2.12E+05	0.00702	0.00058	0.034251359	0.0192296	4.0	1.8	1.53	0.66	5.6	2.42	5.9	13.6	34	42.0	44.5	1.38
1050	2.340	5.87	5.69	2.51E+05	2.47E+05	0.00702	0.00058	0.034185945	0.0190028	5.4	2.4	2.09	0.90	7.5	3.26	6.7	15.5	32			1.18
1200	2.674	6.71	6.51	2.87E+05	2.83E+05	0.00702	0.00058	0.034136036	0.0188252	7.0	3.1	2.72	1.18	9.8	4.24	7.7	17.8	29	39.0		1.03
1350	3.008	7.54	7.32	3.23E+05	3.18E+05	0.00702	0.00058	0.034096643	0.0186821	8.9	3.8	3.45	1.49	12.3	5.33	8.8	20.3	27		42.0	0.92
1500	3.342	8.38	8.13	3.59E+05	3.54E+05	0.00702	0.00058	0.03406472	0.0185642	10.9	4.7	4.26	1.85	15.1	6.56	10.0	23.1	24.5	36.5		0.83
1650	3.676	9.22	8.95	3.95E+05	3.89E+05	0.00702	0.00058	0.034038301	0.0184651	13.1	5.7	5.15	2.23	18.2	7.90	11.4	26.2	22			0.75
1800	4.011	10.06	9.76	4.31E+05	4.24E+05	0.00702	0.00058	0.034016057	0.0183806	15.5	6.7	6.13	2.66	21.6	9.37	12.8	29.6	19	34.0	39.0	0.69
1950	4.345	10.90	10.57	4.67E+05	4.60E+05	0.00702	0.00058	0.033997059	0.0183077	18.1	7.9	7.19	3.12	25.3	10.97	14.4	33.3	17.0			0.64
2100	4.679	11.74	11.39	5.03E+05	4.95E+05	0.00702	0.00058	0.033980635	0.0182441	20.9	9.1	8.34	3.62	29.3	12.69	16.2	37.3	14.0	32.0		0.59
2250	5.013	12.57	12.20	5.38E+05	5.30E+05	0.00702	0.00058	0.033966288	0.0181880	24.0	10.4	9.58	4.15	33.5	14.54	18.0	41.5	11.0		36.5	0.55
2400	5.348	13.41	13.01	5.74E+05	5.66E+05	0.00702	0.00058	0.033953642	0.0181383	27.2	11.8	10.90	4.72	38.1	16.51	20.0	46.1	8.0	29.0		0.52
2550	5.682	14.25	13.83	6.10E+05	6.01E+05	0.00702	0.00058	0.033942407	0.0180938	30.6	13.3	12.30	5.33	42.9	18.61	22.1	50.9	3.0			0.49
2700	6.016	15.09	14.64	6.46E+05	6.36E+05	0.00702	0.00058	0.033932356	0.0180537	34.3	14.9	13.79	5.98	48.1	20.83	24.3	56.1	1.0	27.0	34.0	0.46
2850	6.350	15.93	15.45	6.82E+05	6.72E+05	0.00702	0.00058	0.033923309	0.0180175	38.1	16.5	15.37	6.66	53.5	23.18	26.6	61.5				0.44
3000	6.684	16.77	16.27	7.18E+05	7.07E+05	0.00702	0.00058	0.033915121	0.0179845	42.2	18.3	17.03	7.38	59.2	25.65	29.1	67.2		24.5		0.41
3150	7.019	17.60	17.08	7.54E+05	7.42E+05	0.00702	0.00058	0.033907672	0.0179543	46.4	20.1	18.77	8.14	65.2	28.25	31.7	73.2			32.0	0.39
3300	7.353	18.44	17.89	7.90E+05	7.78E+05	0.00702	0.00058	0.033900866	0.0179267	50.8	22.0	20.60	8.93	71.5	30.97	34.4	79.5		22.0		0.38
3450	7.687	19.28	18.71	8.26E+05	8.13E+05	0.00702	0.00058	0.033894621	0.0179012	55.5	24.1	22.52	9.76	78.0	33.82	37.3	86.0				0.36
3600	8.021	20.12	19.52	8.61E+05	8.49E+05	0.00702	0.00058	0.03388887	0.0178777	60.4	26.2	24.52	10.63	84.9	36.79	40.3	92.9		19.0	29.0	0.34
3750	8.356	20.96	20.33	8.97E+05	8.84E+05	0.00702	0.00058	0.033883555	0.0178559	65.4	28.4	26.61	11.53	92.0	39.89	43.4	100.0				0.33
3900	8.690	21.79	21.15	9.33E+05	9.19E+05	0.00702	0.00058	0.033878629	0.0178356	70.7	30.6	28.78	12.47	99.4	43.11	46.6	107.4		17.0		0.32
4050	9.024	22.63	21.96	9.69E+05	9.55E+05	0.00702	0.00058	0.033874049	0.0178167	76.1	33.0	31.03	13.45	107.2	46.45	49.9	115.2			27.0	0.31
4200	9.358	23.47	22.77	1.01E+06	9.90E+05	0.00702	0.00058	0.033869779	0.0177990	81.8	35.5	33.37	14.47	115.2	49.92	53.4	123.2		14.0		0.30
4350	9.693	24.31	23.59	1.04E+06	1.03E+06	0.00702	0.00058	0.033865789	0.0177824	87.7	38.0	35.80	15.52	123.5	53.52	57.0	131.5				0.29
4500	10.027	25.15	24.40	1.08E+06	1.06E+06	0.00702	0.00058	0.033862051	0.0177669	93.7	40.6	38.31	16.61	132.1	57.24	60.7	140.1		11.0	24.5	0.28

Hydraulic Horsepower (hp)	Brake Pump Power (hp)	Motor Input Power (hp)
0.00	0.00	0.00
0.31	0.48	0.60
0.66	1.01	1.27
1.08	1.66	2.07
1.60	2.46	3.08
2.26	3.48	4.34
3.09	4.75	5.94
4.12	6.34	7.93
5.39	8.29	10.37
6.93	10.66	13.32
8.77	13.49	16.86
10.94	16.83	21.04
13.48	20.74	25.92
16.42	25.26	31.58
19.79	30.45	38.06
23.63	36.35	45.44
27.97	43.03	53.78
32.83	50.51	63.14
38.26	58.87	73.58
44.29	68.14	85.17
50.95	78.38	97.97
58.26	89.64	112.05
66.28	101.96	127.45
75.02	115.41	144.26
84.52	130.03	162.53
94.81	145.86	182.33
105.93	162.97	203.71
117.90	181.39	226.74
130.77	201.19	251.48
144.56	222.41	278.01
159.31	245.10	306.37

Pumps in Parallel - Flow Rate Added

When two or more pumps are arranged in parallel their resulting performance curve is obtained by **adding the pumps flowrates** at the same head as indicated in the figure below.



Centrifugal pumps in parallel are used to overcome larger volume flows than one pump can handle alone.

- for two identical pumps in parallel and the head kept constant - the flowrate doubles compared to a single pump as indicated with **point 2**

Note! In practice the combined head and volume flow moves along the system curve as indicated from 1 to 3.

- **point 3** is where the system operates with **both pumps** running
- **point 1** is where the system operates with **one pump** running

In practice, if one of the pumps in parallel or series stops, the operation point moves along the system resistance curve from point 3 to point 1 - the head and flow rate are decreased.

Note that for two pumps with equal performance curves running in parallel

- the head for each pump equals the head at point 3
- the flow for each pump equals half the flow at point 3

Related Topics

Lift Station Pump Annual Operational Costs

Normal Precipitation in Achorage =	16.58	inches per year
Contributing Area =	1,562,062.00	SF
Total Runoff =	2,158,249.00	Cubic Feet
	16,143,702.50	Gallons
% Runoff at Lift Station	25.3%	(Based on runoff from 10 year model)
Annual Pumped Volume at LS	4,084,356.73	Gallons

Pump Operational Minutes (7.5 hp, 610 gpm)	6,695.67	Minutes =	111.59	hours
Pump Operational Minutes (10 hp, 825 gpm)	4,950.74	Minutes =	82.51	hours

Power Cost (assume residential rates) $ 0.19779 per kWh CEA

1 hp = 0.7457 kw

Pump HP	Pump KW	Motor Eff	kW's	kWh	Cost
7.5 hp =	5.59	72.2%	7.75	864.43	**$ 170.97**
10 hp =	7.46	71.7%	10.40	858.15	**$ 169.73**
				Diff	$ 1.24

Camrose Drive - Lift Station Wet Well Design

Lift Station Cycle Time Calculations

Design Flow (10 Year)	3770.19	GPM		
Wet Well Diameter:	12	FT		
Height Pump 1 On:	1.5			
Wet Well Volume Pump 1 On:	169.6	CF =	1,268.95	Gal
Height Pump 2 On:	2.0			
Wet Well Volume Pump 2 On:	226.2	CF =	1,691.94	Gal
Depth Pump Off to Alarm	7.5			
Wet Well Volume Alarm On:	848.2	CF =	6,344.76	Gal
Pump 1 Output	825	GPM		
Pump 2 Output	825	GPM		

Lift Station 10 year Storm Event

		Min Cycle Time	108.00	Min
Design Flow 1-year (gpm)	3770.19	Max Cycle Time	906.00	Min
Flow In From Cell (gpm)	3770.194	Avg Starts Per Hr.	0.208333	
Flow Out Through Pump (gpm)	1650	Max Starts in 1 Hr	1.00	
Maximum Water Voume in LS	6,125.57	Starts in Less than 10 Min	0.00	
Maximum Volume Allowed	6,344.76			

.

8400 SANDLEWOOD PL • ANCHORAGE, ALASKA 99507 • PHONE: (907)563-3424 • FAX: (907)562-5449

May 17, 2022

ATTN: Shoshanna Johnson - CRW

PH: 907-646-5687

Email: sjohnson@crweng.com

QUOTE: AKP22-0380
Project: Camrose Stormwater Drainage

BUDGETARY

We are pleased to provide pricing for the following equipment:

Qty	Description	Each	Total
2	Station 1 (Pumps) Service Conditions: 825 GPM @ 28' TDH FLYGT | NP 3127.060 LT 3~ Adaptive 425 6" Discharge, FLS, FV, 50' Cord, 10HP, 3PH, 460V	$ 14,368.00	$ 28,736.00
1	Station 1 (Control Panel) PN: SCC10BABABAC STACON | RAPID RELEASE PANEL NEMA 3R STEEL ENCLOSURE, ALUMINUM INNER DEADFRONT DOOR INCOMING POWER TERMINALS WITH NEUTRAL AND GROUND TERMINATION'S, HEAVY DUTY SQUARE H FRAME MOTOR CIRCUIT BREAKERS NEMA RATED SQUARE D MOTOR STARTER W/OVERLOADS FOR EACH PUMP, CONTROL CIRCUIT BREAKER, CONTROL VOLTAGE TRANSFORMER, 4 FLOAT LEVEL CONTROLS, NEMA 4X HAND OFF AUTOMATIC SELECTOR SWITCHES, RUN LIGHTS, ELAPSE TIME METERS, HIGH LEVEL ALARM LIGHT WITH FLASHER, ALTERNATING RELAY, PUMP THERMAL AND LEVEL SENSOR TERMINAL STRIPS, 50W HEATER WITH THERMOSTAT, PHASE MONITOR, SURGE ARRESTOR, UL 508 SERIALIZED, HIGH LEVEL REMOTE TERMINALS	$ 8,430.00	$ 8,430.00
2	Station 2 (Pumps) Service Conditions: 610 GPM @ 30' TDH FLYGT | NP 3127.060 MT 3~ Adaptive 439 4" Discharge, FLS, FV, 50' Cord, 7.5HP, 3PH, 460V	$ 13,294.00	$ 26,588.00

1	Station 2 (Control Panel) PN: SCC7.5BABABAC STACON | RAPID RELEASE PANEL NEMA 3R STEEL ENCLOSURE, ALUMINUM INNER DEADFRONT DOOR INCOMING POWER TERMINALS WITH NEUTRAL AND GROUND TERMINATION'S, HEAVY DUTY SQUARE H FRAME MOTOR CIRCUIT BREAKERS NEMA RATED SQUARE D MOTOR STARTER W/OVERLOADS FOR EACH PUMP, CONTROL CIRCUIT BREAKER, CONTROL VOLTAGE TRANSFORMER, 4 FLOAT LEVEL CONTROLS, NEMA 4X HAND OFF AUTOMATIC SELECTOR SWITCHES, RUN LIGHTS, ELAPSE TIME METERS, HIGH LEVEL ALARM LIGHT WITH FLASHER, ALTERNATING RELAY, PUMP THERMAL AND LEVEL SENSOR TERMINAL STRIPS, 50W HEATER WITH THERMOSTAT, PHASE MONITOR, SURGE ARRESTOR, UL 508 SERIALIZED, HIGH LEVEL REMOTE TERMINALS	$ 8,430.00	$ 8,430.00
Please reference AKP22-0380 when placing order.			**Total: $72,184.00**

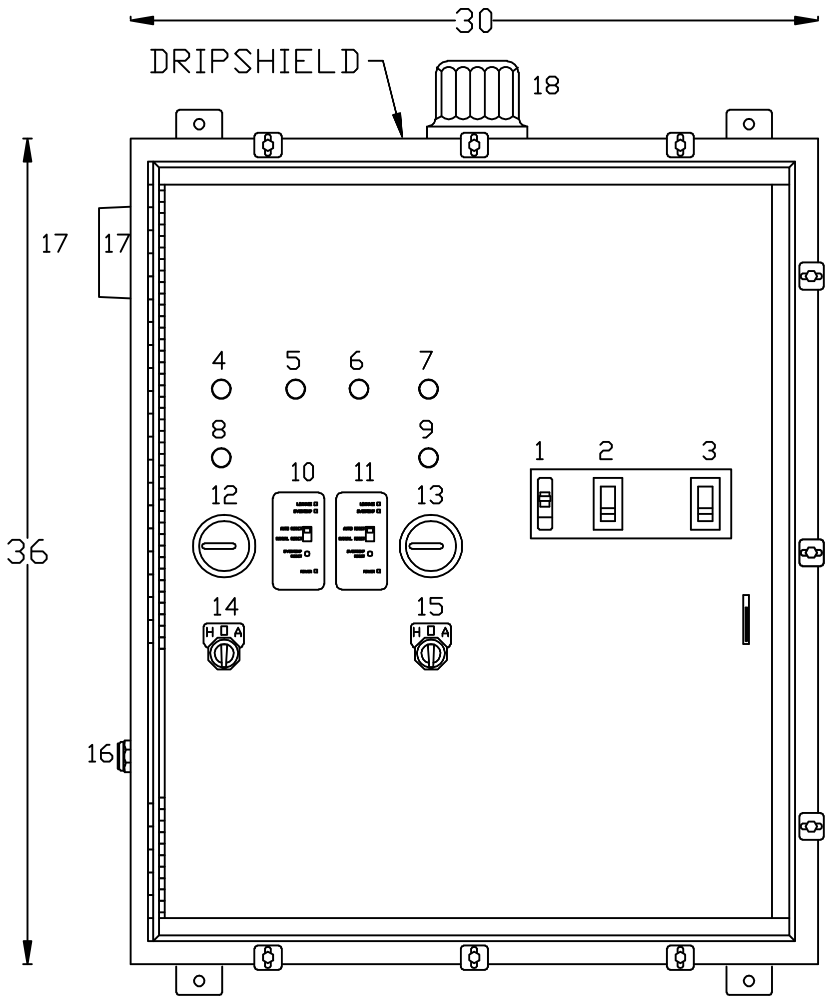
Subject to Alaska Pumps Terms & Conditions of Sale. Net Thirty (30) Terms are subject to Alaska Pumps' credit department approval.

Proposal Valid: 14 Days from Bid Opening, due to Current Market Conditions

F.O.B: FACTORY
Ships: TBD

Regards,

David McFarland
Applications Engineer
DXP | Alaska Pump & Supply, Inc.
Direct: (907) 793-4841
FAX: (907) 562-5449
David.McFarland@dxpe.com



OUTER DOOR HAS BEEN REMOVED FOR CLARITY

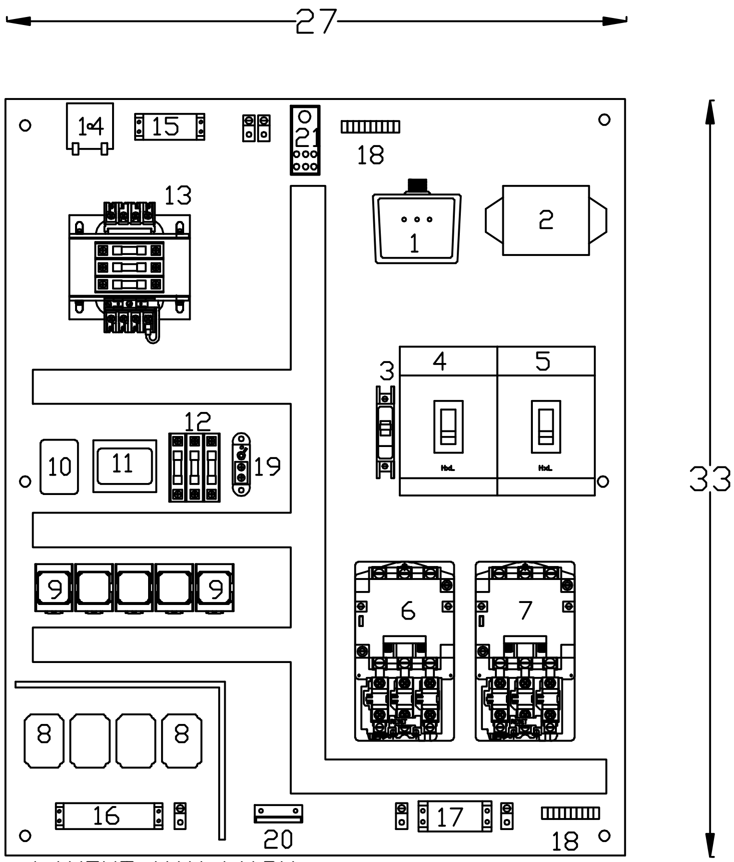
1 - CCB CONTROL CIRCUIT BREAKER
2 - MB1 MOTOR BREAKER 1
3 - MB2 MOTOR BREAKER 2
4 - PL1 OFF LEVEL
5 - PL2 LEAD LEVEL
6 - PL3 LAG LEVEL
7 - PL4 HIGH LEVEL
8 - RL1 RUN LIGHT 1
9 - RL2 RUN LIGHT 2
10 - MC1 MINI CAS 1
11 - MC2 MINICAS 2
12 - ETM1 ELAPSED TIME METER 1
13 - ETM2 ELAPSED TIME METER 2
14 - HOA HAND-OFF-AUTO SWITCH PUMP 1
15 - HOA HAND-OFF-AUTO SWITCH PUMP 2
16 - ASB ALARM SILENCE BUTTON
17 - AH ALARM HORN
18 - AL ALARM LIGHT

INTRINSIC RAPID RELEASE

QUOTE NO.	DATE	DRAWN BY	REVISION
CBABAA	11/07/2006	B.A.S.	

