City of Unalaska
Wastewater Master Plan

Prepared for

City of Unalaska, Alaska

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Prepared by

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This document, the *City of Unalaska Wastewater Master Plan,*
was prepared under the supervision of a registered Professional Engineer.

Executive Summary

The City of Unalaska's (City) wastewater treatment and collection system is a major infrastructure, most of which is invisible to the customers it serves. The wastewater system requires qualified staff to operate and maintain an ongoing capital major maintenance program to replace old components to meet the requirements mandated by federal and state laws. The primary purpose of the City's Wastewater System Master Plan (WWSMP) is to identify and schedule sewer system improvements that correct existing deficiencies and ensure a safe and reliable sewer system for current and future customers.

Overview of Existing System

The City of Unalaska Department of Public Utilities (DPU) owns, operates, and maintains existing wastewater collection and treatment facilities. The collection system consists of approximately 18 miles of gravity sewers and force mains with 12 lift stations that convey collected wastewater to the wastewater treatment plant (WWTP). The WWTP provides chemically enhanced primary treatment (CEPT) followed by chlorine disinfection. The disinfected effluent is dechlorinated and discharged to South Unalaska Bay.

Population, Flow, and Loading

Existing Population

The City experienced rapid population growth in the 1970s and 1980s along with the development of the fish processing industry in Dutch Harbor. Table ES-1 presents a summary of the City's population history according to the U.S. Census Bureau. The wastewater flows to the WWTP are minimally influenced by the seasonal changes in population due to fish processing; the fish processors treat their process wastewater and discharge the treated water through their individual permitted ocean outfalls.

Table ES-1. Population Trends

Year	Population
1950	173
1960	218
1970	178
1980	1,322
1990	3,089
2000	4,283
2010	4,376

Existing Wastewater System Flow Rates and Quality

Influent flow measurements are taken daily at the WWTP and represent all flows to the WWTP, including domestic wastewater and landfill leachate. Table ES-2 summarizes the average annual, maximum month, and maximum day influent flows from 2014 to 2016. The table also includes the peaking factors, which are the ratio of higher loading, such as maximum day, to the average annual loading.

Table ES-2. Existing Average Annual, Maximum Month, and Maximum Day Flow Rates at the WWTP

Year	Average Annual Flow (mgd)	Maximum Month Flow (mgd)	Maximum Day Flow (mgd)	Maximum Month Peaking Factor	Maximum Day Peaking Factor
2014	0.42	0.60	0.9	1.42	2.13
2015	0.40	0.55	0.75	1.38	1.88
2016	0.42	0.52	0.84	1.24	2.00
Average	0.41	0.60	0.90	1.44	2.17

Note: The WWTP receives low flows of 100 gallons per minute (gpm) during the night.
mgd = million gallons per day

The WWTP influent and the landfill leachate are tested for 5-day biochemical oxygen demand (BOD_5), total suspended solids (TSS), and other conventional pollutants per the City's 2004 National Pollutant Discharge Elimination System (NPDES) permit. Concentrations for each constituent were multiplied by the corresponding flow measured at the WWTP to determine loading. Tables ES-3 and ES-4 summarize the BOD_5 and TSS loading between 2014 and 2016.

Table ES-3. Wastewater Treatment Plant 5-Day Biochemical Oxygen Demand Loading

Year	Flow Type	Concentration (mg/L)	Loading (ppd)	Peaking Factor (in terms of AAF)
2014	Average Annual	238	853	1.00
	Max Month	343	1,077	1.44
	Max Day	343	1,077	1.44
2015	Average Annual	245	705	1.00
	Max Month	334	1,022	1.44
	Max Day	450	1,246	1.94
2016	Average Annual	206	752	1.00
	Max Month	344	1,001	1.67
	Max Day	510	1,659	2.48
Average	Average Annual	225	770	1.00
	Max Month	344	1,077	1.53
	Max Day	510	1,659	2.27

mg/L = milligrams per liter
ppd = pounds per day
AAF = average annual flow

Table ES-4. Wastewater Treatment Plant Total Suspended Solids Loading

Year	Flow Type	Concentration (mg/L)	Loading (ppd)	Peaking Factor (in terms of AAF)
2014	Average Annual	151	553	1.00
	Max Month	276	1,110	1.83
	Max Day	276	1,110	1.83
2015	Average Annual	177	517	1.00
	Max Month	320	906	1.81
	Max Day	450	1,317	2.55
2016	Average Annual	157	572	1.00
	Max Month	285	834	1.82
	Max Day	308	1,019	1.96
Average	Average Annual	161	547	1.00
	Max Month	320	1,110	1.98
	Max Day	450	1,317	2.79

Peaking Factors, Flow, and Quality Projections

In order to establish projected flow scenarios for a sewer system, peaking factors need to be determined for the existing system, which can then be applied to future flow rates. Peaking factors are the ratio of higher flows, such as maximum day flow, to the average annual flow. Table ES-5 shows the average annual, maximum month, and maximum day flow rates and peaking factors as measured at the WWTP for 2014 through 2016.

Table ES-5. Summary of Existing Flow Rates and Peaking Factors

Year	Flow Type	Flow (mgd)	Peaking Factor (in terms of AAF)
2014	Average Annual	0.42	1.00
	Maximum Month	0.60	1.42
	Maximum Day	0.90	2.13
2015	Average Annual	0.40	1.00
	Maximum Month	0.55	1.38
	Maximum Day	0.75	1.88
2016	Average Annual	0.42	1.00
	Maximum Month	0.52	1.24
	Maximum Day	0.84	2.00

Note: Flow during the night is generally around 100 gpm.

An existing per person wastewater flow rate was determined for 2014, 2015, and 2016. These numbers were based on the month of May only, since that month has little to no seasonal fish processing population. Table ES-6 presents the existing average wastewater flow rate in gallons per day (gpd) per person.

Table ES-6. Existing Average Wastewater Flow per Person per Day

Month Year	Average Monthly Flow (gpd)	Base Population	Gallons per Day per Person
May 2014	320,149	4,448	72
May 2015	293,580	4,448	66
May 2016	309,645	4,448	70

The maximum population projections (maximum Department of Labor Alaska growth rate projection; see Chapter 3) were used, along with the planning flow rate of 100 gpd per person, to estimate future flows to the City's WWTP.

Table ES-7 presents the existing and projected flow rates to the WWTP for the planning period (through 2037). The maximum month and maximum day peaking factors for the average 2014 through 2016 period (see Chapter 3) were used to project future flows. The peak hour factor of 4.3 from the 2011 Facility Plan (Bristol Engineering Services Corporation and BHC Consultants, 2011) was used to estimate peak hour flows. As previously noted, the WWTP experiences low flows during the night.

Table ES-7. Projected Flows

Year	Base Population	Average Annual Flow (mgd)	Maximum Month Flow (mgd)	Peak Day Flow (mgd)	Peak Hour Flow (mgd)
2016	4,448	0.42	0.52	0.84	--
2021	4,641	0.44	0.64	0.96	1.89
2026	4,815	0.46	0.66	0.99	1.97
2031	4,970	0.47	0.68	1.03	2.04
2037	5,111	0.49	0.70	1.06	2.10

Projected loads for the WWTP were calculated using the design criteria outlined in the 2011 Facility Plan. Table ES-8 presents the projected loading to the City's WWTP.

Table ES-8. Loading Projections

Year	Base Population	Average Annual BOD (ppd)	Maximum Month BOD (ppd)	Maximum Day BOD (ppd)	Average Annual TSS (ppd)	Maximum Month TSS (ppd)	Maximum Day TSS (ppd)
2016	4,448	752	1,001	1,659	572	834	1,019
2021	4,641	928	1,418	2,103	696	1,380	1,941
2026	4,815	963	1,471	2,181	722	1,432	2,013
2031	4,970	994	1,519	2,252	746	1,478	2,078
2037	5,111	1,022	1,562	2,316	767	1,520	2,137

Capital Major Maintenance Program

The information obtained during the site visit completed by CH2M staff in February 2017 (Appendix A) was used to evaluate the improvements required and recommended for the City's wastewater collection and treatment system. A Capital Major Maintenance Program (CMMP) prefix and number has been assigned to each improvement. The improvements are organized and presented in Chapter 5 according to the following primary categories:

- Wastewater Treatment Plant
  - Process Optimization Improvements (P)
  - Regulatory Improvements (R)
  - Maintenance Improvements (M)
  - Safety Improvements (S)
- Lift Station (PS)
- Collection System Inflow and Infiltration (I&I)

Class 5 capital cost estimates were prepared to AACE International standards for the projects identified in the plan. As defined by these standards, the expected accuracy range for a Class 5 estimate is within minus 30 percent to plus 50 percent. All costs are presented in 2017 dollars. The proposed improvements were prioritized based on the perceived need. The City retains the flexibility to reschedule, expand, or reduce the projects included in the CMMP and to add new projects to the CMMP, as best determined by City Council, when new information becomes available for review and analysis. Chapter 5 includes a general description of each group of improvements and an overview of the deficiencies they resolve. Table ES-9 presents the implementation schedule within the 20-year planning horizon and the estimated costs of the improvements.

Table ES-9. Proposed Capital Major Maintenance Program Implementation Schedule

			Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Years 7-10	Years 11-20
			Schedule of Major Maintenance Program Planned Year of Project and Estimated Cost							
No.	Description	Estimated Cost (2017 $)	2018	2019	2020	2021	2022	2023	2024 - 2027	2028-2037
Wastewater Treatment Plant - Process Optimization Improvements										
P1	Clarifier Baffling	$80,000							$80,000	
Wastewater Treatment Plant - Regulatory Improvements										
R1	Wastewater Facilities Plan Update	$175,000								$175,000
Wastewater Treatment Plant - Maintenance Improvements										
M1	Scum Decant Tank Wet Well	$170,000							$170,000	
M2	WWTP Plant Water Modifications	$50,000							$50,000	
M3	WWTP Flocculator Valving	$30,000							$30,000	
M4	WWTP Flocculator Drain Modifications	$20,000							$20,000	
Wastewater Treatment - Safety Improvements										
S1	Tank Drain Pump Station	$21,000		$21,000						
S2	Sludge Holding Tank Protection	$35,000			$10,500	$24,500				
Lift Station										
PS1	Lift Station 2 Improvements	$193,500	$38,700	$154,800						
PS2	Lift Station 5 Improvements	$195,000	$39,000	$156,000						
PS3	U.S. Coast Guard Lift Station Improvements	$100,000					$20,000	$80,000		
PS4	Leachate Lift Station Improvements	$110,000			$33,000	$77,000				

Table ES-9. Proposed Capital Major Maintenance Program Implementation Schedule

No.	Description	Estimated Cost (2017 $)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Years 7-10	Years 11-20
			Schedule of Major Maintenance Program Planned Year of Project and Estimated Cost							
			2018	2019	2020	2021	2022	2023	2024 - 2027	2028-2037
Inflow and Infiltration										
I&I1	Sewer Manhole Rehabilitation	$135,000	$40,500	$94,500						
I&I2	Inflow and Infiltration Study	$250,000			$50,000	$100,000	$100,000			
I&I3	Slip Lining from Powerhouse to Delta Way Lift Station	$260,000		$260,000						
Total		**$1,824,500**	**$118,200**	**$686,300**	**$93,500**	**$201,500**	**$120,000**	**$80,000**	**$350,000**	**$175,000**

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Acronyms and Abbreviations

2011 Facility Plan	City of Unalaska Wastewater Facility Plan (Bristol Engineering Services Corporation and BHC Consultants, 2011)
°F	degrees Fahrenheit
µg/L	micrograms per liter
AAC	Alaska Administrative Code
AAF	average annual flow
ADEC	Alaska Department of Environmental Conservation
AMNWR	Alaska Maritime National Wildlife Refuge
AWCRSA	Aleutians West Coastal Resource Service Area
BOD	biochemical oxygen demand
BOD_5	5-day biochemical oxygen demand
CEPT	chemically enhanced primary treatment
CH2M	CH2M HILL Engineers, Inc.
City	City of Unalaska
CMMP	Capital Major Maintenance Program
DO	dissolved oxygen
DPU	Department of Public Utilities
EPA	U.S. Environmental Protection Agency
gpd	gallons per day
gpm	gallons per minute
HDR Population Memo	"Water Master Plan Technical Memo #1 – Population and Water Demand" (Appendix B)
I/I	infiltration and inflow
LCR	Lead and Copper Rule
mg/L	milligrams per liter
mgd	million gallons per day
mL	milliliters
NPDES	National Pollutant Discharge Elimination System
O&M	operation and maintenance
ppd	pounds per day
SCADA	supervisory control and data acquisition
TMDL	total maximum daily load
TSS	total suspended solids

USCG	U.S. Coast Guard
USFWS	U.S. Fish and Wildlife Service
UV	ultraviolet
WWSMP	Wastewater System Master Plan
WWTP	wastewater treatment plant
ZID	zone of initial dilution

Chapter 1. Introduction and Background

This chapter provides a brief background of the City of Unalaska (City) sewer system ownership and management, briefly describes the existing system, and discusses the compatibility of this Wastewater System Master Plan with other planning documents.

1.1 Background

1.1.1 Sewer System Ownership and Management

Unalaska Island is an island in the Aleutian Chain, approximately 800 miles southwest of Anchorage and approximately 2,000 miles northwest of Seattle (Figure 1-1). The City of Unalaska, Alaska, is located on the coasts of Unalaska and Amaknak islands and is the 11th largest city in Alaska with a population of approximately 4,600 residents. Dutch Harbor, the City's port, is on Amaknak Island and is connected by a bridge to Unalaska. Unalaska's economy is based on commercial fishing, fish processing, fleet services, and transportation. As many as 4,400 transient workers are employed in the fish processing industry during times of peak activity.

1.1.2 Overview of Existing System

The City Department of Public Utilities (DPU) owns, operates, and maintains existing wastewater collection and treatment facilities. The collection system consists of approximately 18 miles of gravity sewers and force mains with 12 lift stations that convey collected wastewater to the wastewater treatment plant (WWTP). The WWTP screens and disinfects an average of 0.4 million gallons per day (mgd) of domestic wastewater. The City of Unalaska Landfill contributes leachate to the collection system and is a source of biochemical oxygen demand (BOD) load to the WWTP. The leachate generated at the City's landfill is the only major nondomestic source of wastewater discharged to the City's WWTP. The WWTP provides chemically enhanced primary treatment (CEPT) followed by chlorine disinfection. The disinfected effluent is dechlorinated and discharged to South Unalaska Bay.

Fish processing is a major industry for the City of Unalaska. The four seafood processing facilities include Unisea, Inc.; Westward Seafoods, Inc.; Alyeska Seafoods, Inc.; and Icicle Seafoods, Inc. The process water used by these industries is not discharged to the City's WWTP. The fish processors treat their process water and discharge the treated water through their individual permitted ocean outfalls.

1.1.3 Related Plans and Studies

- *City of Unalaska Wastewater Facility Plan* (2011 Facility Plan) (Bristol Engineering Services Corporation and BHC Consultants, 2011)
- "Water Master Plan, Technical Memo #1 - Population and Water Demand" (Appendix B)
- "Water Master Plan, Technical Memo #2 – Water System Planning Criteria"

1.2 Authorization and Purpose

In January 2017, the City authorized CH2M HILL Engineers, Inc. (CH2M) to prepare a Wastewater System Master Plan (WWSMP) in accordance with applicable permitting and regulatory requirements. The WWSMP provides the City a framework to plan for improvements in the collection system and at the WWTP as growth occurs within the service area over the next 20 years. The purpose of the WWSMP is to:

- Evaluate the existing wastewater collection and treatment system

- Document deficiencies in the existing system
- Document influent flow and loading information
- Describe collection system infiltration and inflow
- Analyze future flow and loading projections based on population and growth statistics developed in the City's Water System Master Plan (HDR, in preparation)
- Identify existing and potential future regulatory requirements
- Evaluate WWTP solids-handling system and coordinate with landfill master planning
- Recommend and prioritize improvements based on regulatory requirements, operation and maintenance (O&M) concerns, and general process improvements
- Evaluate and recommend future staffing

1.3 Goals of the Wastewater System Master Plan

The goals for this document are to:

- Provide a functional planning document to assist in the DPU's vision development
- Provide direction and justification for future projects to support the City's Capital Major Maintenance Program (CMMP)
- Identify and prioritize regulatory and nonregulatory improvements to the City's sewer system

1.4 Wastewater System Master Plan Organization

This plan has seven main sections:

- The **Executive Summary** summarizes the plan.
- **Chapter 1** introduces the reader to the City's sewer system, the WWSMP objectives, and the plan organization.
- **Chapter 2** presents the wastewater collection area and generally describes the components.
- **Chapter 3** describes population characteristics, identifies the existing wastewater flow rates and quality, and projects future wastewater flow rates and quality.
- **Chapter 4** presents the existing and future wastewater regulations for consideration in planning the system.
- **Chapter 5** presents the existing system deficiencies, proposed wastewater system improvements, and estimated costs and implementation schedule for the improvements.
- **Chapter 6** is a list of references cited in the WWSMP.

FIGURE 2-1
Vicinity Map
City of Unalaska
Wastewater System Master Plan

Chapter 2. Sewer Collection System and Wastewater Treatment Facility

This chapter provides a brief history of the City's sewer collection and treatment systems and describes the sewer service area and the sewer system components. The information presented in Section 2.1 is derived from Chapter 2 of the 2011 Facility Plan. The existing system evaluation and analysis results are presented in Chapter 3.

2.1 Existing Environment

Unalaska is a first class city in the Aleutians West Census Area of the Unorganized Borough of the State of Alaska. The existing City of Unalaska WWTP discharges treated effluent to South Unalaska Bay. A description of the environment surrounding the WWTP is provided below.

2.1.1 Land

Unalaska is located on Unalaska Island and neighboring Amaknak Island in the Aleutian Islands southwest of mainland Alaska. Unalaska and Amaknak islands are connected by a bridge that crosses the channel connecting Iliuliuk Harbor to Captains Bay. Unalaska Island is composed of rugged mountains that rise with steep gradients from the shoreline around most of the island.

2.1.2 Water

The City of Unalaska is primarily a marine port that is surrounded by water. The greater bay, Unalaska Bay, connects to the Bering Sea. A number of smaller bays and harbors surround the City, the most important of which are Dutch Harbor, Iliuliuk Bay, Summer Bay, and Captains Bay.

The shoreline along Unalaska Bay is primarily formed of steep cliffs with a few narrow beaches. There are a number of enclosed bays, and the shoreline is interrupted at several locations by seasonal streams. Unalaska Bay has average depths of 400 feet around Hog Island and 200 feet in the southern portion of the bay.

Mean tidal fluctuations in Unalaska Bay are approximately 1 meter. The maximum tidal amplitude is 3 meters. A water circulation study of Unalaska Bay indicated that the water circulation is primarily a result of winds (90 percent) and secondarily by tides (10 percent). Water circulation is also influenced by a seasonally stratified water column and by minimal currents at the bottom of the bay.

A large freshwater stream, Iliuliuk River, drains from Unalaska Lake into Iliuliuk Bay. The Iliuliuk River is a spawning ground for salmon.

In 1995, the U.S. Environmental Protection Agency (EPA) concluded that seafood processing wastes from five facilities and sewage from the City WWTP contributed significantly to the reduction of dissolved oxygen (DO) levels in South Unalaska Bay. The State of Alaska water quality standard for DO is 6 milligrams per liter (mg/L).

South Unalaska Bay is listed as a Category 4a Impaired Water on the State 303(d) List of Impaired Waters. South Unalaska Bay has total maximum daily loads (TMDLs) for 5-day BOD (BOD_5) and settleable solid residues, including wasteload allocations for the City's WWTP discharge. These TMDLs were created as a result of seafood processing waste discharges for South Unalaska Bay. The TMDLs enforce a total wasteload allocation of 280,761 pounds of BOD_5/day from Unalaska WWTP and four other seafood processors, and 1,785,953 pounds of settleable solid residues/year from four seafood processors. The City of Unalaska was allocated 2,343 pounds per day (ppd) (0.83 percent of the 280,761 total ppd) for its

WWTP. The remaining 278,417 ppd is allocated to the seafood processors based on historical reporting of BOD_5 discharges.

Dutch Harbor and Iliuliuk Harbor are listed as Category 5 Impaired Waters. The impaired water listings for Dutch Harbor and Iliuliuk Harbor are a result of petroleum, hydrocarbon, grease, and oil residues. The petroleum hydrocarbon TMDLs recommend the development of best management practices for controlling and minimizing the risk of further petroleum releases into these water bodies.

The EPA also has a TMDL for settleable solid residues for Udagak Bay of Beaver Inlet, which is located approximately 14 miles southeast of Dutch Harbor. This TMDL regulates wastes from the Northern Victor Partnership facility.

In accordance with the City's WWTP National Pollutant Discharge Elimination System (NPDES) permit, the City currently samples surface water near the outfall in South Unalaska Bay on a semiannual basis for total ammonia, temperature, salinity, and pH. Sampling is conducted for fecal coliform on a quarterly basis. Samples are collected from three locations: two are offshore at the edge of the mixing zone defined by a 150-meter radius from the outfall, and the third is to the east of the outfall at the shoreline.

2.1.3 Air

The Alaska Department of Environmental Conservation (ADEC) regulates air quality standards for the State of Alaska under Alaska Administrative Code Title 18 Chapter 50 (18 AAC 50). In the City of Unalaska there are currently active permits for emissions from the Unalaska seafood processing plant, the City power plant, and the Dutch Harbor seafood processing plant. The City WWTP does not have an air permit. In general, emissions from the removal of sludge or sediment from pits, ponds, and sumps, and emissions from wastewater conveyance and treatment facilities are considered insignificant.

2.1.4 Sensitive Areas

2.1.4.1 Critical Habitat

The marine environment surrounding Unalaska Island is part of the Alaska Maritime National Wildlife Refuge (AMNWR). The WWTP is within the critical habitat area for two Steller sea lion haul-outs but not for any rookeries. NOAA Fisheries defines Steller sea lion critical habitat by a 20-nautical-mile radius (straight-line distance) encircling a haul-out or rookery. Two haul-outs (Old Man Rocks and Cape Sedanka) are approximately 16 nautical miles (straight line distance) from the WWTP. The actual navigable distance between the haul-outs and the WWTP is over 20 nautical miles, since Unalaska Island is between the haul-outs and the WWTP. The closest rookery is Akutan/Cape Morgan, which is just over 20 nautical miles from the WWTP. A haul-out has also been documented at Priest Rock on Unalaska Island.

South Unalaska Bay has been mapped by the U.S. Fish and Wildlife Service (USFWS) as a known wintering location for Steller's eider ducks. USFWS maps indicate that the bay is a wintering area to "1001 or more" individuals. Critical habitat for northern sea otters is designated on Unalaska Island for all water less than 20 meters deep and also on all waters within 100 meters of shore (regardless of depth).

2.1.4.2 Floodplains

The City does not participate in the National Flood Insurance Program. Most flood hazards for the WWTP facility are likely to be coastal in nature (i.e., storm surges or tsunamis). However, there are two recorded flood events for the City not caused by seawater. The events occurred in 1991 and 1985, both due to heavy rainfall. There are no floodplain maps available for the City, and there are no areas designated as being located in floodplains.

2.1.4.3 Shorelands

The shoreline surrounding the WWTP has been designated in the Aleutians West Coastal Resource Service Area (AWCRSA) Coastal Management Plan as gravel beaches with areas of exposed tidal flats and exposed wave-cut platforms in bedrock. The following descriptions are summarized from the Aleutians West Coastal Resource Service Area Coastal Management Plan (AWCRSA, 2006).

Gravel beaches are described in the plan as having the potential to be very steep, with multiple wave-built berms forming the upper beach. The grain size can vary widely, from small pebbles to large boulders. Exposure to wave energy is highly variable. The degree of exposure can be inferred partly by the roundness/angularity of the gravel; well rounded gravel indicates regular reworking of the surface sediments by waves; angular gravel indicates infrequent exposure to waves big enough to rework the sediments. The extent of individual gravel beaches varies widely and changes over time; there are depositional seasons, and seasons when material is removed from the beach areas.

Exposed tidal flats are broad intertidal areas composed primarily of sand and gravel. The presence of sand indicates that the tidal currents and waves are strong enough to mobilize the sediments. This type of area tends to be heavily used by the biological community, especially by birds for roosting and foraging and by mammals as haul-outs, and the offshore area is used by foraging fish. This coastline type has wide variability due to the wave action of a particular season.

Exposed wave-cut platforms of exposed bedrock consists of a bedrock shelf or platform of variable width (up to hundreds of feet wide) and very gentle slope. The surface platform is irregular and the presence of tidal pools is common. The shoreline may be backed by steep rock scarp or low bluffs. There may be a narrow gravel beach because of the scarp. Species diversity varies greatly, but barnacles, snails, mussels, and micro-algae are often abundant.

Native vegetation close to the shoreline may be appealing to ground-nesting birds protected under the Migratory Bird Treaty Act. The USFWS issued an Advisory in 2007 with recommended time periods for avoiding vegetation clearing in the Alaska regions.

2.1.4.4 Wetlands

There are no National Wetlands Inventory or Natural Resource Conservation Service soils data for the Unalaska Island area. The 2010 City of Unalaska Comprehensive Plan (City of Unalaska, 2011) states that wetlands on the islands tend to be associated with river/stream floodplains.

2.1.4.5 Rivers

The closest river to the WWTP is the Iliuliuk River, which discharges from Unalaska Lake into Iliuliuk Bay. The Iliuliuk River is on Unalaska Island, whereas the WWTP is on Amaknak Island. There are three other rivers within the Unalaska city limits (Makushin, Nateekin, and Shaishnikoff). There are several other small, unnamed drainages within the city limits. There are no designated Wild and Scenic Rivers located near the community. The McLees Lake, Summer Bay Lake, Humpy Cove/Creek, Mossir Cove/Lake, Constantine Lake, and Icy Lake watersheds are also within the Unalaska city limits.

2.1.4.6 Historical and Archaeological Sites

Preliminary research at the offices of the State Historic Preservation Office indicates that Dutch Harbor and Amaknak Island are part of the Dutch Harbor Naval Base National Historic Landmark. Additionally, there are over 100 individual sites and/or structures that have been catalogued but are not listed in the National Register of Historic Places.

2.1.4.7 Threatened Species

The USFWS's *Threatened and Endangered Species: A Consultation Guide for Southcentral Alaska* and other internet sources were used to identify special-status plant and animal species in the WWTP area. The following species are designated as special status by the federal government and may be found in the vicinity:

- **Endangered Species:**
  - Short-tailed albatross (*Phoebastria albatrus)*
  - Steller sea lion (*Eumetopias jubatus*)
  - Fin whale (*Balaenoptra physalus*)
  - Humpback whale (*Megaptera novaeangliae*)
  - Sperm whale (*Physeter macrocephalis*)
- **Threatened Species**
  - Northern sea otter (*Enhydra lutris kenyoni*)
  - Steller's eiders (*Polysticta stelleri*)
- **Candidates for Listing**
  - Yellow-billed loon (*Gavia adamsii*)
  - Kittlitz's murrelet (*Brachyramphus brevirostris*)

The species listed in this section are predominantly maritime/aquatic. None of the listed species are known to use the Unalaska/Dutch Harbor area for terrestrial nesting or reproduction.

2.1.4.8 Fisheries

There are extensive shellfish and other fisheries associated with the Unalaska/Dutch Harbor area. Unalaska and Amaknak islands are unique in the Aleutian chain in that they have such a wide variety of fish, shellfish, and marine mammals. The islands' bays host several of the five species of salmon found in Alaska, and Unalaska Bay and Iliuliuk Bay are not only the gateway to important salmon spawning streams on Unalaska Island but also support populations of shrimp and Dungeness crab. King crab and Tanner crab are fished inside Unalaska Bay.

2.1.5 Seismic Issues

Unalaska Island is located in one of the most active seismic regions in the world. Alaska has the greatest earthquake and tsunami potential of any state in the United States. Many of the world's largest recorded earthquakes have occurred in the Alaska-Aleutian subduction zone. The Tsunami Safe Zone on Unalaska Island is currently defined as areas higher than 50 feet above mean sea level.

The region surrounding Unalaska Island has high volcanic activity. Makushin Volcano on Unalaska Island (approximately 16 miles from the WWTP) had significant volcanic activity as recently as 1995. A number of other active volcanoes that have been active within the last two decades are also found near Unalaska Island (Akutan Volcano, Akutan Island; Okmok Volcano, Umnak Island; Bogoslof Volcano, Bogoslof Island).

2.1.6 Extreme Wind Conditions

Unalaska Island experiences extreme wind conditions, and gusts of over 100 miles per hour (mph) are not uncommon. Winter storms are usually strong, and high sustained winds occur with some regularity. Wind speeds of up to 170 mph have been recorded within the City.

The average yearly wind speed is approximately 17 mph. In January and July, average wind speeds are 25 mph and 14 mph, respectively.

The Aleutian region is classified as having 150-mph basic design 3-second gust wind speeds for Category I Buildings.

2.1.7 Cold Weather Concerns

Unalaska Island is located in a maritime climate zone, which is characterized by cool summers and mild winters. The climate typically has high winds, persistently overcast skies, and frequent cyclones. Recorded temperatures in the City of Unalaska range from a low of -5 degrees Fahrenheit (°F) to a high of 81°F. The average winter temperature is 33°F. Average summer temperatures are approximately 50°F.

During periods of cold winter weather, ice up to 2 inches thick can form in Iliuliuk Harbor. The other bays surrounding the City remain ice-free throughout the year. Average snow depth is 5 inches during February (the maximum snow depth month).

2.2 Existing Sewer System

The City owns, operates, and maintains the wastewater system, which includes the collection system, sewage pump stations, a wastewater treatment facility, and an effluent outfall (Figure 2-1).

2.2.1 Collection Piping

The City has approximately 18 miles of sewer piping, including collection sewers and interceptors. There are approximately 3 miles of force main throughout the system, 369 manholes, 18 miles of gravity lines, and 563 sewer service connections.

2.2.2 Lift Stations

The City operates 12 lift stations and owns 10 of the 12. These lift stations are described below and summarized in Table 2-1. Appendix C includes a sewer system map with detail maps of the City's 10 lift stations.

Lift Station 1 is the influent lift station located at the WWTP. It is the final destination for all domestic and landfill leachate sewage flows in the City. Lift Station 1 pumps directly into the CEPT building for screening, treatment, and sludge removal.

Lift Station 2 is located in the Margaret Bay area. It receives domestic sewage from Lift Station 3, Standard Oil Hill, the south end of East Point Loop Road, and the Margaret Bay area. It pumps sewage across Margaret Bay to a gravity line on Salmon Way, which then flows by gravity to the WWTP.

Lift Station 3 is located in Ptarmigan Flats Subdivision. It receives domestic sewage from the airport and surrounding area, the north end of East Point Loop Road, Ptarmigan Flats, and Ballyhoo Road. It pumps sewage over Standard Oil Hill and discharges into a gravity sewer line on Biorka Drive on Standard Oil Hill, which flows into Lift Station 2.

Lift Station 4, located on the north side of Haystack, receives most of the domestic sewage flow from Unalaska Island, with the exception of Captains Bay and part of Haystack. Lift Station 4 pumps into a gravity line, which flows into an inverted siphon on the south side of Haystack, which pushes the flow over the South Channel Bridge. It connects to the main collection line on Airport Beach Road that flows by gravity to the WWTP. This lift station has the largest wet well and has an onsite generator.

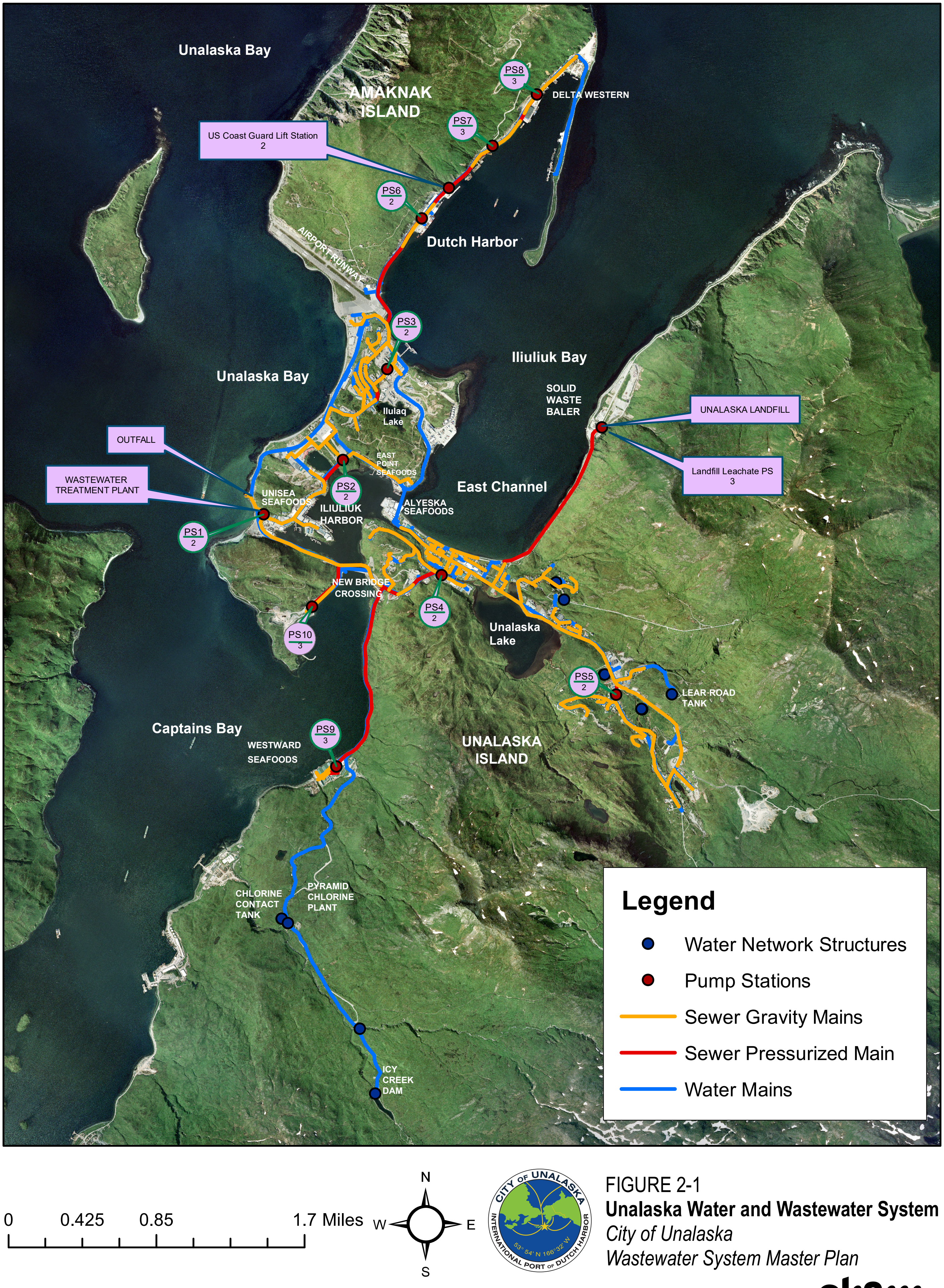

FIGURE 2-1
Unalaska Water and Wastewater System
City of Unalaska
Wastewater System Master Plan

ch2m

Table 2-1. Lift Station Characteristics

General					Pump Station				Pumps			Wet Well	
Lift Station	**Approx. Location**	**Year Installed**	**Backup Power Source**	**Type of Lift Station (Submersible, Self-priming, etc.)**	**Pump Manufacturer**	**No. of Pumps**	**Model**	**Force Main Diameter (inches)**	**Horse-power**	**Design Capacity (gpm)**	**Firm Capacity (gpm)**	**Diameter (feet)**	**Depth (feet)**
1	WWTP	2015	Onsite generator	Submersible	Flygt	3	3127	8	7.5	540	510	10x10 (square)	24.89
High Flow Pumps	WWTP	2015	Onsite generator	Above grade self-priming	Gormann Rupp	2	T6A3S-B	8	25	1,100	1,100	10x10 (square)	24.89
2	265 East Point Rd	1985	Portable generator set	Submersible	Flygt	2	3102	6	5	350	280	8	24.38
3	62 Delta Way	1985	Portable generator set	Submersible	Flygt	2	3127	6	10	400	310	8	22.93
4	64 Airport Beach Rd	2007	Onsite generator	Submersible	Flygt	2	3140	6	15	550	430	8	24.16
5	1062 Broadway	1985	Portable generator set	Submersible	Flygt	2	3085	6	3	325	275	3	18.11
6	660 Ballyhoo Rd	1990	Portable generator set	Submersible	Flygt	2	3085	6	3	325	275	8	17.3
7	1224 Ballyhoo Rd	1990	Portable generator set	Submersible	Flygt	2	3085	6	3	325	275	8	19
8	1216 Ballyhoo Rd	1990	Portable generator set	Submersible	Flygt	2	3085	6	3	325	275	8	18.32
9	1000 Capt Bay Rd	1990	Portable generator set	Submersible	Flygt	2	3127	6	10	410	320	8	19.21
10	Henry Swanson Dr	2012	Portable generator set	Submersible	Flygt	2	3085	6	3	325	275	8	14.5
USCG	Coast Guard Dock		Portable generator set	Submersible	Flygt	2	3085	6	2.2	--	--	8	--
Leachate	Landfill Site		Portable generator set	Submersible	Flygt	2	3085	4	4	90	80	--	--

gpm = gallons per minute
-- = not applicable or not available

Lift Station 5 is located on Steward Road in Unalaska Valley. Domestic sewage from Steward Road and General's Hill flows into this lift station. The flow is pumped to the main collection line on Broadway, which flows by gravity to Lift Station 4.