CBABAB

FLYGT a xylem brand



LAYOUT MAY VARY

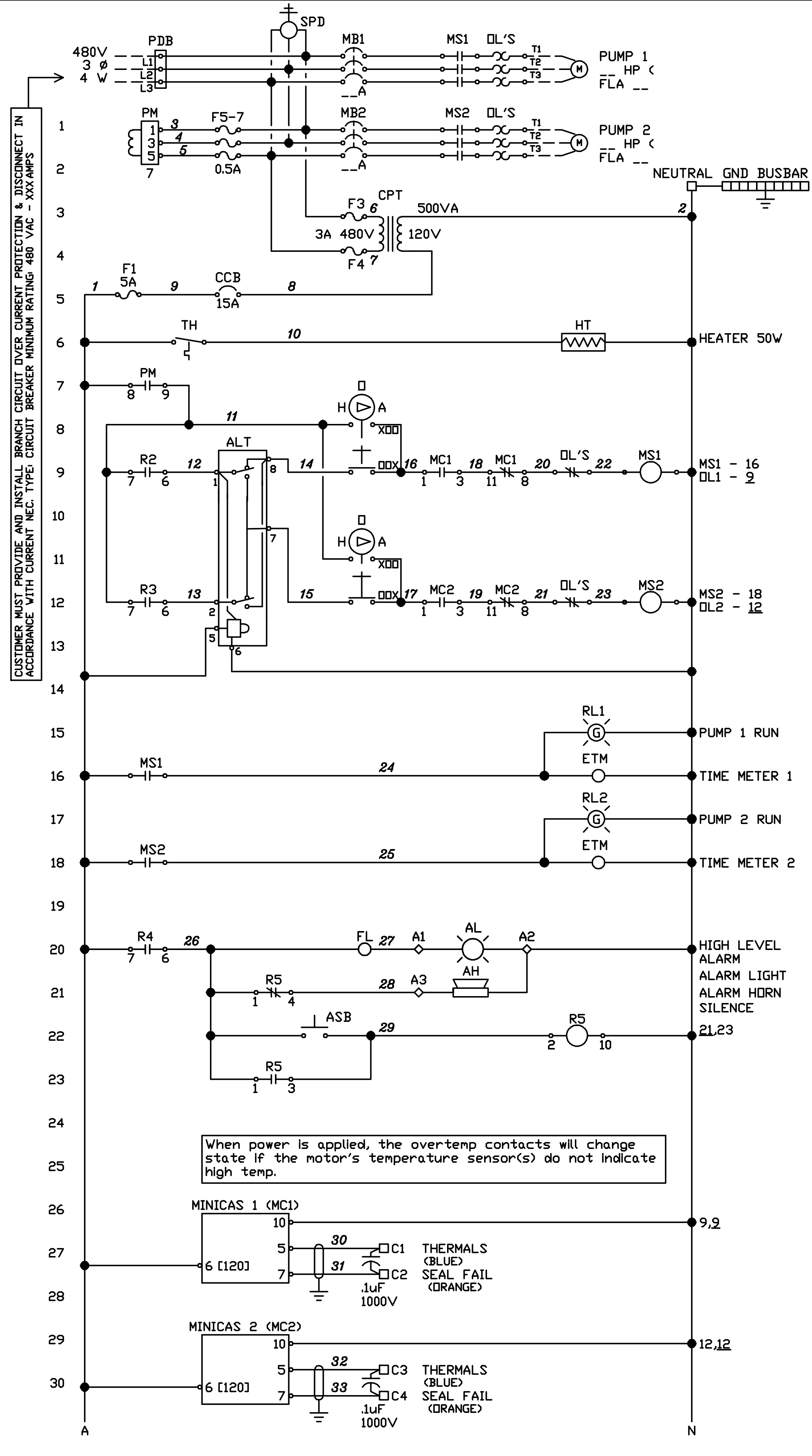
1 - SPD SURGE PROTECTION DEVICE
2 - PDB POWER DISTRIBUTION BLOCK
3 - CCB CONTROL CIRCUIT BREAKER
4 - MB1 MOTOR BREAKER 1
5 - MB2 MOTOR BREAKER 2
6 - MS1 MOTOR STARTER 1
7 - MS2 MOTOR STARTER 2
8 - ISR1-4 INTRINSICALLY SAFE RELAY 1-4
9 - R1-5 RELAY 1-5
10 - ALT ALTERNATOR
11 - PM PHASE MONITOR
12 - FB FUSE BLOCKS
13 - CPT CONTROL POWER TRANSFORMER
14 - FL FLASHER
15 - TSA TERMINAL STRIP A
16 - TSB TERMINAL STRIP B
17 - TSC TERMINAL STRIP C
18 - GB GROUND BUS BAR
19 - TH THERMOSTAT
20 - HT HEATER
21 - NB NEUTRAL BLOCK

INTRINSIC RAPID RELEASE

QUOTE NO.	DATE	DRAWN BY	REVISION
CBABAA	11/07/2006	B.A.S.	

CBABAB

FLYGT a xylem brand



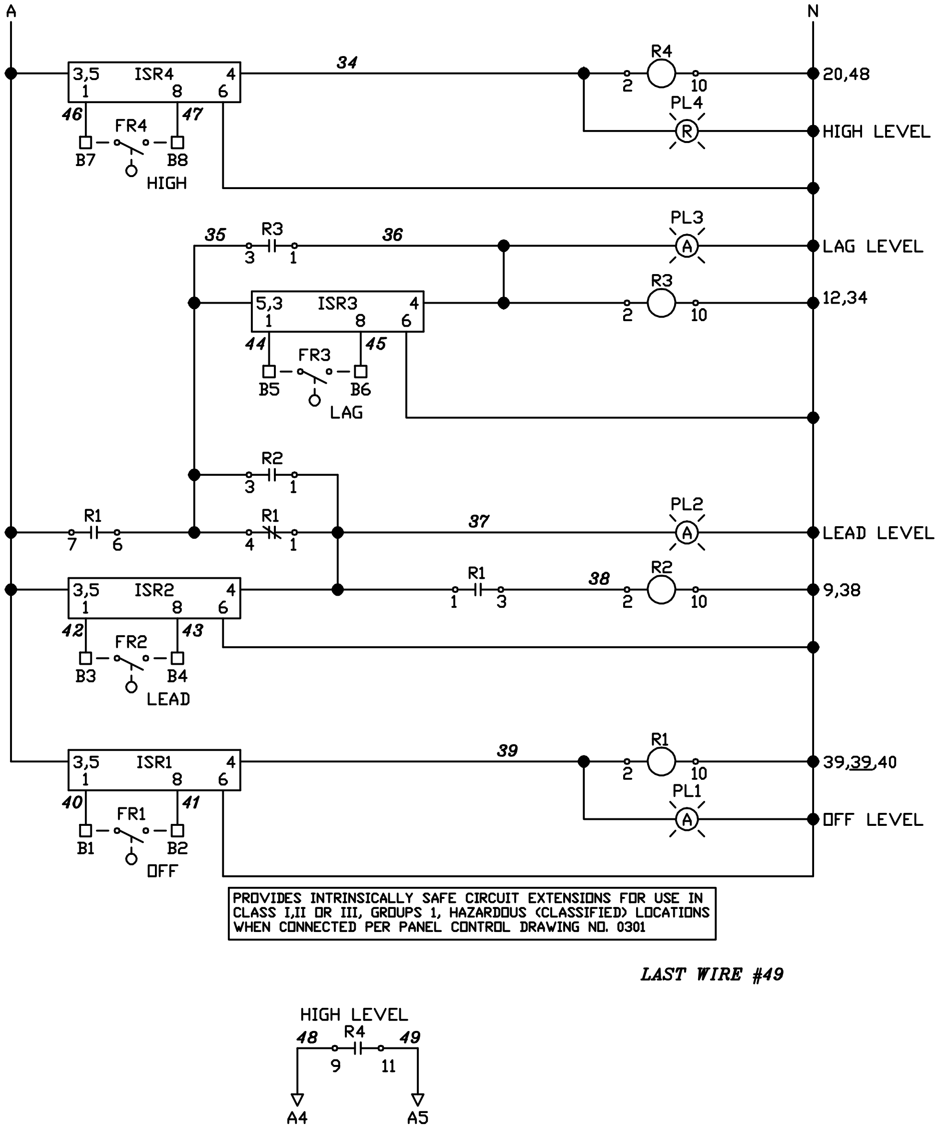
PAGE 1 OF 3

INTRINSIC RAPID RELEASE

QUOTE NO.	DATE	DRAWN BY	REVISION
CBABAA	6/04/2009	B.A.S.	

CBABAB

FLYGT a xylem brand



PROVIDES INTRINSICALLY SAFE CIRCUIT EXTENSIONS FOR USE IN CLASS I,II OR III, GROUPS 1, HAZARDOUS (CLASSIFIED) LOCATIONS WHEN CONNECTED PER PANEL CONTROL DRAWING NO. 0301

INTRINSIC RAPID RELEASE

CBABAB

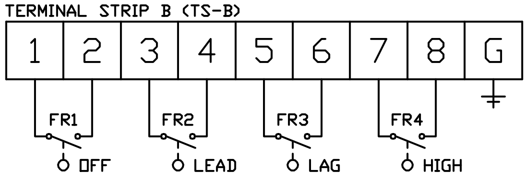
QUOTE NO.	DATE	DRAWN BY	REVISION
CBABAA	6/04/2009	B.A.S.	

FLYGT a xylem brand

THE CIRCUIT WIRING IN THE HAZARDOUS AREA MUST NOT EXCEED 1000 FEET BASED ON CABLE WITH 60pF/FT CAPACITANCE AND 0.2uH/FT INDUCTANCE

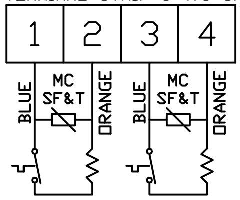
Intrinsically safe wiring terminals
"Install in accordance with Article 504 of the National Electrical Code."

TERMINAL STRIP B (TS-B)



Nonintrinsically safe wiring terminals

TERMINAL STRIP C (TS-C)



FLYGT PUMPS LEAD COLOR CODE	
L1 (PHASE A)	RED
L2 (PHASE B)	WHITE
L3 (PHASE C)	BLACK
GROUND\EARTH	GREEN W/ YELLOW
GROUND CHECK	YELLOW
(MC PIN 5-)	BLUE
(MC PIN 7+)	ORANGE

SQD Ground Busbar
PK7GTA, PK12GTA, PK15GTA

Wire Range AWG CU-AL	Torque lb-in.
14-10 CU, 12-10 AL	20
8	25
6-4	35
Two 14 or 12 CU, Two 12 or 10 AL	25

SQD Terminal Block
GK6 + GR6

Wire Range AWG CU	Torque lb-in.
(Type GK6) 22-10	11-12
(Type GR6) 22-8	18-20

Panduit Ground Lug
One-Barrel

Wire Range AWG CU	Torque lb-in.
(LAMA2-14-QY) 12-14	15
6-10	40
2-4	50
(LAMA1/0-14-QY) 10-14	35
8	40
4-6	45
2/0-3	50
(LAMA250-56-QY) 2-6	275
250-1	375
(LAMA350-38-QY) 2-6	275
350-1	375
(LAMA600-38-6Y) 600-4	500
Two-Barrel	
(LAM2A1/0-14-6Y) 10-14	35
8	40
4-6	45

CUSTOMER
JOB NAME
ENCLOSURE UL TYPE RATING: UL TYPE 1
VOLTAGE 480V PHASE 3 HZ 60
H.P. #1 #2 #3 X #4 X
F.L.A. X X
TOTAL F.L.A.
SERIAL # R10- DATE: 6/1/05
SCCR: 5KA SYMMETRICAL RMS,480V MAX.
MANUFACTURED BY:
STA CON INC 2525 S. OBT APOPKA FL 32703

INTRINSIC RAPID RELEASE

QUOTE NO.	DATE	DRAWN BY	REVISION
CBABAA	6/04/2009	B.A.S.	

CBABAB

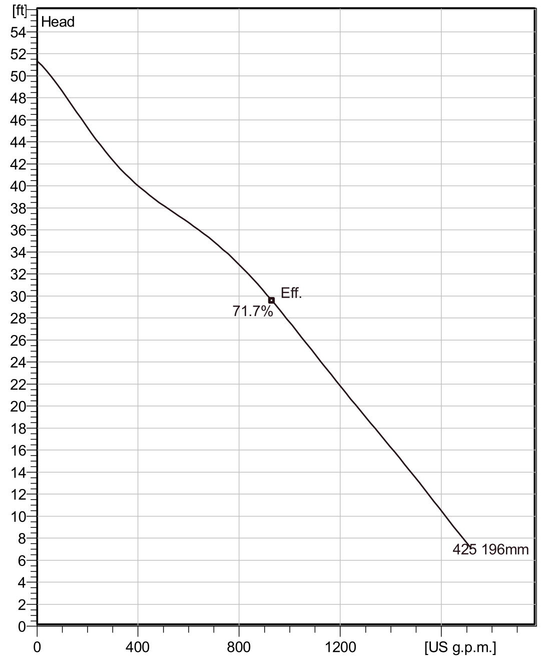
FLYGT a xylem brand

NP 3127 LT 3~ Adaptive 425

Patented self cleaning semi-open channel impeller, ideal for pumping in waste water applications. Modular based design with high adaptation grade.

Technical specification

Curves according to: Water, pure Water, pure [100%],39.2 °F,62.42 lb/ft³,1.6891E-5 ft²/s



Curve: ISO 9906

Configuration

Motor number	Installation type
N3127.060 21-12-4AL-W 10hp	P - Semi permanent, Wet
Impeller diameter	**Discharge diameter**
196 mm	6 inch

Pump information

Impeller diameter
196 mm

Discharge diameter
6 inch

Inlet diameter
150 mm

Maximum operating speed
1750 rpm

Number of blades
2

Max. fluid temperature
40 °C

Materials

Impeller
Hard-Iron ™

Stator housing material
Grey cast iron

Project		**Created by**	david mcfarland		
Block	0	**Created on**	5/17/2022	**Last update**	5/17/2022

NP 3127 LT 3~ Adaptive 425

Technical specification

Motor - General

Motor number N3127.060 21-12-4AL-W 10hp	**Phases** 3~	**Rated speed** 1750 rpm	**Rated power** 10 hp
ATEX approved No	**Number of poles** 4	**Rated current** 13 A	**Stator variant** 38
Frequency 60 Hz	**Rated voltage** 460 V	**Insulation class** H	**Type of Duty** S1
Version code 060			

Motor - Technical

Power factor - 1/1 Load 0.82	**Motor efficiency - 1/1 Load** 87.3 %	**Total moment of inertia** 1.37 lb ft²	**Starts per hour max.** 30
Power factor - 3/4 Load 0.77	**Motor efficiency - 3/4 Load** 88.3 %	**Starting current, direct starting** 82.9 A	
Power factor - 1/2 Load 0.67	**Motor efficiency - 1/2 Load** 87.7 %	**Starting current, star-delta** 27.6 A	

Project		**Created by**	david mcfarland		
Block	0	**Created on**	5/17/2022	**Last update**	5/17/2022

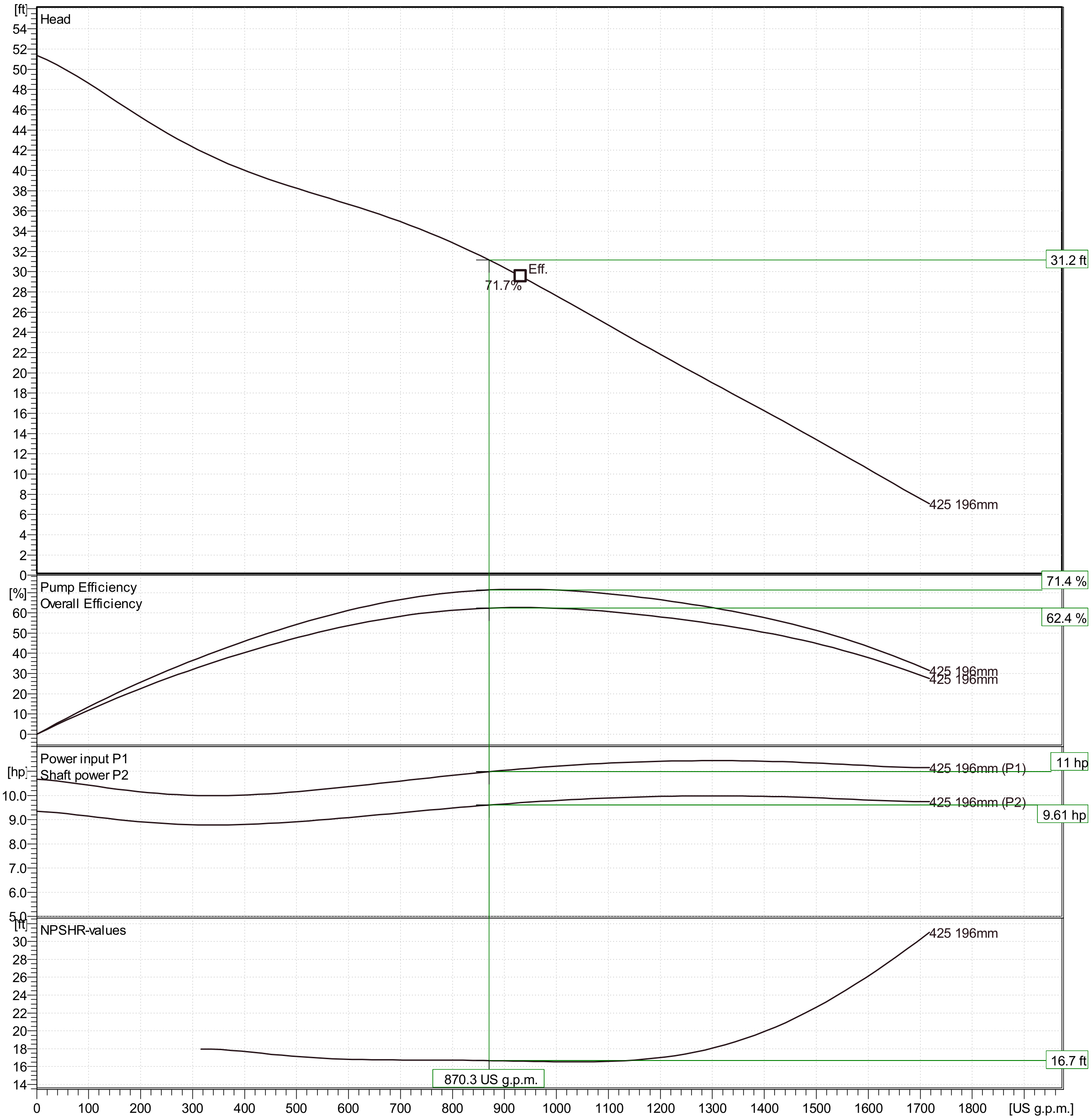
NP 3127 LT 3~ Adaptive 425

Performance curve

Duty point

Flow	Head
870 US g.p.m.	31.2 ft

Curves according to: Water, pure Water, pure [100%],39.2 °F,62.42 lb/ft³,1.6891E-5 ft²/s



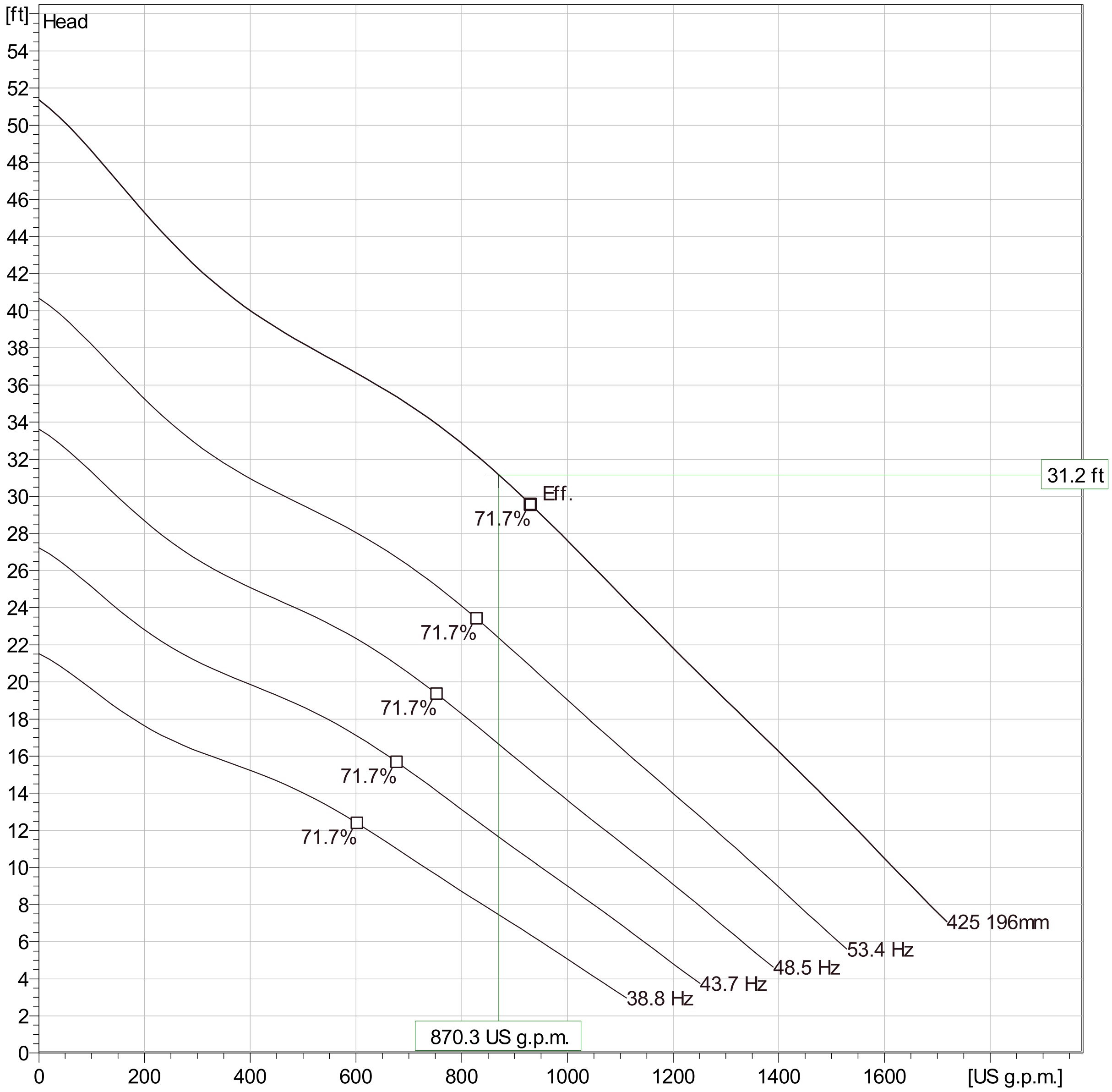
Curve: ISO 9906

		david mcfarland		
0	**Created on**	5/17/2022	**Last update**	5/17/2022

NP 3127 LT 3~ Adaptive 425

Duty Analysis

Curves according to: Water, pure [100%] ; 39.2°F; 62.42lb/ft³; 1.6891E-5ft²/s



Operating characteristics

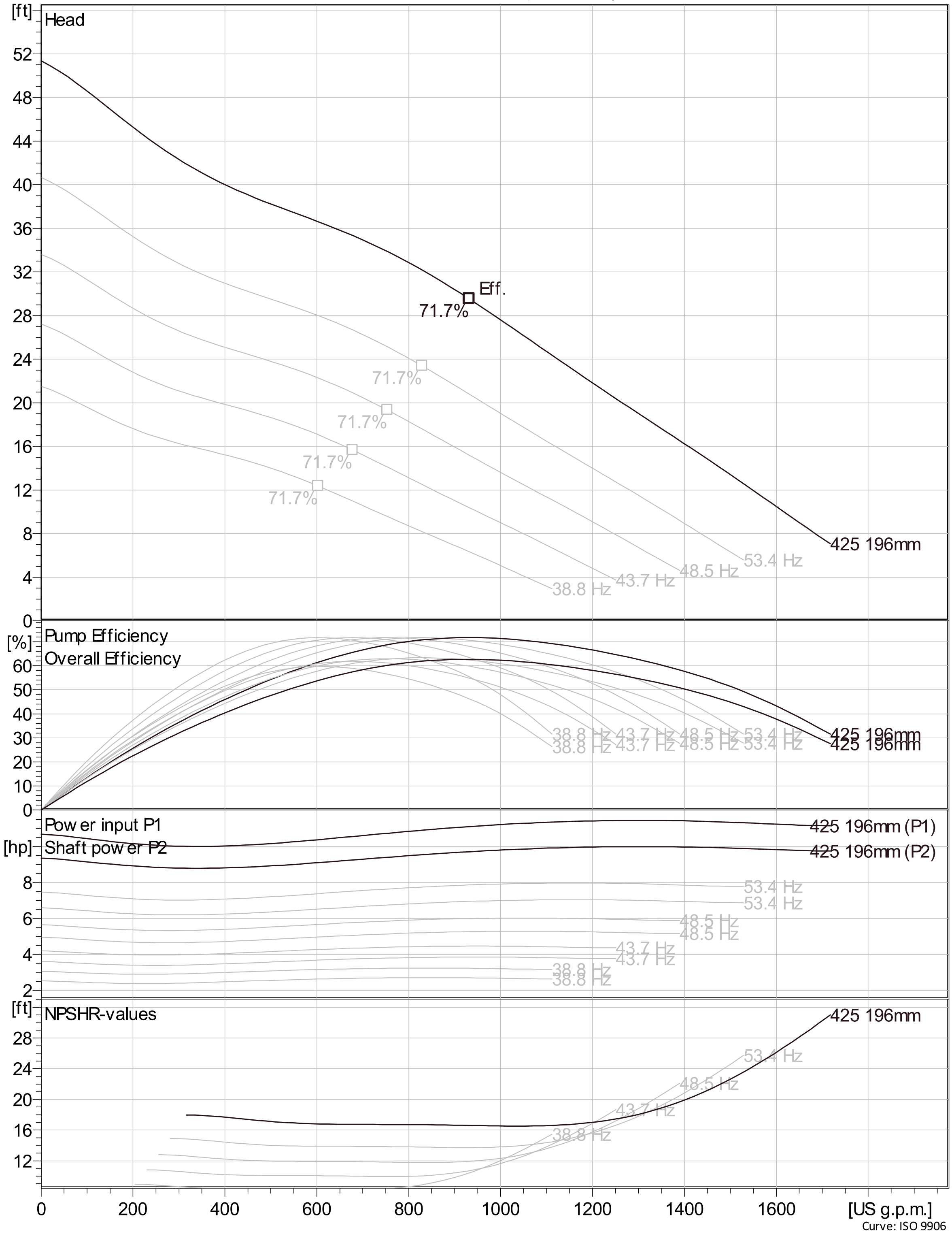
Pumps / Systems	Flow	Head	Shaft power	Flow	Head	Shaft power	Hydr.eff.	Spec. Energy	NPSHre
	US g.p.m.	ft	hp	US g.p.m.	ft	hp		kWh/US MG	ft
1	870	31.2	9.61	870	31.2	9.61	71.4 %	157	16.7

Project	**Created by**	david mcfarland		
Block	**Created on**	5/17/2022	**Last update**	5/17/2022

NP 3127 LT 3~ Adaptive 425

VFD Curve

Curves according to: Water, pure ,39.2 °F,62.42 lb/ft³,1.6891E-5 ft²/s



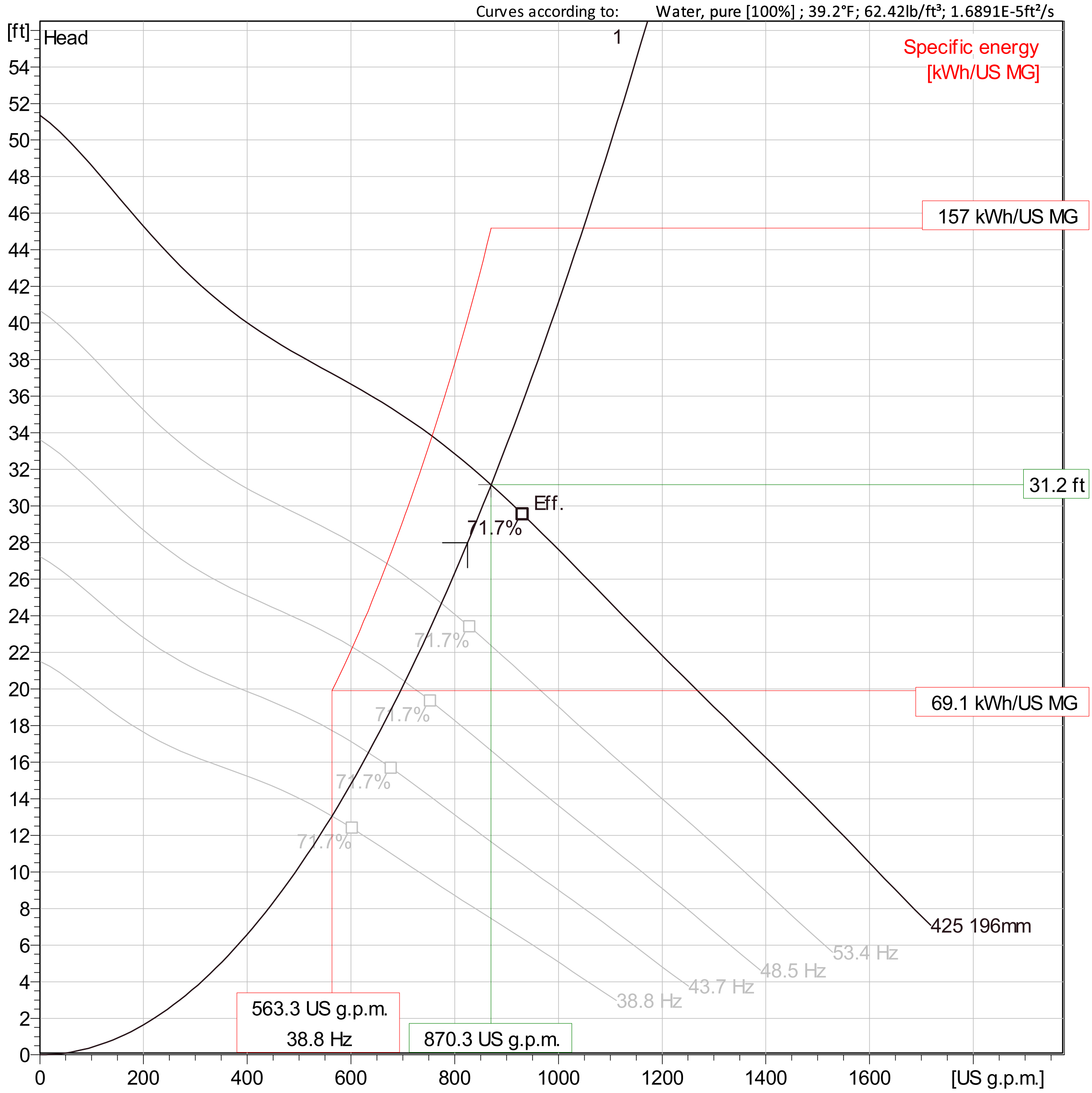
Curve: ISO 9906

Project		**Created by**	david mcfarland		
Block	0	**Created on**	5/17/2022	**Last update**	5/17/2022

NP 3127 LT 3~ Adaptive 425

VFD Analysis

Curves according to: Water, pure [100%] ; 39.2°F; 62.42lb/ft³; 1.6891E-5ft²/s



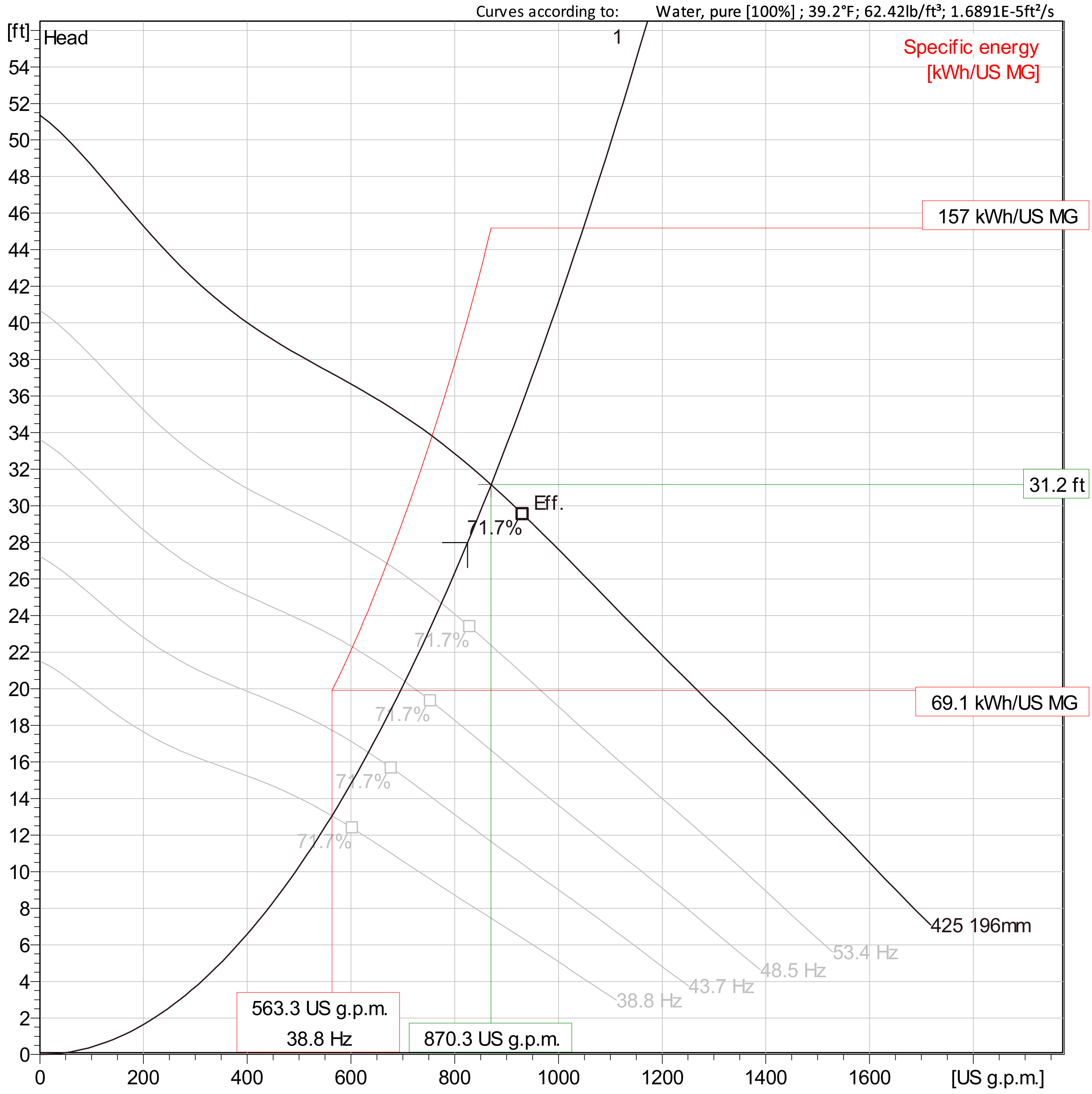
Operating Characteristics

Pumps / Systems	Frequency	Flow	Head	Shaft power	Flow	Head	Shaft power	Hydr.eff.	Specific energy	NPSHre
		US g.p.m.	ft	hp	US g.p.m.	ft	hp		kWh/US MG	ft
1	60 Hz	870	31.2	9.61	870	31.2	9.61	71.4 %	157	16.7
1	53.4 Hz	775	24.7	6.77	775	24.7	6.77	71.4 %	173	13.8
1	48.5 Hz	704	20.4	5.09	704	20.4	5.09	71.4 %	187	11.9
1	43.7 Hz	634	16.5	3.71	634	16.5	3.71	71.4 %	205	10

Project		**Created by**	david mcfarland		
Block	0	**Created on**	5/17/2022	**Last update**	5/17/2022

NP 3127 LT 3~ Adaptive 425

VFD Analysis



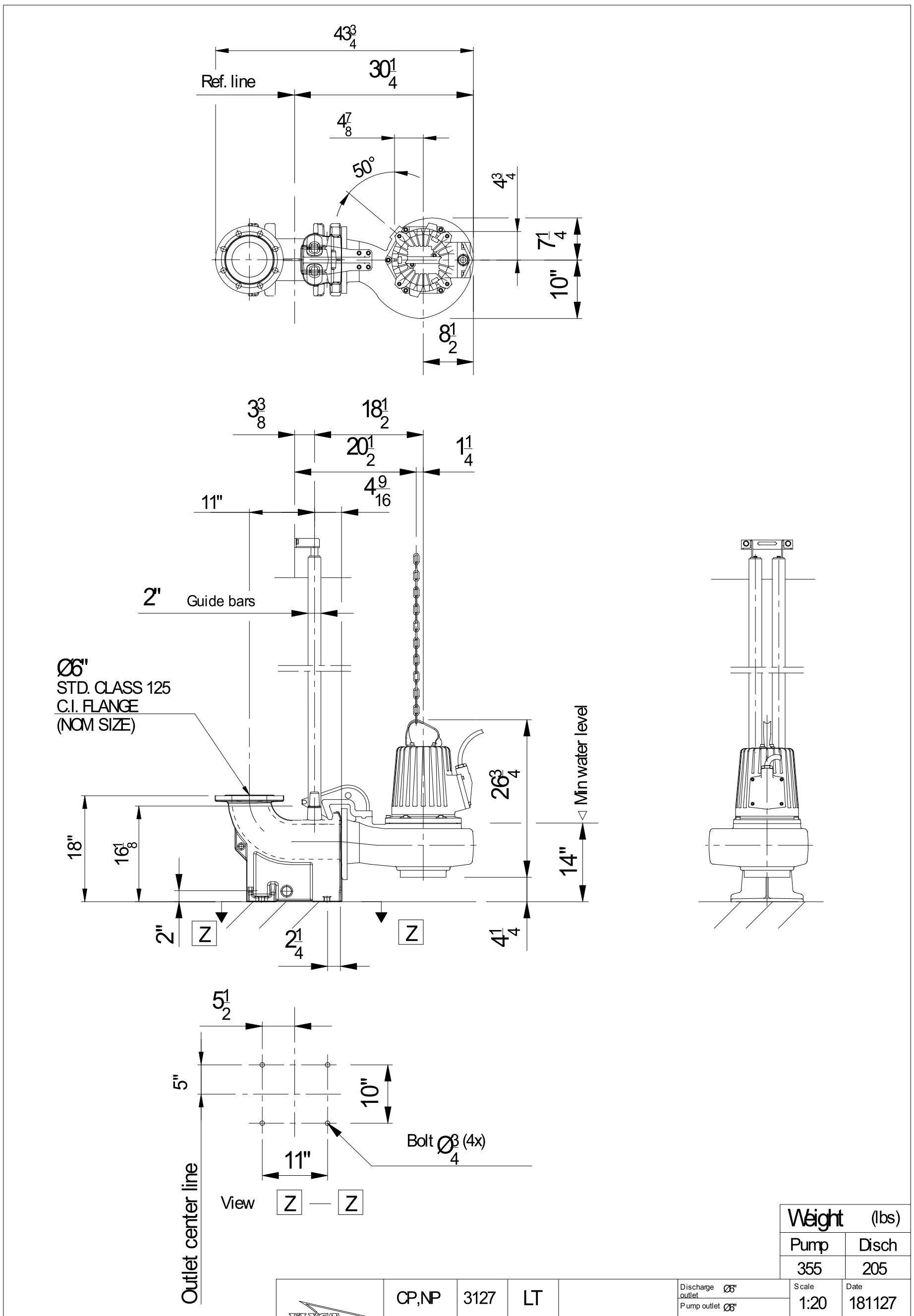
Operating Characteristics

Pumps / Systems	Frequency	Flow	Head	Shaft power	Flow	Head	Shaft power	Hydr.eff.	Specific energy	NPSHre
		US g.p.m.	ft	hp	US g.p.m.	ft	hp		kWh/US MG	ft
1	38.8 Hz	563	13.1	2.6	563	13.1	2.6	71.4 %	227	8.31

Project		**Created by**	david mcfarland		
Block	0	**Created on**	5/17/2022	**Last update**	5/17/2022

NP 3127 LT 3~ Adaptive 425

Dimensional drawing



Weight	(lbs)
Pump	Disch
355	205

CP,NP	3127	LT	Discharge outlet Ø6" / Pump outlet Ø6" / Pump inlet / Suction inlet	Scale 1:20	Date 181127	
				Drawing number 7014200		Revision 6

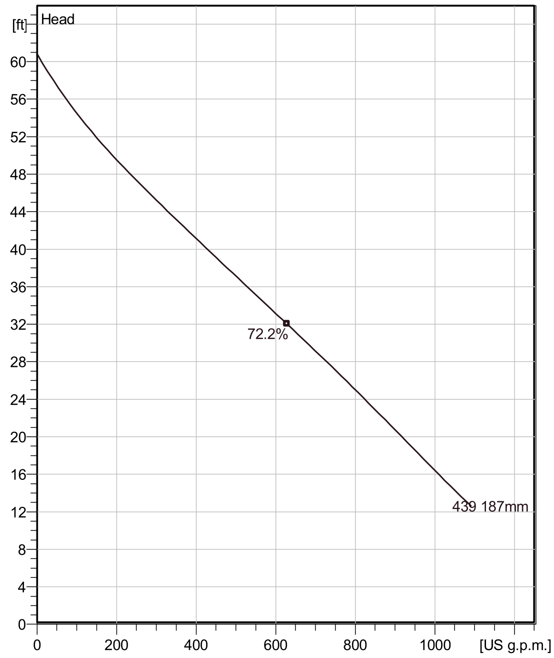
Project		**Created by**	david mcfarland		
Block	0	**Created on**	5/17/2022	**Last update**	5/17/2022

NP 3127 MT 3~ Adaptive 439

Patented self cleaning semi-open channel impeller, ideal for pumping in waste water applications. Modular based design with high adaptation grade.