Lift Stations 6, 7, and 8 receive domestic sewage from Ballyhoo Road. Lift Station 8 is located near the end of Ballyhoo Road. Lift Station 7 receives domestic sewage from Lift Station 8, and Lift Station 6 receives domestic sewage from Lift Station 7 and the U.S. Coast Guard (USCG) lift station. Domestic sewage from Lift Station 6 is pumped into a gravity line on Airport Beach Road, which then flows by gravity to Lift Station 3.

Lift Station 9 receives the domestic sewage flow from Westward Seafoods in Captains Bay and pumps into a 1-mile-long force main. It discharges into the inverted siphon line on Airport Beach Road, which pushes the flow over the South Channel Bridge. It connects to the main collection line on Airport Beach Road that flows by gravity to the WWTP.

Lift Station 10 is located on Henry Swanson Drive at the Carl E. Moses Boat Harbor. It receives domestic sewage from the shower/bathroom facility at the boat harbor and from a small processing plant on Henry Swanson Drive. It pumps sewage into a gravity manhole on Airport Beach Road that flows to the WWTP.

The **USCG lift station** is located at the north end of the City dock on Ballyhoo Road. It is owned by the City Department of Ports and Harbors and is maintained by the City Wastewater Division. It receives sewage discharged from USCG boats moored at the City dock and pumps it to a gravity line on Ballyhoo Road, which then flows by gravity to Lift Station 6.

The **leachate lift station** is located at the landfill site. It is owned by the City Solid Waste Division and maintained by the City Wastewater Division. The leachate lift station has three gravity lines that discharge leachate from cells 1, 2 and 3, 5, and 6 (leachate from cells 5 and 6 is pumped), and domestic sewage flows from the landfill building trench drain and bathroom into the lift station. The lift station discharges into a leachate tank. The leachate tank then discharges to a ¾-mile-long force main from the landfill that discharges into the domestic sewage collection system to Lift Station 4. Domestic sewage from Unalaska Valley and downtown Unalaska also discharge to this line that is conveyed to Lift Station 4.

2.2.3 Wastewater Treatment and Disposal Facilities

2.2.3.1 History

The City owns and operates a wastewater treatment plant that was upgraded in 2015. The WWTP was upgraded from fine screening and ultraviolet (UV) disinfection to a CEPT plant with chemical disinfection. The neutralized treated effluent is discharged to South Unalaska Bay through an outfall located approximately 300 feet offshore at a depth of 100 feet. Appendix D includes the design criteria, hydraulic profile, and process flow diagram for the 2015 WWTP upgrades.

2.2.3.2 National Pollutant Discharge Elimination System Permit

The City of Unalaska was issued a NPDES permit in 2004 that authorized the discharge of treated effluent to South Unalaska Bay, which is connected to the Bering Sea. The City requested in 2004 that the permit's effluent discharge limits be clarified and modified to reflect then-current wastewater flow and loading conditions. EPA and the State began a process to modify the permit to correct these and other limits, but terminated that effort in 2007. In order to meet the new discharge limits for BOD, total suspended solids (TSS), and other constituents outlined in the 2004 NPDES permit, and to address potential future effluent limits that may be established by a revised or new permit, the City implemented upgrades to the existing WWTP. Prior to the WWTP upgrades, effluent limitations for flow and fecal coliform bacteria in the NPDES permit were periodically exceeded. No exceedances have occurred since January 2016 after the WWTP upgrades were brought online.

2.2.3.3 Solids

The WWTP's screened solids are stabilized with lime and hauled to the City's sanitary landfill for disposal.

2.3 Existing Water System

This section provides a brief description of the existing water system and the current operation of the facilities.

2.3.1 Pressure Zones

A wide range of elevations requires that the water pressure in the distribution system be increased or reduced to maintain pressures that are safe and sufficient to meet the flow requirements of the system. The City achieves this by dividing the water system into six distinct pressure zones.

2.3.2 Supply Facilities

Groundwater and surface water supply domestic water to the City and industrial process water to the fish processing industries. The surface water sources include Icy Lake and Icy Creek Reservoir. Icy Lake provides impounded water storage during periods of low water or high demand. Water from the Icy Creek Reservoir is conveyed through a 24-inch ductile iron pipe to the Pyramid Creek Water Treatment Plant. Icy Creek Reservoir is the City's primary source of drinking water.

Domestic water is also supplied from a wellfield in the Iliuliuk Valley. The wellfield includes Wells 1, 1A, 2, 2A, and 3. The wellfield is capable of producing 2,800 gallons per minute. Well 1 is no longer in operation due to damage to the well casing, and Well 2A is no longer in operation because it is categorized as groundwater under the influence of surface water.

2.3.3 Water Treatment

The Pyramid Creek Water Treatment Plant treats the raw water using ultraviolet light disinfection and chlorine gas. The treated water is stored in a 2.6-million-gallon steel tank, which provides chlorine contact time before the water is distributed to the City.

2.3.4 Distribution and Transmission System

The City has approximately 133,000 linear feet of water main ranging in diameter from 4 inches to 24 inches. Most of the water main is constructed of ductile iron pipe encased in polyethylene.

Chapter 3. Current and Projected Population, Flow, and Loading

3.1 Introduction

The City of Unalaska's Water Master Plan (HDR, 2004) is currently being updated. The population planning data presented in this chapter were extracted from HDR's "Water Master Plan Technical Memo #1 – Population and Water Demand" (HDR Population Memo) prepared July 9, 2017, (Appendix B) and is the basis of the existing and future population information.

3.2 Existing Population, Flow, and Loading

3.1.1 Existing Population

The City experienced rapid population growth in the 1970s and 1980s that was attributed to the fish processing industry development in Dutch Harbor. According to the 2011 Facility Plan, a significant number of residents spend more than 6 months out of the year in Dutch Harbor but are also residents in other communities. This makes it difficult to accurately estimate the base population and transient populations that come to the City for long periods of time.

Table 3-1 presents a summary of the City's population history according to the U.S. Census Bureau.

Table 3-1. Population Trends

Year	Population
1950	173
1960	218
1970	178
1980	1,322
1990	3,089
2000	4,283
2010	4,376

According to the 2010 U.S. Census, there were 4,376 permanent residents in the City in 2010. Approximately 2,277 residents were living in households while the rest lived in group quarters. According to the Alaska Department of Labor's yearly estimates, the 2016 City population was 4,448 residents. The City is subject to significant fluctuations in population due to the seasonal fish processing that occurs in the area. The population can double for short periods of time as the transient workers move in and out of the City. According to the 2011 Facility Plan, the WWTP data estimated a peak population of 8,678 people in February 2007. The busiest fish-processing months are February through March and August through September.

According to the HDR Population Memo, the City has experienced irregular growth over the last several years. This is likely attributable to the area's dependence on fisheries, where the demand for transient workers varies along with size of the catch. As presented in Table 3-2, the growth rate ranges between -8.4 percent and +9.3 percent for the last 15 years.

Table 3-2. Population Estimates from the Department of Labor

City of Unalaska		
Year	**Population**	**% Growth**
2000	4,283	
2001	4,310	0.6%
2002	4,144	-3.9%
2003	4,528	9.3%
2004	4,552	0.5%
2005	4,544	-0.2%
2006	4,310	-5.1%
2007	3,949	-8.4%
2008	3,889	-1.5%
2009	4,092	5.2%
2010	4,376	6.9%
2011	4,389	0.3%
2012	4,514	2.8%
2013	4,516	0.0%
2014	4,517	0.0%
2015	4,440	-1.7%
2016	4,448	0.2%

3.1.2 Existing Flow

3.1.2.1 Background

There are three main sources of flow to the WWTP:

- Permanent: Permanent residents and commercial buildings
- Transient: Transient staff working at canneries and seafood processors, tourists, and other visitors
- Landfill: Landfill flows including leachate and a small quantity of domestic wastewater

The City's permanent population is characterized as the population during the months of May and December. The total population doubles during fishing seasons when the transient population live in the area. The permanent and transient population comprise the domestic sewage flows, while the landfill leachate is the only major industrial contributor to the WWTP; all other industrial wastewater is treated via private treatment systems.

The following sections discuss the existing and estimated future wastewater system flow rates and loading. It includes analysis of the past 3 years of data and projects future loads using population growth statistics from the 2017 Water System Master Plan (in preparation).

3.1.2.2 Existing Wastewater System Flow Rates

Influent flow measurements are taken daily at the WWTP per the 2004 NPDES permit, permit number AK004345-1. Influent measurements represent all flows to the WWTP, including domestic and landfill. Table 3-3 summarizes the average annual, maximum month, and maximum day influent flows from 2014 to 2016.

Table 3-3. Existing Average Annual, Maximum Month, and Maximum Day Flow Rates at the WWTP

Year	Average Annual Flow (mgd)	Maximum Month Flow (mgd)	Maximum Day Flow (mgd)	Maximum Month Peaking Factor	Maximum Day Peaking Factor
2014	0.42	0.60	0.9	1.42	2.13
2015	0.40	0.55	0.75	1.38	1.88
2016	0.42	0.52	0.84	1.24	2.00
Average	0.41	0.60	0.90	1.44	2.17

Note: The WWTP receives low flows of 100 gpm during the night.

During this 3-year period, flows to the WWTP remained relatively steady with remarkably low peaking factors. The average annual flow ranges between 0.40 mgd and 0.42 mgd, while the maximum month and maximum day peaking factors range from 1.24 to 1.42 and 1.88 to 2.13, respectively. With a transient population that doubles the total population, higher peaking factors were expected; however, the transient population is typically present for 10 out of 12 months per year, thus contributing substantially to the average annual flow.

Compared to the flows evaluated in the 2011 Facility Plan (2006 to 2009), the average annual and maximum month flows are low, but comparable; from 2006 to 2009, the average annual and maximum month flows were reported as 0.497 mgd and 0.659 mgd, respectively. However, the maximum days recorded in the two time frames are considerably different. From 2006 to 2009, the average maximum day peaking factor was reported as 3.51 which is 75 percent higher than the 2.00 peaking factor observed between 2014 and 2016. The lower peaking factors observed and reported in 2014 to 2016 are attributed to the relatively mild winters during this period compared to historical years. In addition, the City recorded significant snowfalls between 2006 and 2009, which could have attributed to higher peaking factors.

3.1.3 Existing Wastewater Quality

As noted above, influent flow to the WWTP includes both domestic flows and landfill leachate. The WWTP influent and the landfill leachate are tested for BOD_5, TSS, and other conventional pollutants per the 2004 NPDES permit. Concentrations for each constituent were multiplied by the corresponding flow measured at the WWTP to determine loading. Tables 3-4 and 3-5 summarize the BOD_5 and TSS loading between 2014 and 2016. The table also includes the peaking factors, which are the ratio of higher loading, such as maximum day, to the average annual loading.

Typical BOD_5 and TSS concentrations in municipal wastewater average between 200 and 250 mg/L, and may range from 120 to 375 mg/L (Metcalf and Eddy, 2013). The 2014 to 2016 WWTP average concentration for BOD_5 falls within this range at 225 mg/L, while the average TSS concentration falls a bit below the average at 161 mg/L.

Compared to the influent BOD_5 concentrations observed between 2006 and 2009, the BOD_5 concentration in recent years has decreased from an annual average of 267 mg/L to 225 mg/L. This decrease appears to be a continuation of the declining trend noted in the 2011 Facility Plan, although the cause of the decrease has not been determined. The timing did coincide with the conversion of the wire-tie baling system at the City's landfill to the bagging system in June 2010.

Table 3-4. Wastewater Treatment Plant 5-Day Biochemical Oxygen Demand Loading

Year	Flow Type	Concentration (mg/L)	Loading (ppd)	Peaking Factor (in terms of AAF)
2014	Average Annual	238	853	1.00
	Max Month	343	1,077	1.44
	Max Day	343	1,077	1.44
2015	Average Annual	245	705	1.00
	Max Month	334	1,022	1.44
	Max Day	450	1,246	1.94
2016	Average Annual	206	752	1.00
	Max Month	344	1,001	1.67
	Max Day	510	1,659	2.48
Average	Average Annual	225	770	1.00
	Max Month	344	1,077	1.53
	Max Day	510	1,659	2.27

ppd = pounds per day
AAF = average annual flow

Table 3-5. Wastewater Treatment Plant Total Suspended Solids Loading

Year	Flow Type	Concentration (mg/L)	Loading (ppd)	Peaking Factor (in terms of AAF)
2014	Average Annual	151	553	1.00
	Max Month	276	1,110	1.83
	Max Day	276	1,110	1.83
2015	Average Annual	177	517	1.00
	Max Month	320	906	1.81
	Max Day	450	1,317	2.55
2016	Average Annual	157	572	1.00
	Max Month	285	834	1.82
	Max Day	308	1,019	1.96
Average	Average Annual	161	547	1.00
	Max Month	320	1,110	1.98
	Max Day	450	1,317	2.79

The influent TSS concentration in recent years (2014 to 2016) has increased compared to concentrations observed between 2006 and 2009; the average annual concentration increased from 146 mg/L to 161 mg/L. The 2011 Facility Plan noted that the TSS was decreasing between 2006 and 2009, but did not assume the trend would continue in their projections to avoid underestimating future loading. This recent increase in TSS should be monitored by City staff but does not present an issue for the WWTP at this time.

The most notable anomaly in the data occurred on September 9, 2015, when the influent BOD_5 and TSS spiked to 540 mg/L and 880 mg/L, respectively. The influent flow on this day was relatively normal with a flow rate of 0.344 mgd, indicating that the spike was not likely due to a large storm event. It is possible that this irregularity was due to ongoing construction of the WWTP improvements. This data point was excluded from the analysis.

3.3 Peaking Factors and Flow per Person

Once existing flow rates are measured and defined, projected flow rates can be developed. Projected flows are used to further analyze how well the existing system will perform in the future, and to determine improvements required to maintain or improve system function. In order to establish projected flow scenarios for a sewer system, peaking factors need to be determined for the existing system, which can then be applied to future flow rates. Peaking factors are the ratio of higher flows, such as maximum day flow, to the average annual flow. Table 3-6 shows the average annual, maximum month and maximum day flow rates and peaking factors as measured at the City's WWTP for 2014 through 2016. The 2006 through 2009 average annual, maximum month, and maximum day flows and peaking factors from the 2011 Facility Plan are also included for completeness.

Table 3-6. Summary of Existing Flow Rates and Peaking Factors

Year	Flow Type	Flow (mgd)	Peaking Factor (in terms of AAF)
2006	Average Annual	0.462	1.00
	Maximum Month	0.685	1.38
	Maximum Day	1.85	3.73
2007	Average Annual	0.527	1.00
	Maximum Month	0.787	1.58
	Maximum Day	1.54	3.09
2008	Average Annual	0.498	1.00
	Maximum Month	0.582	1.17
	Maximum Day	2.06	4.14
2009	Average Annual	0.476	1.00
	Maximum Month	0.581	1.17
	Maximum Day	1.53	3.07
2014	Average Annual	0.42	1.00
	Maximum Month	0.60	1.42
	Maximum Day	0.90	2.13
2015	Average Annual	0.40	1.00
	Maximum Month	0.55	1.38
	Maximum Day	0.75	1.88
2016	Average Annual	0.42	1.00
	Maximum Month	0.52	1.24
	Maximum Day	0.84	2.00

Note: Flow during the night is generally around 100 gpm.

As previously stated, the City has a significant transient population present for 10 months of the year. Table 3-7 presents the average and peak day on a monthly basis for the 2014 through 2016 period; Figure 3-1 presents the data in graphical form.

Table 3-7. Monthly Average and Maximum Day Influent Flows to the Wastewater Treatment Plant

Year	Month	Average Flow (mgd)	Peak Day/Month (mgd)	Peaking Factor
2014	January	0.49	0.74	1.53
	February	0.59	0.74	1.27
	March	0.53	0.61	1.14
	April	0.48	0.67	1.40
	May	0.32	0.42	1.32
	June	0.38	0.44	1.16
	July	0.39	0.47	1.20
	August	0.37	0.41	1.10
	September	0.36	0.43	1.20
	October	0.45	0.90	2.01
	November	0.40	0.61	1.54
	December	0.32	0.46	1.41
2015	January	0.45	0.61	1.37
	February	0.54	0.66	1.22
	March	0.525	0.75	1.36
	April	0.41	0.58	1.40
	May	0.29	0.42	1.44
	June	0.32	0.35	1.12
	July	0.37	0.43	1.15
	August	0.36	0.38	1.08
	September	0.35	0.38	1.10
	October	0.34	0.43	1.28
	November	0.41	0.53	1.28
	December	0.41	0.50	1.23
2016	January	0.49	0.84	1.73
	February	0.53	0.63	1.19
	March	0.48	0.57	1.18
	April	0.45	0.60	1.32
	May	0.31	0.42	1.36
	June	0.35	0.38	1.07
	July	0.36	0.43	1.18
	August	0.38	0.48	1.26
	September	0.42	0.61	1.45
	October	0.48	0.76	1.57
	November	0.41	0.57	1.39
	December	0.39	0.52	1.34

As shown above, May appears to be the low flow month, which coincides with little to no transient population. A general increasing trend occurs in February and March, which corresponds to the first peak season of fish processing employment each year.

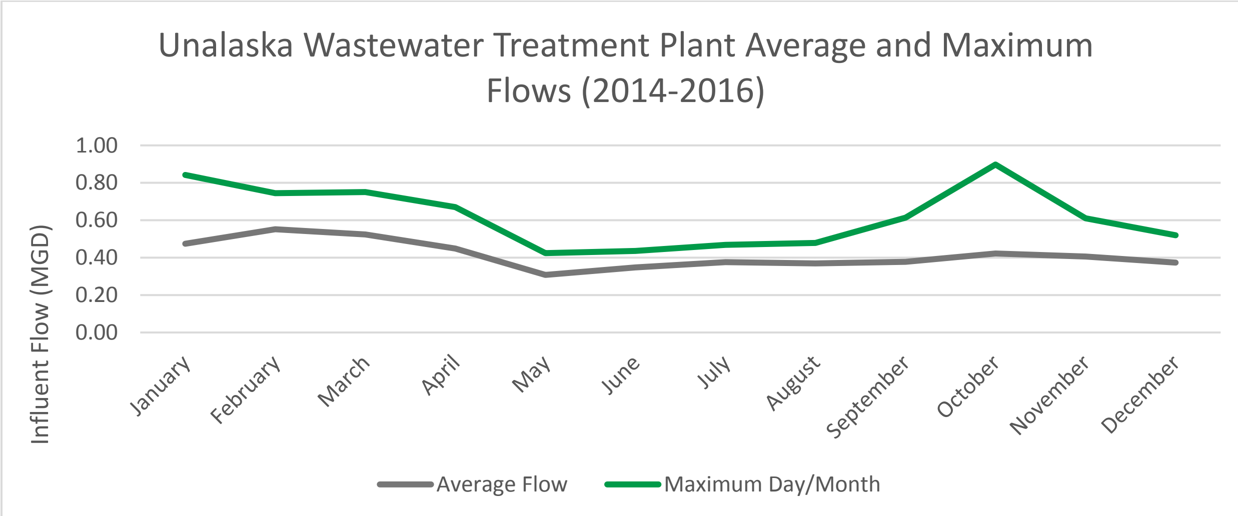

Figure 3-1. Monthly Average and Maximum Day Influent Flows to the WWTP

The fish-processing industry on Unalaska and Amaknak islands has a significant effect on water use. Figure 3-2 is excerpted from the HDR Population Memo and shows the five- to seven-fold increase in water demand during the peak fish processing seasons (February to March and August to September). In contrast, the largest fish-processing month (February) corresponds to only a 70 to 90 percent increase in influent flows to the City's WWTP. It appears that the fish processing industry has a larger effect on the domestic water system compared to the wastewater system as demonstrated by comparing Figure 3-1 and Figure 3-2.

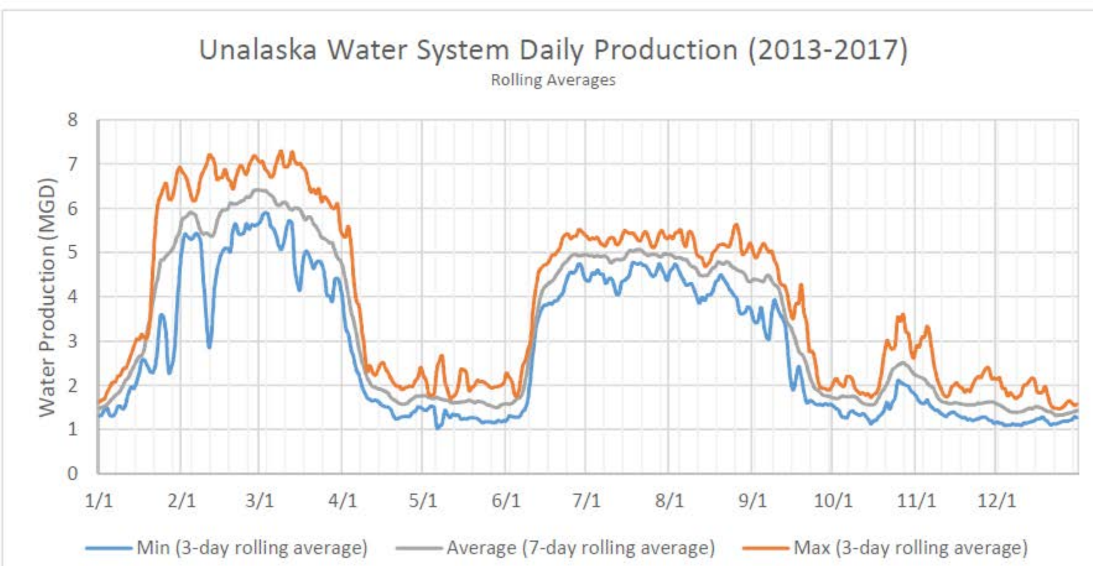

Figure 3-2. Average Daily Water Production Data

Source: HDR Population Memo

An existing per person wastewater flow rate was determined for 2014, 2015, and 2016. These numbers were based on the month of May only, since that month has little to no fish processing population. Table 3-8 presents the existing average wastewater flow rate in gallons per day (gpd) per person.

Table 3-8. Existing Average Wastewater Flow per Person per Day

Month Year	Average Monthly Flow (gpd)	Base Population	Gallons per Day per Person
May 2014	320,149	4,448	72
May 2015	293,580	4,448	66
May 2016	309,645	4,448	70

The base population for 2014 and 2015 was not provided in the HDR Population Memo. It was assumed for Table 3-8 that the population was the same as 2016 considering the current slow growth trend. The 2011 Facilities Plan found that the estimated flow per person per day, including infiltration and inflow, for the base population for 2006 through 2009 was 87 gpd per person.

A flow rate of 66 to 72 gpd per person is below the flow per person per day for sewer planning outlined in the *Recommended Standards for Wastewater Facilities* 2014 Edition (Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, 2014), commonly referred to as the Ten States Standards. Therefore, a future flow rate of 100 gpd per person recommended by the Ten States Standards and industry practice was used for future population that contributed flow (i.e., new persons to the City).

3.2 Projected Population, Flow, and Loading

3.2.1 Projected Population

Population projections for the 5-year (2021), 10-year (2026), 15-year (2031), and 20-year (2036) horizons were provided in the HDR Population Memo and are presented in Table 3-9. Three growth scenarios were presented in the HDR Population Memo:

- Minimum population projections based on Alaska Department of Labor estimates of population loss in the Aleutians West Census Area
- Zero growth population estimates
- Maximum population projections based on a growth rate of 0.5 percent as determined by the Alaska Department of Labor statewide projections

Table 3-9. City Population Projections

Scenario	2016	2021	2026	2031	2036
Department of Labor Unalaska Population Projection (loss)	4,448	4,436	4,417	4,386	4,334
Zero Growth Population	4,448	4,448	4,448	4,448	4,448
Maximum Department of Labor Alaska Growth Rate Projection	4,448	4,641	4,815	4,970	5,111

3.2.2 Projected Flow

In order to be conservative, the maximum population projections (last row of Table 3-9) were used, along with the planning flow rate of 100 gpd per person, to estimate future flows to the City's WWTP.

Table 3-10 presents the existing and projected flow rates to the WWTP. The maximum month and maximum day peaking factors for the average 2014 through 2016 period (from Table 3-6) were used to project future flows. The peak hour factor of 4.3 from the 2011 Facility Plan was used to estimate peak hour flows. As previously noted, the City experiences low flows during the night.

Table 3-10. Projected Flows

Year	Base Population	Average Annual Flow (mgd)	Maximum Month Flow (mgd)	Peak Day Flow (mgd)	Peak Hour Flow (mgd)
2016	4,448	0.42	0.52	0.84	--
2021	4,641	0.44	0.64	0.96	1.89
2026	4,815	0.46	0.66	0.99	1.97
2031	4,970	0.47	0.68	1.03	2.04
2037	5,111	0.49	0.70	1.06	2.10

Note: The population change between 2036 and 2037 was assumed to be minimal.

The flow capacity of the WWTP will not be exceeded by 2037 if population growth occurs as projected in Table 3-9 and the flow characteristics remain the same.

3.2.3 Projected Wastewater Quality

Existing loads to the WWTP for several scenarios are presented below:

- The existing BOD_5 per person loading is:
  - 2014 to 2016 average annual = 0.17 ppd
  - 2014 to 2016 maximum month = 0.24 ppd
  - 2014 to 2016 maximum day = 0.37 ppd
- The existing TSS per person loading is:
  - 2014 to 2016 average annual = 0.12 ppd
  - 2014 to 2016 maximum month = 0.25 ppd
  - 2014 to 2016 maximum day = 0.30 ppd

The 2011 Facility Plan calculated an average BOD load of 0.14 ppd per person for the period of 2006 to 2009. The average BOD for the 2014 to 2016 period is very close to this value. Metcalf and Eddy (2013) defined typical average BOD loads in the range of 0.11 to 0.26 ppd per person. The Ten States Standards recommend an average BOD load of 0.17 ppd per person for new sewage systems. The 2014 through 2016 WWTP data fall within these recommendations.

The 2011 Facility Plan calculated an average TSS load of 0.10 ppd per person for the period of 2006 to 2009. The average TSS for the 2014 to 2016 period is very close to this value. Metcalf and Eddy defined typical average TSS loads in the range of 0.13 to 0.33 ppd per person. The Ten States Standards recommend an average TSS load of 0.20 ppd per person for new sewage systems. The 2014 through 2016 WWTP data fall on the low side of the Metcalf and Eddy values and well below the Ten States Standards.

Projected loads for the WWTP were calculated using the design criteria outlined in the 2011 Facility Plan to remain consistent. In addition, the loading data evaluated for the 3-year period are a small sample data set. In order to remain conservative and consistent with the 2011 Facility Plan, the design criteria from the 2011 Facility Plan were adopted as applicable unless there were new data indicating an update of a criterion was needed. Table 3-11 presents the projected loading to the City's WWTP. The maximum month and maximum day loading peaking factors are based on the peaking factors in Tables 3-4 and 3-5.

Table 3-11. Loading Projections

Year	Base Population	Average Annual BOD (ppd)	Maximum Month BOD (ppd)	Maximum Day BOD (ppd)	Average Annual TSS (ppd)	Maximum Month TSS (ppd)	Maximum Day TSS (ppd)
2016	4,448	752	1,001	1,659	572	834	1,019
2021	4,641	928	1,418	2,103	696	1,380	1,941
2026	4,815	963	1,471	2,181	722	1,432	2,013
2031	4,970	994	1,519	2,252	746	1,478	2,078
2037	5,111	1,022	1,562	2,316	767	1,520	2,137
2030 Design	**7,360**	**1,860**	**3,710**	**4,350**	**1,150**	**2,140**	**2,560**

Based on the loading data, the WWTP will not reach its design capacity by 2036 (presented in Table 3-11) assuming the wastewater characteristics remain the same as the last several years. The individual process components (e.g., clarifiers, disinfection system) were not evaluated for hydraulic or process capacity for this WWSMP. Table 3-12 summarizes the flow and load criteria for the design year 2030 as presented in the 2011 Facility Plan.

Table 3-12. Year 2030 Flow and Load Criteria from 2011 Facility Plan

2030 Design Population		
Average Annual Population	7,360	
Peak Month Population	10,200	
Peaking Factors for Domestic Flows		
Max Month/Average Annual	1.5	
Peak Day/Average Annual	3.5	
Peak Hour/Average Annual	4.3	
WWTP Influent Flows (mgd)		
Average Annual Flow	0.61	
Average Day Maximum Month	1.02	
Peak Day Flow	2.50	
Peak Hour Flow	2.80	
WWTP Total Influent Loads (ppd)	***BOD***	***TSS***
Average Annual Load	1,860	1,150
Maximum Month Load	3,710	2,140
Peak Day Load	4,350	2,560

Source: Tables 4-6 and 4-12, 2011 Facility Plan

3.3 Inflow and Infiltration

After an infiltration and inflow (I/I) study, the Wastewater Division implemented a comprehensive maintenance program for the collection system to mitigate future I/I problems. This program includes cleaning, inspecting, and repairing sewage lines and manholes in the collection system every 3 years; problem areas receive annual services.

In 2008, a followup I/I study was conducted to analyze the effects of the seasonal population versus I/I impacts on daily flow violations of the NPDES permit (Appendix E). The study concluded that the monthly flow violations were affected more by population than by I/I influence except during significant flood events. During flooding, water ponds on top of manholes located at or below ground level and seeps into the system despite leak seals. City of Unalaska staff indicated in February 2017 that they did notice a decrease in I/I to the lift stations or WWTP after increased efforts to replace damaged leak seals.

The 2008 study also found that heavy storm events can cause a significant increase (up to 100,000 gpd) in leachate due to I/I. Wastewater Division and Solid Waste Division personnel have “pinched” down the valves on the leachate during heavy rains to help mitigate the problem; however this practice is not standard and could result in leachate backup at the landfill.

Ultimately, the 2008 study concluded that the City has cost-effective control of its I/I. Estimated dry weather flows (85.2 gpd per person) and wet weather flows (108.3 gpd per person) are well below the national average of 120 gpd per person and 240 gpd per person, respectively. Considering the City has high groundwater in the area, these flows suggest that the conveyance system is in good condition.

The 2011 Facility Plan also analyzed I/I and arrived at the same conclusion that the I/I is not excessive, and it noted that with continued vigilance in the maintenance program, I/I is anticipated to remain under control.

During a site visit conducted in February 2017, City of Unalaska staff expressed concern for system I/I in the Steward Road/Generals Hill area. This issue is included in Chapter 5.

Chapter 4. Regulatory Requirements

The City of Unalaska is permitted to operate the Unalaska Wastewater Treatment Plant under EPA's NPDES permitting program. This chapter provides a summary of the current and anticipated future regulations governing the City's wastewater treatment system.

4.1 Regulatory History

In 1978 the City of Unalaska submitted an application for a waiver of secondary treatment requirements under Section 301(h) of the Clean Water Act. At that time, EPA determined that since discharges would be to marine water and the City was identified as an Alaska Native Village, the waiver requirements would be satisfied by the facility plan that was approved by EPA and ADEC prior to construction.

In 1980 EPA evaluated several locations for the outfall. Both EPA and ADEC determined that primary treatment as defined by EPA 125.56(b)(1)(B) and state regulations 18 AAC 72.990(5) provide adequate treatment to protect water quality.

In 1992 ADEC identified South Unalaska Bay as requiring water-quality-based controls and the bay was included in the Section 303(d) list. Increased discharges from seafood processing operations over the past decades prompted concerns about water quality in greater Unalaska Bay. Waste products from seafood processors and the sewage treatment plant were discharged directly into the waters of the bay. These discharges were responsible for the degradation of the receiving waters.

In 1995 EPA completed an assessment of the pollution and water quality of the bay. The "Water Quality Assessment of Greater Unalaska Bay" (EPA, 1995) reviewed the pollution sources impacting the marine environment and supported the determination of TMDLs for these pollutants.

In August of 1995, the EPA prepared and distributed a preliminary draft NPDES permit to ADEC and the City of Unalaska for review and comment. At that time ADEC found that the mixing zone merited re-evaluation due to significant population growth, and ADEC required the City to submit a new mixing zone application. ADEC continued the existing mixing zone of 1987 on an interim basis until the completed application was submitted by the City and evaluated by ADEC.

In 1996 CH2M completed the application for the City for the reauthorization of the mixing zone. The ADEC Certificate of Reasonable Assurance issued February 1997 determined that the City could no longer discharge non-disinfected wastewater into South Unalaska Bay. A mixing zone for non-disinfected discharge would be of such a large size as to be unacceptable to both the local community and ADEC. A plan was developed by ADEC, EPA, and the City of Unalaska on how the City would disinfect its wastewater. After two preliminary design reports and a pilot study, the City decided to implement UV treatment for effluent disinfection.

In 1997 leachate from the municipal landfill started to flow into the City's wastewater collection system for treatment. The leachate is collected in lined solid waste disposal cells and then pumped and discharged directly into the sanitary sewage collection system. Leachate flows have been measured to contribute between 2.9 and 4.9 million gallons per year to the domestic wastewater. As the landfill expands, the flows are estimated to increase to 5.4 million gallons per year over the next several years. Currently, there are no pretreatment requirements for leachate from this landfill.

The UV system came online in January 2001, and although fecal coliform numbers dropped considerably, the City was not able to continuously meet the average monthly limit of 10,000 fecal coliforms per 100 milliliters (mL). The issue was attributed to the large quantities of iron and solids from the leachate system and potentially the sampling protocols.

The City has a wasteload allocation based on a TMDL for BOD_5 of 2,343 ppd because South Unalaska Bay is an impaired body of water (Section 303(d) listed) for BOD_5. In order to meet this load limit, ADEC had given the City a BOD_5 concentration limit and flow limits in the 2004 permit. The maximum daily load limit was reduced to 1,501 ppd for BOD_5 and TSS to correspond to the new concentration limits. The proposed load limit resulted from a decrease for BOD and TSS to 140 mg/L monthly average and a requirement for 30 percent removal. The City's WWTP had included one-millimeter screening and UV disinfection that could not meet the BOD concentration and 30 percent removal limits. The City was mandated to construct a wastewater treatment system to meet those limits. Unfortunately, due to the system's low I/I wastewater component despite being a wet weather environment, even the lower-cost alternative of standard primary treatment would not meet the BOD concentration limits. As a result, the City was required to design and construct a new WWTP that would provide significantly better BOD removal than standard primary treatment.

The City was issued a NPDES permit on December 15, 2003, (No. AK004345-1) that went into effect February 1, 2004. The permit expired on February 1, 2009, and was administratively extended and remains in effect until the State of Alaska issues the next permit.

Between October 2004 and September 2011, the City reported a large number of violations of effluent limits for coliforms, BOD, TSS, and other parameters from their WWTP that included a rotary sheer screen and UV disinfection. The City entered into an agreement with the Department of Justice to construct and operate an upgraded treatment facility by the end of 2015, as well as interim measures to reduce the severity and frequency of violations.

The City hired Bristol Engineering Services Corporation to prepare a facility plan to evaluate wastewater treatment upgrades and to determine the best solution for the upgrades to the WWTP. A CEPT facility was determined to be the preferred solution for the City.

The CEPT facility was constructed and brought online in the fall of 2015. The facility includes two automatic mechanically cleaned fine screens, one manually operated backup screen, grit removal, clarification, chlorination, and dechlorination. The treated effluent is discharged through a 16-inch-diameter outfall located in Unalaska Bay.

4.2 Current Regulations

The City prepared and submitted a renewal application for its 2004 NPDES permit to EPA in 2008. The permit was accepted as complete, and EPA said that the State of Alaska would be taking over primacy of the City's permit. The 2004 NPDES permit is in effect until ADEC issues a new NPDES permit.

Tables 4-1 through 4-3 present the City's 2004 NPDES permit limits.

Table 4-1. Outfall Effluent Limitations and Monitoring Requirements (excerpted from 2004 NPDES Permit)

	Effluent Limitations			**Monitoring Requirements**		
Parameter	**Average Monthly Limit**	**Average Weekly Limit**	**Daily Maximum Limit**	**Sample Location**	**Sample Frequency**	**Sample Type**
Flow, mgd	0.6	--	0.9	Effluent	Continuous	Recording
Biochemical Oxygen Demand (BOD_5)[a]	140 mg/L		200 mg/L	Influent and Effluent	Monthly	24-hour composite
	700 ppd		1,501 ppd			
Total Suspended Solids[a]	140 mg/L		200 mg/L	Influent and Effluent	Monthly	24-hour composite
	700 ppd		1,501 ppd			

Table 4-1. Outfall Effluent Limitations and Monitoring Requirements (excerpted from 2004 NPDES Permit)

	Effluent Limitations			**Monitoring Requirements**		
Parameter	**Average Monthly Limit**	**Average Weekly Limit**	**Daily Maximum Limit**	**Sample Location**	**Sample Frequency**	**Sample Type**
Fecal Coliform[b,c,h] Bacteria, #/100 mL	200		400	Effluent	Weekly[h]	Grab
Total Ammonia as N, mg/L	--	--	--	Effluent	Quarterly	24-hour composite
pH,[e] standard Units		6.5 to 8.5		Effluent	Quarterly	Grab
Dissolved Oxygen,[e] mg/L		2.0 to 17.0		Effluent	Weekly	Grab
Temperature,[d,e] °C	--	--	--	Effluent	Quarterly	Grab
Total Aqueous[d] Hydrocarbons, µg/L	--	--	15	Effluent	Quarterly	24-hour composite
Total Aromatic[d] Hydrocarbons, µg/L	--	--	10	Effluent	Quarterly	24-hour composite
Hardness,[d] µg/L	--	--	--	Effluent	Quarterly	24-hour composite
Total Arsenic,[d,e,f] µg/L	--	--	--	Effluent	Semi-annual	24-hour composite
Total Chromium,[d,e,f,g] µg/L	--	--	--	Effluent	Semi-annual	24-hour composite
Total Zinc,[d,e,f] µg/L	--	--	--	Effluent	Semi-annual	24-hour composite
Total Iron, [d,e,f] µg/L	--	--	--	Effluent	Semi-annual	24-hour composite
Total Copper, [d,e,f] µg/L	--	--	--	Effluent	Semi-annual	24-hour composite

[a] a. Effluent and influent sampling is to be done within the same 24-hour period. b. These parameters have a compliance schedule in Section 1B of the permit.