Technical specification

Curves according to: Water, pure Water, pure [100%],39.2 °F,62.42 lb/ft³,1.6891E-5 ft²/s



Curve: ISO 9906

Configuration

Motor number
N3127.060 21-10-4AL-W
7.5hp

Installation type
P - Semi permanent, Wet

Impeller diameter
187 mm

Discharge diameter
4 inch

Pump information

Impeller diameter
187 mm

Discharge diameter
4 inch

Inlet diameter
100 mm

Maximum operating speed
1755 rpm

Number of blades
2

Max. fluid temperature
40 °C

Materials

Impeller
Hard-Iron ™

Stator housing material
Grey cast iron

Project		**Created by**	david mcfarland		
Block	0	**Created on**	5/17/2022	**Last update**	5/17/2022

NP 3127 MT 3~ Adaptive 439

Technical specification

Motor - General

Motor number N3127.060 21-10-4AL-W 7.5hp	**Phases** 3~	**Rated speed** 1755 rpm	**Rated power** 7.5 hp
ATEX approved No	**Number of poles** 4	**Rated current** 10 A	**Stator variant** 38
Frequency 60 Hz	**Rated voltage** 460 V	**Insulation class** H	**Type of Duty** S1
Version code 060			

Motor - Technical

Power factor - 1/1 Load 0.79	**Motor efficiency - 1/1 Load** 86.4 %	**Total moment of inertia** 1.01 lb ft²	**Starts per hour max.** 30
Power factor - 3/4 Load 0.72	**Motor efficiency - 3/4 Load** 86.9 %	**Starting current, direct starting** 68 A	
Power factor - 1/2 Load 0.60	**Motor efficiency - 1/2 Load** 85.5 %	**Starting current, star-delta** 22.7 A	

Project		**Created by**	david mcfarland		
Block	0	**Created on**	5/17/2022	**Last update**	5/17/2022

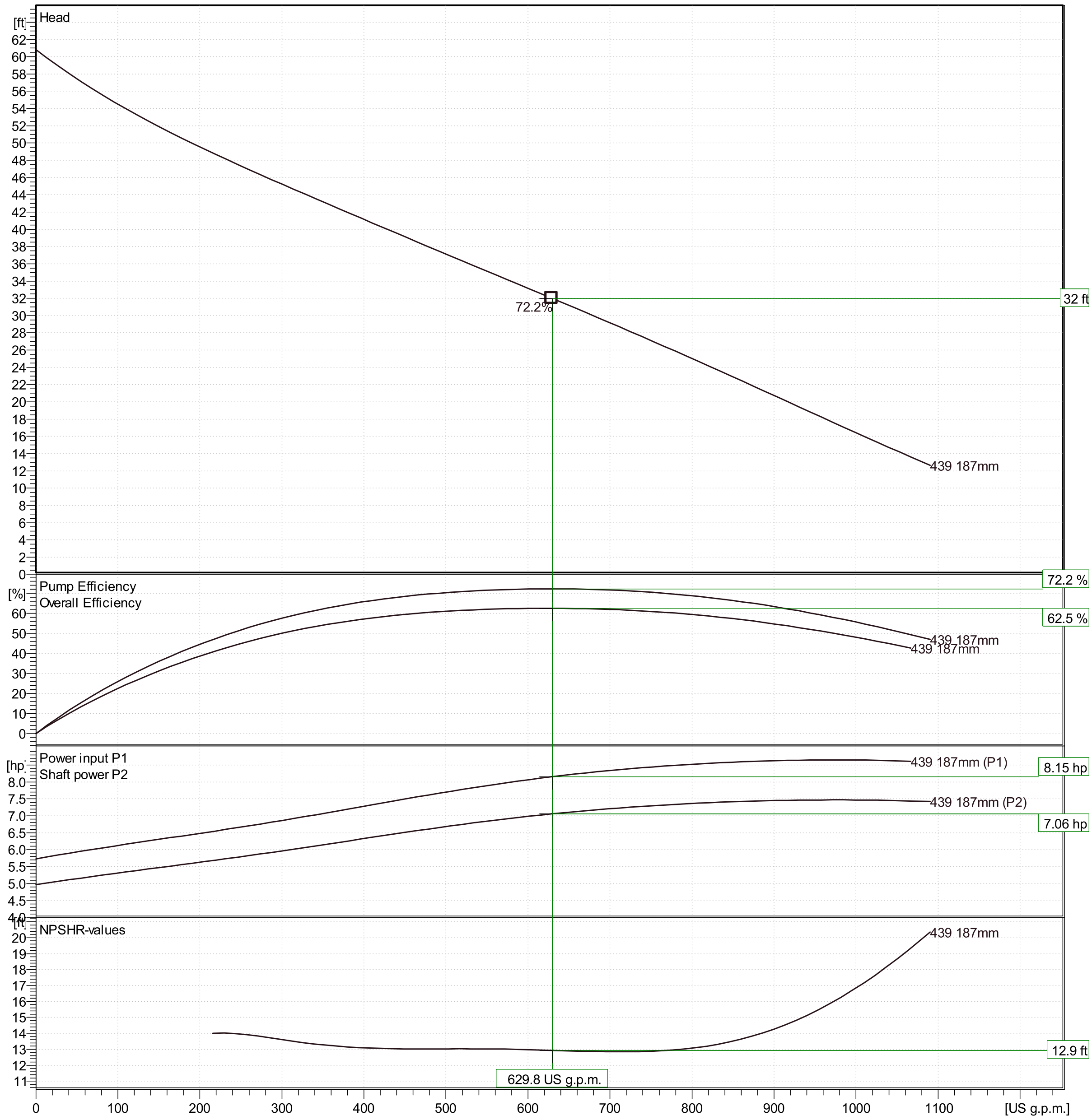
NP 3127 MT 3~ Adaptive 439

Performance curve

Duty point

Flow	Head
630 US g.p.m.	32 ft

Curves according to: Water, pure Water, pure [100%],39.2 °F,62.42 lb/ft³,1.6891E-5 ft²/s

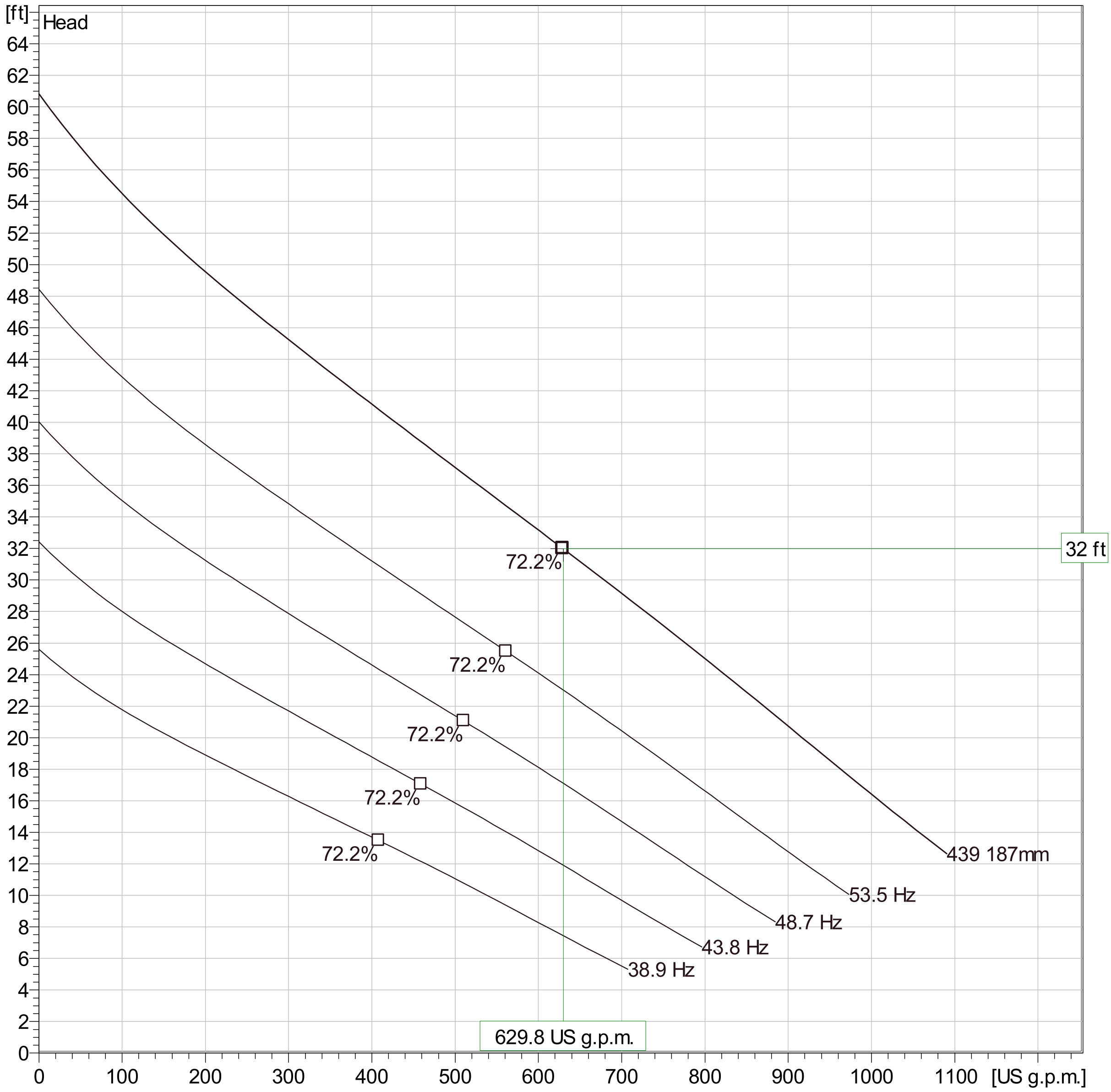


	david mcfarland		
0	**Created on** 5/17/2022	**Last update**	5/17/2022

NP 3127 MT 3~ Adaptive 439

Duty Analysis

Curves according to: Water, pure [100%] ; 39.2°F; 62.42lb/ft³; 1.6891E-5ft²/s



Operating characteristics

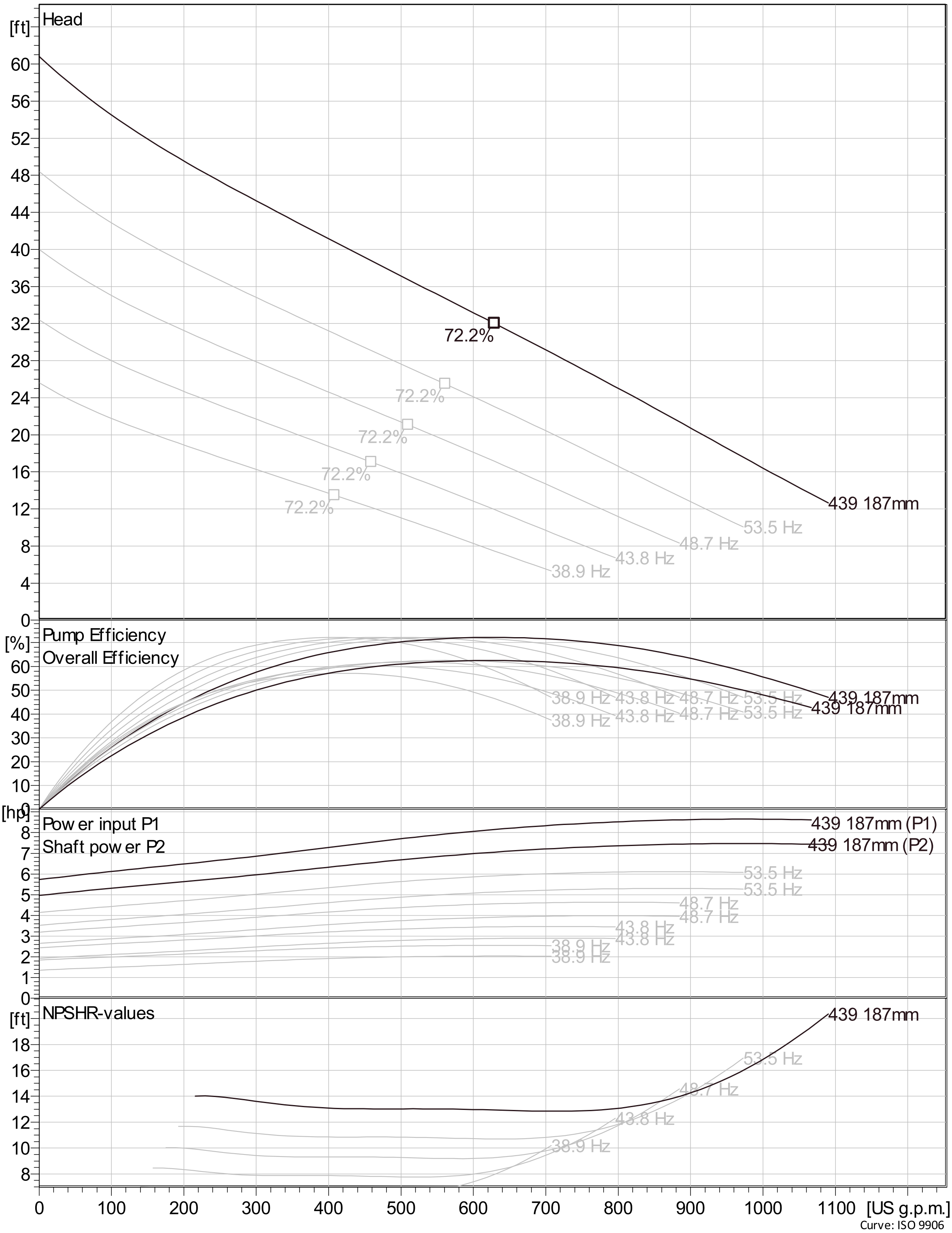
Pumps / Systems	Flow	Head	Shaft power	Flow	Head	Shaft power	Hydr.eff.	Spec. Energy	NPSHre
	US g.p.m.	ft	hp	US g.p.m.	ft	hp		kWh/US MG	ft
1	630	32	7.06	630	32	7.06	72.2 %	161	12.9

Project		**Created by**	david mcfarland		
Block		**Created on**	5/17/2022	**Last update**	5/17/2022

NP 3127 MT 3~ Adaptive 439

VFD Curve

Curves according to: Water, pure , 39.2 °F, 62.42 lb/ft³, 1.6891E-5 ft²/s

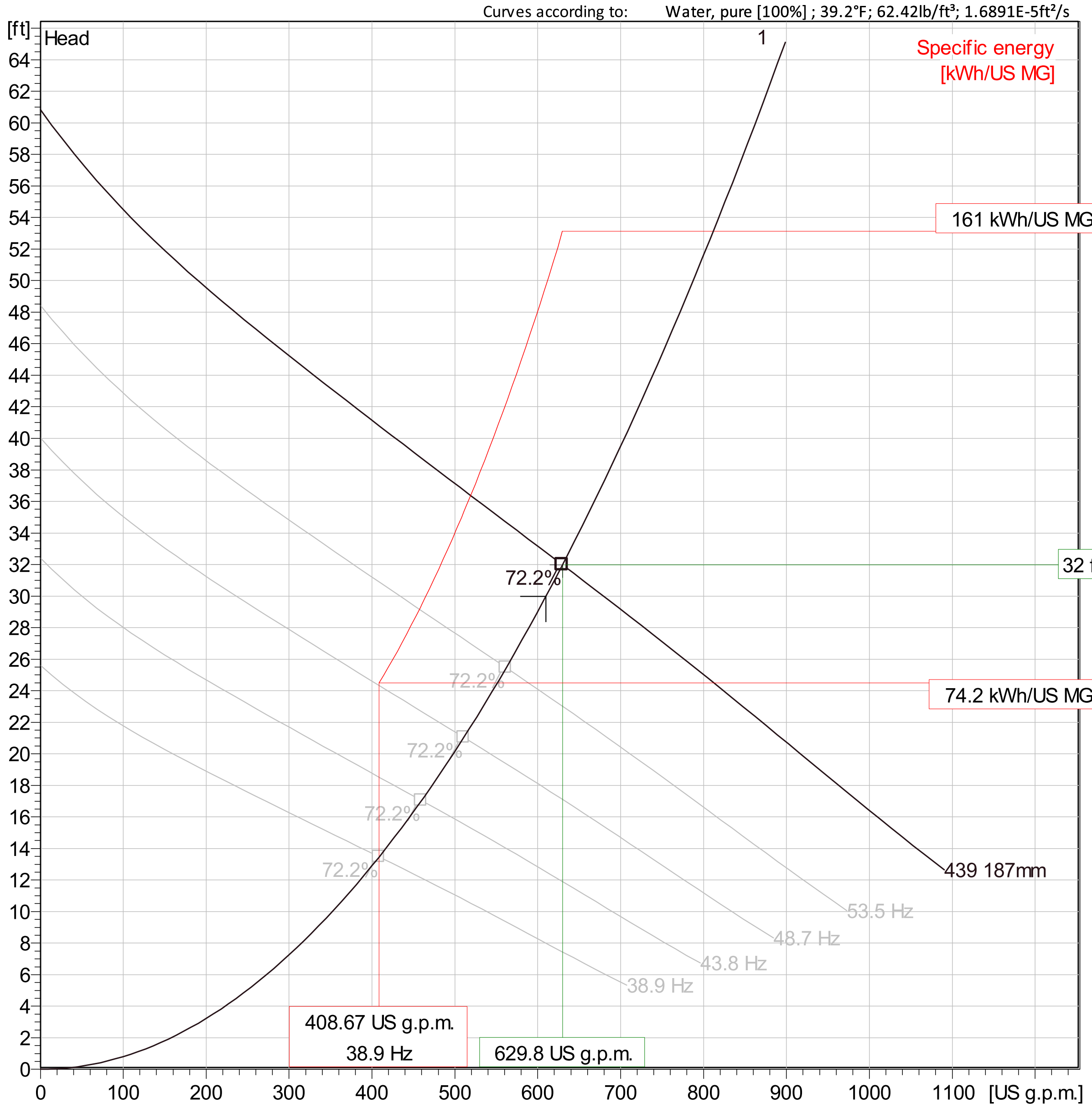


Project		Created by	david mcfarland		
Block	0	Created on	5/17/2022	Last update	5/17/2022

NP 3127 MT 3~ Adaptive 439

VFD Analysis

Curves according to: Water, pure [100%] ; 39.2°F; 62.42lb/ft³; 1.6891E-5ft²/s



Operating Characteristics

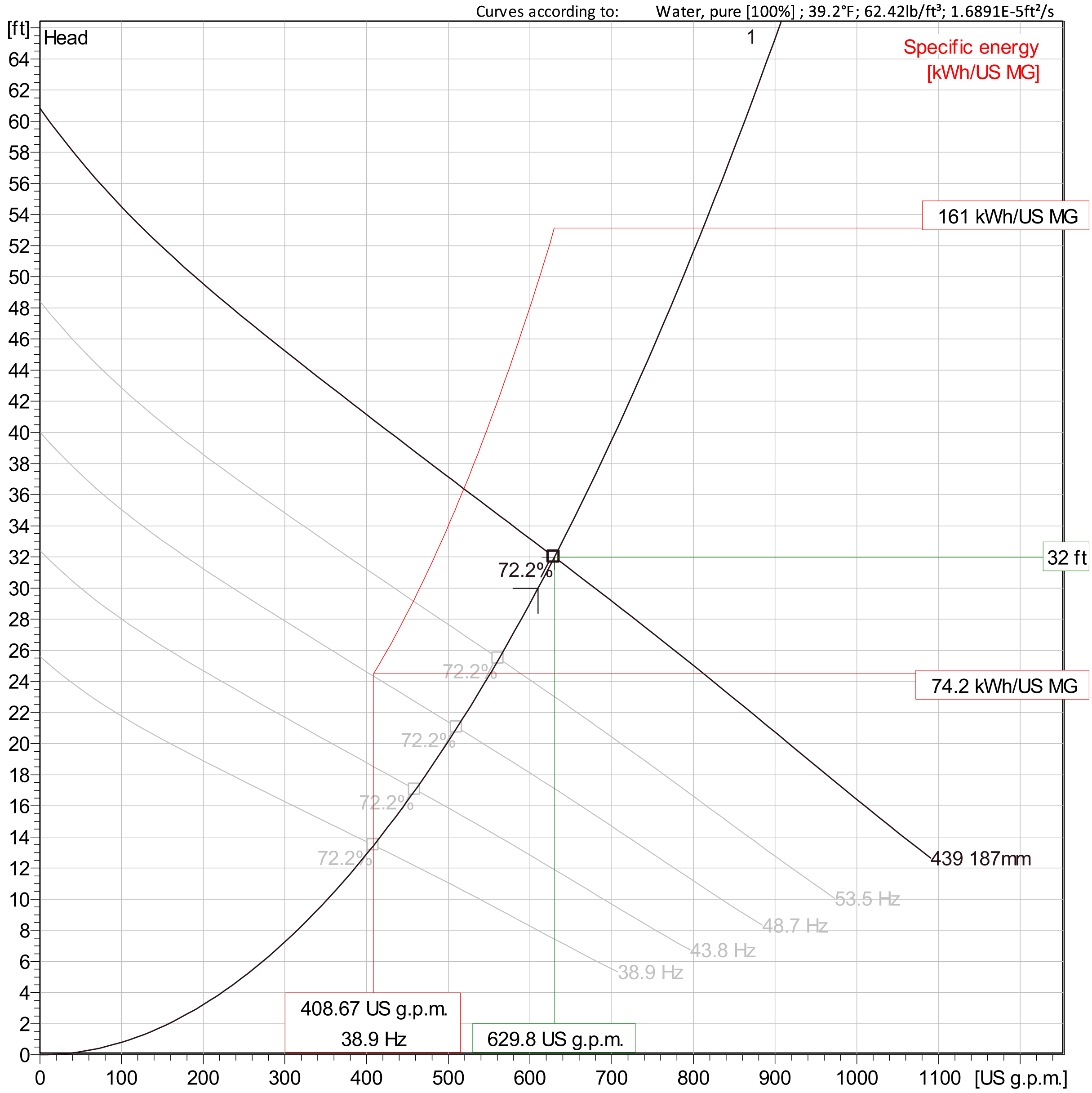
Pumps / Systems	Frequency	Flow	Head	Shaft power	Flow	Head	Shaft power	Hydr.eff.	Specific energy	NPSHre
		US g.p.m.	ft	hp	US g.p.m.	ft	hp		kWh/US MG	ft
1	60 Hz	630	32	7.06	630	32	7.06	72.2 %	161	12.9
1	53.5 Hz	562	25.5	5.01	562	25.5	5.01	72.2 %	176	10.8
1	48.7 Hz	511	21	3.77	511	21	3.77	72.2 %	188	9.26
1	43.8 Hz	460	17	2.75	460	17	2.75	72.2 %	204	7.82

Project		**Created by**	david mcfarland		
Block	0	**Created on**	5/17/2022	**Last update**	5/17/2022

NP 3127 MT 3~ Adaptive 439

VFD Analysis

Curves according to: Water, pure [100%] ; 39.2°F; 62.42lb/ft³; 1.6891E-5ft²/s



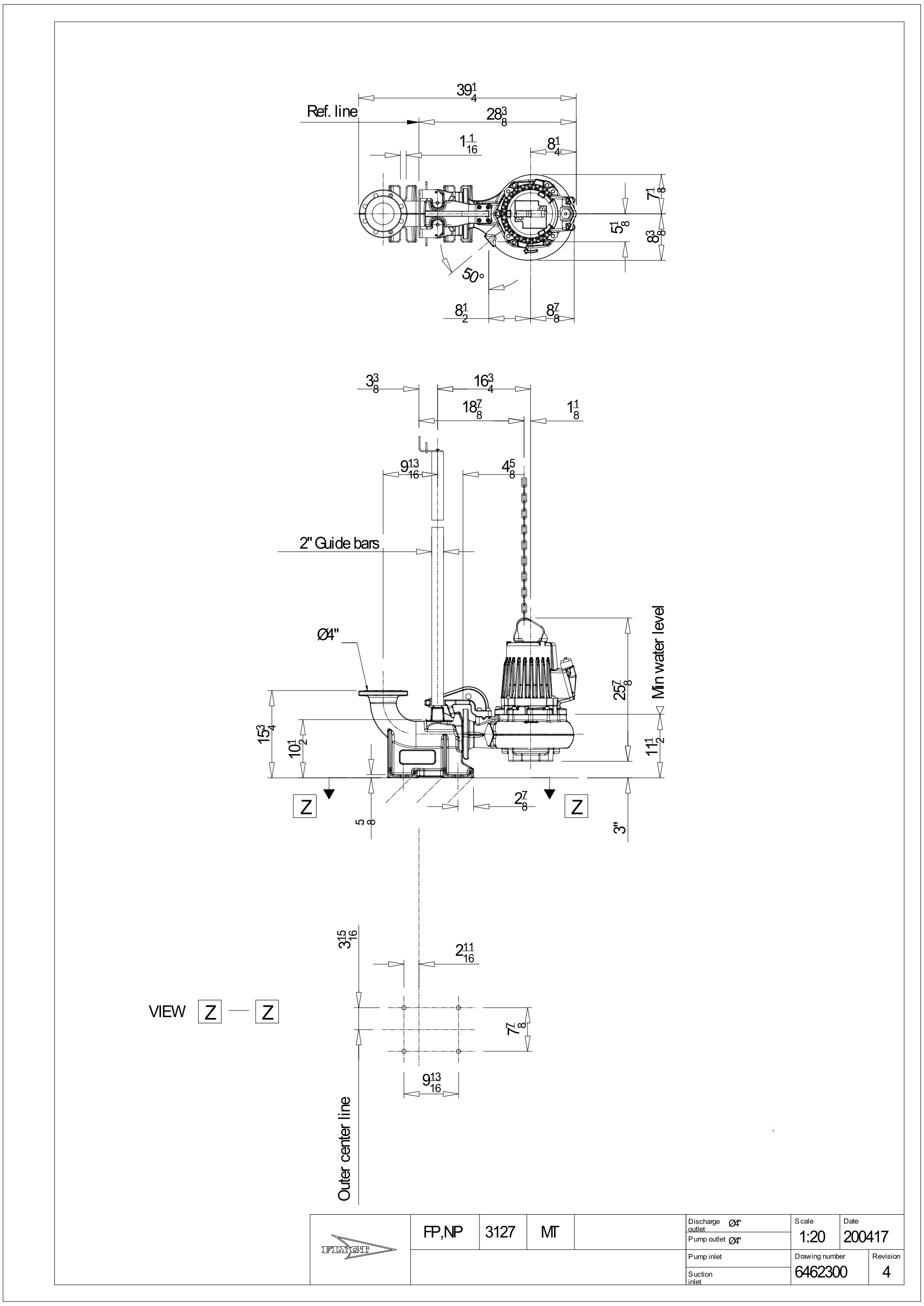
Operating Characteristics

Pumps / Systems	Frequency	Flow	Head	Shaft power	Flow	Head	Shaft power	Hydr.eff.	Specific energy	NPSHre
		US g.p.m.	ft	hp	US g.p.m.	ft	hp		kWh/US MG	ft
1	38.9 Hz	409	13.5	1.93	409	13.5	1.93	72.2 %	223	6.48

Project		**Created by**	david mcfarland		
Block	0	**Created on**	5/17/2022	**Last update**	5/17/2022

NP 3127 MT 3~ Adaptive 439

Dimensional drawing



Project		**Created by**	david mcfarland
Block	0	**Created on**	5/17/2022 **Last update** 5/17/2022

Issued: 11/13 Supersedes: 3/12

TOP Station

Design Data Form

FIELDS IN RED ARE REQUIRED

1. JOB NAME: ____________________
2. STATION DIAMETER (I.D.): 4' ○ 5' ◉ 6' ○
3. STATION HEIGHT: 12' (7' TO 30', 1' INCREMENTS FOR OTHERS CONSULT FACTORY)
4. PUMP DATA:

   PUMP DISCHARGE SIZE: 2" ○ 3" ○ 4" ○ 6" ○

   MODEL: __________ IMPELLER CODE: __________
5. DISCHARGE PIPING: (ALWAYS FACTORY INSTALLED)

   DIAMETER: 2" ○ 3" ◉ 4" ○ 6" ○

   MATERIAL: PVC ○ 316 SST ◉

   DEPTH FROM TOP ______ ANGLE* 0°
6. INLETS:

	1	2	3	4
FACTORY INSTALL:				
FIELD INSTALL:				
DEPTH OF INLET PIPE FROM TOP:				
ANGLE*:				
PIPE O.D.**:				
PIPE MATERIAL:				
PIPE SCH/CLASS:				

   SEAL TYPE IS FRP HUB W/ LINK SEAL FOR ALL PIPE TYPES AND SIZES.
7. INTERNAL VALVES (INSIDE STATION): ◉ NO VALVES: ○

   A. CHECK VALVES: HDL BALL CHECK (STD):

   SWING CHECK:

   OTHER:

   B. ISOLATION VALVES: VAL-MATIC PLUG:

   OTHER:
8. CABLE WALL PENETRATIONS:

   FACTORY INSTALL: ◉ FIELD INSTALL: ○

   POWER: QTY*** 3" 1 LEVEL CONTROL: QTY*** 1-1/4" 1

   POWER, DEPTH FROM TOP: ______ ANGLE*: ______

   LEVEL CONTROL, DEPTH FROM TOP: ______ ANGLE*: ______
9. ADDITIONAL INFORMATION:

10. VENT:

    4" CANDY-CANE STYLE (3' HEIGHT)(STD.): ○

    4" MUSHROOM STYLE: ○

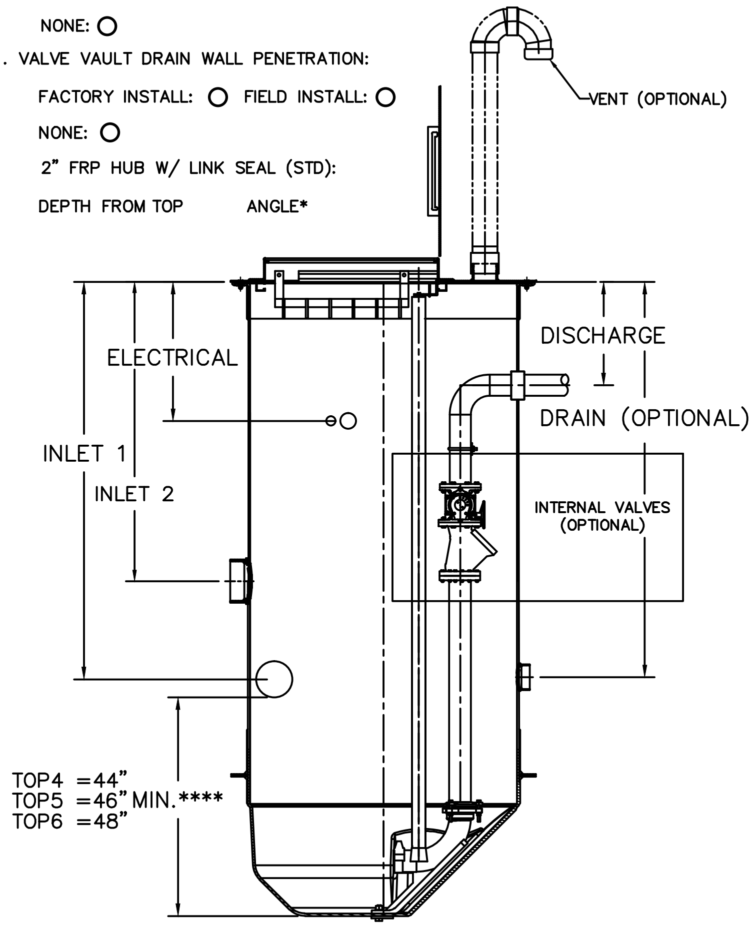
    NONE: ○
11. VALVE VAULT DRAIN WALL PENETRATION:

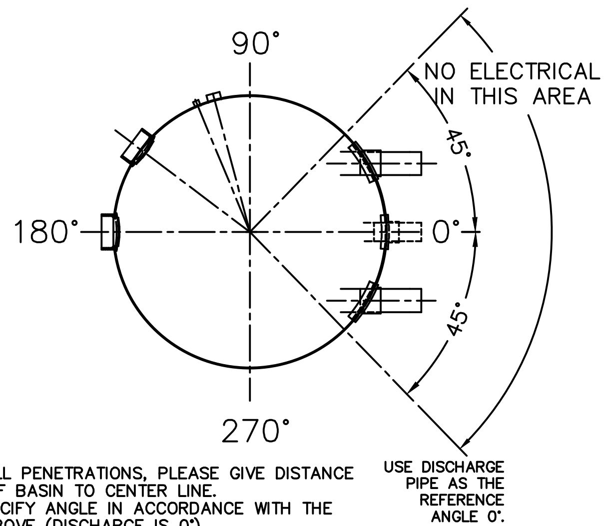
    FACTORY INSTALL: ○ FIELD INSTALL: ○

    NONE: ○

    2" FRP HUB W/ LINK SEAL (STD):

    DEPTH FROM TOP ANGLE*





I CERTIFY THE CORRECTNESS OF THE DATA FOR RELEASE TO THE MANUFACTURER.

NAME: ____________________

SIGNATURE: ____________________

DATE: ____________________

NOTES!
FOR ALL WALL PENETRATIONS, PLEASE GIVE DISTANCE FROM TOP OF BASIN TO CENTER LINE.
*PLEASE SPECIFY ANGLE IN ACCORDANCE WITH THE DIAGRAM ABOVE (DISCHARGE IS 0°).
**INLET PIPE O.D. MUST BE PROVIDED EVEN IF INLET SEAL IS TO BE FIELD INSTALLED.
***A QUANTITY OF 1 FOR EACH SIZE WILL BE PROVIDED UNLESS INDICATED OTHERWISE.
****MINIMUM DIMENSION TO INLET PIPE INVERT (DIMENSION IS APPROX.). IF LOWER ELEVATION OF INSTALLATION IS REQUIRED, PLEASE CHECK WITH YOUR LOCAL APPLICATIONS ENGINEER.

TOP Station

Design Data Form

VALVE VAULT (OPTIONAL): YES ◯ NO◯

1. JOB NAME:

2. DIAMETER: 4' 5' 6'

3. DEPTH:____ (4' TO 10', 1/2' INCREMENTS
FOR OTHERS CONSULT FACTORY)

4. PIPE SIZE/MATERIAL (PRE-INSTALLED):

DIAMETER: 2" 3" 4" 6"

MATERIAL: PVC 316 SST

5.VALVES:

A. CHECK VALVES: HDL BALL CHECK (STD)

SWING CHECK

OTHER:

B. ISOLATION VALVES: VAL-MATIC PLUG

OTHER:

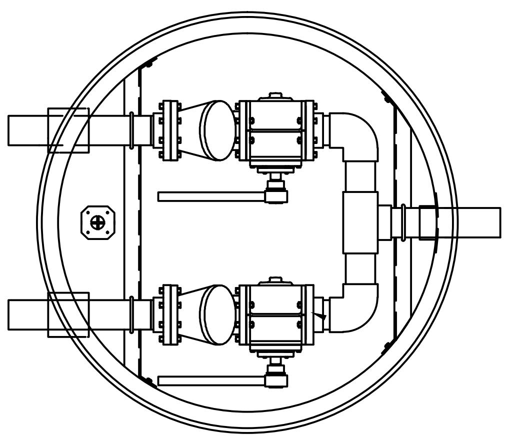
6. HATCH: W/SAFE HATCH (FALL THROUGH PROTECTION)(STD.):

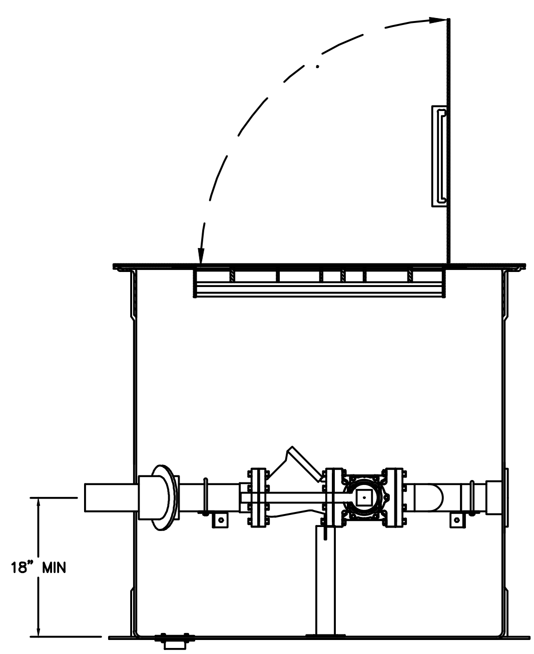
W/O FALL THROUGH PROTECTION:

7. PRESSURE GAUGES: YES NO (STD)

8. FLOOR DRAIN (2" NPT): YES (STD) NO

8. ADDITIONAL INFORMATION:





Chester Creek Culvert Inspection Memo and Storm Drain Inspection Photos

Appendix H

DRAFT

20-27 Camrose Drive Storm Drainage Project South Fork Chester Creek Culvert Inspection at Northern Lights Boulevard

August 2022

Prepared by:

Stephl Engineering, LLC.
3900 Arctic Blvd., Suite 204
Anchorage, Alaska 99503
907-562-1468
rporter@stephleng.com

Draft Memorandum

To: Bill Johnson, P.E., CRW Engineering

From: Brandon Markson, E.I.T., Stephl Engineering, LLC and Russ Porter, PE, Stephl Engineering

Date: August 12, 2022

Re: PM&E Project No. 20-27 Camrose Drive Strom Drainage - Northern Lights Boulevard South Fork Chester Creek Culvert Inspection

---

This memorandum presents the results of the pipe inspection performed by Stephl Engineering LLC (Stephl) on August 10th, 2022 for the Camrose Drive Storm Drainage project. The culvert is located just west of the intersection between E. Northern Lights Boulevard and Ambergate Drive.