[b] The mixing zone for fecal coliform bacteria is defined as a 150-meter-radius circle, centered on the outfall, over the diffuser and extending from the marine bottom to the surface.

[c] Reporting is required within 24 hours of a maximum daily limit violation. See Part III.G of the permit.

[d] Samples are taken twice a year, once during dry season and once during wet season. Monitoring results are reported in the in January and July Discharge Monitoring Reports.

[e] Zone of initial dilution (ZID) for DO, pH, total chlorine, temperature, and metals. The ZID is defined as a radius of 50 meters, centered on the outfall line and over the diffuser, extending from the diffuser to the surface. The ZID provides dilution of 100:1.

[f] Sampling takes place when leachate from the landfill is discharged through the treatment system.

[g] For the first 2 years of the permit, samples will be tested for total chromium; if any values are 50 micrograms per liter (µg/L) or more at this time or any other time, then the samples will be tested for total chromium and Chromium VI; otherwise, continue for duration of permit to sample and test for total chromium.

[h] Weekly sampling for fecal coliform will occur until compliance is achieved for 12 consecutive months. Sampling frequency could then decrease to monthly. If after monthly monitoring is achieved and at any time there is an exceedance, then the permittee will sample every week until 24 consecutive weeks of staying in compliance, then the sampling can return to monthly.

µg/L = micrograms per liter

Table 4-2. Outfall Effluent Limitations and Monitoring Requirements for Chlorine Disinfection (excerpted from 2004 NPDES Permit)

	Effluent Limitations			Monitoring Requirements		
Parameter	**Average Monthly Limit**	**Average Weekly Limit**	**Daily Maximum Limit**	**Sample Location**	**Sample Frequency**	**Sample Type**
Total Residual Chlorine,[a] mg/L	0.17	--	0.34	Effluent	Weekly[a,b]	Grab

[a] Chlorine monitoring is required only when a chlorine compound is used for disinfection. When chlorine is used for less than one week, then sampling must be done once during the usage of chlorine.

[b] An annual report must be submitted to EPA each year that chlorine is used. The annual report must be submitted by February 1.

Table 4-3. Leachate Monitoring Requirements (excerpted from 2004 NPDES Permit)

Metals	Units	Sampling Frequency	Type of Sample
Total Arsenic[a,b]	µg/L	Semiannual	24-hour composite
Total Chromium[a,b,c]	µg/L	Semiannual	24-hour composite
Total Iron[a,b]	µg/L	Semiannual	24-hour composite
Total Copper[a,b]	µg/L	Semiannual	24-hour composite
Total Zinc[a,b]	µg/L	Semiannual	24-hour composite

[a] Sampling will take place when the leachate from the landfill is discharged through the treatment system.

[b] Samples will be taken twice a year, once during dry season and once during wet season.

[c] Testing for total chromium will occur during the first 2 years. If any monitoring values are greater than 50 µg/L, then testing will occur for Chromium VI as well as total chromium.

The Unalaska WWTP received Final Approval to Operate on August 2, 2017.

As previously discussed, the new CEPT process was put online in the fall of 2015. The construction resulted in a significant backlog of sludge until the end of January 2016. Therefore, the data representative of the new process and associated treatment removals are from February 2016 on. Table 4-4 presents influent and effluent BOD and TSS and their associated removals; January 2016 is included for historical reference only.

The 2011 Facility Plan included a section addressing anticipated future permit limits with the construction of the CEPT system. The 2011 Facility Plan made the assumption that the future effluent limits would be based on the influent loading and expected performance of the CEPT process. Based on jar testing and industry standards, it was anticipated that the CEPT process could provide an average reduction of 45 percent for BOD and 75 percent for TSS. Based on data presented in Table 4-4 below, the treatment facility is meeting permit limits, which are at least 30 percent removal of both BOD and TSS.

The 2011 Facility Plan also anticipated an effluent fecal coliform bacteria count of 200 colonies per 100 mL of effluent on a monthly basis and 400 colonies per 100 mL of effluent on a weekly basis. These values are based on the most probable number. A review of the 2016 effluent data for fecal coliform revealed only one instance where the monthly 400 colonies per 100 mL was exceeded. In general, the disinfection solution has produced good results in keeping the fecal coliform to within these values.

Table 4-4. Influent and Effluent BOD and TSS

Date	Influent BOD (mg/L)	Effluent BOD (mg/L)	% BOD Removal	Influent TSS (mg/L)	Effluent TSS (mg/L)	% TSS Removal
January 2016	165	109	34%	89	34	62%
February 2016	223	125	44%	117	31	73%
March 2016	191	117	39%	163	35	79%
April 2016	190	110	42%	110	29	74%
May 2016	179	80	55%	127	42	67%
June 2016	159	93	42%	158	24	85%
July 2016	231	132	43%	96	20	80%
August 2016	344	138	60%	285	32	89%
September 2016	263	101	63%	232	31	87%
October 2016	266	107	60%	215	55	74%
November 2016	153	72	53%	144	35	76%
December 2016	141	60	58%	145	37	74%

4.3 NPDES Permitting Changes in the Future

Currently, the City is exempt from secondary treatment under the Alaska Native Village Waiver. It is uncertain if or when the City will be required to add secondary treatment to the existing process. State regulators are working with the City to keep the WWTP in compliance with the current regulations.

During a conversation on March 10, 2017, the ADEC regulator responsible for the City of Unalaska's plan review mentioned that ADEC suspects it will be some time before EPA requires advanced treatment for Unalaska WWTP (Bill Rieth, ADEC engineer, personal communication). However, since the City is transitioning from a native village with a large seafood industry to a more permanent community, the City will remain aware of this potential requirement. The federal secondary treatment standards require 85 percent BOD and TSS removal. The secondary treatment effluent concentrations of BOD and TSS must be less than 30 mg/L on a monthly basis and 45 mg/L on a weekly basis.

City staff have expressed concern that the flow limits in the current NPDES permit do not accurately represent the City's monthly average and maximum daily flows. Since the City does experience a significant influx in population during the processing season, the large increase in flow may become an issue as the base population increases. The 0.6-mgd monthly average and 0.9-mgd daily maximum flow should be reviewed by the City and ADEC during the next permit cycle to ensure there are no flow violations.

4.4 Other Constituents of Concern

4.1.1 Ammonia

If advanced treatment at the WWTP is considered, any change that substantially increases ammonia to the plant should be avoided. This also includes any improvements made at the City's landfill site. Additional ammonia loading would be detrimental to most advanced treatment processes if the concentrations are high. Currently, the City's WWTP influent does not have a high ammonia concentration, so this is not a concern. In addition, the City's NPDES permit requires semiannual monitoring of ammonia outside of the mixing zone of South Unalaska Bay to establish the presence or absence of background ammonia to be used to compare to the ammonia from the WWTP discharge.

4.1.2 Copper

Average levels of copper in the City's wastewater effluent are approximately half of the water quality limit for seawater, considering the 100:1 mixing zone. If future permitting altered the mixing zone to 50:1, then the City would frequently exceed the water quality limit. Even lower bioinhibition limits for copper would apply if a future process included biological treatment. Therefore, levels of copper in wastewater, biosolids, and landfill leachate are a concern.

The City has determined that the origin of the copper is the drinking water system, which has low enough pH to dissolve copper from municipal and domestic pipes. The dissolved copper passes through the wastewater collection and treatment system, where approximately half is removed by the CEPT process. WWTP biosolids delivered to the landfill and the landfill leachate returned to the wastewater system create a closed loop that increases copper levels. If biosolids composting is implemented (instead of landfilling the biosolids), the amount of copper in the landfill leachate will likely decrease, reducing the copper content in the WWTP influent and effluent and sludge.

CH2M recommends that the City undertake a study to determine the best way to boost the potable water supply's pH (make it less acidic) to decrease its corrosivity, thereby decreasing the amount of dissolved copper in the City's water and wastewater. Laboratory tests can be conducted to estimate the amount of copper reduction that is possible at reasonable cost by increasing the water's pH. After those tests are completed, the City will have the data needed to decide how to implement a drinking water corrosion-control program. Not only will this be useful for wastewater effluent requirements, but it will help the City meet the Lead and Copper Rule (LCR) requirements for drinking water. Future LCR requirements may be more restrictive due to the recent Flint, Michigan, issues and other concerns.

Many Alaska communities add soda ash (sodium carbonate) to their drinking water to increase the alkalinity to at least pH 8.0 to reduce the corrosion potential in the water distribution system. This is important because lead and copper components in both the City water distribution system and customer plumbing systems more readily dissolve in waters with pH below 7.0 compared to water with higher pH. For example, Ketchikan Public Utilities adds soda ash and orthophosphate for corrosion control, with a target pH of 8.3.

Most Alaska communities have switched from gaseous chlorine disinfection to onsite-generated sodium hypochlorite disinfection. This has been done primarily for community and operator safety reasons, but a secondary benefit has been to significantly increase pH in low-alkalinity water. This is because gaseous chlorine forms hypochlorous acid, which can significantly decrease the water's pH. The City's water treatment plant has unique transportation and access issues that led the City to choose gaseous chlorine over onsite-generated sodium hypochlorite. Although that decision has been made and a new gaseous chlorine system has been installed, a corrosion-control program could achieve the desired pH and reduce wastewater copper levels. In the meantime, we recommend that the City closely monitor the copper levels in wastewater, biosolids, and landfill leachate.

Chapter 5. Capital Major Maintenance Program

This chapter presents proposed improvements to the City of Unalaska's wastewater collection and treatment system that are necessary to resolve existing system deficiencies as identified by City staff.

A Capital Major Maintenance Program prefix and number has been assigned to each improvement. The improvements are organized and presented in this chapter according to the following primary categories:

- Wastewater Treatment Plant
  - Process Optimization Improvements (P)
  - Regulatory Improvements (R)
  - Maintenance Improvements (M)
  - Safety Improvements (S)
- Lift Station (PS)
- Collection System Inflow and Infiltration (I&I)

Process optimization improvements are required or recommended to optimize the WWTP equipment or process. Implementing these improvements will reduce maintenance or provide a higher quality effluent. Regulatory improvements are required by the State or other regulations. Maintenance improvements include improvements that would reduce plant staff time to resolve frequent maintenance tasks or hardship. Safety improvements resolve existing and potential safety issues to protect staff, equipment, or the WWTP site. This chapter presents a brief description of each group of improvements, the criteria for prioritizing them, the basis for the cost estimates, and the implementation schedule.

For planning purposes, the improvement projects described herein are based on one alternative or conventional concept for providing the necessary improvement. Other methods of achieving the same result should be considered during predesign to ensure the best and lowest-cost alternative design is selected. For example, flow capacity increases could be achieved by adding one large gravity main or by using multiple gravity pipes, force main/gravity main combinations, or multiple force mains.

5.1 Estimating Costs and Prioritization of Improvements

Class 5 capital cost estimates were prepared to the AACE International standards for the projects identified in the plan. As defined by these standards, the expected accuracy range for a Class 5 estimate is within minus 30 percent to plus 50 percent. All costs are presented in 2017 dollars.

Proposed improvements were prioritized by the City based on the perceived need for the improvement. These prioritized projects may be completed prior to projects with fewer deficiencies or less risk of damage due to failure of the system. In addition, projects that address safety concerns were given a higher priority.

Future projects that are not identified as part of the City's CMMP may also become necessary. Such projects may be required in order to remedy an emergency situation or to address unforeseen problems. Because of budgetary constraints, the completion of such projects may require modifications to the recommended CMMP. The City retains the flexibility to reschedule, expand, or reduce the projects included in the CMMP and to add new projects to the CMMP, as best determined by City Council, when new information becomes available for review and analysis.

5.2 Description of Improvements

This section provides a general description of each group of improvements and an overview of the deficiencies they will resolve. The required resolution and timing of each recommended improvement is provided for budgeting and financial projection purposes only. The actual design parameters should be evaluated at the project design phase, using a hydraulic model or another accepted engineering procedure. Updated population and flow data should be used when available to ensure the proposed facilities are adequately sized to handle build-out flows. A variety of alternatives are possible for some of the CMMP projects listed, and alternatives should and will be considered during each project's design.

5.2.1 Wastewater Treatment Plant

5.2.1.1 Process Optimization Improvements (P)

CMMP P1 – Clarifier Baffling

Estimated Cost: $80,000

Proposed Years: 2025-2026

Deficiency: After screening, the wastewater is rapidly mixed with a coagulant and polymer to improve the settling process in the clarifier. The wastewater in the first clarifier portion is clear and settles well. As the wastewater effluent goes under the clarifier baffle wall at the discharge end, the water quality degrades by becoming turbid. It is presumed that the settled sludge is carried downstream to the chlorine contact tanks, where it settles. This is very inefficient and requires the operators to clean the tank at least twice a month to prevent excessive sludge buildup. The stirred sludge also requires more chlorine for disinfection and, as a result, more sodium bisulfate for dechlorination. Significant benefit will be realized in both labor and chemical costs if the clarifier's performance is improved.

Improvement: CMMP P1 involves evaluating and installing potential improvements to the two WWTP clarifiers. The evaluation should include a review of the record drawings, a site tour of the plant, and an evaluation of alternatives to optimize the configuration of the clarifiers. Appendix F contains the structural drawings of the clarifiers and chlorine contact tanks.

5.2.1.2 Regulatory Improvements (R)

CMMP R1 – Wastewater Facilities Plan Update

Estimated Cost: $175,000

Proposed Years: 2028-2030

Deficiency: As outlined in the City's 2011 Facility Plan, biological treatment to achieve an enhanced level of BOD removal and removal of other constituents of concern may be required in the future. A Facilities Plan update will be required in order to evaluate treatment alternatives and plan for future improvements.

Improvement: The City will update its *Wastewater Facilities Plan* prior to implementing advanced treatment improvements, or when the City's wastewater treatment plant is approaching 85 percent of its flow capacity.

5.2.1.3 Maintenance Improvements (M)

CMMP M1 – Scum Decant Tank Wet Well

Estimated Cost = $170,000

Proposed Years = 2024-2025

Deficiency: At times, there can be large mats of accumulated grease in the clarifier. While skimming, the water/grease mixture is directed down the clarifier drain pipe to the scum decant tank. As the water/grease mixture cascades into the scum decant tank, the grease resuspends into the water. This allows the grease to flow under the baffle (Figure 5-1) with the water into the tank drain lift station. The grease then congeals and becomes a maintenance challenge for the tank drain lift station.

Improvement: CMMP M1 would evaluate solutions to prevent the grease from entering the scum decant tank with such force. This CMMP item includes the costs for an engineering evaluation and implementation of a small improvement. Replacement of the wet well in its entirety or similar larger capital improvements are not included.

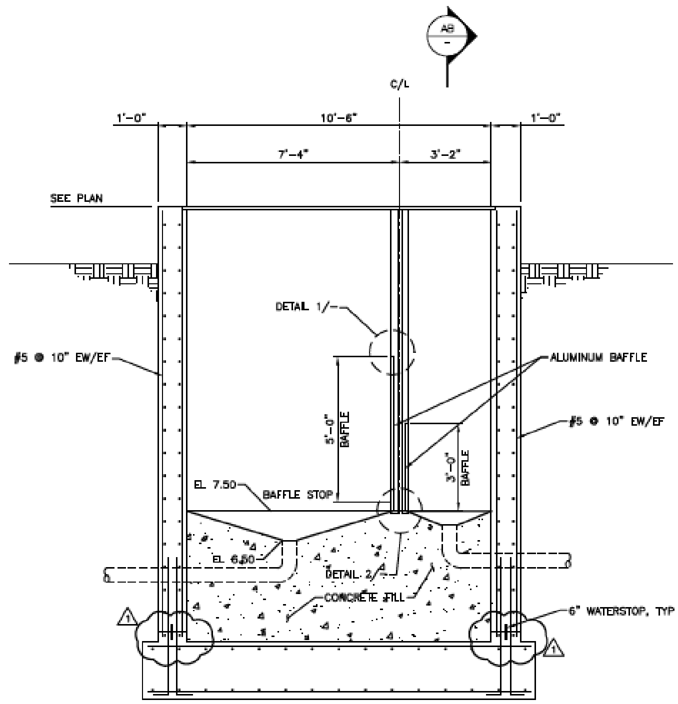

Figure 5-1. Scum Decant Tank

CMMP M2 – WWTP Plant Water Modifications

Estimated Cost = $50,000

Proposed Years = 2024-2027

Deficiency: The plant process water is connected downstream of the chlorination injection point. The sodium hypochlorite dose is high due to the quantity of solids in the wastewater. The high chlorine levels in the plant water cause significant corrosion in the lines. This results in more maintenance to replace carrier pipes, valves, fittings, etc.

Improvement: CMMP M2 would involve evaluating the chlorine dose and reviewing alternative connection points for the plant process water. Another option to evaluate would be the addition of a sodium bisulfite system to dechlorinate the water prior to it feeding the process water pumps.

CMMP M3 – WWTP Sludge Flocculator Valving

Estimated Cost = $30,000

Proposed Years = 2024-2027

Deficiency: When the sludge flocculator starts, the discharge valve positions are opened and closed several times, and plant staff verify that the valve position is closed upon operation. If the valves are left open, the contents of the solids storage tank can drain to the influent pump station. The WWTP staff are careful to set the valves to the appropriate position. Several options were evaluated by the City's WWTP design consultant and it was determined that replacing the sludge pump check valves with back-pressure valves was the best option. This would prevent the sludge from getting past the Penn Valley sludge pumps and exiting the plant if the valve is accidently left open.

Improvement: This CMMP improvement would include purchase and installation of back-pressure check valves.

CMMP M4 – WWTP Flocculator Drain Modifications

Estimated Cost = $20,000

Proposed Years = 2024-2027

Deficiency: The 2-inch flocculator drain (Figure 5-2) is currently tied into the building drain system. A more appropriate drain system would be the 6-inch filtrate drain. The building drain was not constructed to deal with the filtrate material and is prone to clogging.

Improvement: CMMP M4 would include preparing a drain modification design and connecting the flocculator drain to the filtrate drain.

Figure 5-2. Flocculator Drain

5.2.1.4 Safety Improvements (S)

CMMP S1 – Tank Drain Pump Station

Estimated Cost = $21,000

Proposed Years = 2019

Deficiency: The tank drain pump station is located just outside of the WWTP main building on the north side (Figures 5-3 and 5-4). The pump station's top and embedded access hatch are approximately 5.5 feet above grade. The pumps are located more than 18 feet below grade. Accessing the pumps inside the wet well presents a safety risk due to the wet well height above grade. The access hatch doors make up most of the wet well cover. WWTP staff cannot safely service the pumps.

Improvement: CMMP S1 would entail evaluating alternatives to enable staff to safely service the tank drain pumps. This may include platform construction with tie-offs and a davit crane penetration.

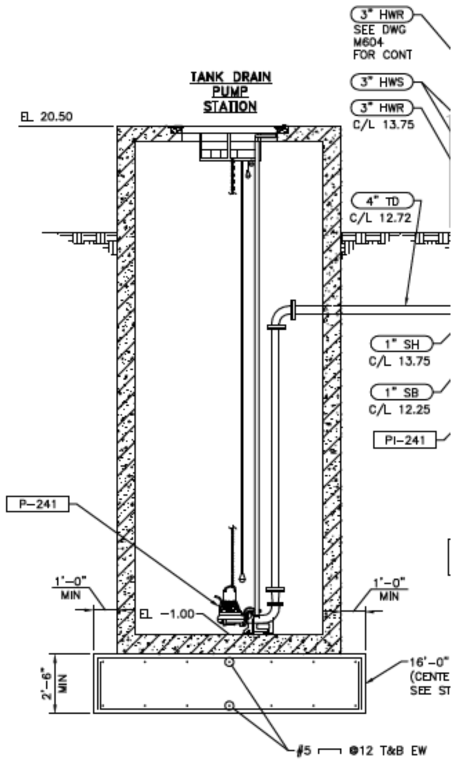

Figure 5-3. Tank Drain Pump Station Detail

Figure 5-4. Photo of Tank Drain Pump Station

CMMP S2 – Sludge Holding Tank Protection

Estimated Cost = $35,000

Proposed Years = 2020-2021

Deficiency: The 25-foot-diameter, 20-foot-high bolted steel sludge holding tank is located on the WWTP's north side and 15 feet from the base of a rock bluff (Figures 5-5 and 5-6). Rocks frequently slough off the bluff, and at times they strike the sludge holding tank. The tank is glass lined steel. It would be prudent to construct a shield to protect the tank from damage or penetration and loss of the tank.

Improvement: CMMP S2 would design and construct a steel shield on the north side of the sludge holding tank. The shield would be approximately 6 feet high and half of the tank circumference and would include a coating.

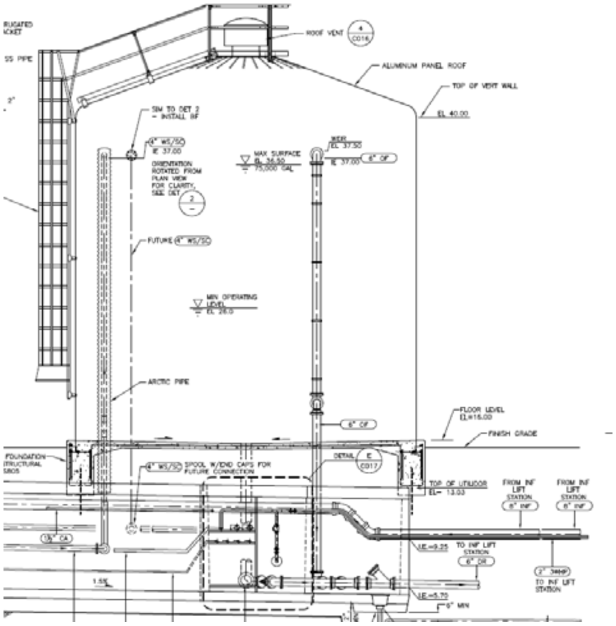

Figure 5-5. Sludge Holding Tank Detail

Figure 5-6. Sludge Holding Tank and Adjacent Bluff

5.2.2 Lift Station (PS)

CMMP PS1 – Lift Station 2 Improvements

Estimated Cost = $193,500

Proposed Years = 2019

Deficiency: Lift Station 2 was constructed in 1986. The City has reported seeing piping and associated valving corrosion inside the wet well.

Improvement: CMMP PS1 would involve demolishing existing corroded piping and valving, and then furnishing and installing piping and valving in Lift Station 2’s wet well. Consideration should be given to completing this improvement in combination with PS2 due to cost efficiencies. However, the CMMP assumes that this project is completed at a different time than PS2 for more conservative budgeting.

CMMP PS2 – Lift Station 5 Improvements

Estimated Cost = $195,000

Proposed Years = 2019

Deficiency: Lift Station 5 was constructed in 1986. The City has reported seeing piping and associated valving corrosion inside the wet well.

Improvement: CMMP PS2 would demolish existing corroded piping and valving, and furnish and install piping and valving in Lift Station 5’s wet well. Consideration should be given to completing this improvement in combination with PS1 due to cost efficiencies. The CMMP assumes that this project is completed at a different time than PS1 for more conservative budgeting.

CMMP PS3 – U.S. Coast Guard Lift Station Improvements

Estimated Cost = $100,000

Proposed Years = 2022-2023

Deficiency: The USCG lift station, located at the Unalaska Marine Center dock, requires control system upgrades to improve pump station reliability and alarm response.

Improvement: A new control cabinet is required for supervisory control and data acquisition (SCADA) system access along with new pump controls. These items will be housed in a fiberglass hut on a 7-foot by 7-foot pad. An auxiliary power connection will also be included. The existing floats will be removed and replaced by a level sensor. The floats may be considered for backup to the level sensor. The junction boxes are already installed.

It is important to note that the budgeting for these improvements would be allocated to the Department of Ports and Harbors.

CMMP PS4 – Leachate Lift Station Improvements

Estimated Cost = $110,000

Proposed Years = 2020-2021

Deficiency: The leachate lift station, located at the landfill, requires control system upgrades in order to improve pump station reliability. It appears the interior of the wet well may also need rehabilitation; the liner is wearing off.

Improvement: CMMP PS4 includes new controls, two junction boxes outside the wet well for pump and float wiring, and a fiberglass hut to house controls and SCADA system. Removal and reapplication of the wet well liner is also included. The upgrade will allow remote notification of lift station problems.

It is important to note that the budgeting for these improvements would be allocated to the Solid Waste Division.

5.2.3 Inflow and Infiltration (I&I)

CMMP I&I1 – Sewer Manhole Rehabilitation

Estimated Cost: $135,000

Proposed Years: 2018-2019

Deficiency: There are three collection system sewer manholes that are suspected of leaking as reported to CH2M by City staff. Collection system manhole deterioration significantly increases collection system infiltration. Infiltration is groundwater that enters through the cracks and holes in the collection system infrastructure and increases the wastewater treatment plant flows. In addition, the manhole structure is compromised and could lead to structure failure.

Improvement: CMMP I&I1 would inspect and remove the deteriorated portions of the three sewer manholes. For the CMMP, it is assumed that the whole structure will need to be replaced to provide a conservative budget. Each manhole is 48 inches in diameter. It is important to note that one of the manholes is installed at a depth of 20 feet below grade and it is unlikely that it can be replaced. This manhole will need to be sealed and relined in place.

CMMP I&I2 – Inflow and Infiltration Study

Estimated Cost: $250,000

Proposed Years: 2020-2022

Deficiency: As the sewer collection system ages, the sewer pipes and structures deteriorate. The pipes are subject to corrosion, displaced joints, and other issues. These areas are subject to groundwater infiltration.

Improvement: The City should conduct an I/I evaluation to confirm sewer collection system areas that are suspected of having high I/I based on increased lift station pump run times. As part of this evaluation, cost-effective sewer rehabilitation measures should be evaluated to reduce or eliminate any excessive inflows.

CMMP I&I3 – Slip Lining from Powerhouse to Delta Way Lift Station

Estimated Cost: $260,000

Proposed Year: 2019

Deficiency: A leaky sewer line adjacent to the Delta Western warehouse was discovered by City staff in the summer of 2017. The oil is leaking into an 8-inch sewer main and damaging three lift stations and entering the City’s WWTP.

Improvement: The City will contract with Northern Alaska Contractors to complete cured-in-place pipe lining between manholes 18 to 19, 16 to 17, and 15 to 16. The work will include pipe cleaning and bypass pumping. A proposal for this work has already been received by the City. In addition, Northern Alaska Contractors completed the immediate risk sewer rehabilitation work in the fall of 2017.

5.3 CMMP Schedule

The improvements were prioritized as noted in Section 5.1 to establish an implementation schedule for the City’s 6-year, 10-year, and 20-year CMMPs. The implementation schedule for the proposed improvements is shown in Table 5-1. The City will identify and schedule the repair/replacement projects during the annual budget process. This provides the City with the flexibility to coordinate these projects with road or other projects within the same area.

5.4 Future Project Cost Adjustments

The cost estimates shown in Table 5-1 are presented in year 2017 dollars. Therefore, future costs should be adjusted to account for inflation and changing construction market conditions at the actual time of project implementation. Future costs can be estimated using the *Engineering News Record* Construction Cost Index for the closest city/area or by applying an estimated inflation rate that reflects the current and anticipated future market conditions.

Table 5-1. Proposed Capital Major Maintenance Program Implementation Schedule

			Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Years 7-10	Years 11-20
			Schedule of Major Maintenance Program Planned Year of Project and Estimated Cost							
No.	**Description**	**Estimated Cost (2017 $)**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024 - 2027**	**2028-2037**
Wastewater Treatment Plant - Process Optimization Improvements										
P1	Clarifier Baffling	$80,000							$80,000	
Wastewater Treatment Plant - Regulatory Improvements										
R1	Wastewater Facilities Plan Update	$175,000								$175,000
Wastewater Treatment Plant - Maintenance Improvements										
M1	Scum Decant Tank Wet Well	$170,000							$170,000	
M2	WWTP Plant Water Modifications	$50,000							$50,000	
M3	WWTP Flocculator Valving	$30,000							$30,000	
M4	WWTP Flocculator Drain Modifications	$20,000							$20,000	
Wastewater Treatment - Safety Improvements										
S1	Tank Drain Pump Station	$21,000		$21,000						
S2	Sludge Holding Tank Protection	$35,000			$10,500	$24,500				
Lift Station										
PS1	Lift Station 2 Improvements	$193,500	$38,700	$154,800						
PS2	Lift Station 5 Improvements	$195,000	$39,000	$156,000						
PS3	U.S. Coast Guard Lift Station Improvements	$100,000					$20,000	$80,000		
PS4	Leachate Lift Station Improvements	$110,000			$33,000	$77,000				

Table 5-1. Proposed Capital Major Maintenance Program Implementation Schedule

			Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Years 7-10	Years 11-20
			Schedule of Major Maintenance Program Planned Year of Project and Estimated Cost							
No.	**Description**	**Estimated Cost (2017 $)**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024 - 2027**	**2028-2037**
Inflow and Infiltration										
I&I1	Sewer Manhole Rehabilitation	$135,000	$40,500	$94,500						
I&I2	Inflow and Infiltration Study	$250,000			$50,000	$100,000	$100,000			
I&I3	Slip Lining from Powerhouse to Delta Way Lift Station	$260,000		$260,000						
Total		**$1,824,500**	**$118,200**	**$686,300**	**$93,500**	**$201,500**	**$120,000**	**$80,000**	**$350,000**	**$175,000**

Chapter 6. References

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Appendix A
Site Visit Notes

Wastewater & Landfill Master Plan Site Visit Summary

ATTENDEES:	Rebecca Venot/CH2M Karla Kasick/CH2M Cory Hinds/CH2M	J.R. Pearson/City of Unalaska Don Lane/City of Unalaska BJ Cross/City of Unalaska Robert Lund/City of Unalaska
COPY TO:	Floyd Damron/CH2M	
PREPARED BY:	Rebecca Venot, Karla Kasick, and Cory Hinds	
DATE:	February 23, 2017	
PROJECT:	690297 (Solid Waste) and 690823 (Wastewater)	

Monday, February 20

The CH2M team arrived at 12:30 pm on Monday, February 20, 2017. They met with J.R. Pearson in the afternoon to discuss his vision for the plan and the details of the kickoff meeting and schedule for the site visits.

HDR is not yet under contract for the water master plan, but will be soon and can provide population and flow data. Since FY 2001, landfilled solid waste growth has averaged 3.8 percent per year; a 61 percent increase of baled landfilled material. The population has not changed significantly in many years, but analysis of electrical utility residential customers, all of whom are metered, shows that the average growth rate from 2004 through 2016 is 0.6 percent.

The master plans should consider labor needs. The landfill is dramatically understaffed, and the wastewater plant received funding for new staff during the WWTP improvements.

Note: In the discussion about labor, it should be noted that over the past 12 plus years, landfill personnel have been required to do virtually all mechanical repairs and maintenance of the baler, and more recently the leachate facility. Prior to that, the Public Works Department (we are Public Utilities) provided skilled welders for nearly all the maintenance on the baler. The landfill is now baling tires and has more cells and roads to upkeep.

Tuesday, February 21

Notes from meeting at Department of Public Works:

Tuesday morning, the team met with J.R. (Deputy Director of Public Utilities), Don Lane (WWTP Manager), BJ Cross (Landfill Manager), and Robert Lund (City Engineer) at the Department of Public Works building to discuss the two plans, the landfill and wastewater supervisors' and city engineer's desires for the planning documents, and the data needs.

Plan Goals

The goal of the plans is for it to be a tool for management to communicate to Council effectively. The capital improvements should be easy to follow and clearly justifiable. The plans will be a tool for securing funding from City Council, so needs to justify improvements using regulations, industry standards, operational improvements, and cost savings.

Executive summary needs to be clear and concise to help with funding requests.

CH2M staff will be sensitive to operator wish lists; justification needs to be provided.

The schedule driver for the master plans is the need to have the content for inclusion in the Capital Major Maintenance Program (CMMP), which needs to be ready by October 1, then finalized before Christmas.

Notes from site visits to WWTP and landfill:

Baler Facility

The City would like a weather station (to be used to record data for future design changes) to be included at the landfill. They feel that the weather at the landfill is sufficiently different from other locations like the airport.

Waste is handled at the baler facility as follows: Incoming waste from commercial clients arrives in steel bins on trucks. Trucks are weighed in and out. Waste is dumped onto the tipping floor in the baler building and materials that are not acceptable for the baler are removed and segregated (e.g., scrap metal, rope/nets, large scrap wood/pallets, tires, etc.). Waste that is removed from the tipping floor is aggregated, weighed, then transported to the landfill for segregated storage. Remaining waste is pushed with a loader to the steel conveyor, which feeds the baler.

The baler is a Mosely Badger (Badger is the model, their smallest unit), purchased in 1997. The baler has a 100-hp electric motor driving two hydraulic rams. The first ram is vertical, compressing the waste, and the second is horizontal to eject the bale. Bales are ejected into woven poly bags (Enviro Bale system), tied by hand, then pushed directly onto the City's flatbed truck. When the truck has 5 or 6 bales, it is driven across the scale to record total landfilled weight then out to the landfill and the bags are dumped near the working face. Bales are stacked with a loader.

Residential waste is self-hauled and dumped in bins inside the baler doors. This waste is not weighed, but is estimated as the difference between the incoming commercial and the total weight of bales outgoing to the landfill.

BJ Cross and his crew rebuilt various plates and components of the baler and conveyor recently. The baler is currently beyond its expected lifespan. BJ expects the baler/conveyor will run for another 5 years at least.

Bale Placement in Landfill

Bales are stacked in the landfill to required side slopes. Soil cover is placed on side slopes and between lifts. One lift is 4 bales high. Fine-grained soil is placed on the side slopes to minimize leachate breakout on the side slopes. Coarse-grained soil (3" minus) is placed on top of each lift for infiltration and driving surface. Stockpiles of the fine-grained soil and coarse-grained soil are maintained at the landfill.

Dewatered, lime-treated solids from the WWTP (approximately 42 percent solids) is transported in Supersacks® and stacked with bales in the landfill. Sometimes the solids bags are cut open to fill voids. Mostly they remain intact.

Inerts

Stockpiles of inert wastes, including scrap metal, nets and ropes, junk cars, tires (loose and baled), and construction/demolition (C&D) wastes are maintained at the landfill. Scrap metal and junk cars are removed via contract periodically. Baled tires are made available for local construction projects.

Cell Leachate Pumping

Leachate from the closed landfill (Phase 1 Cells 1-4) flows via gravity to the Landfill Lift Station (LLS). It is then pumped into the leachate storage/equalization tank (Storage Tank). Leachate from Phase 2 Cells 2-1 and 2-2 (aka Cells 5 and 6) is pumped (Cell 6 is active), or will be pumped (Cell 5 is not yet active) directly to the Leachate Equipment Building and to the Storage Tank. Leachate from Cell 6 is pumped via submersible side slope pump from within the cell.

Leachate Pumping/Treatment

Leachate in the Storage Tank is aerated to remove volatiles and decrease BOD. Leachate is recirculated to keep the solids in suspension until it reaches the WWTP. Citric acid is used as a descaling agent in the leachate piping between the Leachate Equipment Treatment Building and the Storage Tank.

DO is controlled in semi-auto by timer on aeration. Older DO probes have not worked well due to clogging. During initial filling of Cell 5, leachate was found to be highly concentrated (high BOD). As more bales are stacked in Cell 5, the concentration of BOD has decreased somewhat. This may be due to natural filtration through the bales. It is possible that use of the DO probes could be restarted for better DO control and less energy consumption now that the BOD concentration has decreased.

A significant problem with the leachate collection and pretreatment system is that leachate pumping system cannot keep up with leachate flows into the treatment system during significant rain events. The reason for this is that flow into the Storage Tank is restricted to one 4” diameter pipe. As a consequence, during these significant rain events, leachate backs up into the baler facility and floods the baler loading lock. A check-valve in the line from the baler facility is broken or clogged with fats, oils and grease (FOG). There is no easy access to this check valve.

Liquid waste from the baler (rain/snowmelt, squeezings, and restrooms) flows to the leachate treatment system.

Pretreated leachate is discharged via 4” diameter force main to a manhole near the cemetery, where it is combined with domestic wastewater routed to the WWTP. The leachate pumps run at only 30 to 40 percent efficiency, one at a time, and pumping rates are lower than anticipated.

The LLS needs to be replaced/upgraded. Potentially upgrade pumps or review hydraulics so the pumps run more efficiently. It will be a significant project to upsize the force main from the landfill to town.

The LLS does need an upgrade, but the pumps in the lift station only pump into the leachate tank. These pumps are not 100 percent efficient, but it is the leachate pumps in the leachate building that are pumping at only 30 to 40 percent efficiency. Prolonged rain events will cause overflow into the baler building. The check valve needs to be repaired or replaced immediately.

LLS needs to be included in SCADA so WWTP operators can view it. [Capabilities for this may exist; programming or configuration adjustment may be a solution here.]

The LLS needs to be upgraded before it can be viewed on SCADA. Capability exists today for the WWTP to view the leachate SCADA screens.

WWTP Regulations

2004 NPDES permit + interim permits on fecal coliforms (200/400 monthly/weekly average)

City used to be on an Alaska Native Village Waiver and only had screening. Current permits have become more restrictive than even a 301H waiver.