The following is a summary of significant pipe defects found during the inspection:

- Invert was not visible due to flow level, debris, and sediment in the pipe.
- 14% pipe ovality deformity at one pipe joint.
- Surface Corrosion observed at the flowline. No significant metal loss was observed.
- Separated joints.
- Large boulders located in the pipe invert.

Purpose

The purpose of this memo is to present the results of the inspection of the culvert crossing under E. Northern Lights Boulevard.

Site Description and Background

The project pipe is a 108-foot long 84-inch Corrugated Metal Pipe (CMP) culvert that is used to convey the flow of South Fork Chester Creek under E. Northern Lights Boulevard. The culvert is located just west of the intersection of E. Northern Lights Boulevard and Ambergate Drive. The pipe is owned and maintained by the Municipality of Anchorage (MOA).

Pipe Inspection Procedure

The pipe inspection work was completed by Stephl. Stephl performed a man-entry inspection of the culvert. Confined space procedures were followed throughout the inspection process. The pipe inspection work was documented on inspection logs and video recordings. A 360-degree video camera was used to document the interior or the pipe as the inspector traveled along the pipe. A point and shoot camera was used to document defects observed during the pipe inspection. Additional lighting was necessary to perform the camera work.

Measurements were taken at the crown of the pipe with a 200-foot long rag tape. Measurements are from the upstream (entrance) to downstream (exit). All clock positions are while facing downstream. A metal bar was used to probe the invert along the length of the culvert from the 4 to 8 o'clock positions to check for soft metal or metal loss. The invert of the culvert was unable to be visually inspected due to the flow level. The entirety of the invert was unable to be probed due to gravel and debris in the invert of the pipe. At the time of the inspection, flow control was not provided.

Summary of Pipe Condition

The attached Figure 1 shows the project area and layout of the culvert. Defects observed during the inspection work are documented in Figure 1. Observations during the inspection are documented in the attached inspection notes.

The storm drain system consists of approximately 108 LF of storm drain culvert. The following is a summary of the characteristics observed during the condition assessment:

- Gravel debris was observed in the invert of the pipe. Debris level varied from approximately six to twenty four inches.
- 108 LF of pipe was estimated to have been inspected for major defects visible above the flow line. Only the portion above the liquid or debris flow level could be observed. This equates to 100% of the project pipe length being visually inspected for significant defects above the flow line.

Ovality

Ovality occurs when a circular pipe starts to collapse and becomes more oval in shape. Ovality is defined as being the original diameter minus the minimum diameter of the deformed pipe. To put ovality into percent terms the following equation is used:

- $$Percent\ Pipe\ Ovality = 100 * \frac{(original\ diameter - minimum\ diameter)}{original\ diameter}$$

Significant Pipe Defects

All measurements were taken the upstream (entrance) to downstream (exit).

- Four boulders were found throughout the pipe between two and four feet in diameter.
- Surface corrosion was observed at the flowline at the four and eight o'clock positions. Probing did not indicate significant metal loss along the invert of the culvert. See Images 1 and 2.
- 13 Feet – Multiple two inch long by ¼ inch horizontal cuts just above the flowline. The cuts appear to be caused by a pipe saw cutting pipe wall. There is a possible repair band behind the cuts. Cuts likely happened during the construction of the culvert. See Images 1 & 2.
- 33 Feet – Deformation with approximately 14% ovality and a two-inch gap between the lip of the pipe end and the pipe band from the 9 to 12 o'clock position. See Images 3 & 4.
- 58 Feet – Two inch gap between the lip of the pipe end the pipe band from the 2 to 4 and 9 to 11 o'clock positions.

- 88 Feet – Four inch gap between the lip of the pipe end and the pipe band from the 2 to 5 o'clock positions. See Image 5.
- 107 Feet – Three 1/2 inch diameter holes in pipe at the 4 o'clock position. See Images 7 & 8.

Image 1 – Cuts with surface corrosion at 13 Feet

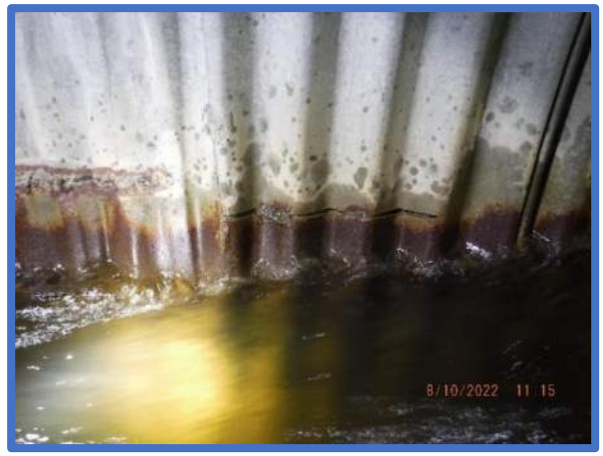


Image 2 – Cuts at 13 feet appear to be welded

Image 3 – 2-inch gap at 33 feet

Image 4 –Deformation with 14% ovality at 33 feet

Image 5 – 4 Inch gap at 88 Feet pipe joint

Image 6 – Beginning of gap at 88 Feet

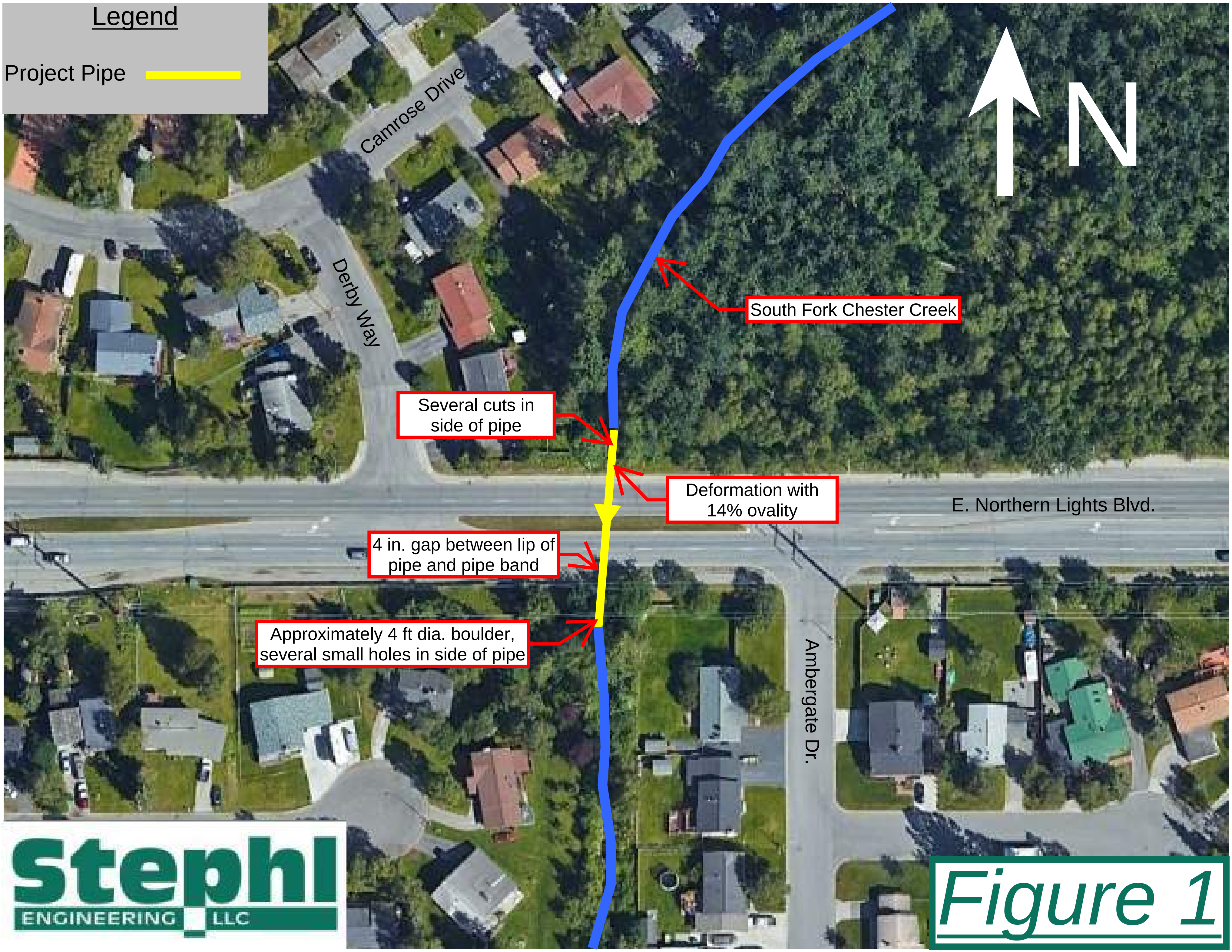
Image 7 –Three ½ Inch diameter holes at 107 feet

Image 8 – ½ inch diameter holes in pipe wall

Video Inspection

The 360 degree video inspection can be viewed at the following link:

https://www.youtube.com/watch?v=QYWgifbPeTg



Legend
Project Pipe
Camrose Drive
Derby Way
N
South Fork Chester Creek
Several cuts in side of pipe
Deformation with 14% ovality
E. Northern Lights Blvd.
4 in. gap between lip of pipe and pipe band
Approximately 4 ft dia. boulder, several small holes in side of pipe
Ambergate Dr.
Stephl ENGINEERING LLC
Figure 1

Storm Drain Inspection Photos
by MOA Operations and Maintenance
May & June 2020

Photo 1 - Collapsed Pipe with Debris (MOA Pipe ID # 1538-32512)

Photo 2 - Grout/Concrete failure at Pipe Penetration (MOA Pipe ID # 1538-26036)

Photo 3 - Backwater from South Fork Chester Creek (MOA Pipe ID # 1538-24114)

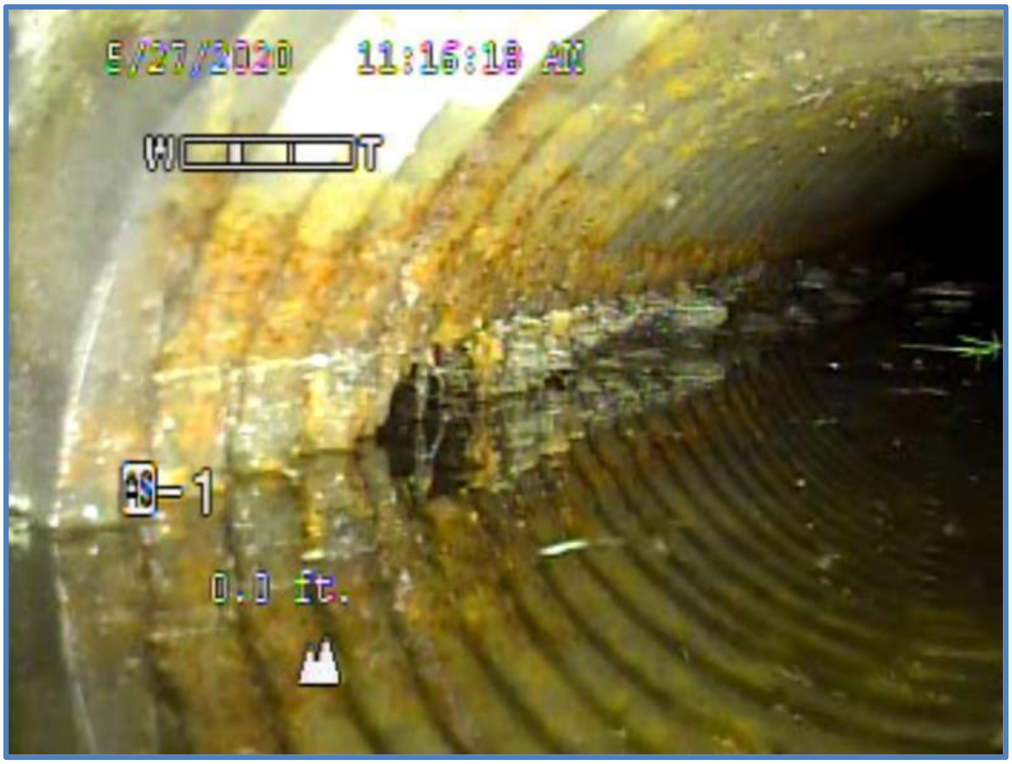


Photo 4 - Metal Loss at Flow Line (MOA Pipe ID # 1538-24962)

Storm Drain Inspection Photos

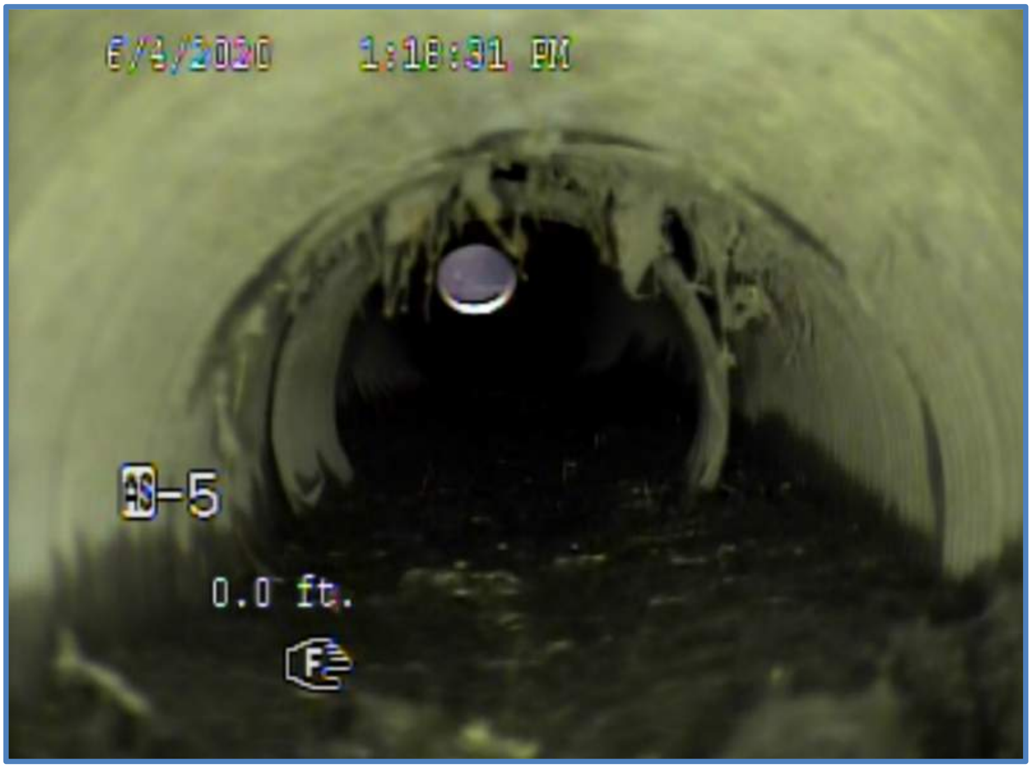


Photo 5 - Pipe Joint Separation & Debris (MOA Pipe ID # 1538-15612)

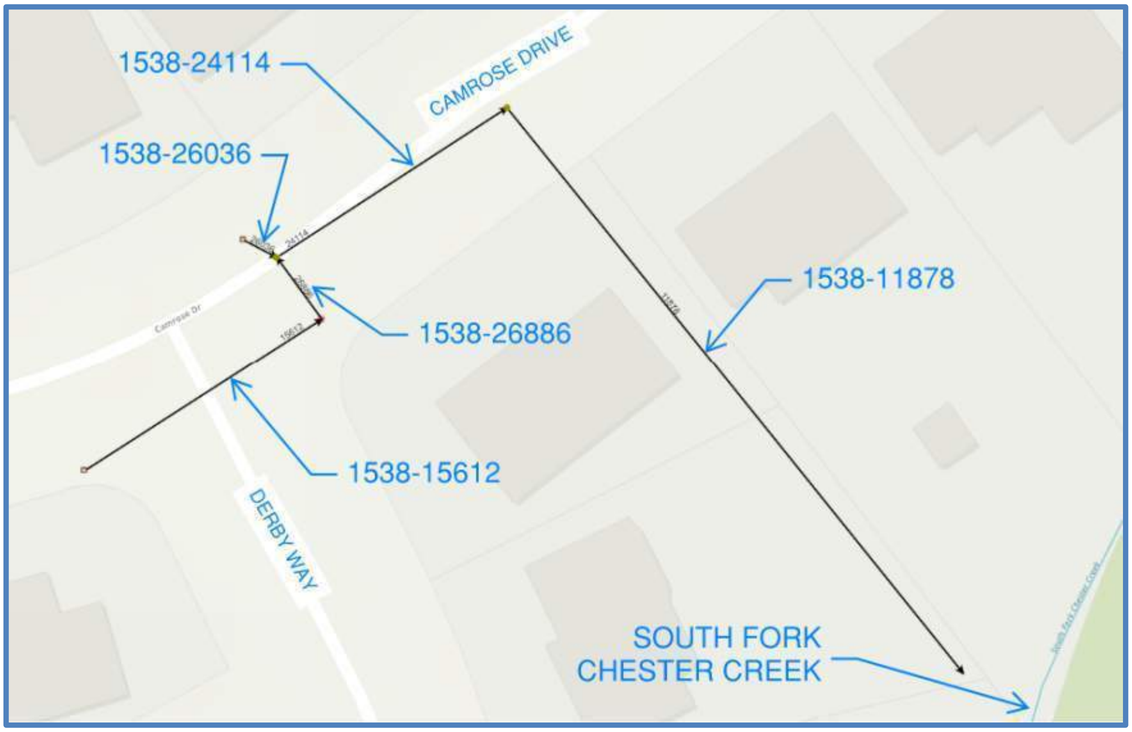


Figure 1 - West Storm Drain System

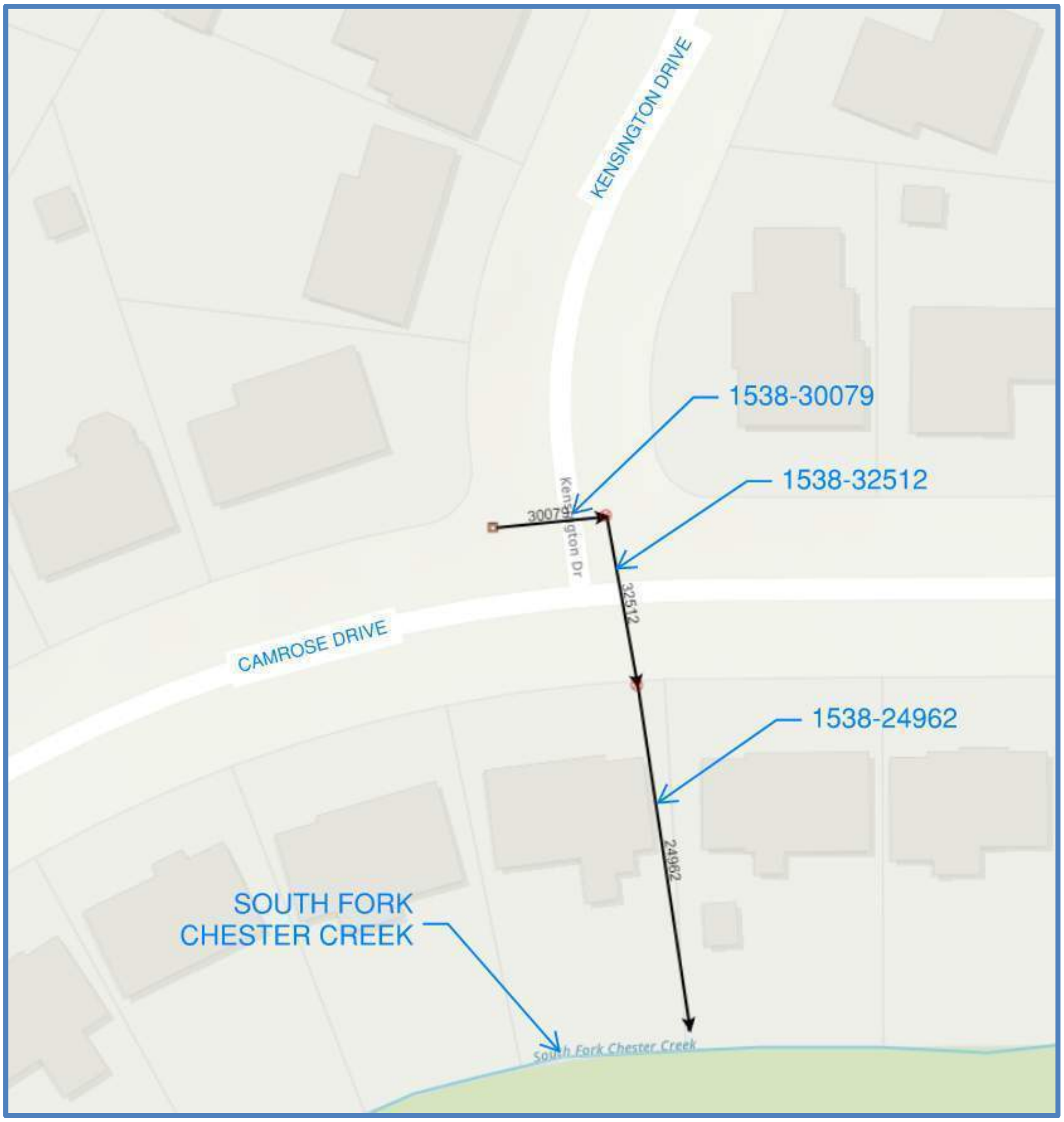
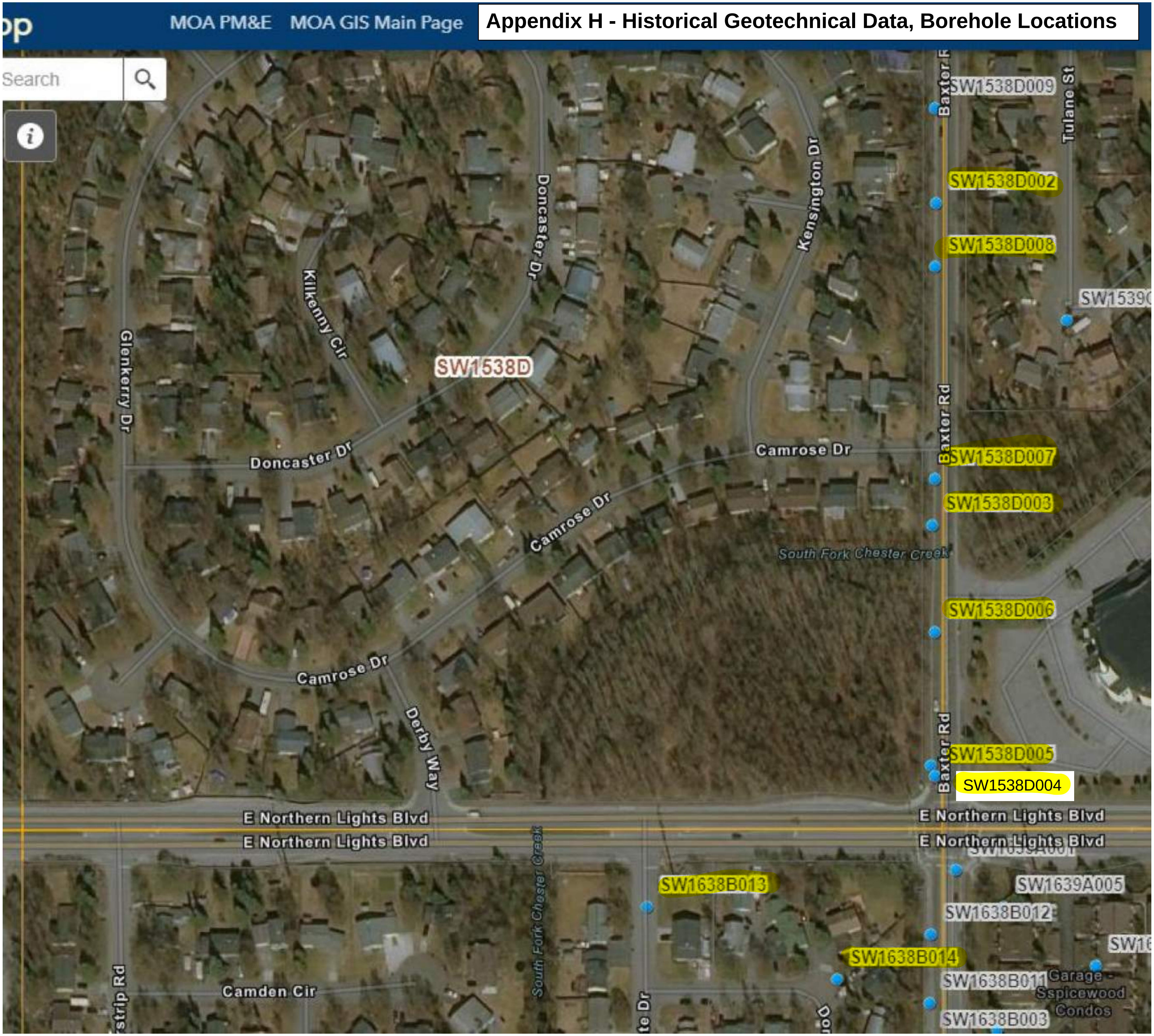


Figure 2 - East Storm Drain System

Historical Geotechnical Data

Appendix I

Appendix H - Historical Geotechnical Data, Borehole Locations



SW1538D002

1974-894

CITY OF ANCHORAGE

DEPARTMENT OF PUBLIC WORKS

SOILS LOG

②

Test Hole 9 Date 11-21-74 By BHD

Location Baxter Road Testholes

0 - MA-353 SW-SM 7% #200

1 -

2 - Cobbles

MA-354 GM 13% #200 very Sandy Gravel

3 -

4 -

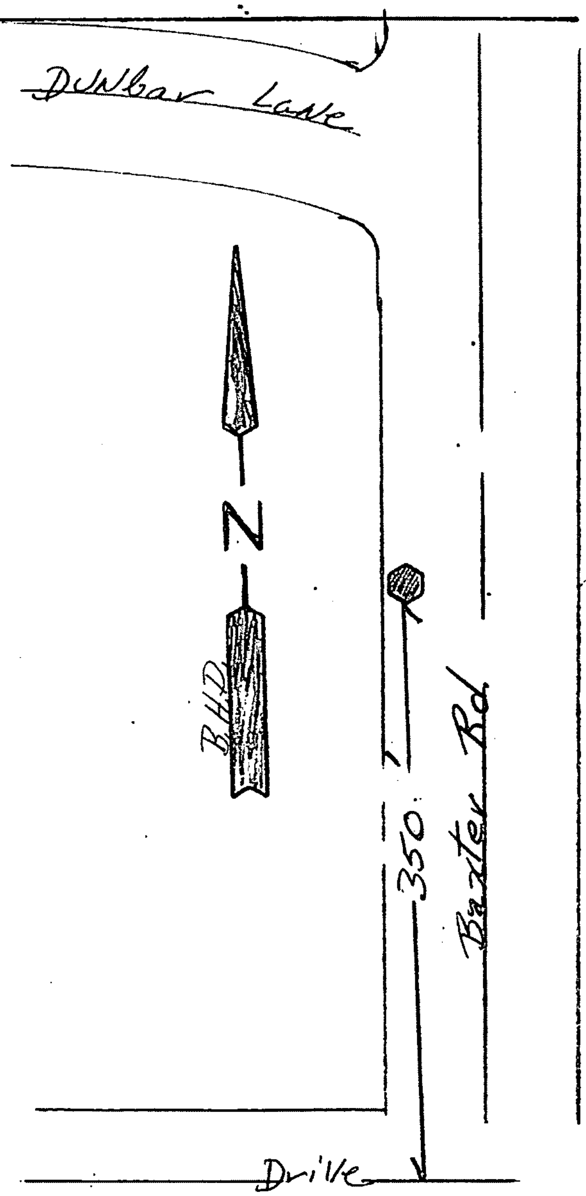
5 -

6 -

MA-355 GP-GM 5% #200

7 -

8 -



Hole Depth 7.0'

1974- 894
SW1538D003

CITY OF ANCHORAGE

DEPARTMENT OF PUBLIC WORKS

SOILS LOG

③

Test Hole 11 Date 11-21-74. By BHD

Location BAXTER

0 - MA-356
SP-SM 7% #200
Gravelly Sand
Some Cobbles

1 -

2 -

3

MA-357
SW-SM 9% #200

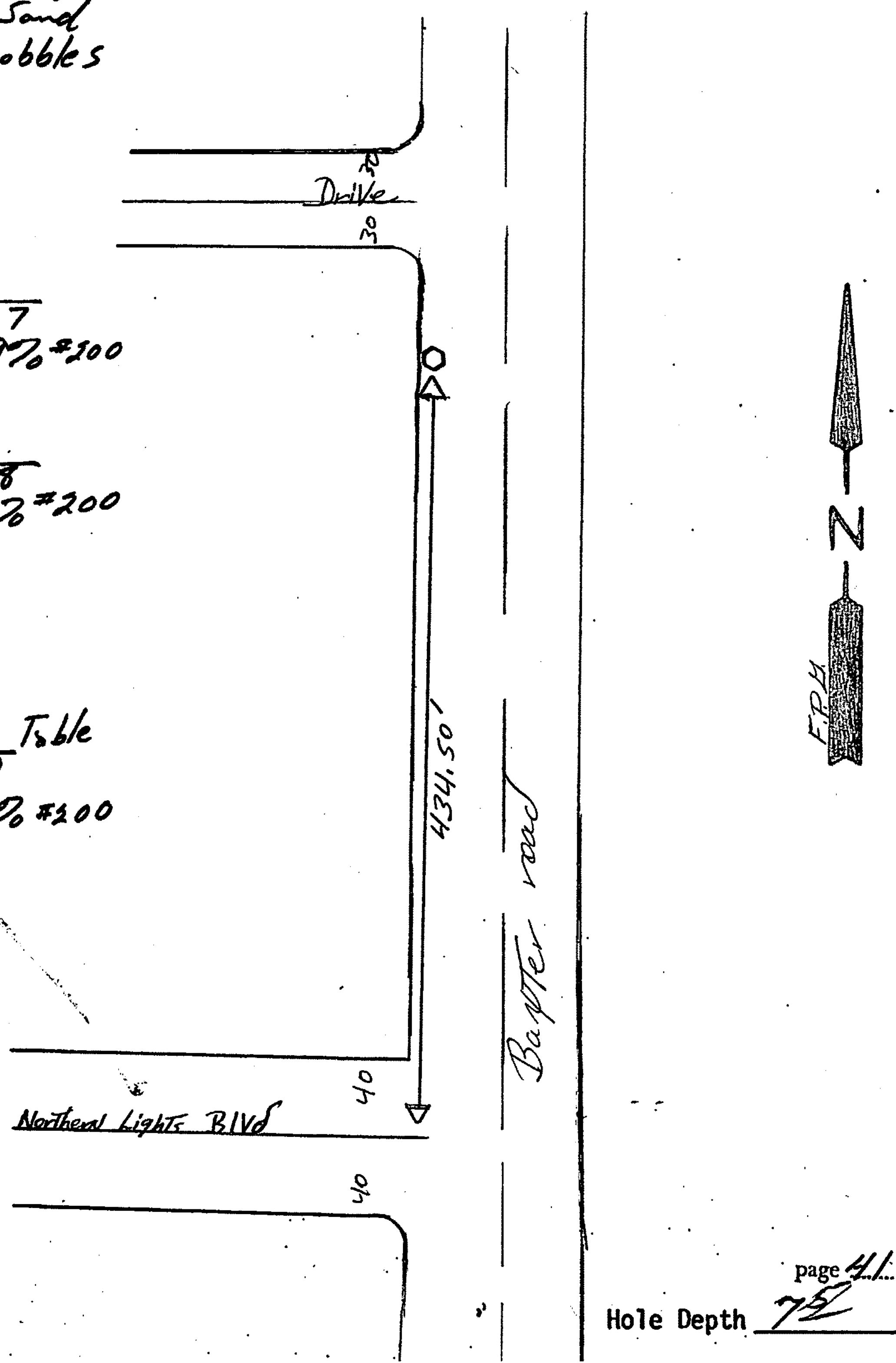
4 -

MA-358
5 SM 20% #200

6 -

7 Also Water Table
MA-359
GW 4% #200

8 -



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Hole Depth 7.5

1974-894

SW1538D004

CITY OF ANCHORAGE

DEPARTMENT OF PUBLIC WORKS

SOILS LOG

(4)

Test Hole 13 Date 11-21-74 By BHD

Location BAXTER ROAD

0

MA-360
SW 4% #200

1

2

3

MA-361
GW-GM 10% #200

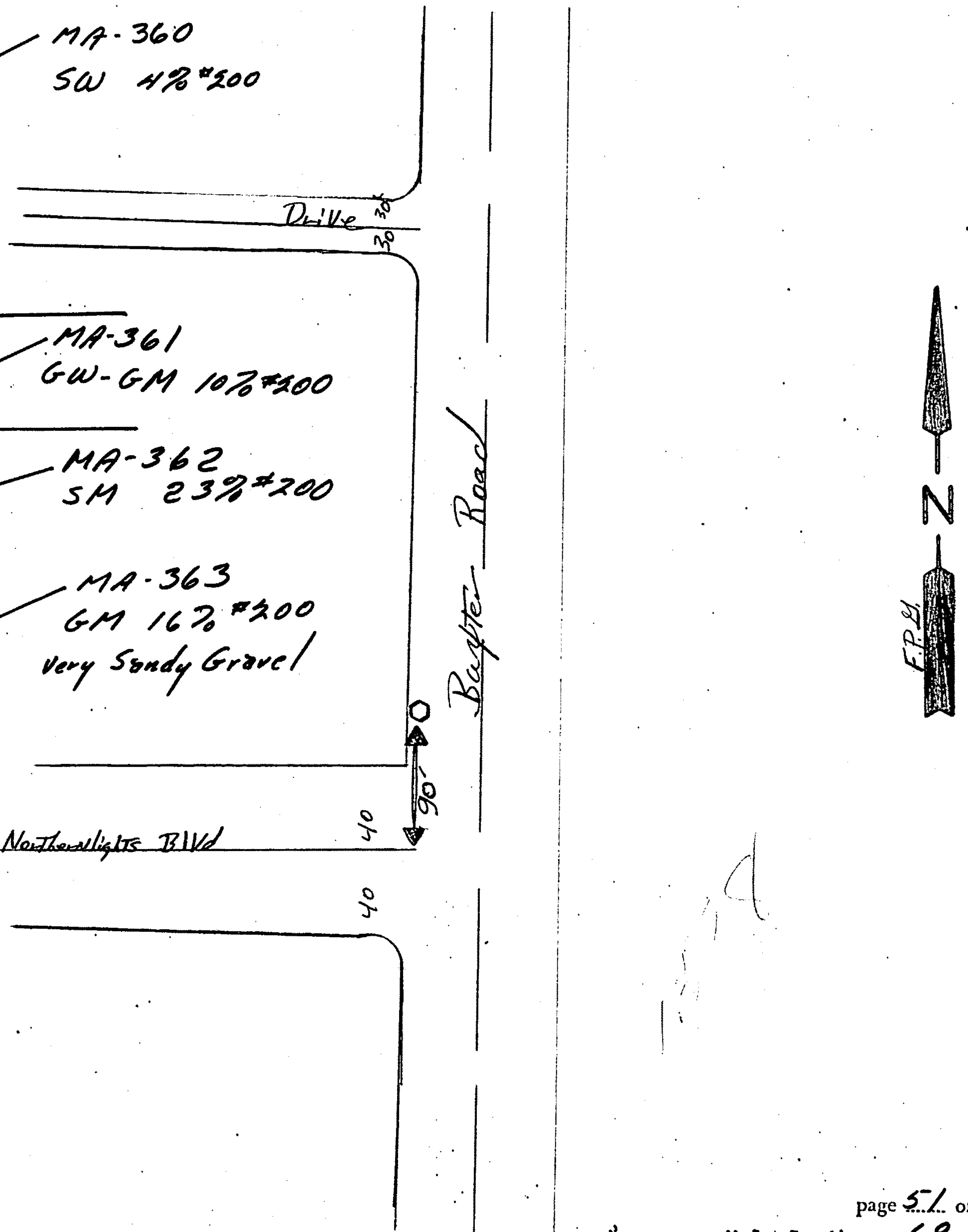
4

MA-362
SM 23% #200

5

MA-363
GM 16% #200
Very Sandy Gravel

6



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Hole Depth 6.0

SW1538D005

5

Soil Description

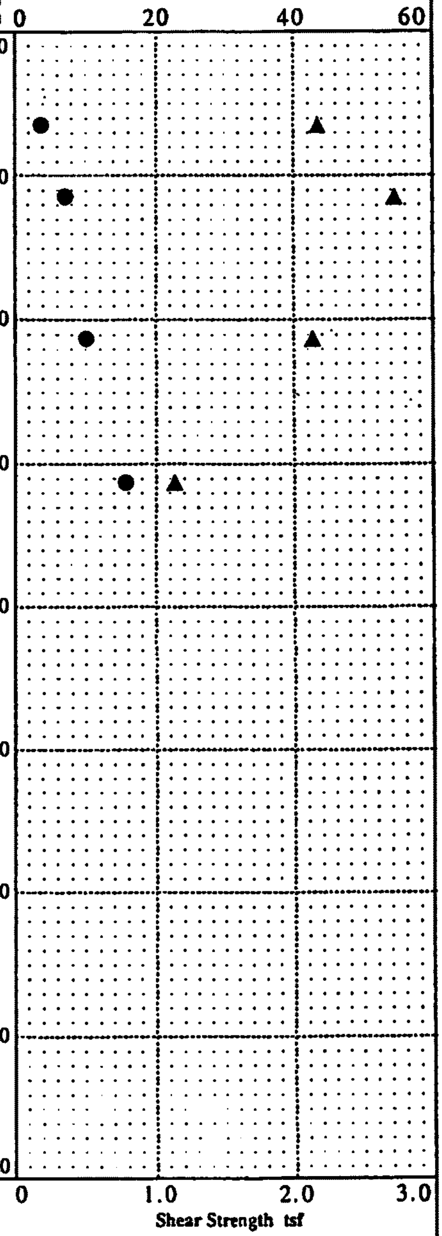
Surface Elevation: Unknown

Soil Description	Depth ft.	Dry Unit Weight pcf	Sample	Ground Water	Depth ft.
Asphalt 2 inches thick					0.0
Dense, brown, slightly silty, gravelly SAND (SP-SM) (F2); dry P200: 9.2%			S-1		
Very dense, brown, silty, gravelly SAND (SM) (F3); moist to dry	5.0		S-2		5.0
			S-3	▽ While Drilling	10.0
Medium dense, grey-brown, slightly gravelly SAND	15.0		S-4		15.0
Bottom of Boring Boring Completed 4/21/97 Groundwater encountered at 10 feet during drilling	16.5				
					20.0
					25.0
					30.0
					35.0
					40.0

DRAFT

Atterberg Limits & Water Content
Natural Water Content %
Plastic Limit ├──●──┤ Liquid Limit

Standard Penetration Resistance
(140-lb. weight / 30 in. drop)
▲ Blows/foot or indicated depth



Legend

- 3" O.D. thin-wall sample
- 2" O.D. split-spoon sample
- continuous sample
- REC% RQD% Rock core sample
- Grab sample
- Impervious seal
- ▽ 0hr Water level at indicated number of hours after drilling
- Piezometer tip

Method of Measurement
- ○ Unconfined Compression
- △ Unconsolidated - Undrained triaxial compression
- ◇ Torvane
- □ Pocket Penetrometer

1. Groundwater levels may vary with time, precipitation, infiltration, and other factors
2. The stratification lines represent approximate soil boundaries. Actual boundary may be transitional.