During 1999 and 2000, the City constructed a new WWTP with both screening and a UV disinfection system to comply with the 1997 NPDES permit requiring fecal coliform to meet 10,000 maximum daily limit. The 1997 NPDES permit had BOD maximum daily limits of 2,343 lb/day and 468 mg/L. The permit did not specify TSS limits, but the City believes it was assumed.

In the 2004 NPDES permit, the fecal coliform limit was changed to 10,000/15,000 monthly average/daily max limits. The 2004 NPDES permit decreased BOD and TSS limits to 140/200 mg/L and 700/1,501 lb/day (average monthly/daily max), which ADEC acknowledged later was a mistake. The 2004 NPDES permit also enforced the 30 percent removal requirement for primary treatment from the Clean Water Act.

The U.S. Department of Justice consent decree established a number of interim limits during design and construction of the new CEPT WWTP, and upon completion, the new facility would be required to meet the 2004 NPDES permit limits. However, they changed the 2004 NPDES permit limits for fecal coliform; the new facility must meet 200/400 monthly/weekly average limits.

The future status of the Alaska Native Village waiver is in question, and 301H waiver applications are no longer being accepted, so it is unclear of future regulatory situation.

Applied for new permit in 2008; still waiting for ADEC/EPA.

Trickling filters were depicted in the preliminary design site plan for the new CEPT WWTP as a potential future upgrade. With this in mind, stub-outs were installed to accommodate a future upgrade.

Operating costs have doubled with the new plant, and rates have not yet caught up. Chemical costs and landfill tipping fees for sludge account for much of the added costs, followed by electricity, heating fuel, and water.

Influent Lift Station

Flygt submersible pump installed. Wet well gets build up because of polymer from belt filter press filtrate. Have to use fire hose to break up.

Headworks

Screening – wish it was finer to get more solids removal. Screens generally work ok though. Gate on one screen and overall geometry limits the ability to rotate screens out of trough for maintenance.

Influent troughs/gates not ideal for how flow is equalized between the two screens. They do not turn on quickly enough with changes in flow/level.

Backup floats in channels do not work.

Washer/compactor is good. Use lime for odor control of screenings.

Grit removal system (Eutek) is offline. It is oversized for the typically observed flows; settlement was causing operational issues.

Flocculation and Mixing

Plant design was for cationic polymer for primary treatment. Caused significant problems when mixed with anionic polymer in sludge handling, so switched to the same anionic polymer. Typically dosed at approximately 2 mg/L.

Aluminum chlorohydrate (ACH) dosed as coagulant. Typically dosed at approximately 35 mg/L.

ACH lines clog with ACH and have to be cleaned with hot water and high pressure water weekly. Polymer injection line cleaned, although it is not subject to as much clogging.

Primary Clarification

Clarification basins have a “clear” area in the middle, and a baffle wall or other issue is causing water quality degradation at the end of the clarifier that flows over the launder.

Scum removal – wet well scum tank is too small, and scum overflows into other side.

Tank Drain Pump Station

This pump station is located on the north side of the WWTP. City staff have indicated that maintenance on this pump station is difficult due to the height (approximately 6 feet above grade) and size of the access hatch. The access hatch includes a majority of the top of pump station. This LS needs a work platform built around it and a socket for a davit crane installed. This a huge fall safety concern standing on an 18” concrete ring 6’ off the ground over an open wet well 18’ deep with no way to access pumps other than pull them by hand.

Chlorination/Dechlorination

Foaming in CT tank, can change significantly with ACH dose.

Significant foaming in channel at times.

Currently dosing 8-9 mg/L of chlorine to get a residual of close to 4 mg/L to control coliforms. Higher doses than designed for, but needed or otherwise coliforms are not completely killed.

Bisulfite pumps may be too small to work with this level of required dechlorination. Occasional high chlorine hits in the discharge, potentially due to bad mixing.

Perhaps change the location of the chlorine residual sampling point to be sure that bisulfite is fully mixed and has time to react prior to sampling

Plant Water

Plant water seems to be pulpy from toilet paper not settling. City staff indicated that solids and quality of process water may be adding to issues at the WWTP.

Plant water filters seem undersized, frequent backwashing needed to process drain sump.

Plant water has high chlorine because it is collected before dechlorination. Signification corrosion in lines due to high chlorine levels.

Chlorine Generation

Equipment seems to run well and is in good condition.

Some HDPE tank leakage at low elevation bulkhead fittings.

Solids

Storage tank sized for 65,000 gallons of storage. Overflow returns to influent pump station.

Storage tank (constructed of glass-lined steel) is occasionally struck by rocks from hillside above it. Consider building a shield to protect it from breaking.

Process solids 5 days/week. 8 hours on Monday, and 4 hours other days.

If solids sit in tank for too long, they get too thick, and flows through press feed pump drop, and they aren’t able to keep up with solids production.

Flocculator startup requires drain (which returns to influent pump station); if valves are not set correctly, can gravity drain the entire solids storage tank to the pump station.

2” flocculator drain needs to be tied into 6” filtrate drain.

Solids Press/Pumps

Press has space for a third press unit, and they have a spare onsite.

Operators speak highly of the press and find that it works very well.

Lime Addition

Lime feed equipment is ok.

Lime mixing in solids conveyor is poor. The design calls for the trough to be approximately ½ full. It currently is about 10 percent full, so there is not good mixing within the conveyor.

Typically dose 7 percent wt/wt of lime.

Lime dust fouls the odor control system due to not getting well mixed with the solids.

Solids Conveyors

Conveyors designed for 60 gpm of sludge pumping (typically good day is 30-40 gpm; if sludge too thick from sitting, only 20 gpm).

Solids Bagger

Bagging system is designed for grain. Auger at top pushes solids into space between bottom of trough and top of knife gate. Solids solidify and clog opening, and do not fall into bag when knife-gate opens.

Typically send 7 to 8 bags of solids to the landfill on Monday. The WWTP sends 2 to 3 bags per day Tuesday through Friday.

Bagging system is designed for 6-bag operation. With system running as is, we can use only 2 bagging chutes.

Laboratory

Lab manager going through training to get the lab certified to do fecal coliform testing in-house.

Will eventually be doing total coliform testing for water side as well.

No problems in lab.

Landfill/WWTP Relationships

Typically try to maintain not more than 5 percent of plant flow as leachate. Controlled by shutting down leachate LS and using the tank as storage.

Lift Station 5

Lift station 5 was installed in 1986; seeing some corrosion in piping inside wet well (will be replaced in 2017). Lift station 2'.

Collection system upstream of LS has some reverse grades and leaking MH’s.

City staff have indicated that this lift station does operate three times more during a storm event compared to average conditions. This lift station receives the flow from the older part of the town.

Lift Station 4

Has existing standby generator. Largest wet well in system.

Leachate Lift Station

Lift station located at the landfill site. Wet well has three gravity lines that discharge leachate from cells 1, 2, and 3; leachate from cells 5 and 6; bathrooms; and trench drain from the building.

Other Lift Station Notes

Most lift stations have been upgraded in the last 5 years to have the electrical/controls in fiberglass huts, and to integrate controls and alarms into SCADA.

The Leachate Lift Station needs the same upgrades that the other lift stations received – new electrical controls, 2 junction boxes outside wet well for pump and float wiring, and a fiberglass hut to house controls and SCADA equipment.

USCG lift station also needs the same upgrades for SCADA access.

Outfitted with portable generator plug to pump out lift stations as needed. Generally power is available and does not go out since the new powerhouse was installed recently.

LS 2 will have wet well piping replaced in 2017 because of corrosion.

In general, City staff believe lift stations are in good shape.

Collection System

Most of the collection system is made of Class 52 ductile that is in good condition.

Potentially some cement mortar lining is corroding from the pipes. Generally grit is not too bad at WWTP. Suspected that some road construction work on Ballyhoo may have led to more cement in the line in that area.

City flushes 1/3rd of collection system every year as maintenance.

City staff expressed concerns of collection system infiltration and inflow in the Steward Road/Generals Hill area.

City staff have installed rain seals on manhole lids to limit the amount of inflow to the collection system. J.R. indicated that he did notice a reduction in influent flow to the lift stations and WWTP after City staff increased efforts to replace rain seals when damaged.

Wednesday, February 22

Meeting with J.R. in the morning to review and understand landfill data spreadsheets. Additional visit to City Hall and landfill to obtain specs and available information on the baler.

Flash drives provided by City to CH2M with wastewater and landfill files, reports, and documents.

Appendix B
HDR Population Memo

Memo

Date:	Sunday, July 09, 2017
Project:	Unalaska Water System Master Plan Unalaska Project # 43-467, HDR Project # 10057343
To:	JR Pearson, Deputy Director of Public Utilities, City of Unalaska
From:	Dan Billman, Wescott Bott, Anson Moxness
Subject:	Water Master Plan, Technical Memo #1 – Population and Water Demand

Introduction

One of the goals of a water master plan is to determine the existing planning conditions in the community and then forecast the future conditions. These forecasted conditions help define the design criteria that will govern the size and extent of future improvement recommendations. This memorandum will review the project parameters including: current and projected population, current and projected water demands, and existing and anticipated future storage requirements.

Current Population

The 2010 U.S. census reports that there are 4,376 residents for the City of Unalaska. The 2010 U.S. Census reports that 2,277 residents of the City of Unalaska live in households and 2,099 residents live in "group quarters".

The Alaska Department of Labor (DOL) provides yearly population estimates. The DOL estimates that in 2016 there are 4,448 residents in the City of Unalaska.

The population for Unalaska varies throughout the different seasons as people move in and out for the commercial fishing industry. According to the City website 5,000 to 6,000 transient people can come to Unalaska during peak fishing seasons and processing times.

Current Water Production and Use

The City has identified water use for Unalaska as metered services (industrial, commercial, and multi-family units), unmetered services (residential), miscellaneous water use for hydrants and water truck fills, and unaccounted (leakage or lost). Current water use data has been developed using monthly flow data from 2003 to 2016 and daily water production data from 2013-2017. Figure 1 shows the minimum, average, and maximum daily water production data from 2013-2017

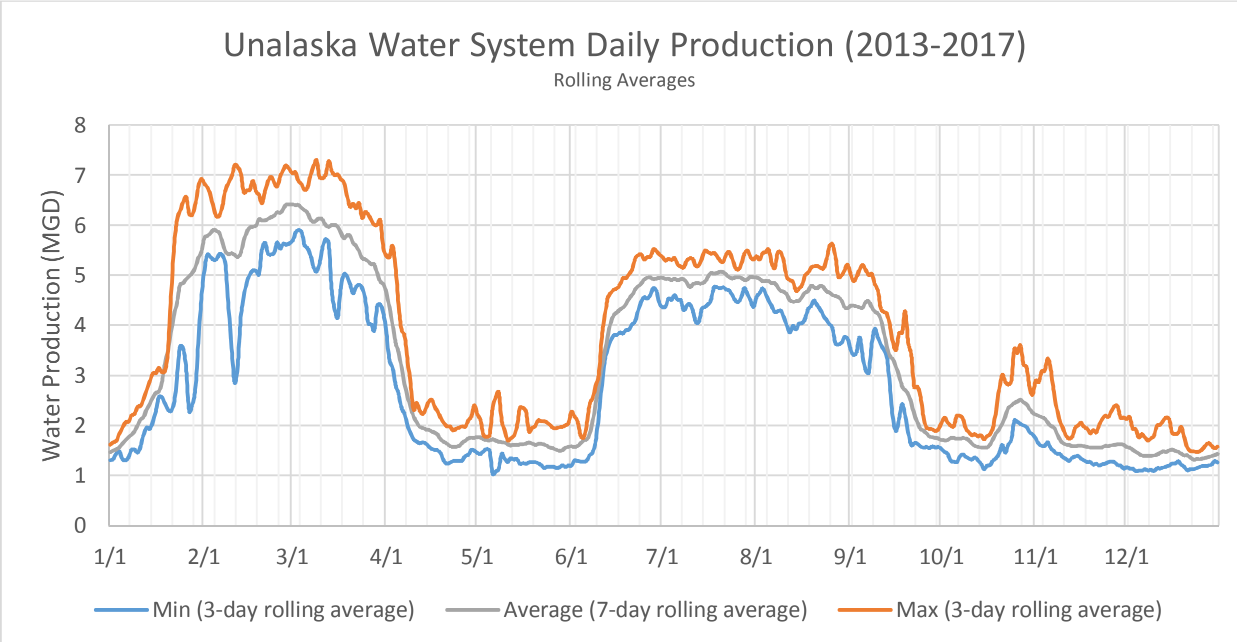

Figure 1: Average Daily Production Data (2013-2017)

Metered Users

Most water demand comes from metered commercial and industrial services. The largest component of this water demand comes from four seafood processing facilities (Unisea, Westward, Alyeska, and Icicle). Other metered structures include multi-family residential buildings, restaurants, retail stores, City facilities, and seafood processing support facilities.

Metered Water Use

The majority of water use in Unalaska is metered, largely because of the substantial demand from the seafood processors. Within the thirteen years of records collected (2003-2016) the metered water demand has remained relatively stable with an average total demand of 983 million gallons (MG) per year. In 2016, metered water use accounted for approximately 83% (1,052 MG) of the total water produced. Typically the highest demands on the system occur in February, March, August and September, which are also the highest seafood processing months.

Metered services include both the large, seasonal water demands of seafood processing facilities and smaller year-round water demands such as multi-family residential, and city facilities. A base metered use was determined by calculating the average daily demands during May, between the A and B fish processing seasons, when there is no fish processing. The base metered use was subtracted from the metered data to determine estimated processor use during the fish processing seasons. The estimated annual processor use was compared to recorded annual fish landings as reported by NOAA Fisheries. Figure 2 below shows a comparison between annual fish landings, base use, and estimated annual processor use.

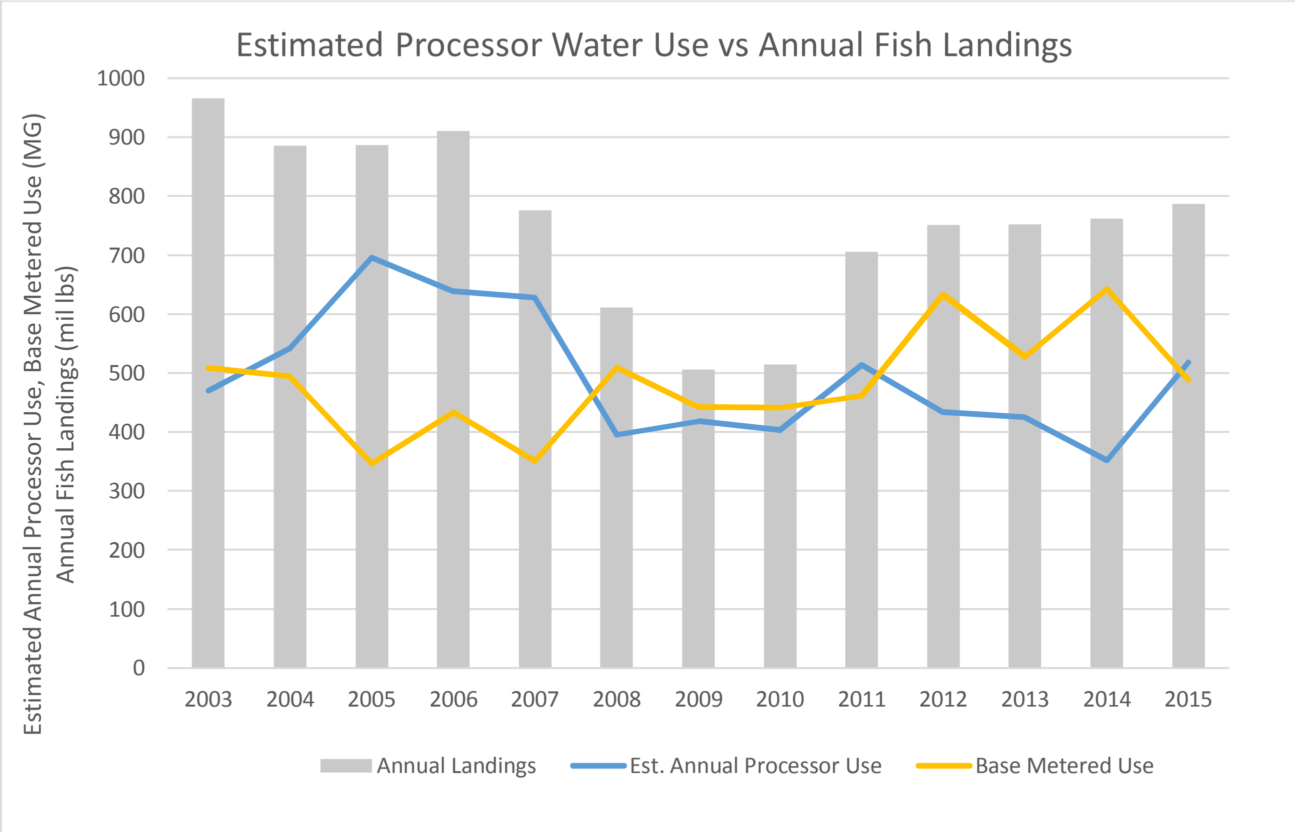

Figure 2: Estimated Base and Processor Water Use vs Annual Fish Landings in Dutch Harbor

Unmetered Users

Single-family residential units are not metered by the City but instead charged a flat fee for water service. The majority of residential properties in Unalaska are serviced by the public water system. According to the 2016 water records from the City, 371 homes are billed for unmetered water service.

Unmetered Water Use

According to 2016 records, unmetered water use accounts for 2.1% of the total water produced, totaling approximately 27 MG in 2016. The City calculates unmetered water use by multiplying the total number of dwelling units by a daily water demand of 200 gallons per dwelling unit. The water use rate assigned to each dwelling unit assumes an average of 4 people per dwelling unit and a consumption rate of 50 gallons per capita per day.

Unmetered water use *(gal/month)* = # of dwellings * 200 *gal/day/unit* * days/billing cycle

The unmetered water use for each month are then summed over the year to find an annual average number of unmetered water service connections. Figure 3 below shows the number of unmetered water services between 2004 and 2016.

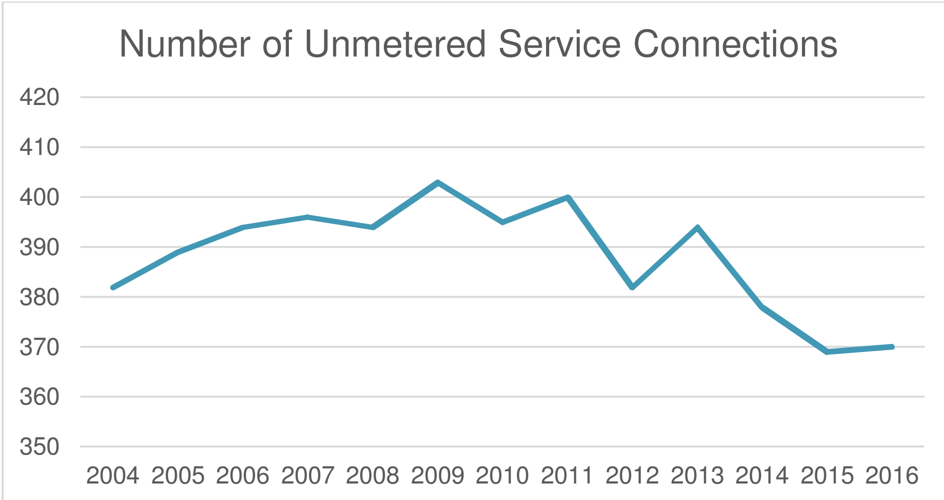

Figure 3: Number of Unmetered Service Connections 2004-2016

The number of unmetered water service connections has remained relatively constant over the past 12 years, with a slight drop in 2014-2016 as some meters were installed on previously unmetered services. Over this period the average daily flow to unmetered service connections is calculated as 80,000 gallons per day.

Miscellaneous Water Use

The water reports from the City identify water used for hydrants and water truck fills as part of the total water records for the community, although this is a small component of system demands. Water for hydrant and truck fills was found to be 3.5 MG per year, only 0.3% of the total water produced in 2016.

Unaccounted Water Use

Unaccounted water includes any water use not included in the metered, unmetered, and miscellaneous categories. The City considers this water to be primarily leakage in the system. The City calculates unaccounted water by subtracting the recorded metered, calculated unmetered water use, and miscellaneous water use from the recorded total water produced.

Records indicate that unaccounted water is approximately 14% of the total water use, totaling about 182 MG for 2016. On average, the City loses 0.5 million gallons per day (MGD) to unaccounted water use. Figure 4 below shows the monthly unaccounted water use from 2007-2016. A linear trend line shows an approximately 1.2% annual growth in unaccounted water use over this period

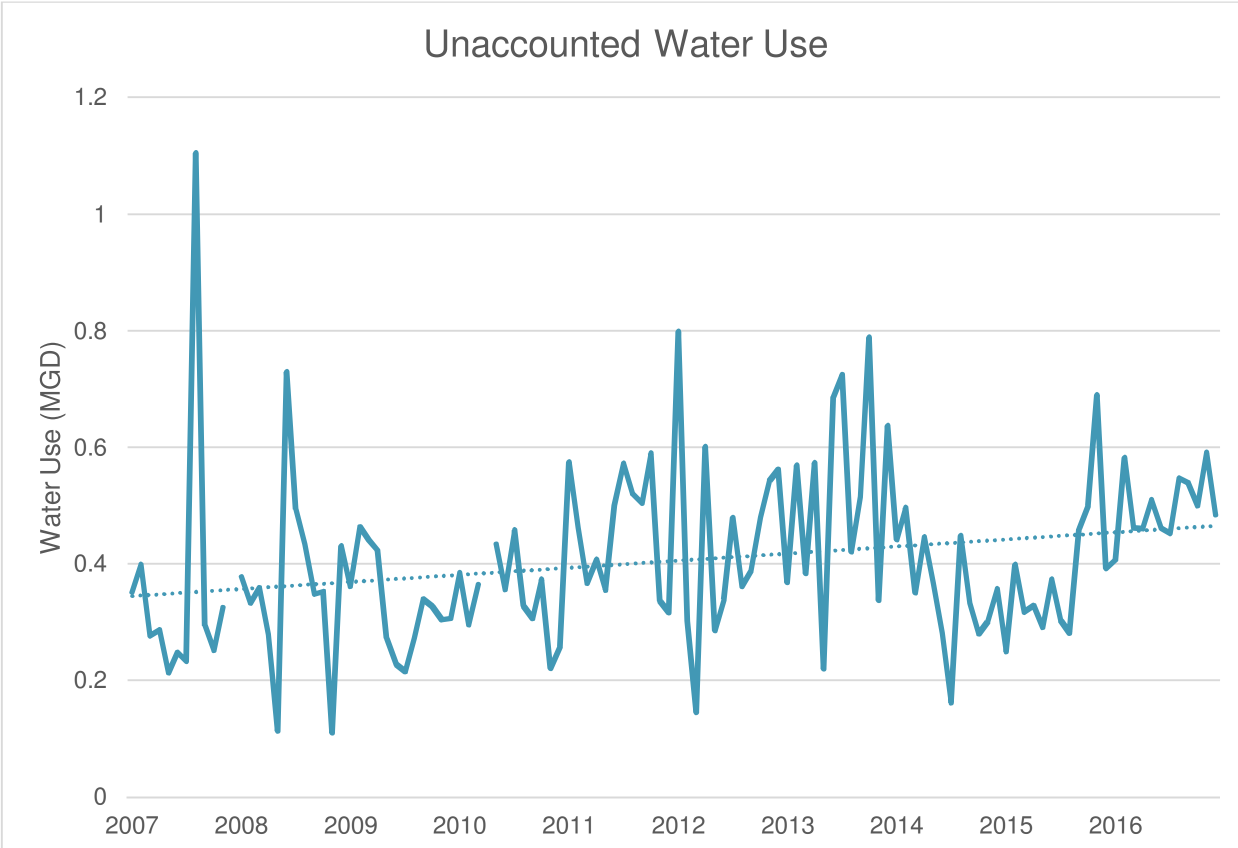

Figure 4: Unaccounted Water Use 2007-2016

Future Population

DOL and DCCED reports show irregular growth in the community throughout the recorded history. Based on census records and DOL estimates for the last 13 years, the growth rate ranges from -8.4% to 9.3%. It is often difficult to predict future populations in the Aleutian area due to the dependence on fisheries, which brings large transient numbers to the community. DOL projections found that Unalaska's permanent resident growth rates may range from no change to a 0.3% annual loss. Based on these predictions, three scenarios were selected to project future population for water planning purposes: minimum population projection based on the DOL estimates of population loss in the Aleutians West Census area; zero growth population estimate; and a maximum population projection growth rate of 0.5% based on DOL statewide projections. Table 1 and Figure 5 show these population projections for Unalaska.

Table 1: Unalaska Population Projections

Year	2016	2021	2026	2031	2036
DOL Unalaska Population Projection	4,448	4,436	4,417	4,386	4,334
Zero Growth Population	4,448	4,448	4,448	4,448	4,448
DOL Alaska Growth Rate Projection	4,448	4,641	4,815	4,970	5,111

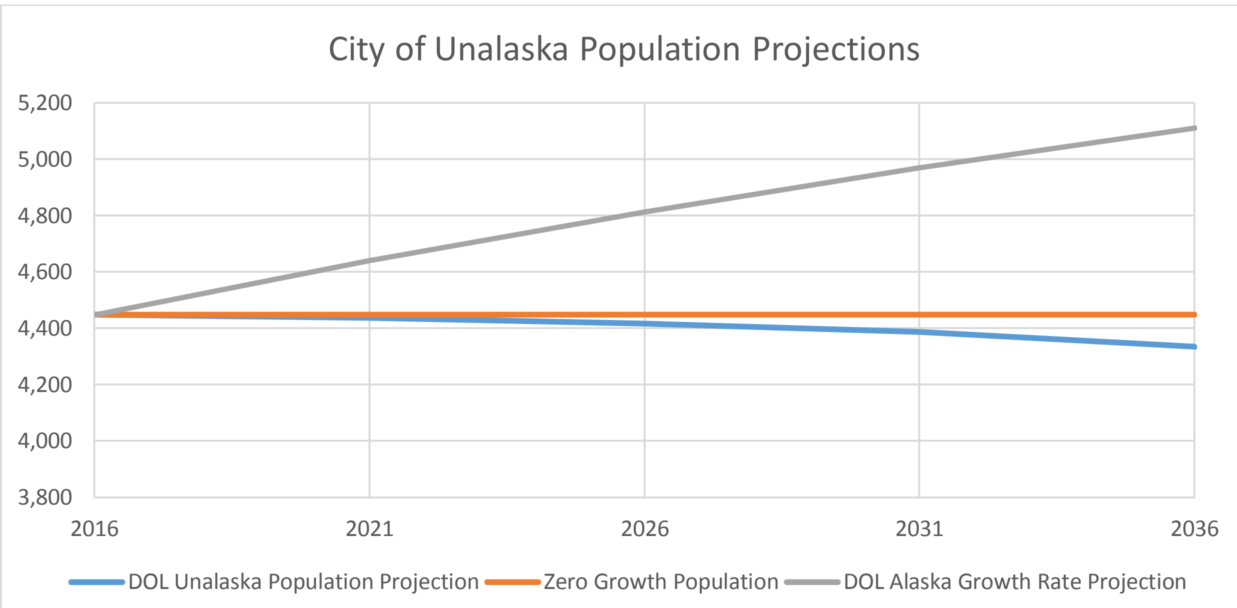

Figure 5: City of Unalaska Population Projections 2016-2036

These projections represent an average annual population of year-round permanent residents. The seasonal surges in population will increase demands on the community's utilities.

Future Water Production and Use

Evaluation of previous and current water use records have shown that Unalaska's industrial water use dwarfs domestic use. The local industry—fish processing—is water-intensive. As Dutch Harbor is one of the two largest fishing ports in the United States, large quantities of water are needed to process the volume of fish moved through this port. An examination of past landing records from NOAA Fisheries for Dutch Harbor establish a range of expected values from a high point of 966 million pounds in 2003 to 506 million pounds in 2009. An analysis of water demand compared to annual fish landings show a very close relationship as seen in Figure 2.

For planning and estimation purposes, water demands were split into five use categories: base metered, estimated processor, unmetered residential, miscellaneous, unaccounted water.

Planning Assumptions Used for Projected Water Use

Growth rates for the community's population, housing, and fishing industry trends were selected to assist in predicting future water use for the community. Table 2 summarizes the planning assumptions used for the community of Unalaska to determine estimated future water use. Discussion on how the growth rates were applied to each water use category follows the individual water use sections.

Table 2: Community Growth Rates

Category	Growth Rate
Metered Base Use	1.0%
Processor Fish Landings	0%
Population	0%
Miscellaneous water use	0%
Piping Infrastructure	1.0%

In addition to the assumed growth rates, water use rates were developed to estimate future water needs for two categories. Table 3 summarizes the water use rates assumed for the community of Unalaska to determine projected future water use. Discussion on how the rates were applied is in the individual category sections below.

Table 3: Water Use Rates

Type of Water Use	Water Use Rate	Units
Metered Water (industrial processing)	0.75	gal/lb of fish processed
Unmetered Water	200	gal/service connection/day

Projected Base Metered Water Use

The base metered water use represents a year-round water use rate of service connections attached to the system via water meters. This water use currently accounts for city-operated facilities, multi-family dwellings which are inhabited year-round, restaurants, and other services. Some of these connections, such as restaurants, will use larger amounts of water during fish processing seasons, but this water is accounted for in the estimated fish processor use. Over the five year period from 2018-2023, it is assumed that all unmetered service connections will have meters installed.

The base metered water use is found by extrapolating the metered water use in May, an off-peak month, to the entire year, plus the additional metered water use from newly installed residential water meters.

To estimate future residential water use, an annual 0% growth rate was applied to the current (2016) number of housing units. The 0% growth rate was selected to match the population growth rate of the community. While the DOL estimates the population of the Aleutians West Census Area to drop slightly over the planning period, a 0% growth rate for population was selected as the census area encompasses a larger area than just the City of Unalaska. Department of Labor population estimates generally show a decrease in census areas which are primarily rural, and a flat or slight increase in areas which are more urban. As the Aleutians West Census Area also contains some rural areas outside the City of Unalaska, it is assumed that the population loss is predominantly coming from those areas. The high level of industry may insulate the City from the projected population loss seen in other parts of the Aleutians.

Records from 2016 indicate that there were 370 dwelling units billed. Current residential unmetered flows were estimated by multiplying the City's residential usage rate of 200 gallons per day per unit by the number of dwelling units. Using the City's usage rate, the 2016 unmetered water demand was calculated to be 27 MG per year. One fifth of the 27 MG per year of unmetered water demand (5.4 MG/year) was added to each year of estimated base metered water use from 2018 to 2023 to represent the additional meters installed on residential properties.

Figure 6 below shows the historic and projected base metered water use for the City over the planning period.

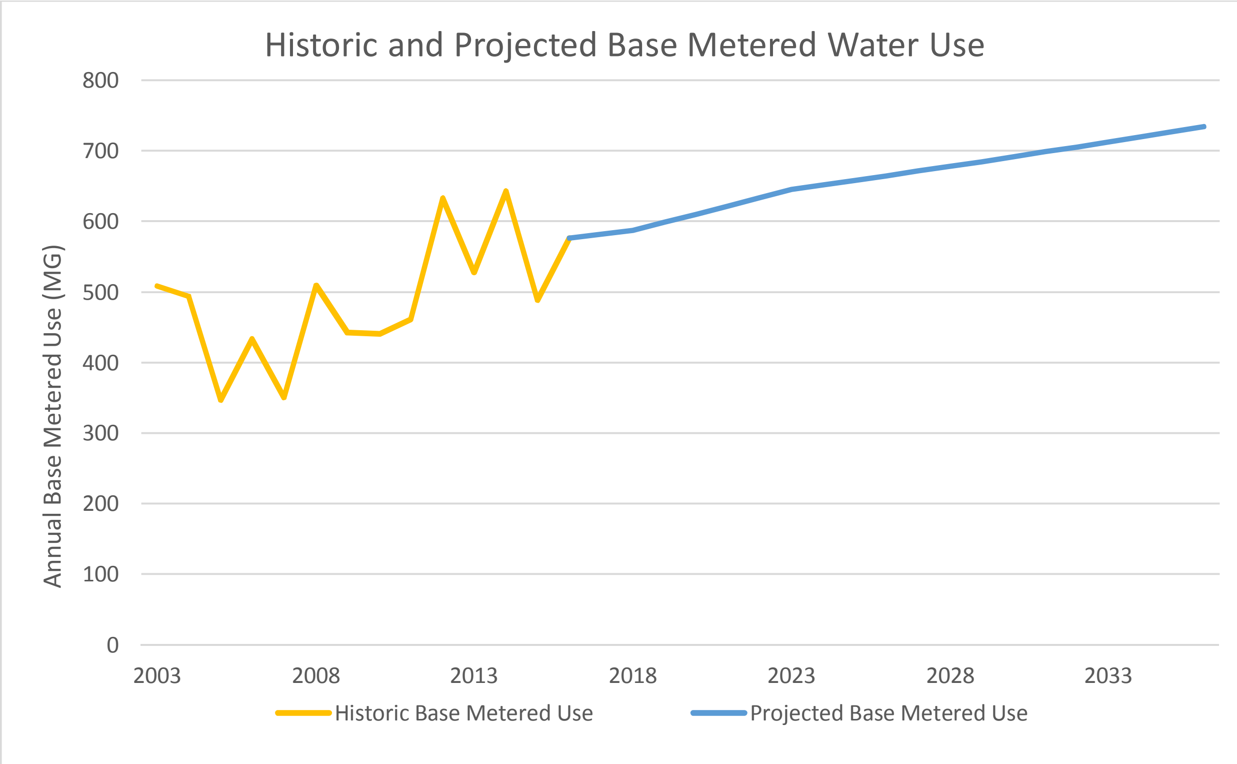

Figure 6: Historical and Projected Base Metered Water Use

Projected Fish Processing Metered Water Use

As seen in Figure 2, the estimated annual processor water use closely mirrors the total annual fish landings in Dutch Harbor. The projected annual fish landings as published by NOAA Fisheries can be used to estimate processor water use in the near future. It is difficult to predict the ebb and flow of fisheries in the Bering Sea and Gulf of Alaska for a 20-year planning period. To account for this, a range of possible fish landings, based on prior data, is used to estimate future processor water use.

In the prior 13 years, the highest amount of fish landings in Dutch Harbor occurred in 2003 when 966 million pounds of fish came through the port. This value will represent the maximum projected catch. After several years of landings at or near 900 million pounds, Dutch Harbor saw several years of only 500 million pounds of fish landing in 2009 and 2010. 500 million pounds will represent the minimum projected catch. From 2012 to 2015, the total fish landings have stabilized between 750 and 780 million pounds, which represents the projected annual landings.

The addition of an Icicle Seafoods processor ship, which formerly operated offshore, is expected to add approximately 0.3 MGD from one production line during the A processing season (Jan 15th through Apr 15th). This operation is estimated to add approximately 30 MG per year of demand at peak production. Icicle may choose to add an additional production line, which would add another approximately 30 MG per year of demand. No other large expansions in fish processing operations are expected during the planning period. The projected annual landings should be between 950 million pounds and 500 million pounds. The Projected Median Processor Use shows an increase of 30 MG per year over the course of 2 years to account for the new processing ship and additional processing line.

As seen in Figure 7, between 2003 and 2015, the water use per pound of fish processed has remained fairly level between 0.46 and 0.83. The average value over this period is 0.66 gal/lb of fish. For the purpose of this analysis, a slightly more conservative value of 0.75 gal/lb of fish processed was used to project estimated processor water use in the future.