Log of Boring B-1

SHANNON & WILSON, INC.
Geotechnical Consultants

Baxter Street
Anchorage, Alaska

A-833

Fig. A-2

SW1538D006

(6)

Soil Description

Surface Elevation: Unknown

Soil Description	Depth ft.	Dry Unit Weight pcf	Sample	Ground Water
Asphalt 2 inches thick			S-1	
Brown ~~gravelly~~ SAND (SP) (F1); dry; large cobbles P200 6.0% NO GRADATION F-2 (SP-SM)	6.0			
Hard, grey, sandy clayey SILT ?	15.0		S-2, S-3	While Drilling
Dense, grey, slightly silty, gravelly SAND (SP-SM) (F2); wet	16.5		S-4	

Bottom of Boring

Boring Completed 4/21/97

Groundwater encountered at 10 feet during drilling

DRAFT

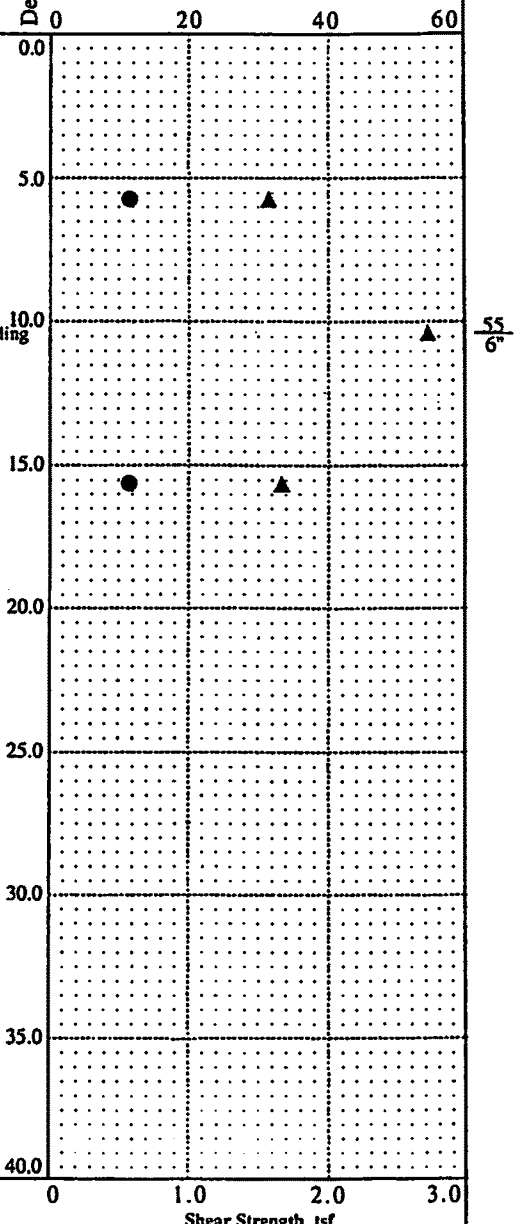
Atterberg Limits & Water Content

Natural Water Content %

Plastic Limit ├──●──┤ Liquid Limit

Standard Penetration Resistance (140-lb. weight / 30 in. drop)

▲ Blows/foot or indicated depth



Legend

- 3" O.D. thin-wall sample
- 2" O.D. split-spoon sample
- continuous sample
- REC% RQD% Rock core sample
- Grab sample
- Impervious seal
- Water level at indicated number of hours after drilling (0hr)
- Piezometer tip

Method of Measurement

- ○ Unconfined Compression
- △ Unconsolidated - Undrained triaxial compression
- ◇ Torvane
- □ Pocket Penetrometer

1. Groundwater levels may vary with time, precipitation, infiltration, and other factors
2. The stratification lines represent approximate soil boundaries. Actual boundary may be transitional.

Log of Boring B-2

SHANNON & WILSON, INC.
Geotechnical Consultants

Baxter Street
Anchorage, Alaska

A-833

Fig. A-3

SW1538007

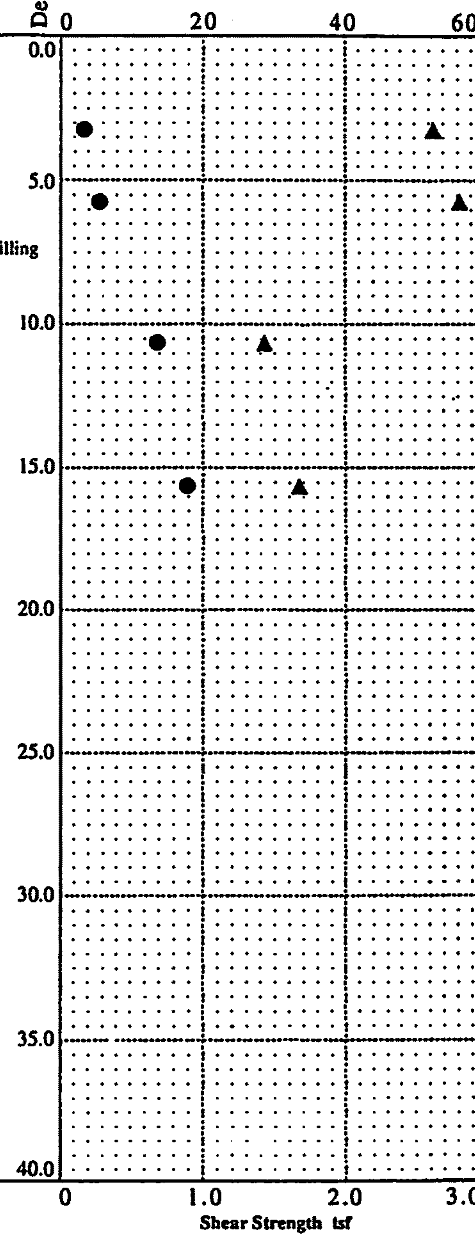
Soil Description

Surface Elevation: Unknown

Depth ft.	Soil Description	Dry Unit Weight pcf	Sample	Ground Water
0.0	2 inches of asphalt — No gradation			
	Very dense, brown, slightly silty, gravelly SAND (SP-SM) (F2); dry P200: 11.5%		S-1 S-2	While Drilling (7 ft)
10.0	Medium dense, grey, silty, gravelly SAND (SM) (F2); wet P200 = 14%		S-3 S-4	
16.5	Bottom of Boring Boring Completed 4/21/97 Groundwater encountered at 7 feet during drilling			

Atterberg Limits & Water Content
Natural Water Content %
Plastic Limit —●— Liquid Limit

Standard Penetration Resistance
(140-lb. weight / 30 in. drop)
▲ Blows/foot or indicated depth



DRAFT

Legend

- 3" O.D. thin-wall sample
- 2" O.D. split-spoon sample
- continuous sample
- REC% RQD% Rock core sample
- Grab sample
- Impervious seal
- Water level at indicated number of hours after drilling (0hr)
- Piezometer tip

Method of Measurement
- ○ Unconfined Compression
- △ Unconsolidated - Undrained triaxial compression
- ◇ Torvane
- □ Pocket Penetrometer

1. Groundwater levels may vary with time, precipitation, infiltration, and other factors
2. The stratification lines represent approximate soil boundaries. Actual boundary may be transitional.

Log of Boring B-3

SHANNON & WILSON, INC.
Geotechnical Consultants

Baxter Street
Anchorage, Alaska

A-833

Fig. A-4

SW1538008

8

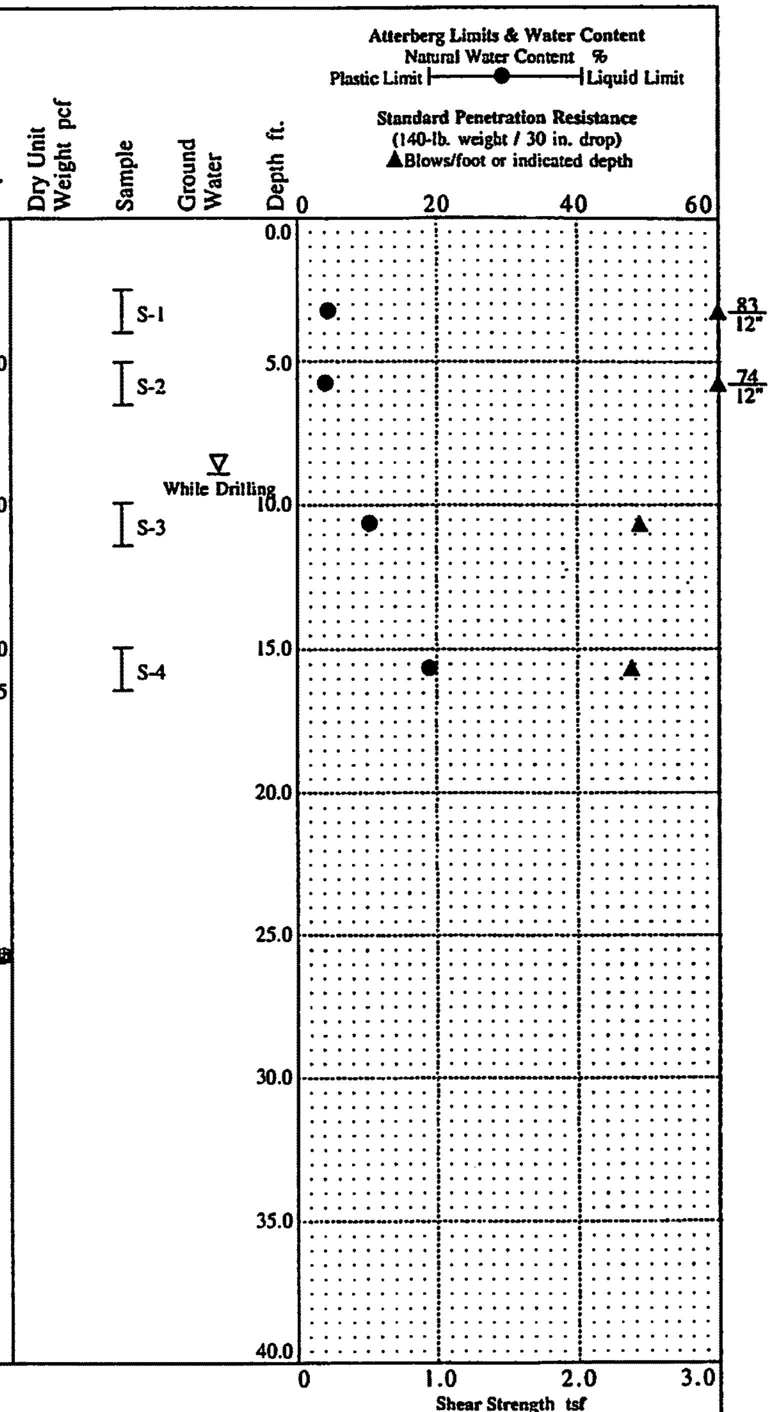
Soil Description

Surface Elevation: Unknown

Soil Description	Depth ft.	Sample
1 inch asphalt		
Very dense, brown, slightly silty, gravelly SAND (SP-SM) (F2); dry P200: 10.9% (13.9%)	5.0	S-1
Very dense, brown, silty, sandy GRAVEL (GP) (F2); dry	10.0	S-2
Dense, brown, sandy GRAVEL; wet	15.0	S-3
Dense, brown, gravelly SAND	16.5	S-4

Bottom of Boring
Boring Completed 4/21/97

Groundwater encountered at 9 feet during drilling



DRAFT

Legend

- 3" O.D. thin-wall sample
- 2" O.D. split-spoon sample
- continuous sample
- REC% RQD% Rock core sample
- Grab sample
- impervious seal
- Water level at indicated number of hours after drilling (0hr)
- Piezometer tip

Method of Measurement
- O Unconfined Compression
- △ Unconsolidated - Undrained triaxial compression
- ◇ Torvane
- □ Pocket Penetrometer

1. Groundwater levels may vary with time, precipitation, infiltration, and other factors
2. The stratification lines represent approximate soil boundaries. Actual boundary may be transitional.

Log of Boring B-4

SHANNON & WILSON, INC.
Geotechnical Consultants

Baxter Street
Anchorage, Alaska

A-833

Fig. A-5

SW1638B013

Soil Description

Surface Elevation:

Soil Description	Depth ft.	FID Measurement (ppm)	Sample	Ground Water
Concrete ~ 3 inches				
Loose to medium dense, brown to grey silty sandy GRAVEL, moist to wet (GM) (F2)		5	1	
		10	2	
				∇ while drilling
		20	3	
		100	4	
Bottom of Boring	16.5			

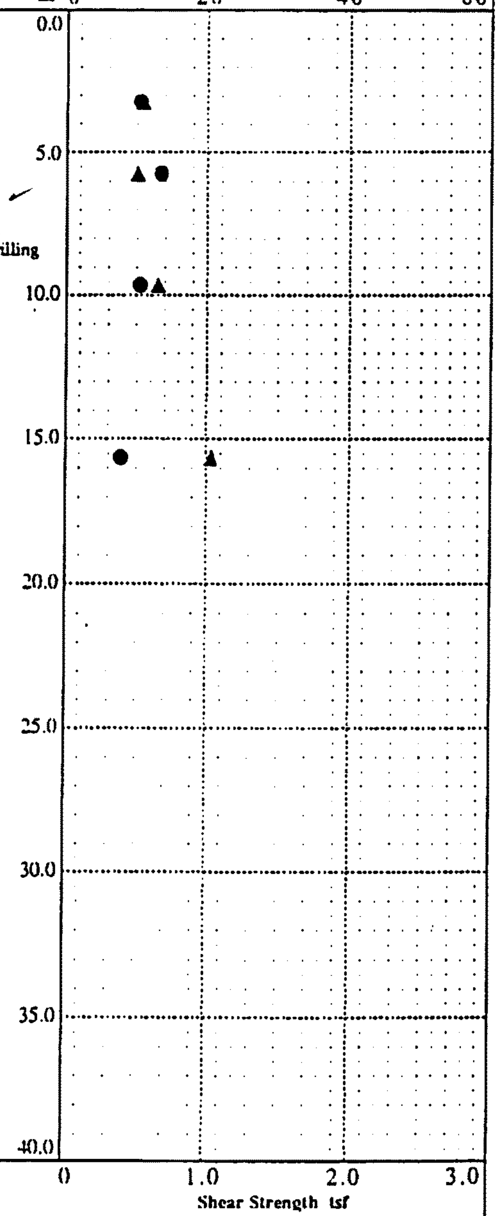
Boring Completed 06/22/95

Groundwater encountered at 8 ft while drilling.

Atterberg Limits & Water Content
Natural Water Content %
Plastic Limit ├──●──┤ Liquid Limit

Penetration Resistance
(340-lb. weight / 30 in. drop)
▲ Blows/foot or indicated depth

13



Legend

- 3" O.D. thin-wall sample
- 3" O.D. split-spoon sample
- continuous sample
- REC% / RQD% Rock core sample
- Grab sample
- Impervious seal
- ∇ Water level at indicated 0hr number of hours after drilling
- Piezometer tip

Method of Measurement
- ○ Unconfined Compression
- △ Unconsolidated - Undrained triaxial compression
- ◇ Torvane
- □ Pocket Penetrometer

1. Groundwater levels may vary with time, precipitation, infiltration, and other factors
2. The stratification lines represent approximate soil boundaries. Actual boundary may be transitional.

Log of Boring B-1

SHANNON & WILSON, INC.
Geotechnical Consultants

College Gate Water R & R
Anchorage, Alaska

A-659

Fig. 2

SW1638B014

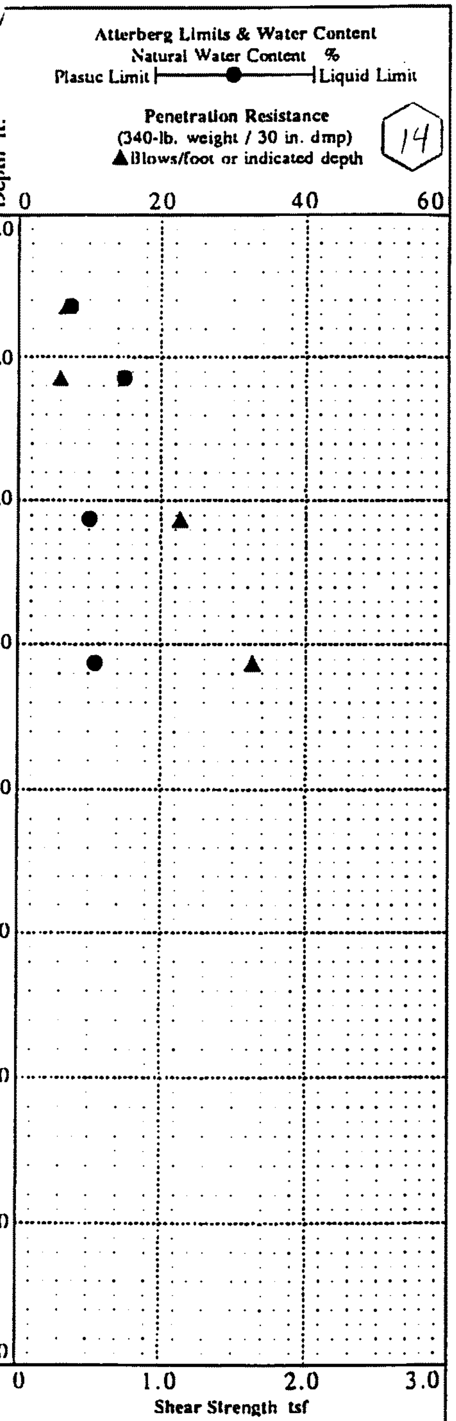
Soil Description

Surface Elevation:

Soil Description	Depth ft.	FID Measurement (ppm)	Sample	Ground Water	Depth ft.
Asphalt - 2 inches					0.0
Loose, brown, slightly gravelly, slightly silty SAND, slightly moist (SP-SM) (F2)		6	1		
		25	2	while drilling	5.0
Medium dense, grey, slightly silty, sandy GRAVEL, wet (F2)	10.0	100	3		10.0
Dense, grey, silty SAND, wet (F3-F4)	15.0	22	4		15.0
	16.5				

Bottom of Boring
Boring Completed 06/22/95

Groundwater encountered at 7.5 ft while drilling.



14

Legend

- 3" O.D thin-wall sample
- 3" O.D. split-spoon sample
- continuous sample
- REC% RQD% Rock core sample
- Grab sample
- Impervious seal
- Water level at indicated number of hours after drilling (0hr)
- Piezometer tip

Method of Measurement
- O Unconfined Compression
- △ Unconsolidated - Undrained triaxial compression
- ◇ Torvane
- □ Pocket Penetrometer

1. Groundwater levels may vary with time, precipitation, infiltration, and other factors
2. The stratification lines represent approximate soil boundaries. Actual boundary may be transitional.

Log of Boring B-2

SHANNON & WILSON, INC.
Geotechnical Consultants

College Gate Water R & R
Anchorage, Alaska

A-659

Fig. 3

Geotechnical Report (Pending, Dec 2022)

Appendix J

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