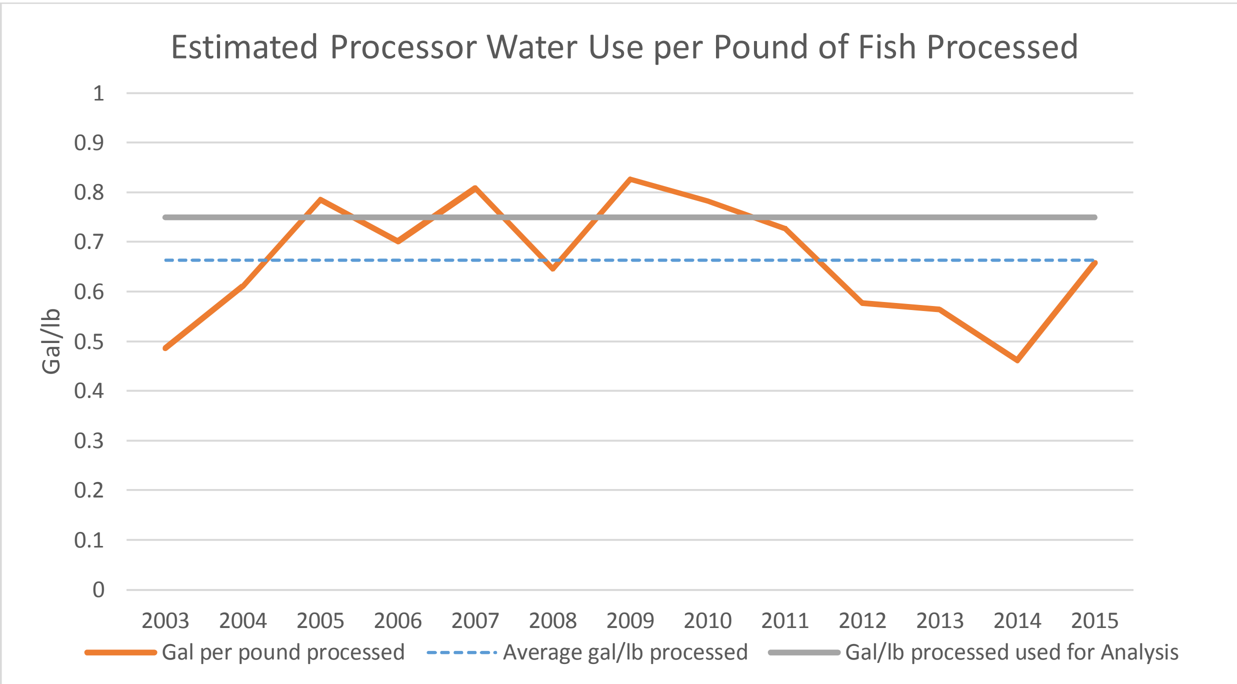

Figure 7: Estimated Processor Water Use per Pound of Fish Processed

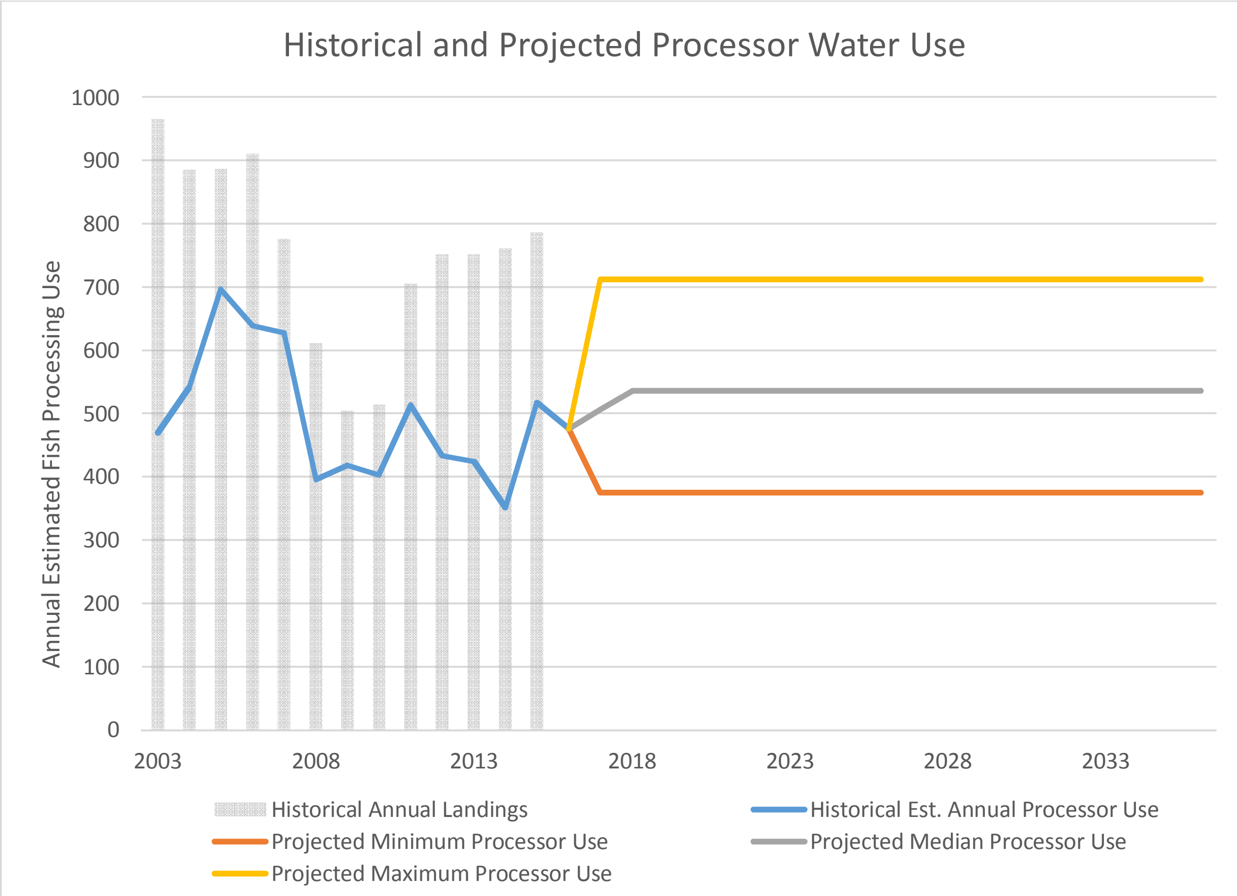

Figure 8: Historical and Projected Processor Water Use

Projected Unmetered Water Use

City water records collected from 2003 through 2016 identified the number of dwelling units billed by the City for unmetered water use (see Figure 3). Over the next 5 years, the City intends to install meters on all unmetered service connections. The water which currently is classified as Unmetered Water, will change to Metered Water over this period. It is assumed that the installation of meters on unmetered service connections will occur evenly over the five year period from 2018 to 2023.

Figure 9 shows the recorded and projected unmetered water demands for the City through the planning period.

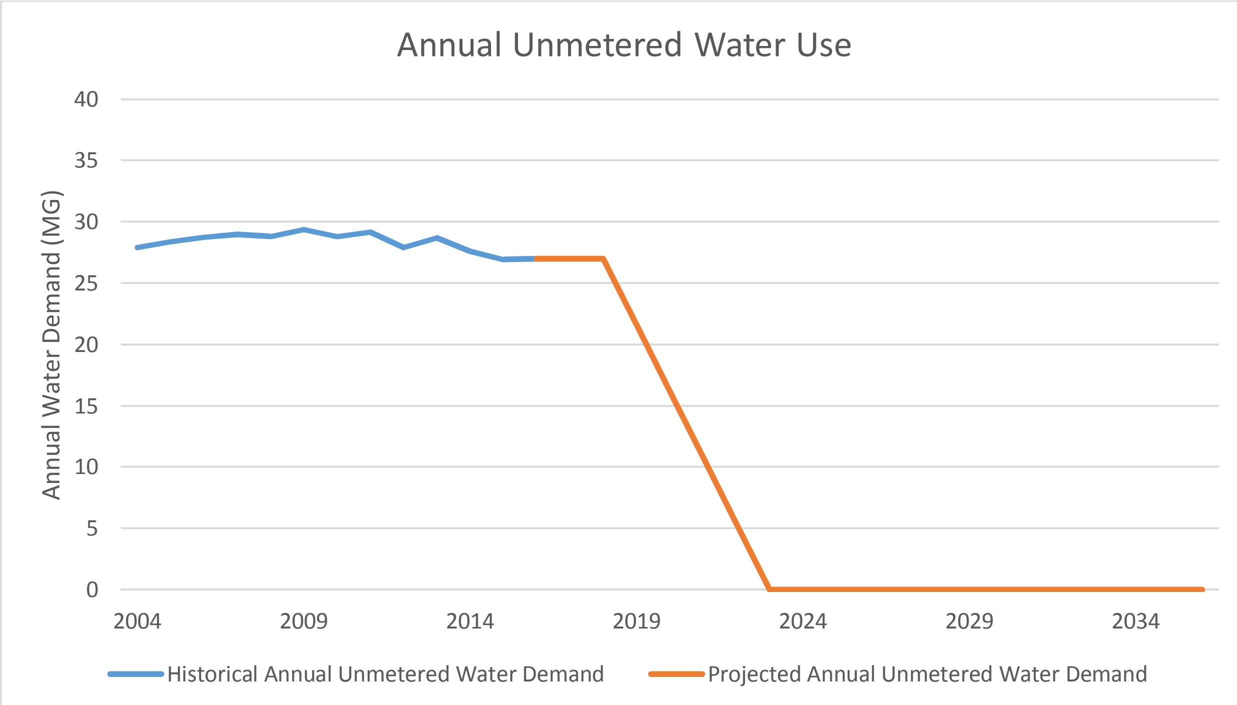

Figure 9: Historical and Projected Annual Unmetered Water Use

Projected Unaccounted Water Use

Unaccounted for water is defined as the remaining water not accounted for by metered or unmetered water, most of which is attributed to leakage and losses in the system. It is difficult to project future unaccounted water as the loss rates can change as piping systems ages and as leaks are detected and fixed. Based on past observations, the unaccounted water use was assumed to grow at a rate of 1.0% annually. This rate accounts for system expansion, aging of pipe, and other growth that may be seen in the system. 182 million gallons of water was unaccounted for in 2016.

Using a 1.0% annual increase in unaccounted water use, the estimated future unaccounted water use is 200 million gallons in 2025 and 222 million gallons in 2036. Figure 10 shows the projected unaccounted water over the planning period.

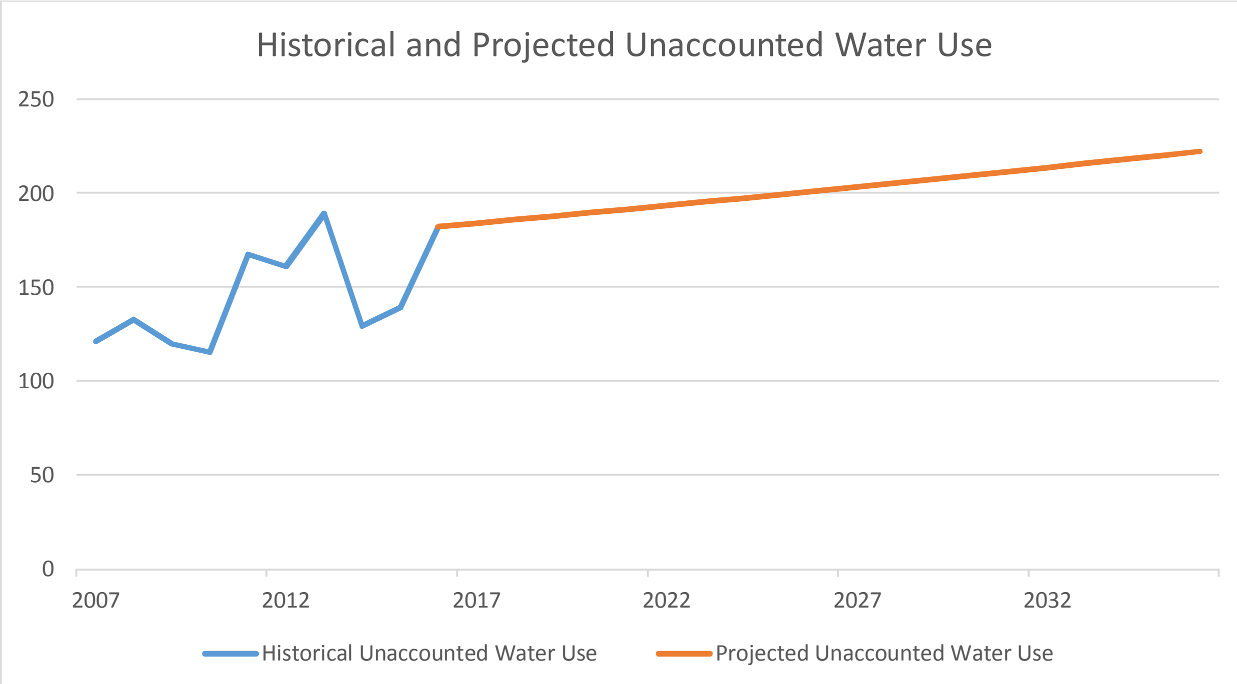

Figure 10: Historical and Projected Unaccounted Water Use

Projected Miscellaneous Water Use

To account for hydrant use and truck fills, an estimated future value was found by averaging the recorded data from the past 7 years (2009-2016) excluding the months during startup of the new water treatment plant and any large water use that was noted as belonging in another category. The average value was found to be 6.0 MG per year. With the exception of one large outlier of 18 MG in 2013, the recorded values for hydrant and water truck had little variation over the seven year data period. Future hydrant and water truck use is assumed to remain constant at 6.0 MG per year over the planning period.

Summary of Water Use

Figure 11 and Table 4 show a summary of the current and projected future water use for the City.

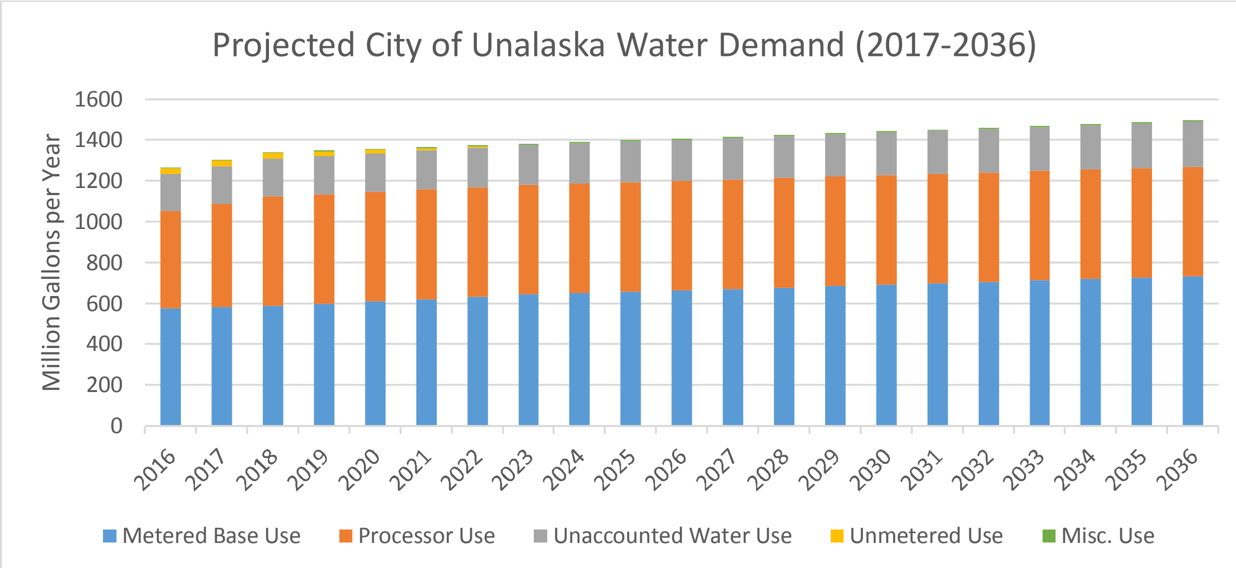

Figure 11: Projected City of Unalaska Water Demand 2016-2036

Table 4: Summary of Current and Projected Water Use

Type of Use	Current Water Use (2016)	Projected Water Use (2024)	Projected Water Use (2036)
Base Use	576,320,000	651,900,000	734,700,000
Processor Use	476,310,000	536,250,000	536,250,000
Unmetered	26,990,000	0	0
Unaccounted	182,110,000	197,200,000	222,200,000
Misc.	5,980,000	6,000,000	6,000,000
Total	**1,267,710,000**	**1,391,350,000**	**1,499,150,000**

Summary

The Unalaska water system provides service for residential users (unmetered flow), commercial and industrial users (metered flow), and miscellaneous City uses (hydrants and water truck fills). In addition to the services, a component of total water produced is lost in the system to leakage. The City refers to this as unaccounted water. The Unalaska water system is unique in that the four seafood processing facilities create the majority of water demand on the system (nearly 90%). Because of the large need for water to serve the industrial users, the City must forecast accordingly by evaluating the trends of the fishing industry in addition to the typical population forecasts for the community.

To understand the potential population growth for the community, research was completed using census and Department of Labor statistics. Research found that over the planning period, a constant population should be used to estimate future population, housing, and water piping infrastructure growth in the community.

Based on the large industrial water demand, research was also completed on the potential growth for the fishing industry in Unalaska. This research indicates that the catch rates and processing should remain relatively stable over the planning horizon for this water master plan. It was also assumed that no new processing facilities would come into Unalaska, except for one offshore processing ship moving to onshore operations. Water use for the processors is directly tied to the amount of fish (pounds) landed. To estimate future industrial water use, the current amount of fish landings was projected to increase slightly with the new processing ship and then remain constant. The base water use is expected to follow current trends and increase an annual rate of 1% growth.

Using the growth criteria selected for the population and fishing industry the total water use is projected to be 1.4 billion gallons per year in 2024 and 1.5 billion gallons per year in 2036.

Appendix C
Unalaska Collection System Map

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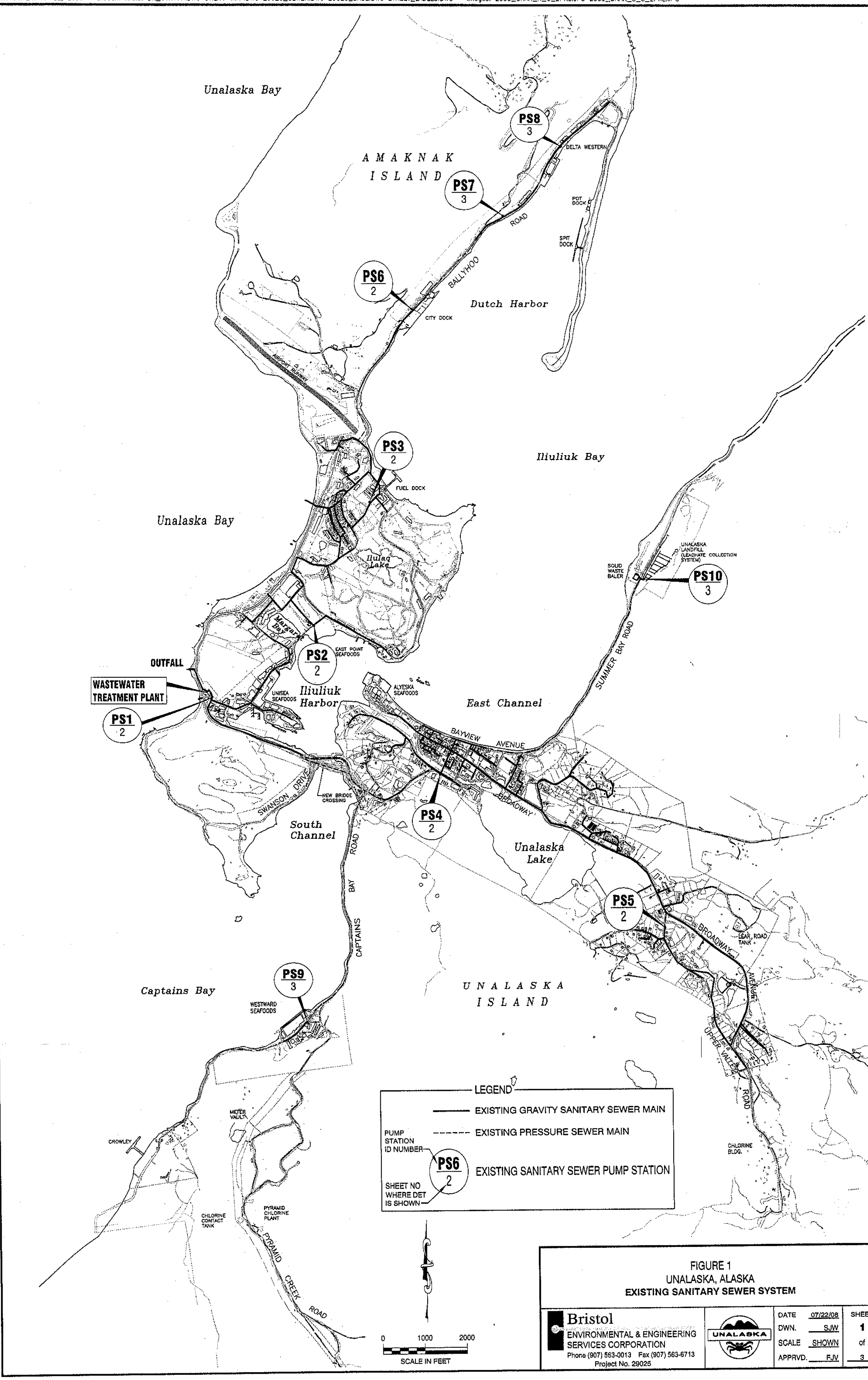

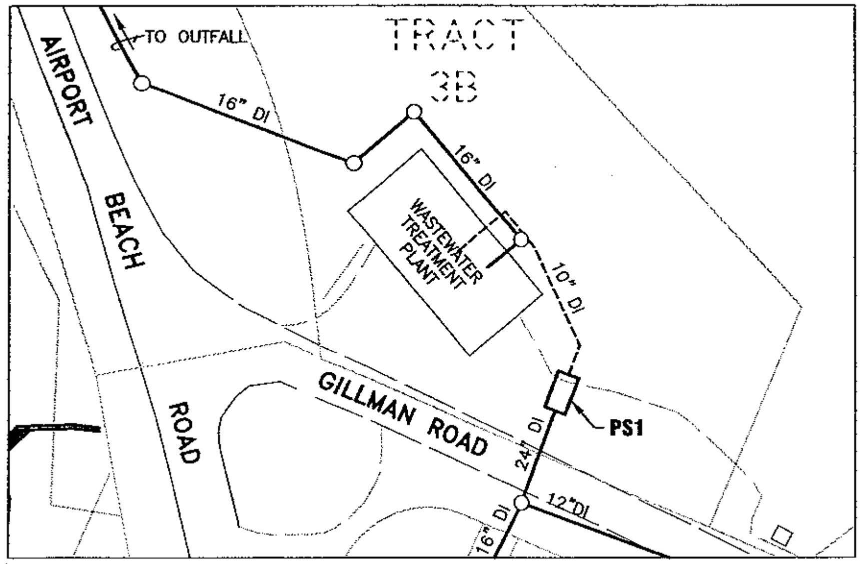

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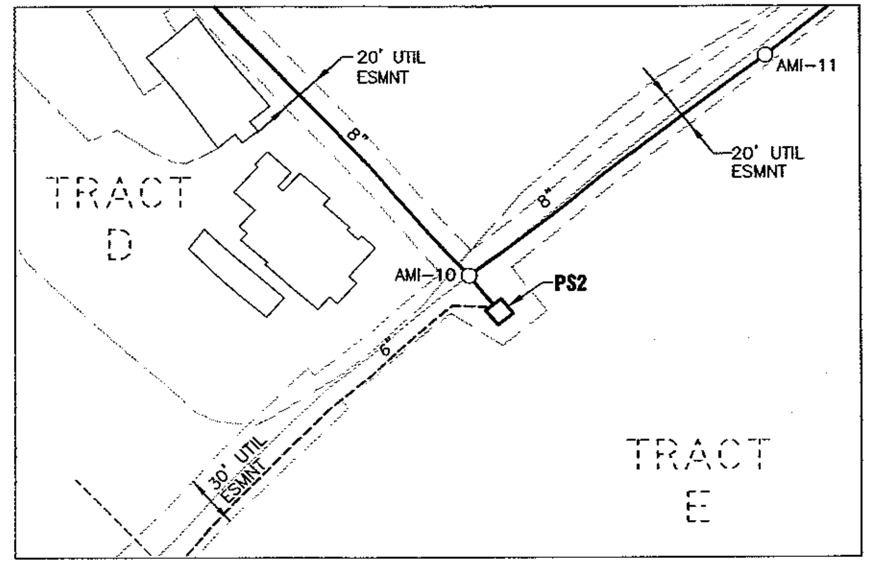

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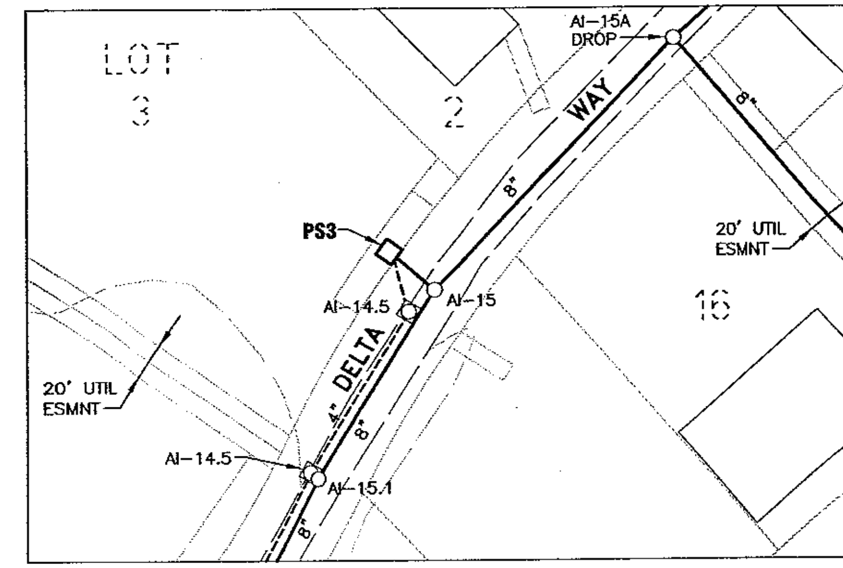

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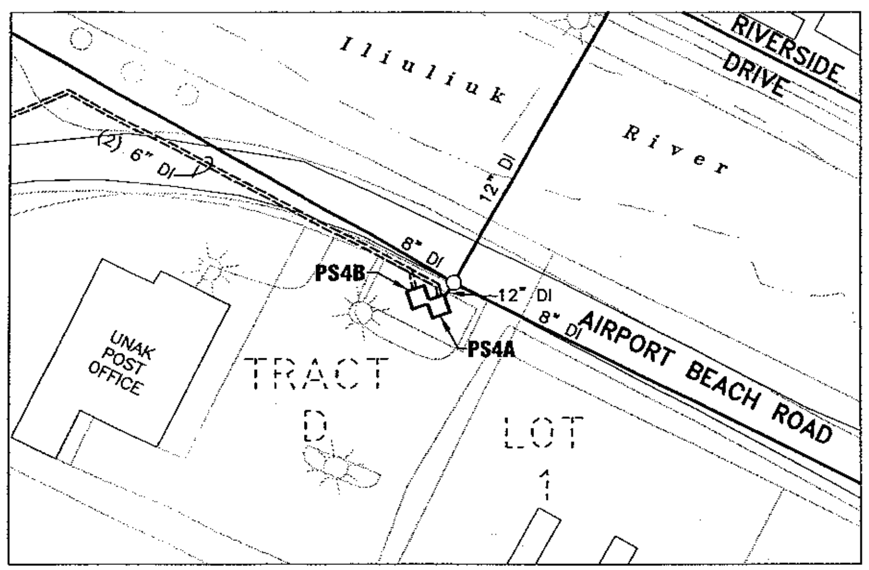

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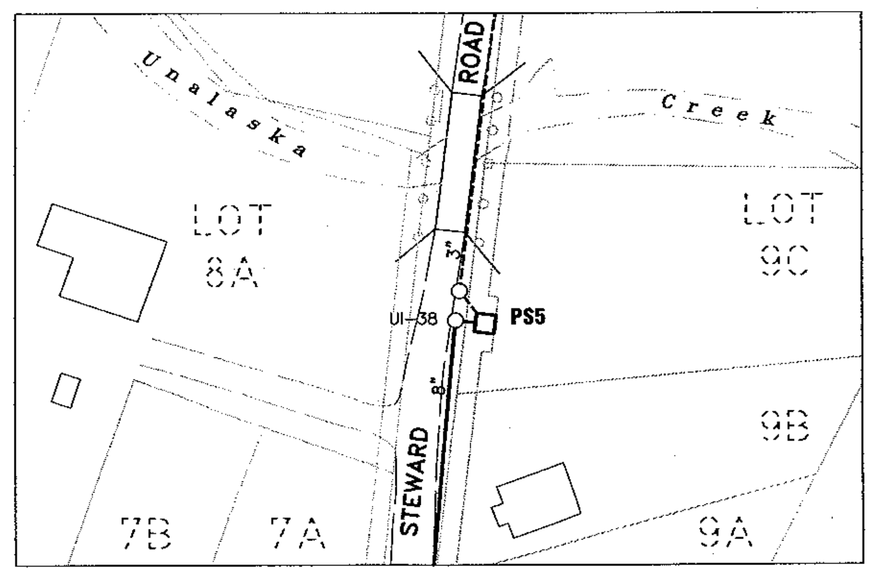

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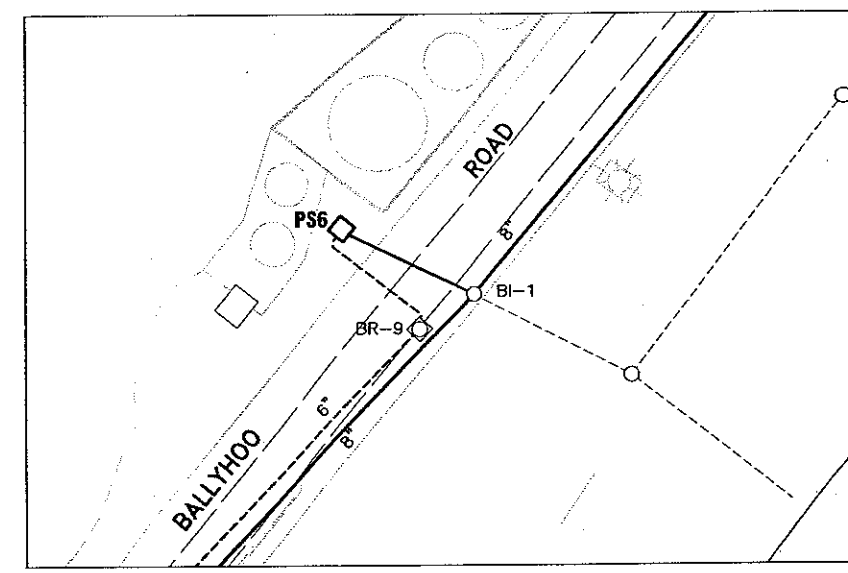

PS6 PUMPSTATION DETAIL
SCALE: NTS

LEGEND

- EXISTING GRAVITY SANITARY SEWER MAIN
- EXISTING PRESSURE SANITARY SEWER MAIN
- EXISTING SANITARY SEWER SERVICE
- EXISTING SANITARY SEWER MANHOLE
- EXISTING SANITARY SEWER CLEANOUT

FIGURE 2
UNALASKA, ALASKA
EXISTING SANITARY SEWER PUMP STATION DETAILS

Bristol
ENVIRONMENTAL & ENGINEERING
SERVICES CORPORATION
Phone (907) 563-0013 Fax (907) 563-6713
Project No. 29025

UNALASKA

DATE	07/22/08	SHEET
DWN.	SJW	2
SCALE	SHOWN	of
APPRVD.	FJV	3

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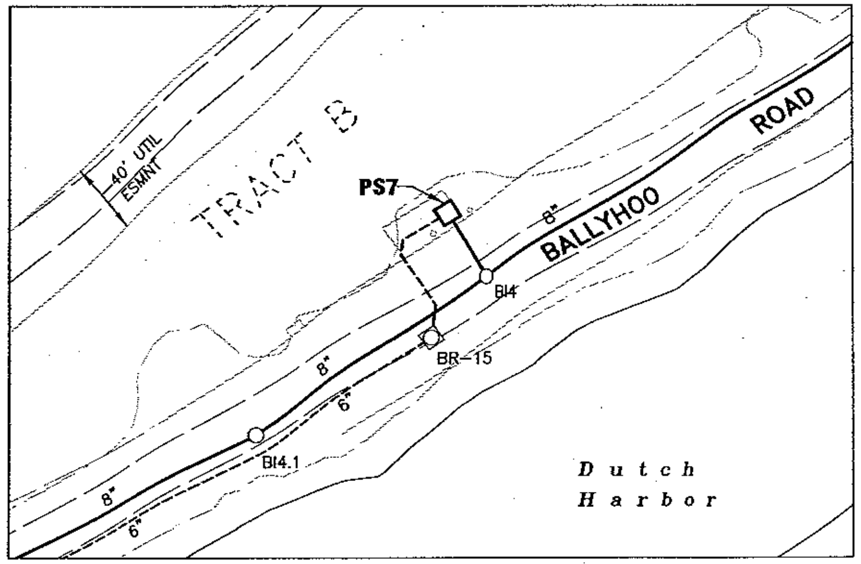

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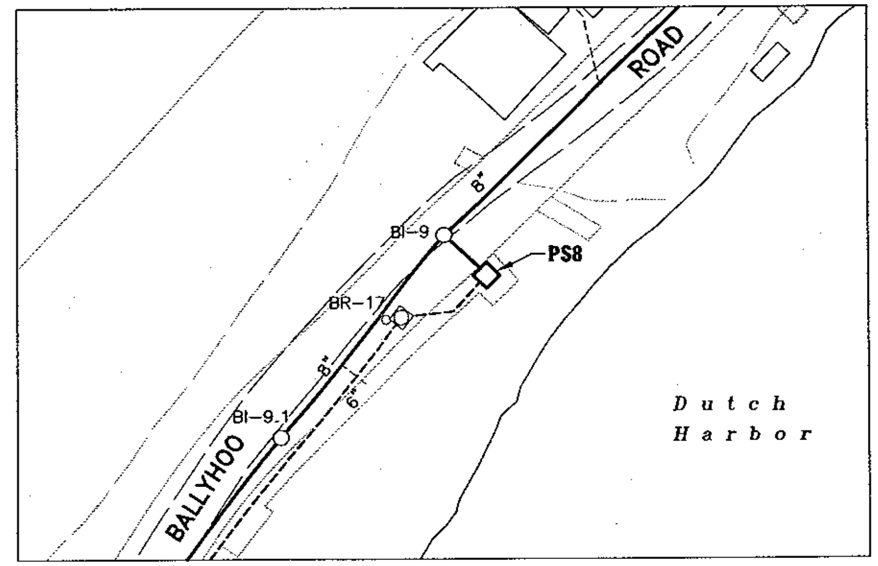

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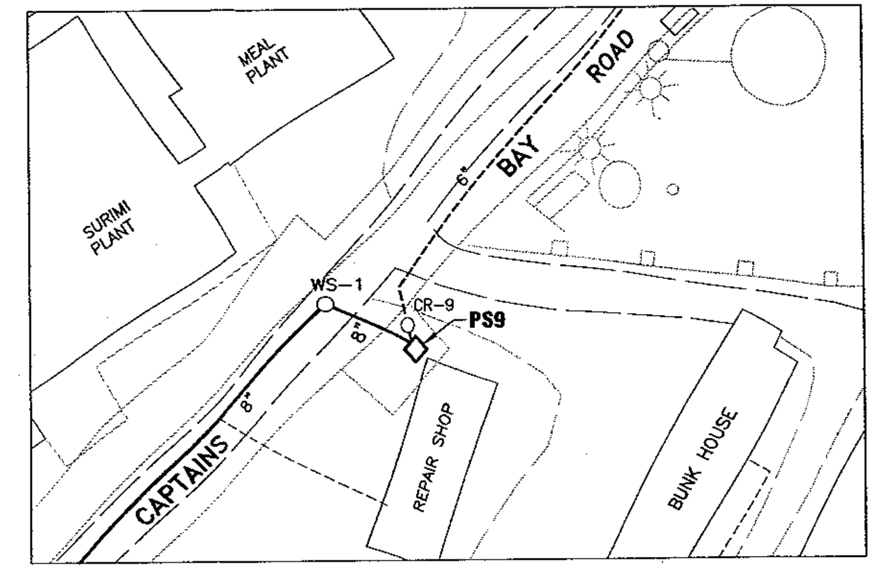

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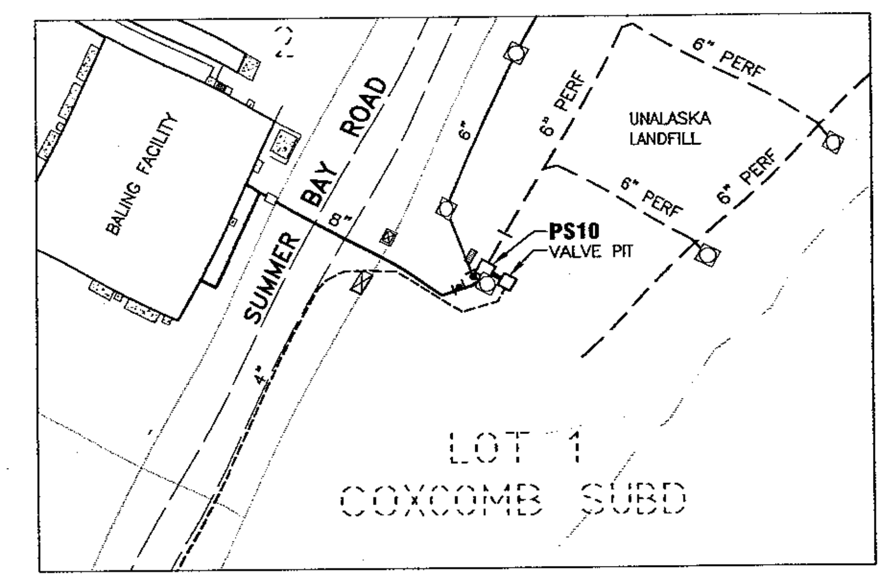

PS10 PUMPSTATION DETAIL
SCALE: NTS

FIGURE 3
UNALASKA, ALASKA
EXISTING SANITARY SEWER PUMP STATION DETAILS

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Project No. 29025

UNALASKA

DATE	07/22/08	SHEET
DWN.	SJW	3
SCALE	SHOWN	of
APPRVD.	FJV	3

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Appendix D
Design Criteria, Hydraulic Profile, and Process Flow Diagram for the 2015 WWTP Upgrades

Unalaska WWTP

Design / Plant Component	Start-up	Year 2030
Average Population	5,901	7,360
Flow, mgd		
Average Annual	0.48	0.62
Maximum Month	0.67	1.01
Peak Day	1.45	3.00
Peak Hour	2.64	3.47
BOD5, lbs/day		
Annual AVG	1,026	1,863
Max month AVG	2,567	3,815
Peak Day AVG		5,207
TSS, lbs/day		
Annual AVG	597	1,147
Max month AVG	1,489	2,210
Peak Day AVG		3,480
Effluent, less than		
BOD5, lbs/day		
AVG month, 140 mg/L (NPDES)		700
or		
AVG week, 200 mg/L (NPDES)		1,501
TSS, lbs/day		
AVG month, 140 mg/L (NPDES)		700
or		
AVG week, 200 mg/L (NPDES)		1,501
Fecal Coliform Bacteria		
Monthly geometric mean		10,000
Weekly geometric mean		15,000
Chlorine, mg/L		
AVG month (NPDES)		0.17
AVG week (NPDES)		0.34
Influent Pumps		
One Pump, min, gpm	150	
One Pump, max, gpm	*	504
Two Pump, max, gpm	*	921
Three Pump, max, gpm	*	1,240
* VED controlled for lower flows		
Peak Flow Pumps		
One Pump, gpm		1,200
(2nd Pump is standby)		
Headworks		
Mechanical Filter Screens		
Number	2	2
Width, ft	2.0	2.0
Perforated opening, inches	1/4	1/4
Capacity, each gpm	1,250	1,250

Headworks (continuation)	Start-up	Year 2030
Grit Collector Basin		
Number of basins	1	1
Basin dimension, ft., L x W x SWD	9x9x13.0	9x9x13.0
Stacked trays:		
Diameter, each, ft	6	6
Number of trays	7	7
Total tray surface area per unit, sq ft	198	198
Grit Removal, %	**Start-up**	**Year 2030**
Annual average flow, (> 75 microns)		
Maximum month flow, (> 110 microns)	95%	95%
	95%	95%
Flocculation Basin	**Start-up**	**Year 2030**
Number	2	2
Basin Size, each, L x W x SWD	12x11x16.0	12x11x16.0
Volume, each, gallons	15,800	15,800
Total volume , gal	31,600	31,600
Detention Time, minutes		
Annual avg	94.8	73.4
Max month	67.9	45.1
Peak hour	17.2	13.1
Coagulant Feed System		
Number	2	2
Capacity, gal/hr	7.7	7.7
Dosing gal/hr of soln @ 100 mg/L		
Annual average flow	2.0	2.6
Maximum month flow	2.8	4.2
Peak hour flow (@ 50 mg/L)	5.5	7.2
Polymer Feed System		
Number	2	2
Capacity, dry lb/hr @ 1.0 mg/L		
Annual average flow	4	5
Maximum month flow	6	8
Peak hour flow (@ 1.0 mg/L)	22	29
Chemically Enhanced Primary Clarifiers		
Number	2	2
Width, ft	20	20
Length, ft	60	60
Average Depth, ft	12.0	12.0
Total settling area, sf	2,400	2,400
Total basin volume, gallons	215,000	215,000
Effluent launder:		
No. of Launders per tank	4	4
Launder dimensions, each LxWxD, ft	17 x 1 x 1.5	17 x 1 x 1.5
Total weir length per tank, ft.	136	136
Surface overflow rate, gpd/sf		
Annual average flow	200	258
Maximum month flow	279	421
Peak hour flow	1,100	1,446
Weir Loading Rate, gal/ft		
Annual average flow	1,800	2,300

Chemically Enhanced Primary Clarifiers (continuation)	Start-up	Year 2030
Maximum month flow	2,500	3,700
Peak hour flow	9,700	12,800
Detention Time, hr		
Annual average flow	10.8	8.3
	7.7	5.1
Maximum month flow	2.0	1.5
BOD Removal, %		
Annual average flow	45%	45%
Maximum month flow	45%	45%
TSS Removal, %		
Annual average flow	80%	80%
Maximum month flow	80%	80%
Chlorine Contact Basins		
Number of Tanks	2	2
Length, ft	20	20
Width, ft	18	18
Side water depth, ft	9.20	9.20
Basin volume, each, gallons	24,774	24,774
Total basin volume, gallons	49,548	49,548
Detention Time, min.:		
Annual average flow	149	115
Maximum month flow	106	71
Peak hour flow	27	21
Sludge Production, lb/day		
In lbs/day		
Annual average	741	1,258
Maximum month	1,559	2,323
In gal/day @ 4.0% solids concentration		
Annual average flow	2,223	3,772
Maximum month flow	4,675	6,964
Primary Sludge Pumps		
Number	2	2
Type- double disc diaphragm		
Capacity, each, gpm	75	75
Running time, min./day:		
Annual average	30	50
Maximum month	62	93
Sludge Storage Tank		
Diameter, feet	25	25
Total height, feet	24.0	24.0
Side water depth, feet	20.5	20.5
Capacity @ SWD, gallons	75,300	75,300
Detention, days:		
Annual average	33.9	20.0
Maximum month	16.1	10.8

Sludge Press Feed Pumps		
Number	2	2
Type- double disc diaphragm		
Capacity, each, gpm	75	75
Sludge Dewatering	**Start-up**	**Year 2030**
Number of Presses	1	1
Type- Fournier Rotary Press		
Number of Channels (+ 1 spare)	2	2
Capacity:		
Solids loading/ channel, lbs/hr	425	425
Solids loading, total, lbs/hr	850	850
Hydraulic loading/ channel, gpm	21	21
Hydraulic loading- 2 channels, gpm	42	42
Hydraulic loading- 3 channels, gpm	64	64
Run time, 1 channel, hours/ week:		
Annual average	12.2	20.7
Maximum month	25.7	38.3
Run time, 2 channels, hours/ week:		
Annual average	6.1	10.4
Maximum month	12.8	19.1
Dewatered Cake TS%	30%	30%
Lime Feed		
Lime dry weight, lbs/day:		
Annual average	111	189
Maximum month	234	348
Number of 2,500 lb super sacks / month:		
Annual average	1.4	2.3
Maximum month	2.9	4.3
Limed Sludge Produced		
Combined Weight of Lime + Sludge, lbs/day:		
Annual average	853	1,447
Maximum month	1,793	2,672
Volume of Limed Sludge, cy/ week:		
Annual average	9.7	16.4
Maximum month	20.4	30.4

CONFORMED DOCUMENTS

STATE OF ALASKA 49TH KRAIG R. HUGHES No. CE-8997 REGISTERED PROFESSIONAL ENGINEER

REVISIONS			
NO.	DATE	BY	DESCRIPTION

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STATE OF ALASKA 49TH Martin E. Harper No. CE-6571 3-8-2013 REGISTERED PROFESSIONAL ENGINEER

UNALASKA

CITY OF UNALASKA
WASTEWATER TREATMENT PLANT – CEPT UPGRADE

DESIGN DATA

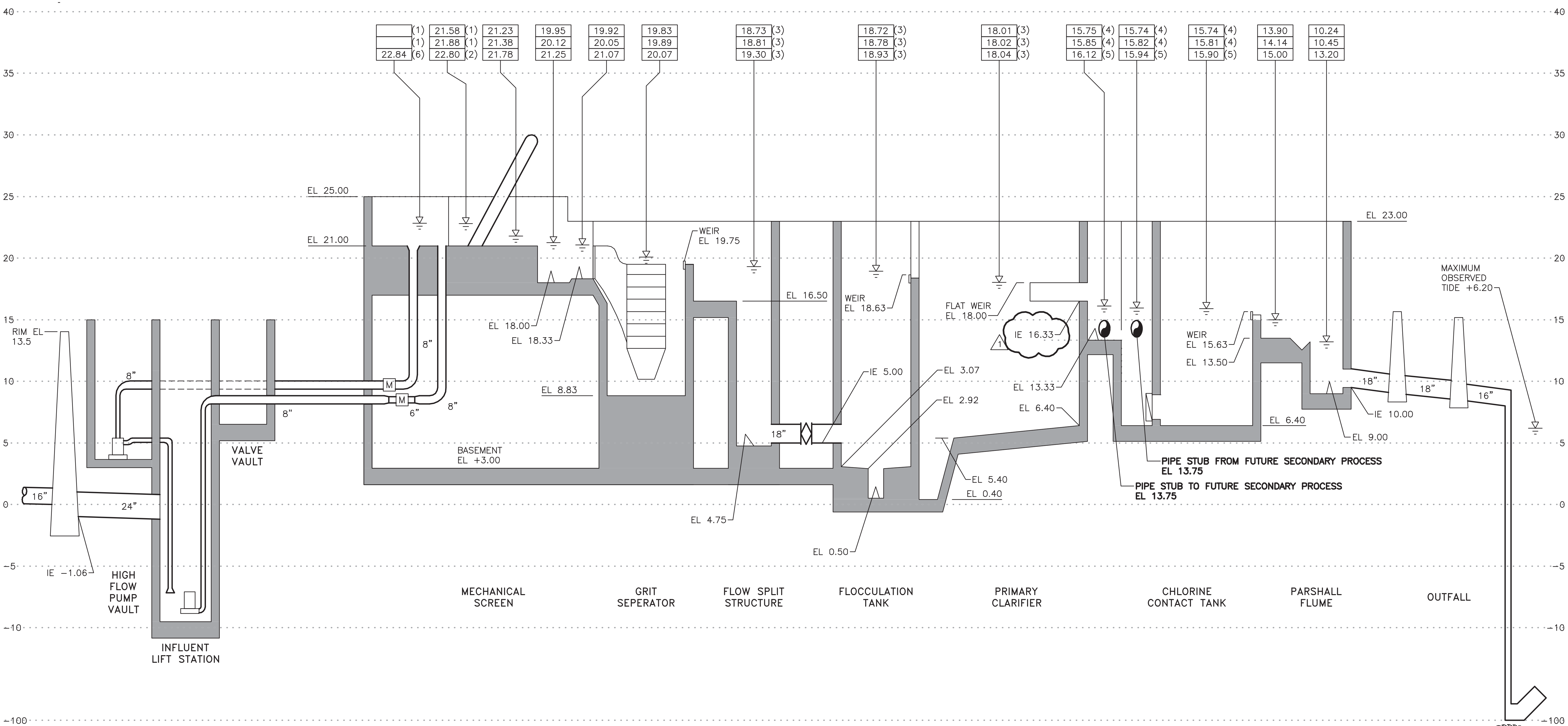
SHEET G005

SCALE: NTS | DESIGNED: JH | CHECKED: RD | DRAWN: MC | DATE: 05/30/13 | SHEET 5 OF 281

User: MCALDWELL May 30, 2013 – 10:23am
Drawing: S:\CAD\UNALASKA\11-10257 WWTP DESIGN\DWGS\P11-10257_G004_G005.DWG – Layout: G005
Xrefs: (DIESEL evaluation failed) – Images: (DIESEL evaluation failed)

(A)	CONDITION (A) 2012 ANNUAL AVERAGE – 0.48 MGD
(B)	CONDITION (B) 2030 MAXIMUM MONTH – 1.01 MGD
(C)	CONDITION (C) 2030 PEAK HOUR – 3.47 MGD

(1) BASED ON ONE MECHANICAL SCREEN IN SERVICE
(2) BASED ON TWO MECHANICAL SCREENS IN SERVICE
(3) BASED ON ONE FLOCCULATION TANK AND ONE CLARIFIER IN SERVICE
(4) BASED ON ONE CHLORINE TANK IN SERVICE
(5) BASED ON TWO CHLORINE TANKS IN SERVICE
(6) BASED ON ONE MECHANICAL SCREEN AND ONE MANUAL BAR RACK IN SERVICE



CONFORMED DOCUMENTS

STATE OF ALASKA 49TH CRAIG R. HUGHES No. CE-8997 REGISTERED PROFESSIONAL ENGINEER

REVISIONS

NO.	DATE	BY	DESCRIPTION
1	04/09/13	CS	ADDENDUM #1

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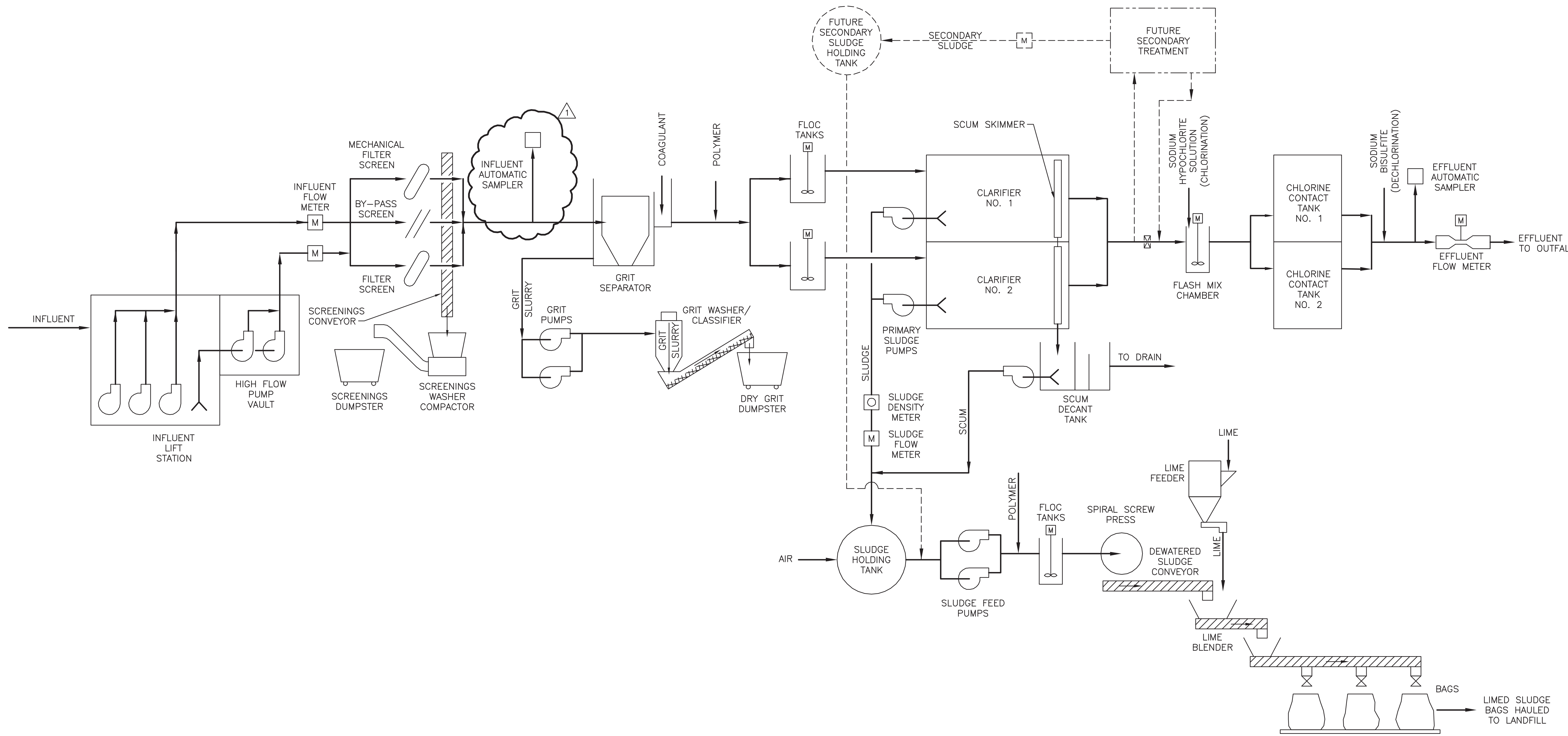
UNALASKA

CITY OF UNALASKA
WASTEWATER TREATMENT PLANT – CEPT UPGRADE

HYDRAULIC PROFILE

SHEET G006

SCALE: NTS | DESIGNED: CS | CHECKED: RD | DRAWN: GC | DATE: 05/30/13 | SHEET 6 OF 281



CONFORMED DOCUMENTS

STATE OF ALASKA 49TH KRAIG R. HUGHES No. CE-8997 REGISTERED PROFESSIONAL ENGINEER

REVISIONS

NO.	DATE	BY	DESCRIPTION
1	04/09/13	JH	ADDENDUM #1

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UNALASKA

CITY OF UNALASKA
WASTEWATER TREATMENT PLANT – CEPT UPGRADE

PROCESS FLOW DIAGRAM

SHEET G004

SCALE: NTS | DESIGNED: JH | CHECKED: RD | DRAWN: GC | DATE: 05/30/13 | SHEET 4 OF 281

Appendix E
2008 Infiltration and Inflow Study

Inflow and Infiltration Study

City of Unalaska
Wastewater Collection System

By

Clint Huling
Water/Wastewater Supervisor
&
J. R. Pearson
Utility Analyst/Compliance Coordinator

Date Completed
June 30, 2008

Inflow and Infiltration Study

Introduction

The City of Unalaska is located in the eastern part of the Aleutian Island Chain. It is a community whose primary purpose is to support the seafood industry. Through various fishing seasons each year there are significant changes in population, resulting in periods of heavy use of the water supply, electricity, and domestic wastewater collection system.

Current NPDES Permit flow limits are based on the permanent population in Unalaska rather than the actual population. The City of Unalaska is home to the largest onshore fish processing plants on the West Coast. The plants employ thousands of seasonal workers. This doubles Unalaska's population during the fishing seasons, which run up to ten months out of the year. The only months that could be considered representative of the permanent population are May and December.

Results of the previous I & I study caused the Wastewater Utility to implement an intensive preventive maintenance program for the collection system. In this program, virtually every sewage line and manhole in the domestic wastewater collection system is cleaned, inspected, and repaired as necessary every three years. Some areas that have been noted as potential problem areas receive annual cleaning and inspections at a minimum. For many years, the Wastewater Utility has continuously monitored potential sources of I & I and corrects problems as they are found.

Description

The primary goal in this Inflow & Infiltration (I & I) Study was to demonstrate the effect of seasonal population increases. This is shown in the Data Results section of this report. The effect of the population has been known for many years, but City of Unalaska staff may not have effectively communicated this to EPA.

The study also focused on the high flow events that resulted in daily flow violations and attempted to isolate the source of these high flows. In the Wastewater Utility's preventive maintenance program, electric usage and run-hour data are collected on all lift stations. The Wastewater Utility routinely uses this data to help isolate potential sources of I & I or find other maintenance related problems.

In this study, the run hour data and pump ratings at each lift station were used to estimate the gallons per day flows in order to compare each lift station in the collection system during significant high flow events.

Here is a brief description of how the lift stations are tied into the system:

Lift Stations on Unalaska Island:

Leachate Lift Station (Lift Station #10) discharges into a ¾ mile long force main from the Landfill that discharges into the domestic sewage collection system. From there, the collection system gravity feeds its way to Lift Station #4, while picking up domestic sewage from Unalaska Valley and Downtown Unalaska.

Lift Station #5 is located on Steward Road in Unalaska Valley. Domestic sewage from Steward Road and General's Hill flows into this lift station. The flow is pumped to the main collection line on Broadway, which gravity feeds all the way to Lift Station #4.

Lift Station #4, located on the north side of Haystack, receives virtually all the domestic sewage flow from Unalaska Island, with the exception of Captains Bay and Haystack. Lift Station #4 pumps into a gravity line, which flows into an inverted siphon on the south side of Haystack, which pushes the flow over the South Channel Bridge. It feeds into the main collection line on Airport Beach Road, which then gravity feeds to the Wastewater Treatment Plant.

Lift Station #9 receives the domestic sewage flow from Westward Seafoods in Captains Bay and pumps into a 1 mile long force main. It discharges into the inverted siphon line on Airport Beach Road, which pushes the flow over the South Channel Bridge. It then feeds into the main collection line on Airport Beach Road, which then gravity feeds to the Wastewater Treatment Plant.

Lift Stations #6, 7, and 8 receive domestic sewage from Ballyhoo Road. Lift Station #8 is furthest out Ballyhoo Road; Lift Station #7 receives domestic sewage flowing from Lift Station #8; and Lift Station #6 receives domestic sewage flowing from Lift Station #7. Domestic sewage from Lift Station #6 gravity feeds to Lift Station #3.

Lift Station #3 is located in Ptarmigan Flats Subdivision. It receives domestic sewage from the airport and surrounding area, the north end of East Point Loop Road, Ptarmigan Flats, and Ballyhoo Road. It pumps sewage over Standard Oil Hill and discharges into a gravity sewer line on Biorka Drive on Standard Oil Hill, which flows into Lift Station #2.

Lift Station #2 is located in the Margaret Bay area. It receives domestic sewage from Lift Station #3, Standard Oil Hill, the south end of East Point Loop Road, and the Margaret Bay area. It pumps sewage across Margaret Bay to a gravity line on Gilman Road, which then gravity feeds to the Wastewater Treatment Plant.

Refer to the attached wastewater system diagram for more information.

The City's Wastewater Utility has an active preventive maintenance program and routinely searches for and repairs problems by using a video camera. To help with this study, a smaller camera was used to allow inspection of lateral service lines to search for problems. If they find a problem with a lateral service line, the owner must repair the service line in a timely manner.

Data Results

Comparing Estimated Population and Rainfall to Wastewater Flows

Table 1 provides monthly average population estimates, flows, and estimated I & I. Population was first given a rough estimate based on busiest processing seasons and slow times. Then monthly average rain and average influent flow were statistically compared to these rough estimates using the multiple regression calculation.

The resulting calculation produced an adjusted R-squared fit of 91.2% and a standard error of 383, which means that the estimated population has a 95% probability of being within 766 of the actual population. The formula produced by the multiple regression calculation was used to provide a smoothed estimated average population for each month. Note, however, that the result for November 2007 was somehow skewed out of the normal range for that month. So an estimated population value was inserted that represented previous estimates for November.

To calculate the GPD/Capita with I & I flow, the average flow for each month was divided by the estimated population for the given month. The GPD/Capita minus I & I flow was assumed to be 70 GPD.[1] The remaining calculations in Table 1 can be easily deduced. Using the same process as that used to estimate the population, we obtained a result of 71.9 GPD/Capita minus I & I flow with a standard deviation of 0.8. This indicates that the assumed 70 GPD/Capita minus I & I flow is relatively close.

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[1] "Guidance for evaluating INFILTRATION AND INFLOW for State Revolving Fund Projects": http://www.deq.louisiana.gov/portal/Portals/0/financial/srf/guide-ii.doc

Statistics

By reviewing the statistical data in Table 1, the following information can be obtained:

Statistics from January 1, 2005 to February 29, 2008:

Estimated Average Population	6217	Residents
Average Gallons Per Resident	85.2	Gal/Resid.
Average Flow	0.528645	MGD
Flow Equivalent at 120 Gal/Resident	0.746027	MGD
Average Flow Contributed by Rain	0.093462	MGD
Average Flow Increase Per Inch of Rain	0.488711	MGD
Estimated Maximum Population	8678	Residents
Flow Equivalent at Average Gal/Resident	0.739741	MGD
Flow Equivalent at 120 Gal/Resident	1.041410	MGD
Estimated Minimum Population	4001	Residents
Flow Equivalent at Average Gal/Resident	0.341050	MGD
Flow Equivalent at 120 Gal/Resident	0.480131	MGD

Estimated I & I

The formulas in Table 1 determined that an overall monthly average of 93,462 gallons per day (GPD) may be attributed to I & I. There was an overall average flow of 85.2 gallons per day per capita (gpd/c) with I & I included. This is significantly less than the national average of 120 gpd/c in wastewater systems that are considered to have cost effective removal of their I & I.[1] Although we could not locate the national wet weather average for cost effective removal of I & I, we assume it would be 240 gpd/c.

Areas with high water tables, where most of the sewer collection system lines are below the water table, such as Louisiana, have been allowed to consider an average of 150 gpd/c to be cost effective removal of I & I and a wet weather average of 300 gpd/c for cost effective removal of I & I.[1] The Wastewater Utility staff have noted that the water table in Unalaska is frequently between 6 to 10 feet below ground level, placing much of the sewer collection lines below the water table.

According to Table 1, Unalaska's maximum estimated monthly average I & I flow was 0.202 MGD and occurred in March 2005. The average WWTP flow, which included I & I, for March 2005 was 96.5 gpd/c. The month that represented the highest flow in gpd/c was December 2005, which averaged 108.3 gpd/c. Both of these wet weather months averaged well less than the national average of 120 gpd/c, not even approaching the assumed 240 gpd/c national wet weather average.

Population Effect on I & I

As shown in Table 1, the monthly flow violations are affected more by population than by I & I. Virtually all of the monthly flow violations, highlighted yellow, occurred during peak processing seasons when there was a significant increase in population.

Flow Comparison at Lift Stations

Table 2 compares daily flow violations to the lift station flows to show where the most significant increases occurred. Three lift stations showed marked affects of I & I during extreme rain events. They were Lift Stations #4, 5, and Leachate Lift Station. Lift Station #4 receives all the flow from Lift Station #5, the Leachate Lift Station, and the rest of the township located on Unalaska Island, with the exception of Captains Bay and Haystack.

Another source of I & I is the Landfill Leachate. The Leachate flows can top 100,000 GPD during significant rain events. In order to reduce the effect, Wastewater Utility and Solid Waste personnel have "pinched" down the valves on the leachate flowing into the Leachate Lift Station during heavy rains and open them back up after the heavy rains have subsided. Because each of the significant rain events can contribute over 100,000 GPD, it is apparent which events in Table 2 that operators "pinched" down the valves. The problem with this approach is that this is not accepted procedures for Landfill operations, as it creates the potential for a backup of water in the cells, which could result in leachate breakouts that can enter the stormwater drainage system. The Wastewater Utility and Solid Waste Utility have hired a consulting firm to help provide a solution to this leachate issue.

Lift Station #9 also appears to have significant issues during high flood events. The Wastewater Utility noted that when Lift Station #4 has high flows, Lift Station #9 works harder and runs longer. This is because it is pumping against a higher head from the Lift Station #4 force main. As a result, run hours in Lift Station #9 can show false high readings when estimating flow. During normal flows, Lift Station #9 run hours reflects the flow more accurately.

Lift Stations #6, 7, and 8 have shown a significant increase in flow during the last few floods. Normally, these lift stations have been relatively unaffected by floods. The Wastewater Utility noticed the increased flow in Lift Station 6, 7, & 8 during rain events that began occurring sometime after the flood event in February 2006. The flood event in February 2006 not only flooded portions of the town, but also resulted in a number of avalanches and mudslides that severely damaged several businesses and homes. During later cleanup operations, contractors ripped open some of the service lateral lines. The Wastewater Utility discovered the damaged service connections in December 2007 and ordered the connections to be repaired as soon as the site is accessible.

Lift Stations #2 and 3 have shown some significant increases in flow during extreme flood events. Lift Station #3 is in low lying flats that can be totally submerged during winter flood events. Many of the manholes that precede these Lift Stations are at ground level, resulting in stormwater flowing over the top of the lids during flood conditions.

Manholes

Table 3 shows that over 60% of the manholes in the domestic wastewater collection system are either at or below ground level. The rain seals appear to work very well for moderate rains and moderate flooding, but are less effective for heavy rains and heavy floods. It is estimated that any manhole seal leaks equivalent to only a ½ inch diameter opening can receive over 1.25 gallons per minute if overflowed. Even with rain seals, the 218 manholes placed at or below ground level could potentially contribute more than 400,000 gallons per day of I & I during flooding conditions.

Weather

Table 4 shows that Unalaska received a measurable amount of rain 74.46% of the days in this study. By taking 0.1912 inches of rain per day as shown in Table 1, and multiplying by 365 days in a year, the rainfall averaged 69.79 inches of rain per year. This is higher than Unalaska's historical average rainfall of 60.75 inches per year indicated in Table 5. According to Chart 2, the rest of the United States averages about 38 inches of precipitation per year.

The amount of rain, however, does not quantify the amount of snow that is received during each year. According to Table 5, historical snow averaged 87.2 inches per year.

Observations

From interviewing the Wastewater Utility staff, it was determined that the high flows to Lift Station #5 during extreme rain events are attributed to flood conditions covering the manholes that are located at or below ground level. It should be noted that the manholes preceding Lift Station #5 are in one of the more flood prone areas in the City and have been placed in a location where they cannot be raised. During extreme floods, the flow into Lift Station #5 alone, which averages about 19,000 gallons per day, can contribute close to half the flow that Lift Station #4 receives.

All the manholes in Unalaska have rain seals installed. By using the camera to observe the manholes, Wastewater Utility personnel have found that the rain seals are not 100% effective during heavy flooding. The Wastewater Utility routinely replaces the rain seals as they find damaged or leaking seals but have not been able to find a cost effective solution to further reduce the I & I to Lift Station #5 during flooding. The increased flows appear to be directly proportional to the depth of the stormwater flowing over the manholes.

Wastewater Utility staff has determined that most of the domestic sewage lines are located below the water table. They estimate that the water table is generally six to ten feet below ground level. Whenever repairs are made to a domestic sewage line or new services are installed, Wastewater Utility staff adjusts their procedures to account for groundwater. During routine inspections, staff has not noted any I & I effects due to the surrounding groundwater indicating that the collection lines are in very good condition.

Table 1 – Comparison between Estimated Population and I & I to Wastewater Flows

Date By Month	Est Population	Average Daily Rain, Inches	Average Influent Flow, MGD	Est. GPD/Capita Minus I & I	Est. GPD/Capita with I&I	Estimated Flow from Population Only	Estimated Flow From I & I, MGD
January-05	6505	0.3765	0.652018	70.0	100.2	0.455317	0.196701
February-05	8303	0.2729	0.727758	70.0	87.7	0.581190	0.146568
March-05	7623	0.3810	0.735834	70.0	96.5	0.533632	0.202202
April-05	6165	0.3060	0.589866	70.0	95.7	0.431585	0.158282
May-05	5498	0.2900	0.532795	70.0	96.9	0.384873	0.147922
June-05	6653	0.1000	0.515722	70.0	77.5	0.465684	0.050038
July-05	6767	0.0981	0.523026	70.0	77.3	0.473683	0.049343
August-05	6899	0.1145	0.541386	70.0	78.5	0.482943	0.058443
September-05	6202	0.2187	0.546089	70.0	88.0	0.434167	0.111922
October-05	6305	0.2268	0.557882	70.0	88.5	0.441362	0.116520
November-05	5395	0.1317	0.441025	70.0	81.8	0.377624	0.063401
December-05	4503	0.3410	0.487502	70.0	108.3	0.315221	0.172281
January-06	6574	0.1490	0.536069	70.0	81.5	0.460164	0.075905
February-06	7749	0.2796	0.691076	70.0	89.2	0.542431	0.148645
March-06	6236	0.1181	0.495046	70.0	79.4	0.436551	0.058496
April-06	4544	0.0747	0.348803	70.0	76.8	0.318065	0.030738
May-06	4001	0.0345	0.287925	70.0	72.0	0.280076	0.007848
June-06	4379	0.1023	0.351505	70.0	80.3	0.306523	0.044982
July-06	6109	0.0655	0.457777	70.0	74.9	0.427600	0.030177
August-06	7177	0.0535	0.529163	70.0	73.7	0.502411	0.026753
September-06	6761	0.2010	0.577343	70.0	85.4	0.473273	0.104070
October-06	6614	0.3306	0.635623	70.0	96.1	0.462988	0.172635
November-06	5650	0.1360	0.461923	70.0	81.8	0.395509	0.066414
December-06	4238	0.1803	0.382741	70.0	90.3	0.296658	0.086083
January-07	6533	0.3268	0.627641	70.0	96.1	0.457291	0.170351
February-07	8678	0.3175	0.778848	70.0	89.7	0.607489	0.171359
March-07	8153	0.0600	0.603655	70.0	74.0	0.570741	0.032914
April-07	5816	0.1357	0.473801	70.0	81.5	0.407106	0.066695
May-07	4570	0.1019	0.365191	70.0	79.9	0.319892	0.045300
June-07	6392	0.0480	0.469084	70.0	73.4	0.447432	0.021651
July-07	7071	0.0074	0.496889	70.0	70.3	0.494946	0.001942

August-07	6702	0.0652	0.500780	70.0	74.7	0.469120	0.031660
September-07	6127	0.1827	0.521435	70.0	85.1	0.428874	0.092561
October-07	5823	0.2100	0.513873	70.0	88.2	0.407612	0.106261
November-07	5600	0.6173	0.565758	70.0	101.0	0.392000	0.173758
December-07	4190	0.2490	0.415769	70.0	99.2	0.293266	0.122503
January-08	6551	0.2148	0.569403	70.0	86.9	0.458552	0.110850
February-08	7187	0.1486	0.580466	70.0	80.8	0.503083	0.077384
Average	6217	0.1912	0.528645	70.0	85.2	0.435182	0.093462

Yellow highlighted cells compare the estimated population to monthly average flow violations.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.957670068
R Square	0.917131959
Adjusted R Sq.	0.912396643
Standard Error	382.7932002
Observations	38

ANOVA

	df	SS	MS	F	Significance F
Regression	2	56759848.86	28379924.43	193.6791211	1.17971E-19
Residual	35	5128572.194	146530.6341		
Total	37	61888421.05			

	Coefficients	Standard Err.	t Stat	P-value	Lower 95%	Upper 95%
Intercept	296.6357987	325.5145604	0.911282735	0.368380385	-364.1938869	957.4654844
Rain, Inches	-7310.841322	603.0948482	-12.12220821	4.39094E-14	-8535.188947	-6086.493697
Inf. Flow, MGD	13742.05491	699.7323947	19.63901488	1.76378E-20	12321.52264	15162.58718

Formula:

Est. Population = (Rain, Inches) x (-7310.841322) + (Inf. Flow, MGD) x (13742.05491) + (296.6357987) $\pm$ (2 x 382.7932002)

Table 2 – Comparison of Lift Station Flows during Heavy Rain Events Resulting in Daily Flow Limit Violations

Date	WWTP Influent Flow, MGD	Estimated Pop. Equiv. Flow at 120 GPD/Capita, MGD	Rain, Inches	Pump Stn #2 Est Flow, MGD	Pump Stn #3 Est Flow, MGD	Pump Stn #4 Est Flow, MGD	Pump Stn #5 Est Flow, MGD	GPD/Capita with I & I
Normal Average	0.528645	0.746040	0.19	0.070583	0.033053	0.096841	0.019486	85.2
1/14/2005	0.968638	0.780000	1.67	**0.112428**	**0.060762**			149.0
3/17/2005	1.062967	0.914760	3.70	**0.090072**	**0.041730**			139.4
2/13/2006	1.852952	0.929880	2.63					239.1
2/4/2007	1.352000	1.041360	2.31	**0.106920**	**0.052182**			155.8
11/28/2007	1.495129	0.672000	4.51					267.0
11/29/2007	1.385888	0.672000	1.63	**0.110268**				247.5
1/18/2008	0.960783	0.786120	1.95	**0.077760**	**0.046410**			146.7

Date	WWTP Influent Flow, MGD	Estimated Pop. Equiv. Flow at 120 GPD/Capita, MGD	Rain, Inches	Pump Stn #6 Est Flow, MGD	Pump Stn #7 Est Flow, MGD	Pump Stn #8 Est Flow, MGD	Pump Stn #9 Est Flow, MGD	Leachate Lift Station, MGD
Normal Average	0.528645	0.746040	0.19	0.008205	0.006808	0.009793	0.124536	0.015685
1/14/2005	0.968638	0.780000	1.67	**0.009828**	**0.006912**	**0.008316**	**0.136440**	**Unknown**
3/17/2005	1.062967	0.914760	3.70	**0.010908**	**0.010368**	**0.010908**	**0.157920**	**Unknown**
2/13/2006	1.852952	0.929880	2.63	**0.008640**	**0.008640**	**0.004320**		
2/4/2007	1.352000	1.041360	2.31	**0.006696**	**0.006912**	**0.010584**		**0.024110**
11/28/2007	1.495129	0.672000	4.51					
11/29/2007	1.385888	0.672000	1.63				**0.204360**	
1/18/2008	0.960783	0.786120	1.95	**0.014364**	**0.012960**		**0.162360**	

Note: ■ indicates flow increases of 100% or higher than the average. **Yellow** indicates less than 100% increase above average.

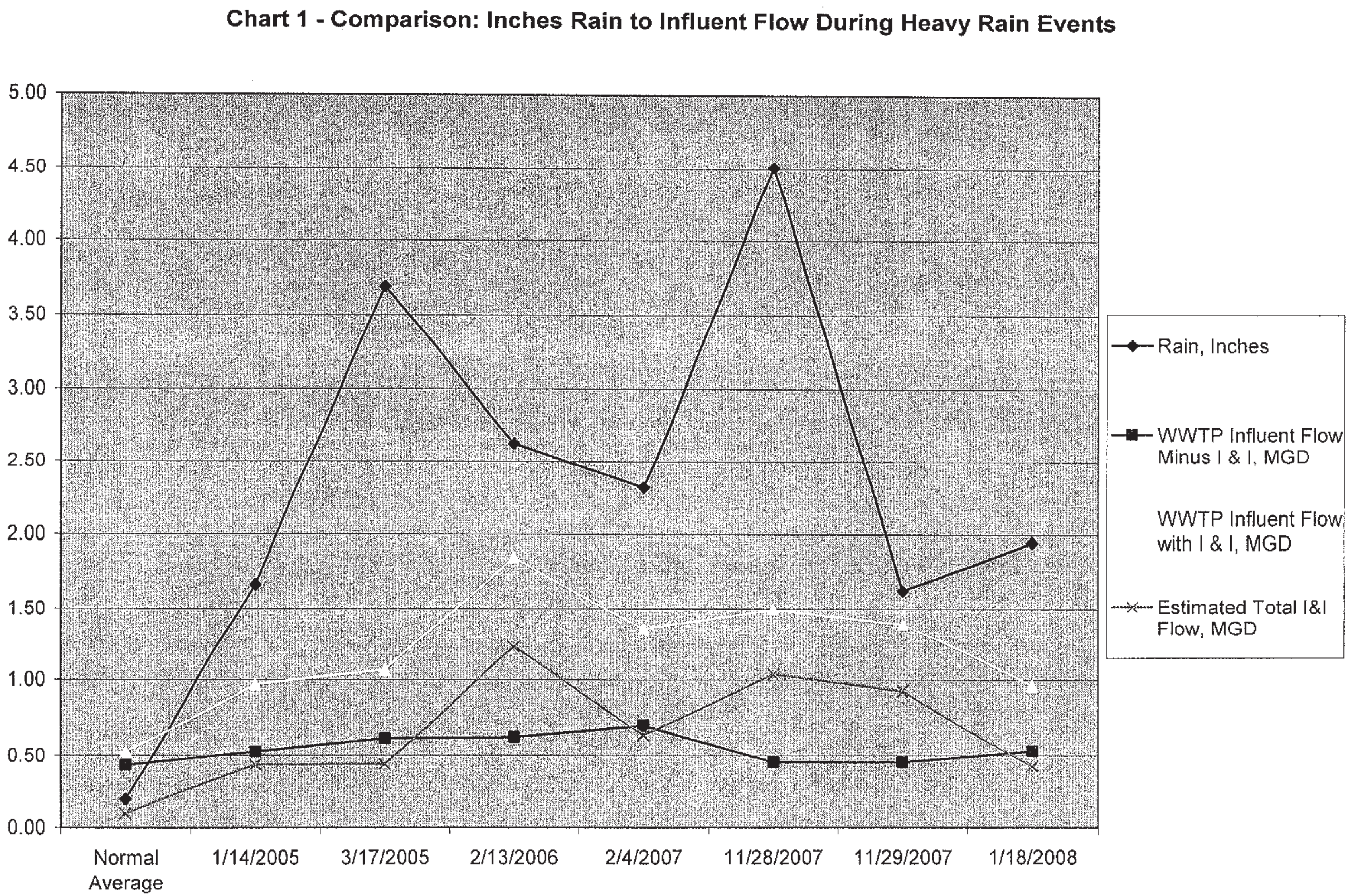


Chart 1 - Comparison: Inches Rain to Influent Flow During Heavy Rain Events
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Normal Average
1/14/2005
3/17/2005
2/13/2006
2/4/2007
11/28/2007
11/29/2007
1/18/2008
Rain, Inches
WWTP Influent Flow Minus I & I, MGD
WWTP Influent Flow with I & I, MGD
Estimated Total I&I Flow, MGD

Table 3 – Manholes

	Manholes feeding	Above ground	Below ground
L.S.#5	41	6	35
L.S.#4 (minus #5)	154	43	70
L.S.#9(WSI)	11	1	10
Amaknak Island	139	36	103
Other	14		
Total	**359**	**86**	**218**
	Percent	**23.96%**	**60.72%**

Note: All manholes have rain seals.

Table 4 – Days of Measurable Rain

	Days without Rain	Days with Rain	Total
Jan 2005 to Feb 2008	295	860	1155
	25.54%	74.46%	

Table 5 – Historical Weather Data[2]

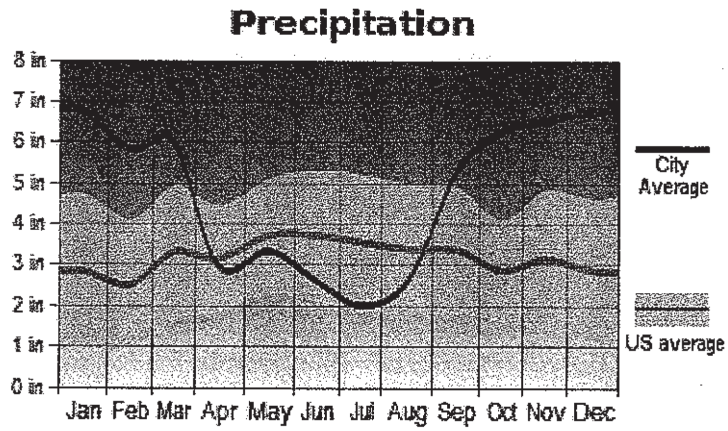
DUTCH HARBOR/UNALASKA			
(Fishing port in Aleutian Islands)			
Period of record: 1/1/1951 to 12/31/2000			
Average annual	Average annual	Average annual	Average annual
high temperature	low temperature	total precipitation	total snowfall
45.7	35.3	60.74	87.2

---

[2]Dutch Harbor/Unalaska information source:
http://www2.alaska.com/about/weather/v-page2/story/4481284p-4775752c.html

Chart 2 – Comparison between Unalaska and U.S. Average Precipitation[3]

Average climate in Unalaska, Alaska
Based on data reported by over 4,000 weather stations



* Chart 2 indicates a total US average of approximately 38 inches per year of precipitation.

Conclusion

The results of the study indicate that I & I is a potential problem ***only*** during significant flood events. It is especially evident when heavy snow melt combines with heavy rain. During the three years of this study, there was measurable rain 74.46% of the total days and an annual average of 69.79 inches of rain. However, an average of only 85.2 gpd/c of the flow could be attributed to I & I. This is well less than the 120 gpd/c U.S average for wastewater collection systems that are considered to have cost effective control of their I & I.

Average wet weather flows in Unalaska were also well less than 120 gpd/c, with a peak monthly average of 108.3 gpd/c. This is much less that the assumed national average wet weather flow of 240 gpd/c in wastewater collection systems that are considered to have cost effective control of I & I. Only two of the peak flow days shown in Table 2 exceeded 240 gpd/c.

The City of Unalaska's wastewater collection system's highly effective removal of I & I is also indicated in the fact that much of the domestic sewage lines are below the water table. Groundwater in Unalaska is generally less than 10 feet from ground level. As previously referenced, a high water table has been given as a reason to increase the allowable average flow to 150 gpd/c and wet weather flow to 300 gpd/c as standards for effective control of I & I. It is obvious that the City's wastewater collection system is very tight and does not appear to be influenced by groundwater.

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[3]Unalaska information source:
http://www.city-data.com/city/Unalaska-Alaska.html

The Landfill Leachate has been a known I & I issue during high rain events. The problem is currently being analyzed by Bristol Environmental & Engineering Services Corporation. They are looking at the possibility of installing a one million gallon flow leveling tank. They are also researching temporary covers for the Landfill cells to reduce total leachate flow. According to plan, the leachate flow problem should be resolved by the year 2012.

The sewer line that flows into Lift Station #5 has also been a known source of I & I. However, the Wastewater Utility has not found a permanent solution. Most of the manholes in the collection line that feed into Lift Station #5 are below ground level and some are in the middle of the stormwater drainage ditches. The location of these manholes does not allow them to be raised. Although rain seals have been installed on all the manholes, and are replaced as necessary due to damage or natural wear and tear, they have been found to still allow a significant amount of inflow when heavy storm water flows over the top of the manholes.

As shown in this study, the City of Unalaska's wastewater collection system already achieves highly effective removal of I & I. Because the system provides a much better removal of I & I than the national average, there were no Sanitary Sewer Overflows (SSOs) in the wastewater collection system during this study. However, Lift Station #5 had some hydraulic issues that resulted in one SSO event during the previous permit. The hydraulic problem was resolved with redesigned piping that was completed in 2006.

This study demonstrated conclusively that the permanent fulltime population upon which the existing flow limit was based is less than half the maximum population and only two-thirds of the average population throughout the year. Although the predicted maximum population is estimated at 8,678 residents, using the Standard Error of 383, a conservative estimate of Unalaska's maximum population would be 9,827 residents. This is derived by the following formula, which provides a 99% confidence level of the maximum probable population:

$$(3 \times 383) + 8{,}678 = 9{,}827$$

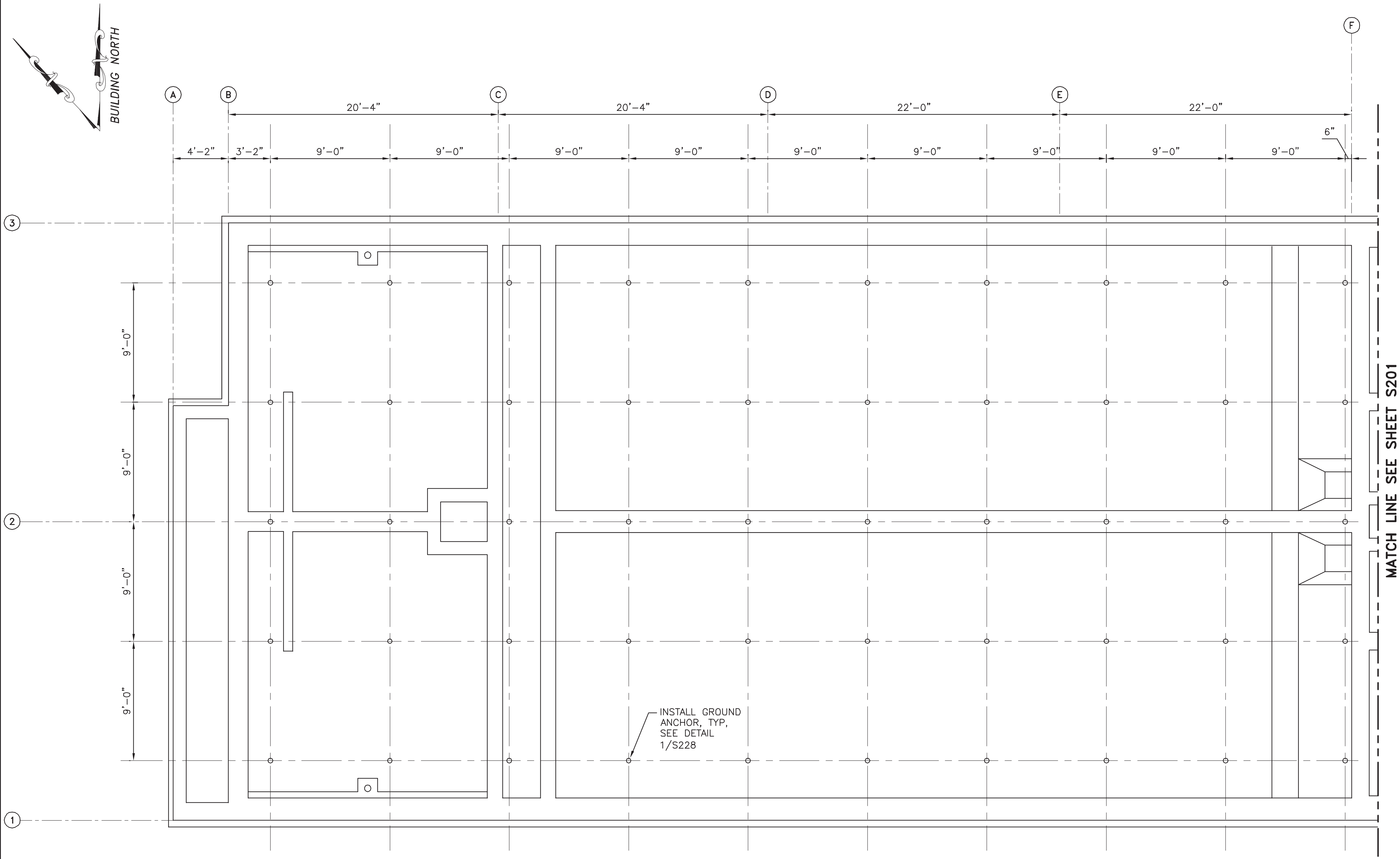
Clearly, a mechanical application of a formula based on permanent fulltime residents is not a logical manner in which to establish flow limits for the unique situation presented by the City of Unalaska. The study demonstrates that the City's request for an increased flow to the current permit was not based on a system that is defective in the limitation of I & I. Rather, the request was based on a very simple fact – there are significantly more people using the system than assumed under the current permit.

The City of Unalaska's Wastewater Treatment Plant influent BOD averages around 312 mg/L while the national average BOD is considered to be less than 200 mg/L. The difference between the City's influent average BOD and the national average is closely proportional to the differences between the City of Unalaska wastewater collection system's highly effective removal of I & I and the national average of systems with cost effective removal of I & I.

It is understood that permit writers generally use national averages when establishing limits when there is no supporting data available. However, this study provides data that clearly shows that the limits that were set in the current permit are unrealistic. For example, if permit writers set technology based limits using an assumed national average influent BOD of 200 mg/L, they are placing an unrealistic hardship on a community that has already expended a significant amount of finances and labor to control their I & I.

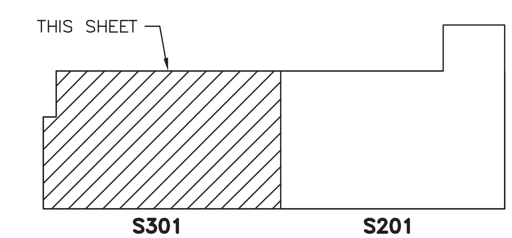
Although this study concluded that the City of Unalaska's wastewater collection system already achieves highly effective removal of I & I, the Wastewater Utility plans to invest in more reliable rain seals as they become available. Future development activities will focus on improving the location of manholes in some areas. The Wastewater Utility will continue to research new developments to improve the inflow problem of the manholes preceding Lift Station #5.

Appendix F
Clarifier and Chlorine Contact Tanks
Structural Drawings



NOTES:

1. FOUNDATION MAT SLAB SHALL BE 2'-0" MINIMUM THICKNESS.
2. UNDER SLAB PREPARATION SHALL BE 18" THICK STRUCTURAL FILL ADOT & PF "SUB-BASE A" GRADATION AND MATERIAL PROPERTIES LOCALIZED AREA OF UP TO 24" MAY BE REQUIRED WHERE BLAST FRACTURES OR ROCK DISCONTINUATIONS EXIST.
3. STRUCTURAL FILL SHALL EXTEND 1'-0" HORIZONTALLY BEYOND THE EXTERIOR LIMITS OF THE MAT SLAB.



BUILDING LOCATION KEY

CONFORMED DOCUMENTS

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Project No. 211042

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UNALASKA

CITY OF UNALASKA
WASTEWATER TREATMENT PLANT – CEPT UPGRADE

FOUNDATION ANCHOR PLAN CLARIFIER

SHEET S301

SCALE: 1/4" = 1'-0" | DESIGNED: JL | CHECKED: RD | DRAWN: MC | DATE: 05/30/13 | SHEET 109 OF 281

User: MCALDWELL May 30, 2013 – 3:03pm
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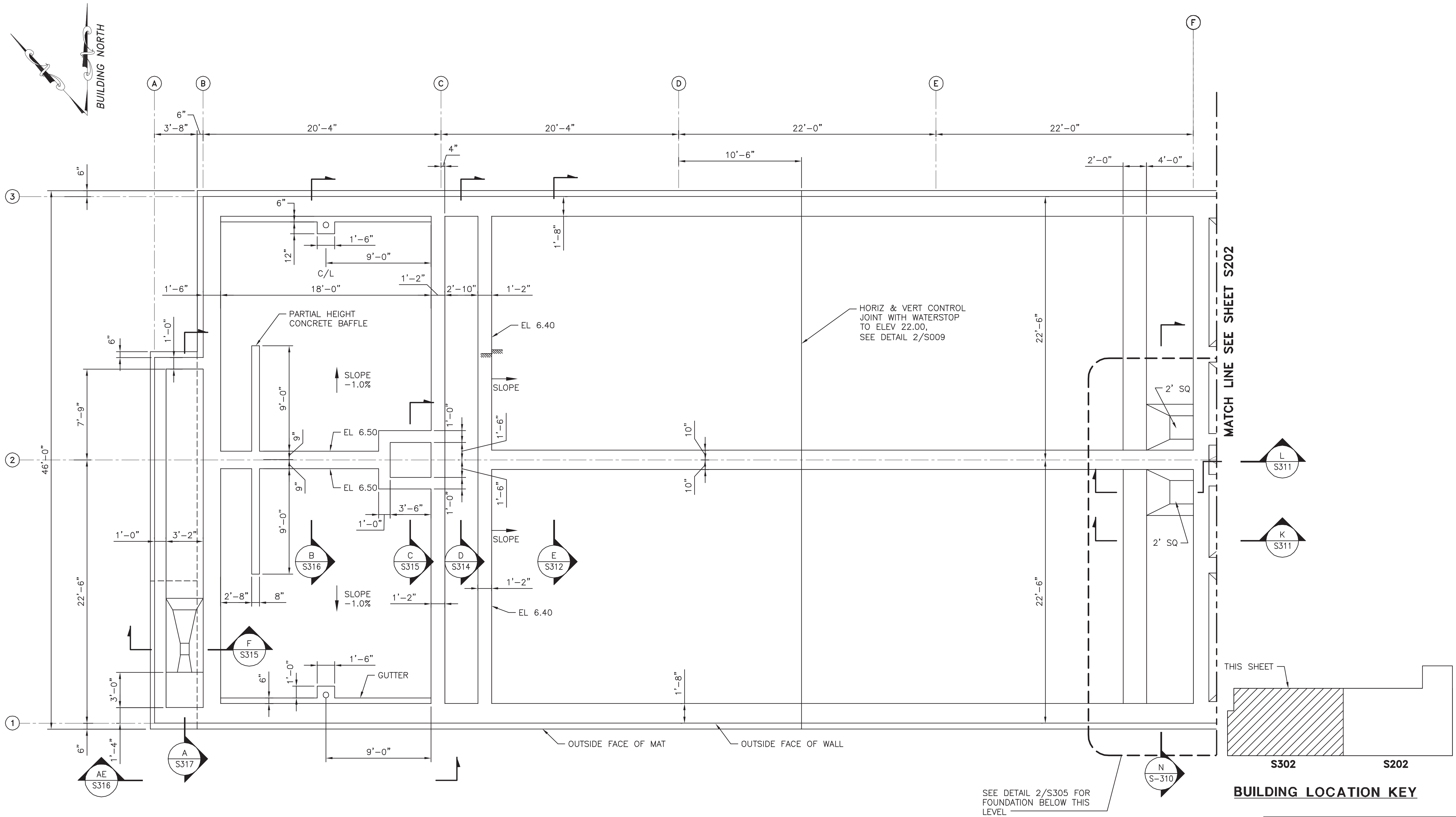
Xrefs: X11-10257_TB.DWG X11-10257_PLAN-FOUNDATION LEVEL.DWG – Images: (DIESEL evaluation failed)



CONFORMED DOCUMENTS

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Xrefs: X11-10257_TB.DWG X11-10257_PLAN-LOWER LEVEL.DWG – Images: (DIESEL evaluation failed)

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STATE OF ALASKA 49TH REGISTERED PROFESSIONAL ENGINEER 3-11-13

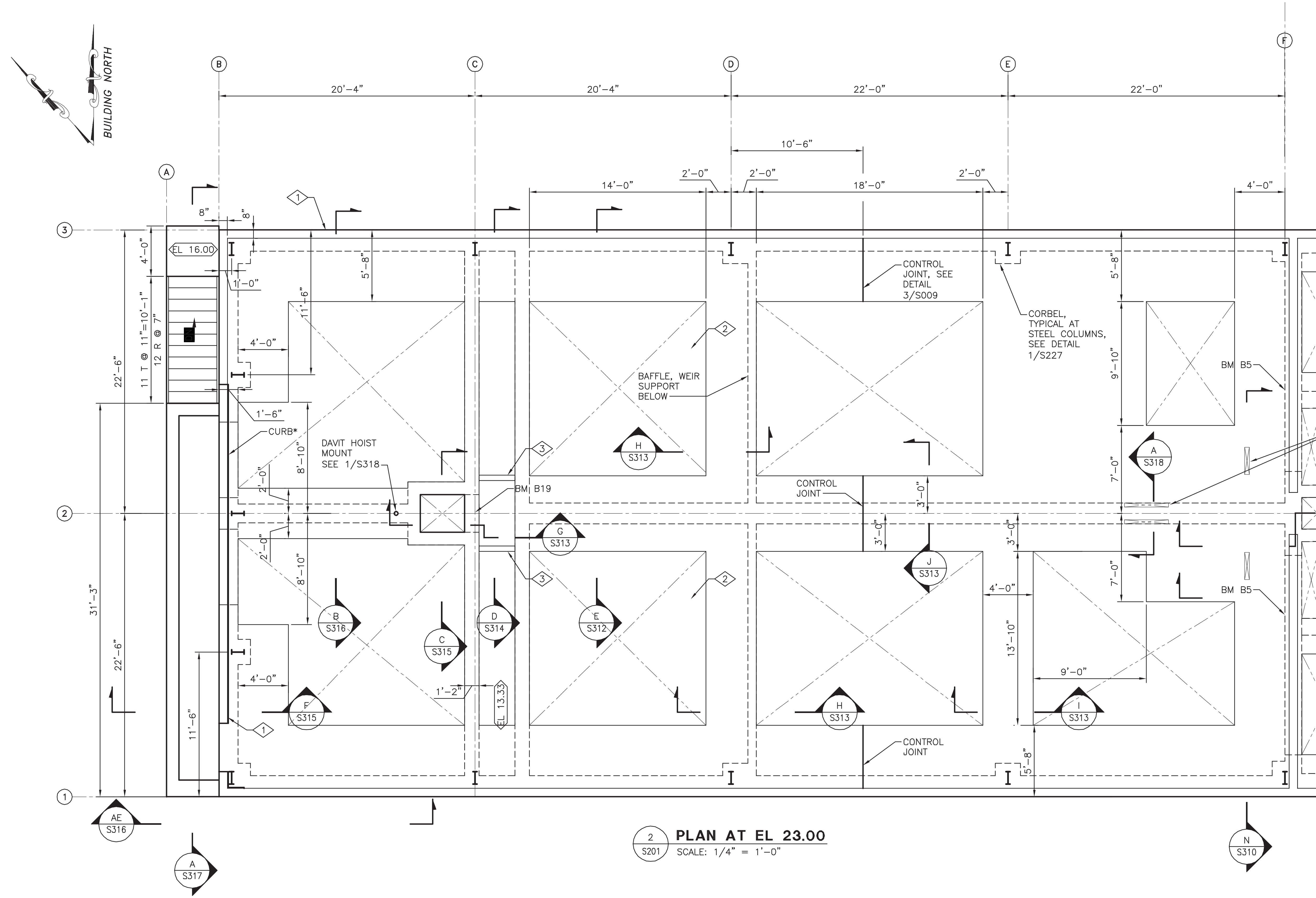
UNALASKA

CITY OF UNALASKA
WASTEWATER TREATMENT PLANT – CEPT UPGRADE

FOUNDATION PLAN
CLARIFIER

SHEET S302

SCALE: 1/4" = 1'-0" | DESIGNED: JL | CHECKED: RD | DRAWN: MC | DATE: 05/30/13 | SHEET 110 OF 281



2 PLAN AT EL 23.00

S201

SCALE: 1/4" = 1'-0"

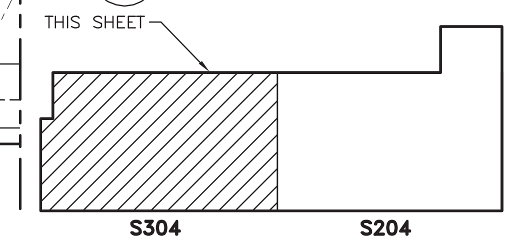
NOTES

1. SEE PLAN FOR REFERENCE FLOOR ELEVATION.
2. SLAB SHALL BE 12" CONCRETE SLAB WITH THE FOLLOWING REINFORCEMENT CONFIGURATION AND PLACEMENT UNLESS OTHERWISE NOTED.
   - NORTH – SOUTH #5 @ 9 BOT
   - EAST – WEST #4 @ 10 BOT
   - EAST – WEST #4 @ 10 TOP
   - NORTH – SOUTH #5 @ 9 TOP
3. WHERE NOTED THUS, B4, SEE BEAM SCHEDULE ON S002 FOR REINFORCEMENT.
4. SEE ARCHITECTURAL DRAWINGS FOR EXTENT OF CONCRETE CURBS AND EXTERIOR WALLS.

⟨1⟩ GIRTS AND SIDING ABOVE. SEE ARCHITECTURAL FLOOR PLANS.

⟨2⟩ SEE DRAWING S306 FOR RAILING, GRATING AND TANK COVERS NOT SHOWN THIS VIEW.

⟨3⟩ SLIDE GATE, SEE MECHANICAL DRAWINGS FOR LOCATION AND 6/S011 FOR BLOCKOUT DETAILS.



BUILDING LOCATION KEY

CONFORMED DOCUMENTS

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Xrefs: X11-10257_TB.DWG X11-10257_PLAN-TOP SLAB.DWG – Images: (DIESEL evaluation failed)

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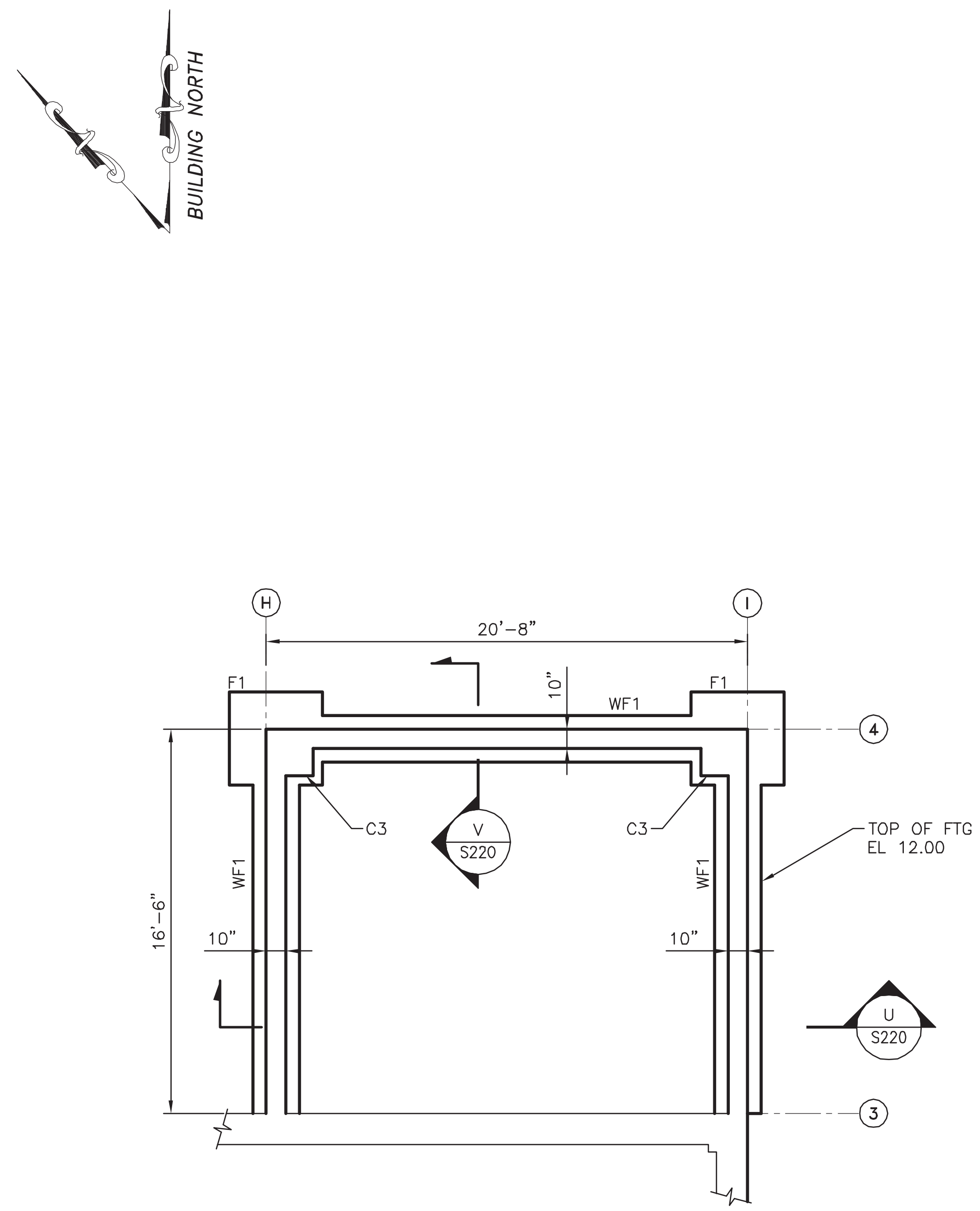
UNALASKA

CITY OF UNALASKA
WASTEWATER TREATMENT PLANT – CEPT UPGRADE

FLOOR FRAMING PLAN CLARIFIER

SHEET **S304**

SCALE: AS NOTED | DESIGNED: JL | CHECKED: RD | DRAWN: MC | DATE: 05/30/13 | SHEET 111 OF 281



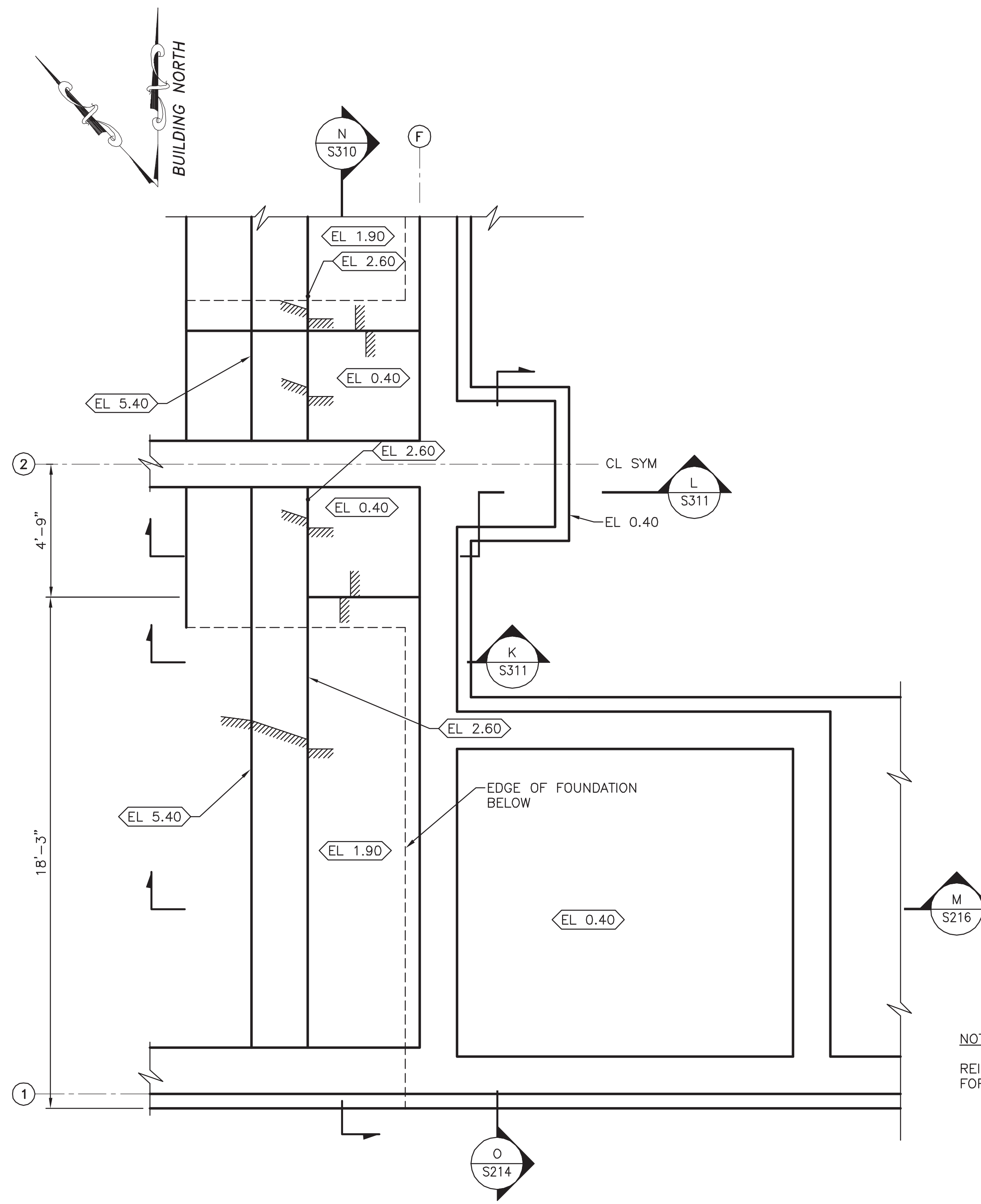
NOTES:

1. WHERE NOTED THUS, WF1, SEE WALL FOOTING SCHEDULE ON S006.
2. WHERE NOTED THUS, F1, SEE CONCRETE COLUMN FOOTING SCHEDULE ON S006.

1
S202

PARTIAL FOUNDATION PLAN

SCALE: 1/4" = 1'-0"



NOTE:

REINF NOT SHOWN FOR CLARITY.

2
S202

LOWER FOUNDATION ELEVATIONS PLAN

SCALE: 3/8" = 1'-0"

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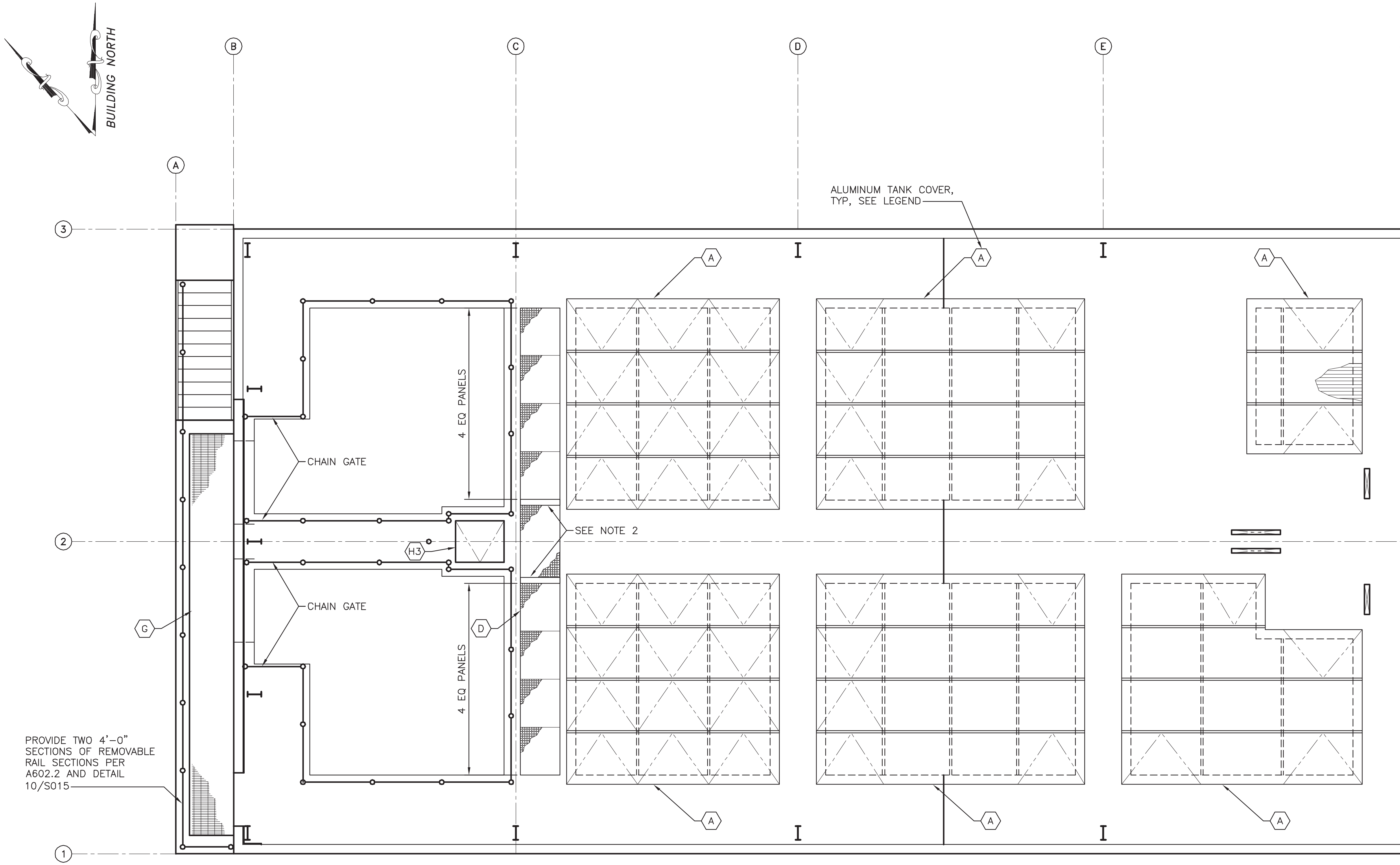
UNALASKA

CITY OF UNALASKA
WASTEWATER TREATMENT PLANT – CEPT UPGRADE

ENLARGED PLANS
CLARIFIER

SHEET S305

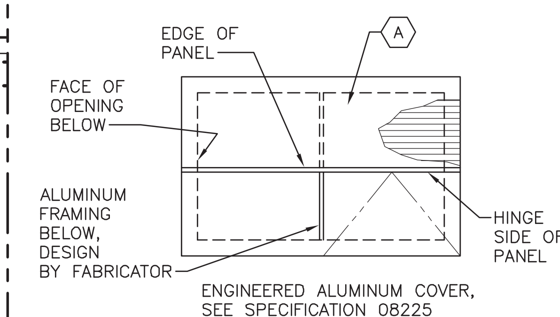
SCALE: AS NOTED | DESIGNED: JL | CHECKED: RD | DRAWN: MC | DATE: 05/30/13 | SHEET 112 OF 281



2 / S200 **PLAN AT EL 23.00**
SCALE: 1/4" = 1'-0"

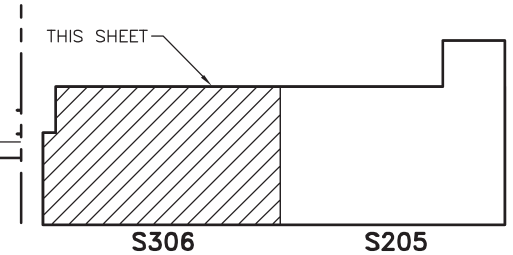
LEGEND

(railing symbol)	ALUMINUM RAILING
(handrail symbol)	ALUMINUM HANDRAIL, WALL MOUNTED
H1	ALUMINUM FLOOR HATCH, SEE SCHEDULE
G	SERRATED ALUMINUM GRATING PANELS
D	ALUMINUM DIAMOND PLATE, SEE DETAIL 4/S017



NOTES:

1. PROVIDE GRATING SEATS OR ANGLES PER STANDARD DETAILS AND THIS DRAWING UNO. GRATING IS NOT SHOWN ON CONCRETE SECTIONS.
2. PROVIDE OPENINGS AS REQ'D FOR GATE OPERATION.



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UNALASKA

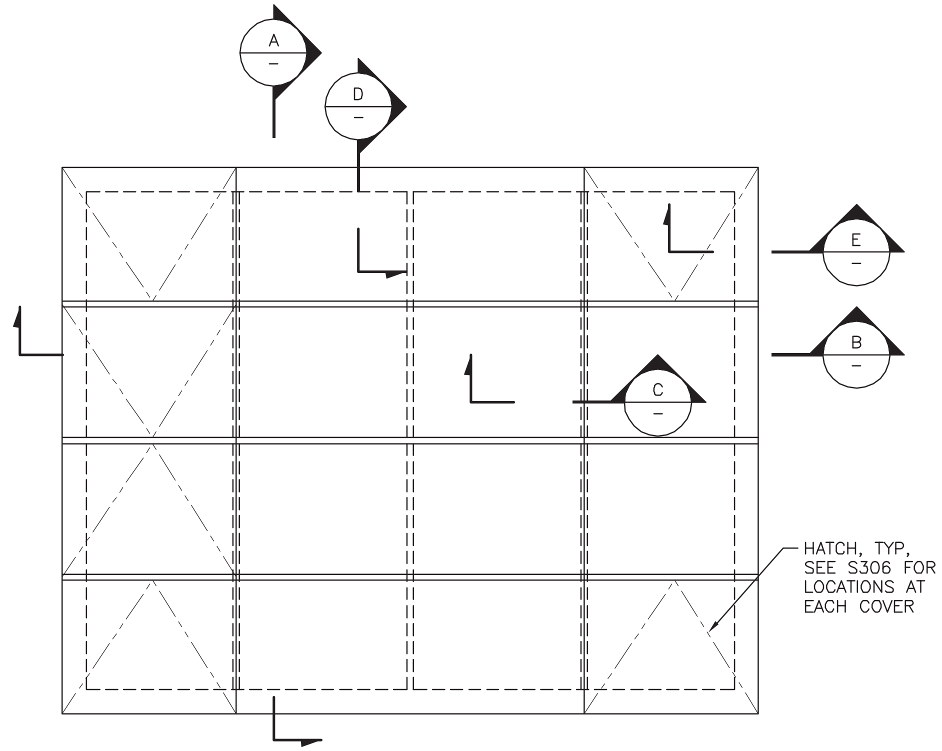
CITY OF UNALASKA
WASTEWATER TREATMENT PLANT – CEPT UPGRADE

CLARIFIER COVER AND RAILING PLAN

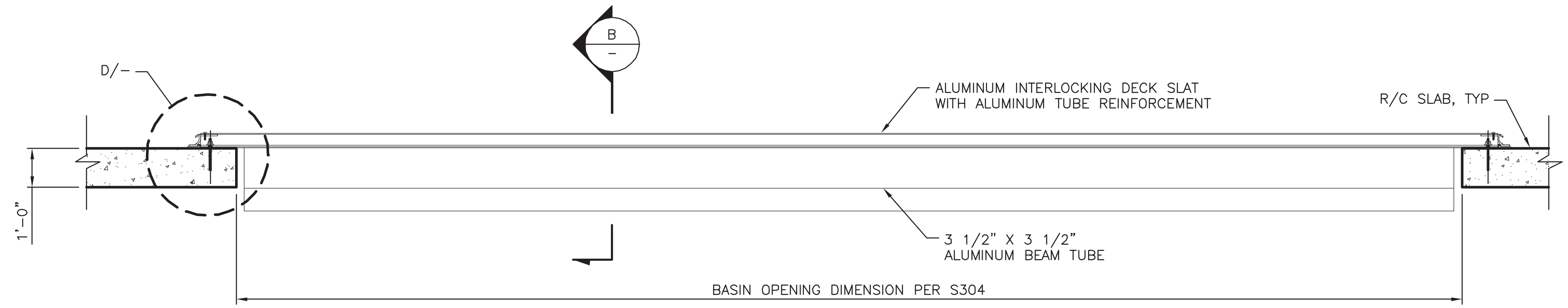
SHEET **S306**

SCALE: AS NOTED | DESIGNED: JL | CHECKED: RD | DRAWN: PS | DATE: 05/30/13 | SHEET 113 OF 281

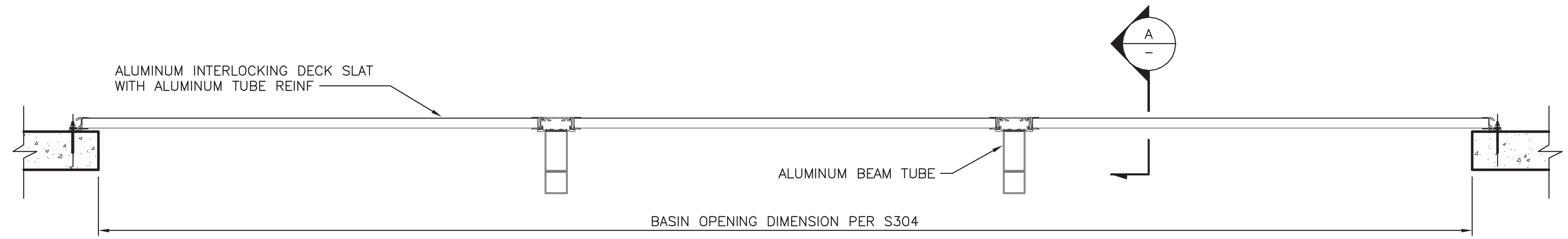
User: MCALDWELL May 30, 2013 – 3:12pm
Drawing: S:\CAD\UNALASKA\11-10257 WWTP DESIGN\DWGS\P11-10257_S306.DWG – Layout: S306
Xrefs: X11-10257_TB.DWG X11-10257_PLAN-TOP SLAB.DWG – Images: (DIESEL evaluation failed)



1 / S306 **TYPICAL ALUMINUM COVER PLAN**
NTS



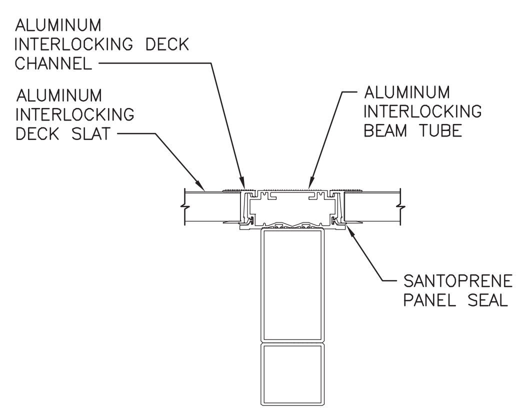
A / – **BEAM ELEVATION**
NTS



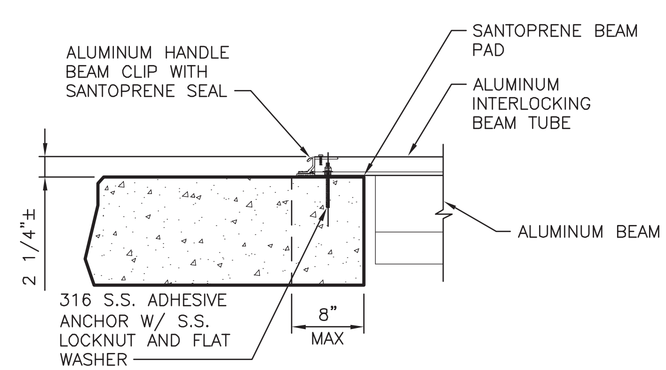
B / – **BEAM SECTION**
NTS

NOTE:

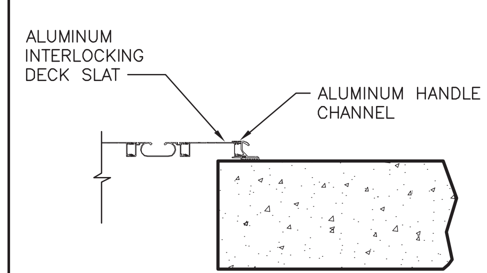
1. DETAILS FOR FRAMING SHOWN ARE SCHEMATIC. DETAILED DESIGN OF COVERS AND ATTACHMENT TO CONCRETE SHALL BE BY THE CONTRACTOR'S SUPPLIER.
2. LIVE LOAD CAPACITY SHALL BE NOT LESS THAN 50 PSF UNIFORM LOAD OR A CONCENTRATED LOAD OF 400 LBS ON ANY 4" x 4" AREA.
3. SEE SPECIFICATION SECTION 08225 FOR ADDITIONAL REQUIREMENTS.



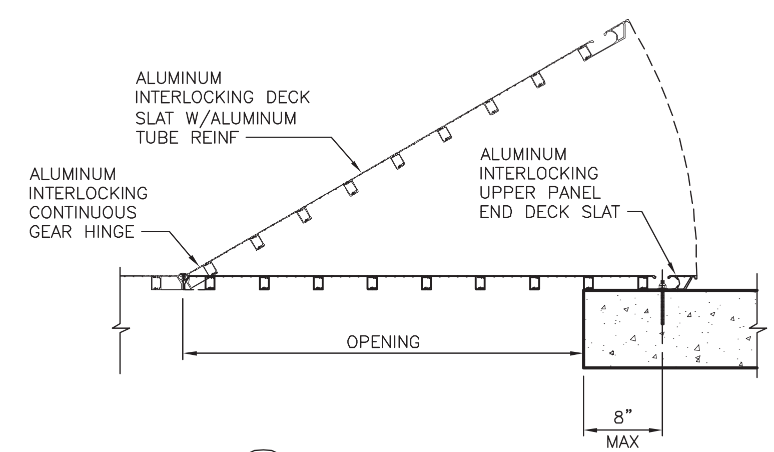
C / – **BEAM SECTION**
NTS



D / – **BEAM END SECTION**
NTS



E / – **DECK SECTION**
NTS



F / – **HATCH SECTION**
NTS

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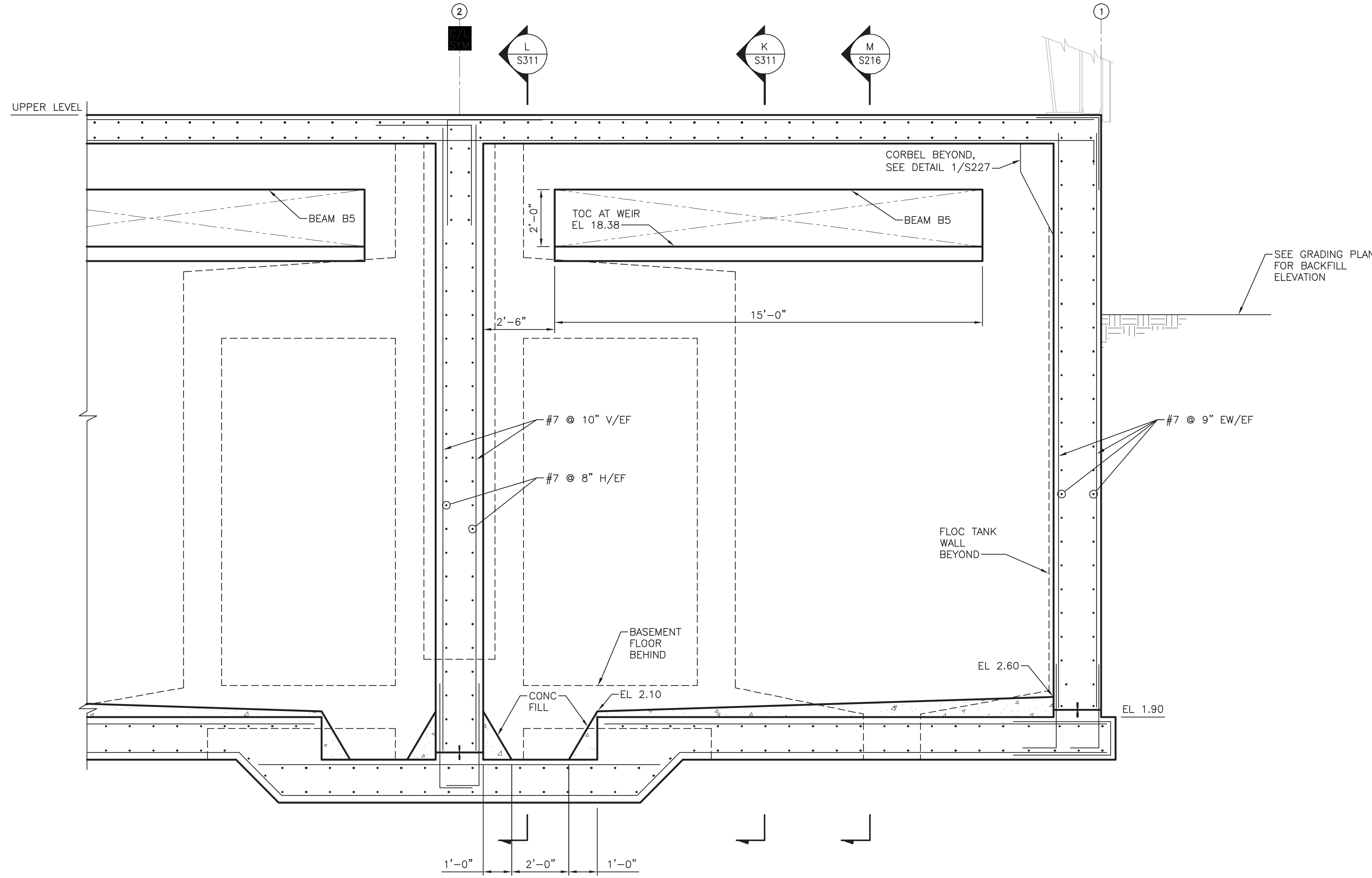
UNALASKA

CITY OF UNALASKA
WASTEWATER TREATMENT PLANT – CEPT UPGRADE

TYPICAL ALUMINUM COVER PLAN AND SECTIONS

SHEET **S307**

SCALE: NTS | DESIGNED: JL | CHECKED: RD | DRAWN: MC | DATE: 05/30/13 | SHEET 114 OF 281



N
S202
S302, [redacted] S305

SECTION
SCALE: 1/2" = 1'-0"

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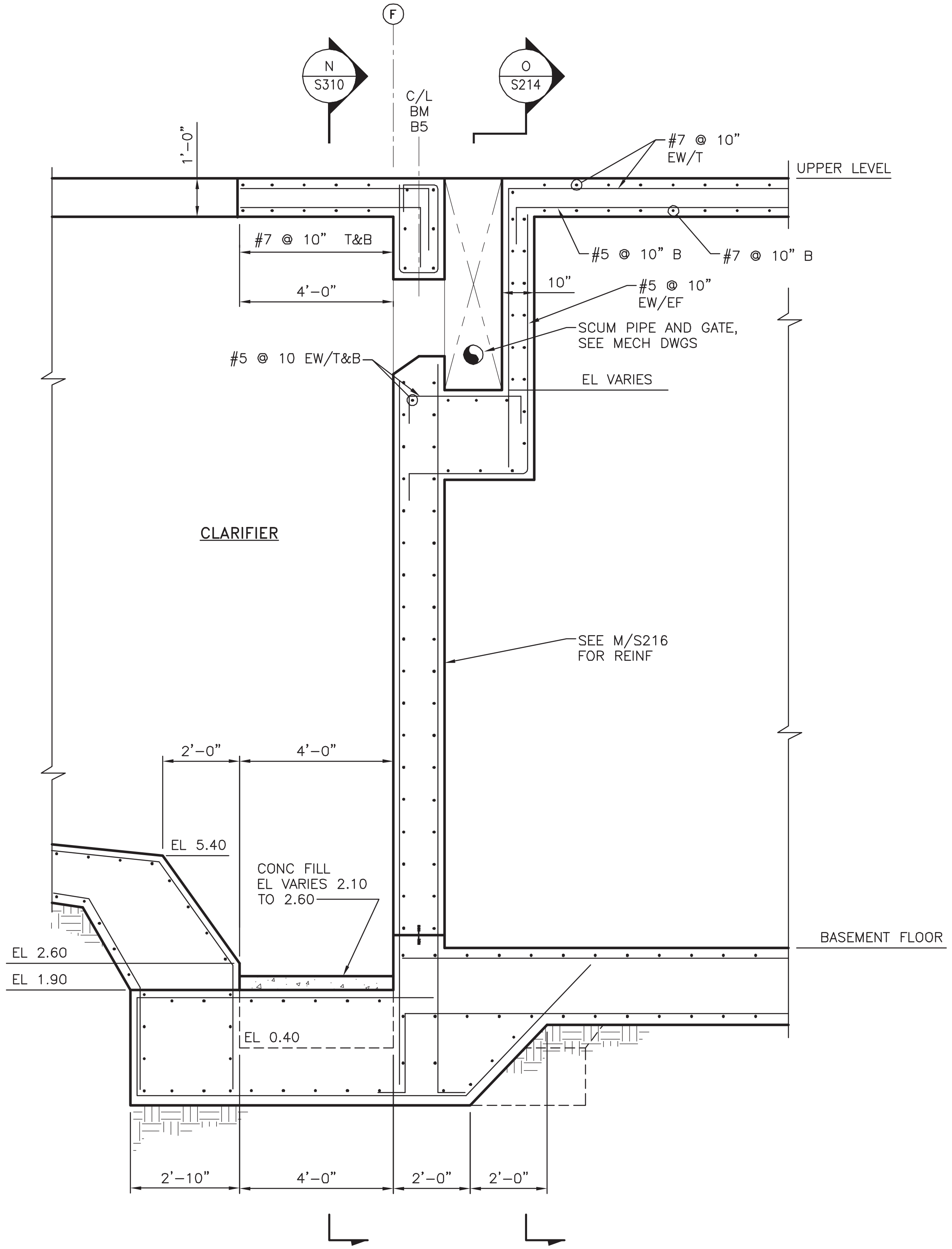
UNALASKA

CITY OF UNALASKA
WASTEWATER TREATMENT PLANT – CEPT UPGRADE

CONCRETE SECTIONS

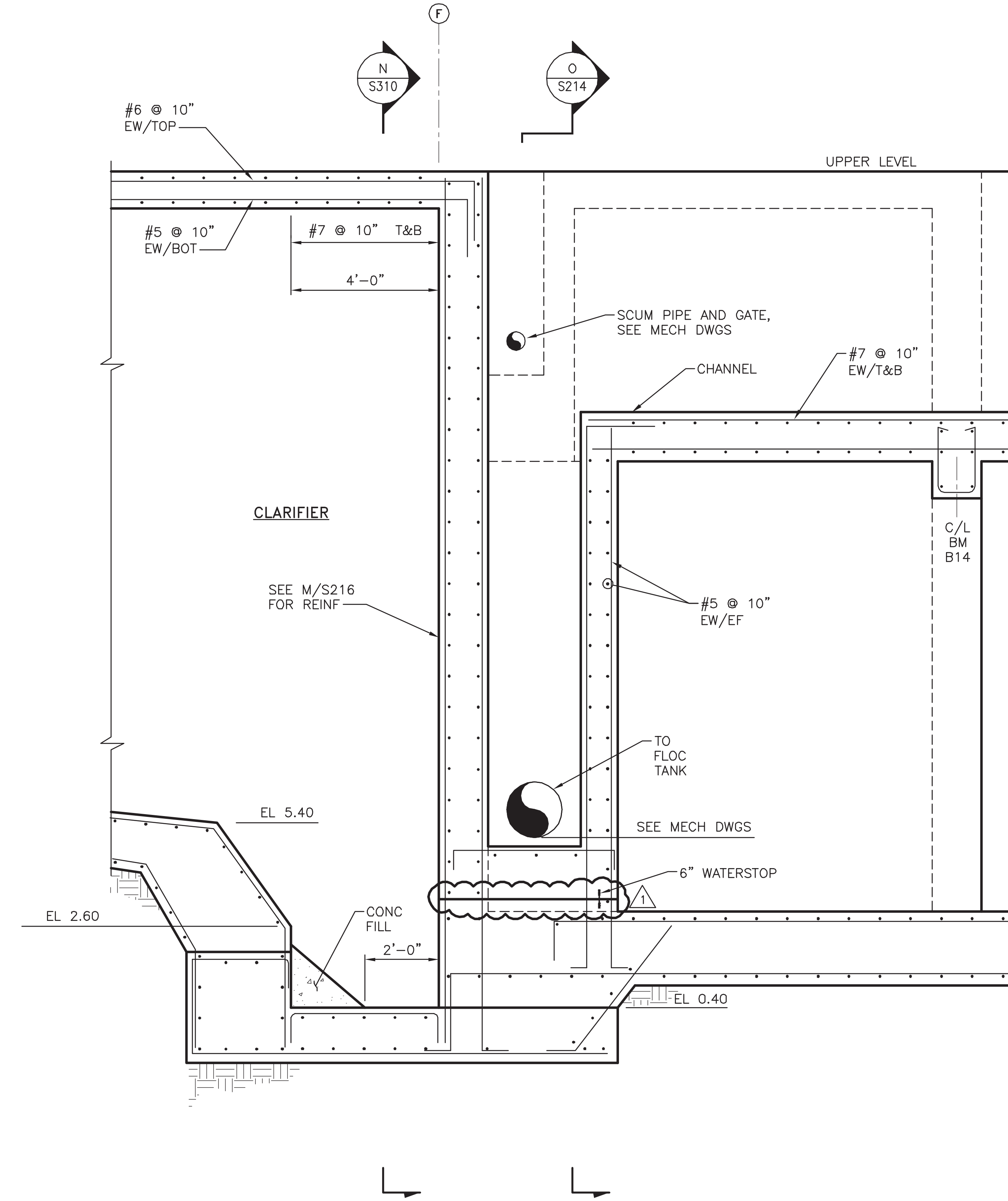
SHEET
S310

SCALE: AS NOTED | DESIGNED: JL | CHECKED: RD | DRAWN: MC | DATE: 05/30/13 | SHEET 115 OF 281



K
S202
S20[redacted]04,
S302, S304,

SECTION
SCALE: 1/2" = 1'-0"



L
S202
S20[redacted]04,
S302, S304,

SECTION
SCALE: 1/2" = 1'-0"

CONFORMED DOCUMENTS

User: MCALDWELL Jun 04, 2013 - 1:48pm
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Xrefs: X11-10257_TB.DWG - Images: (DIESEL evaluation failed)

REVISIONS

NO.	DATE	BY	DESCRIPTION
1	04/09/13	JL	ADDENDUM #1

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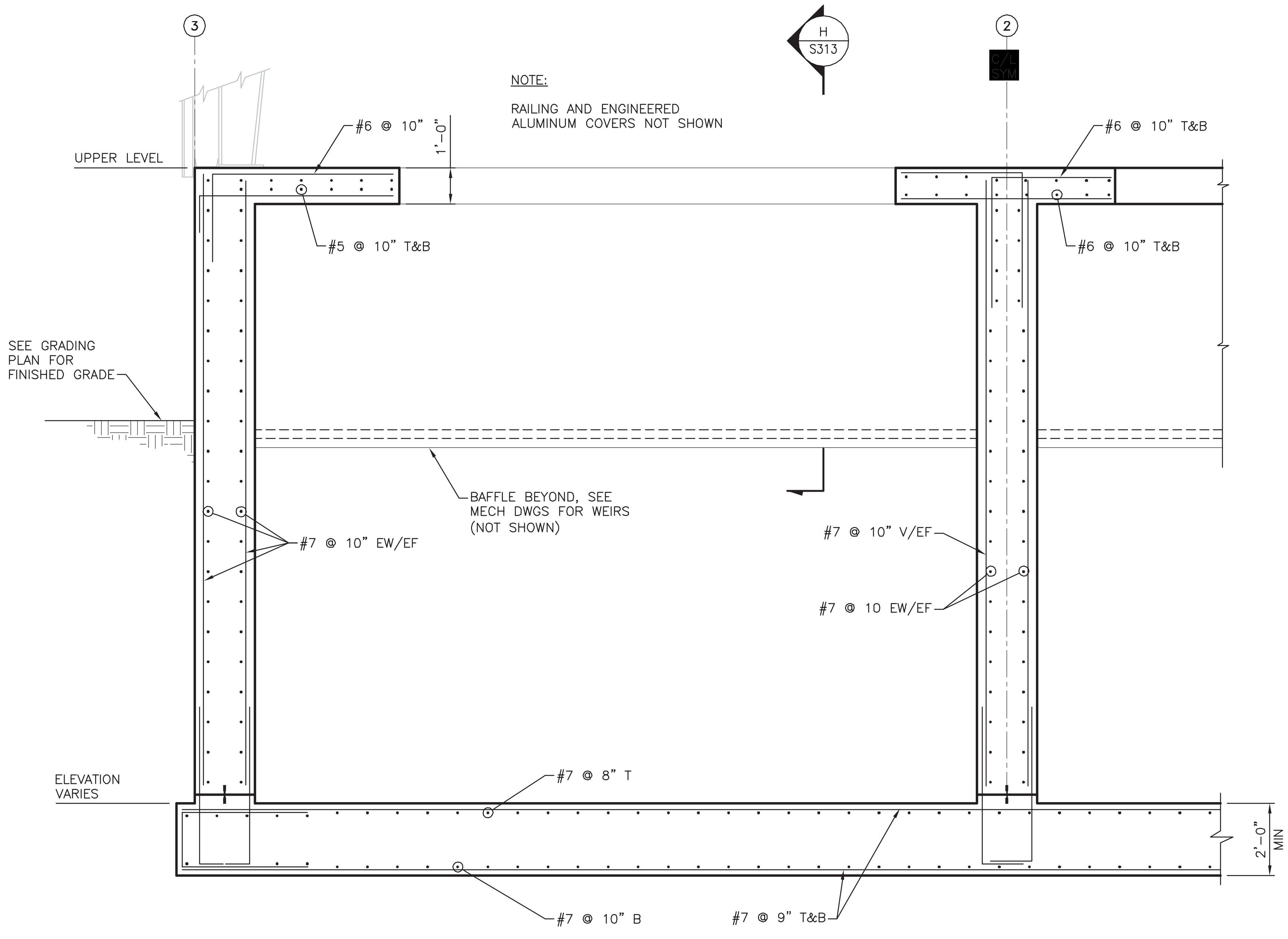
UNALASKA

CITY OF UNALASKA
WASTEWATER TREATMENT PLANT – CEPT UPGRADE

CONCRETE SECTIONS

SHEET
S311

SCALE: AS NOTED | DESIGNED: JL | CHECKED: RD | DRAWN: MC | DATE: 05/30/13 | SHEET 116 OF 281



E
S302

SECTION
SCALE: 1/2" = 1'-0"

CONFORMED DOCUMENTS

User: MCALDWELL May 30, 2013 – 3:17pm
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Xrefs: X11-10257_TB.DWG – Images: (DIESEL evaluation failed)

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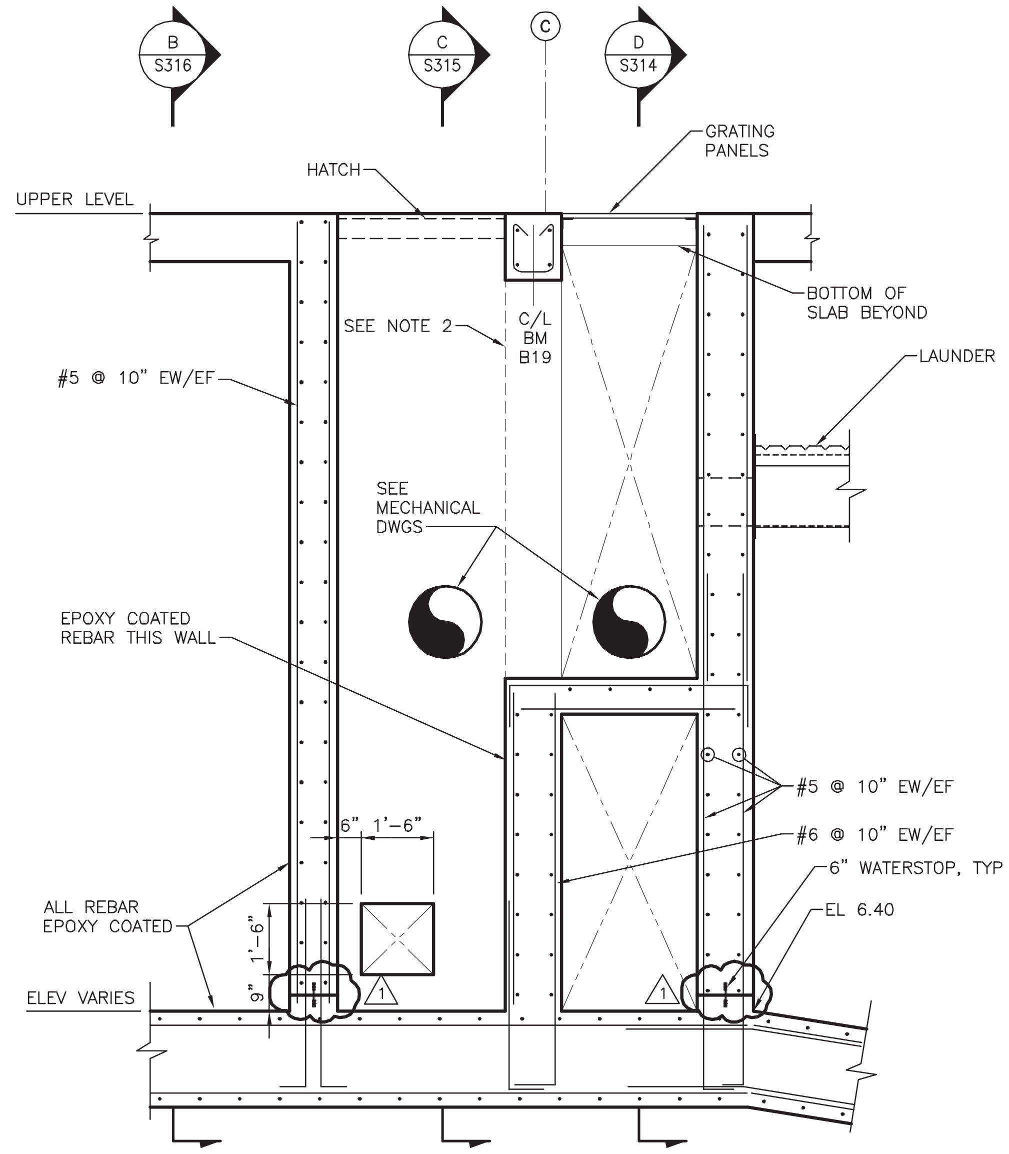
SHEET
S312

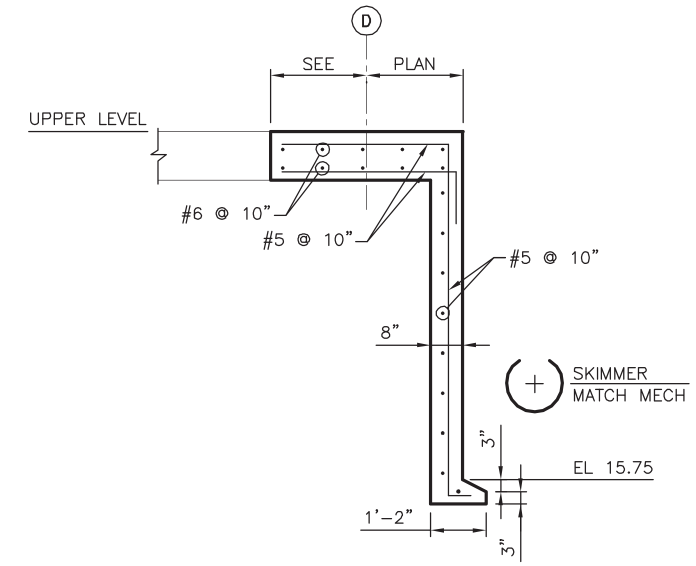
SCALE: AS NOTED | DESIGNED: JL | CHECKED: RD | DRAWN: PS | DATE: 05/30/13 | SHEET 117 OF 281



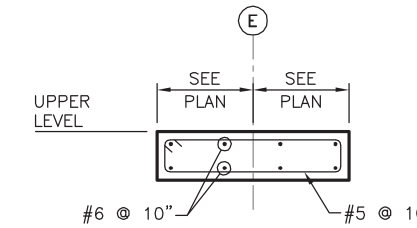
NOTES:

1. SEE DRAWING S305 FOR RAILING AND ENGINEERED ALUMINUM COVER NOT SHOWN.
2. WALL BEYOND REINF SAME AS WALL BELOW.

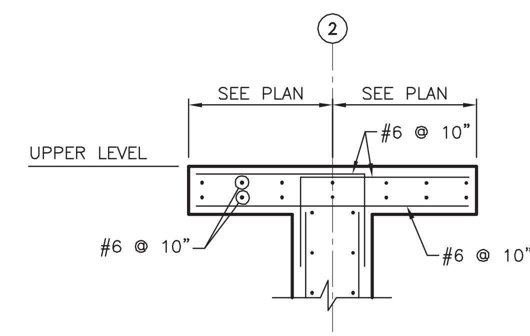
G / S304 **SECTION** SCALE: 1/2" = 1'-0"



H / S304 **SECTION** SCALE: 1/2" = 1'-0"



I / S304 **SECTION** SCALE: 1/2" = 1'-0"



J / S304 **SECTION** SCALE: 1/2" = 1'-0"

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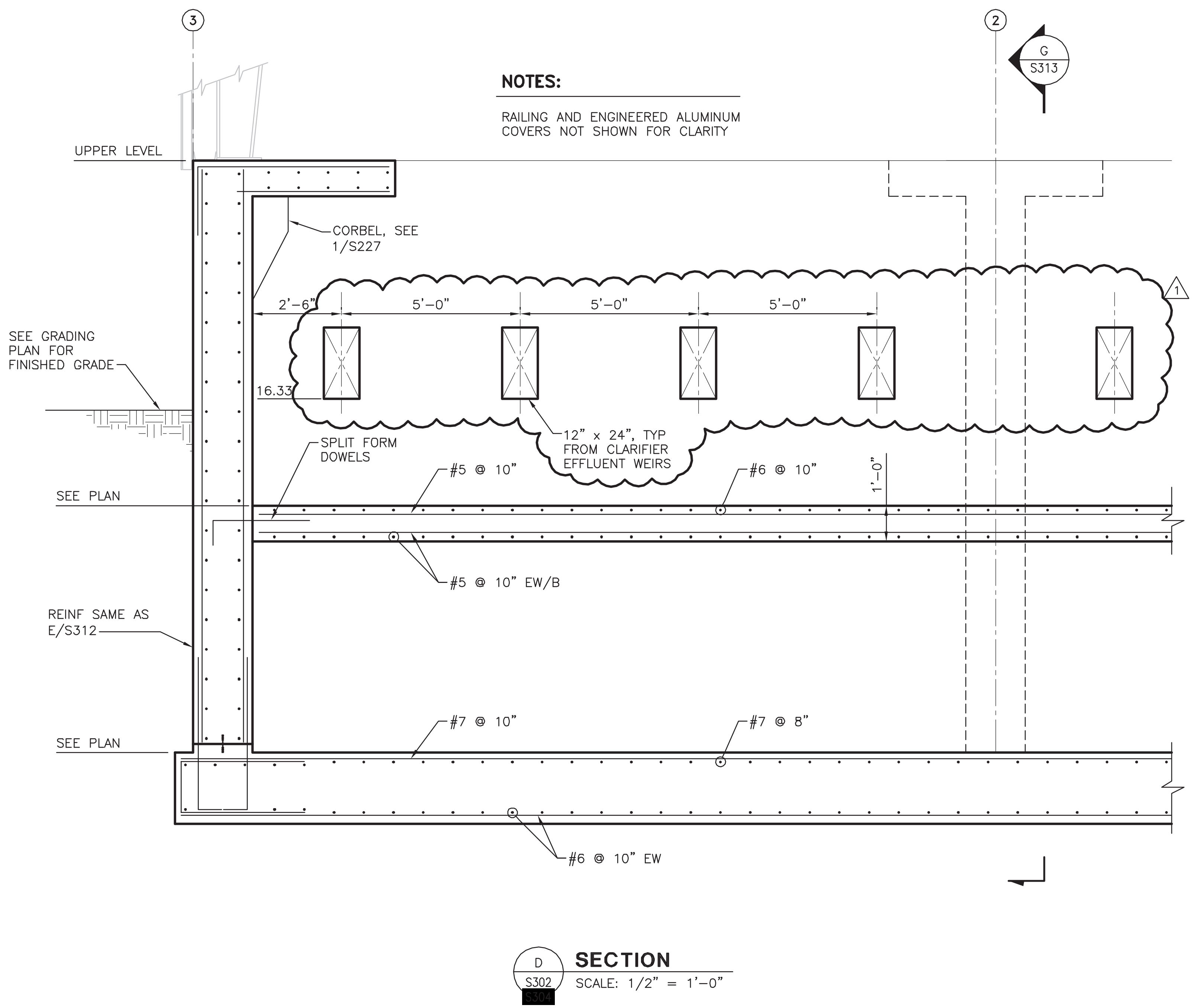
UNALASKA

CITY OF UNALASKA
WASTEWATER TREATMENT PLANT – CEPT UPGRADE

CONCRETE SECTIONS

SHEET **S313**

SCALE: AS NOTED | DESIGNED: JL | CHECKED: RD | DRAWN: PS | DATE: 05/30/13 | SHEET 118 OF 281



SECTION

SCALE: 1/2" = 1'-0"

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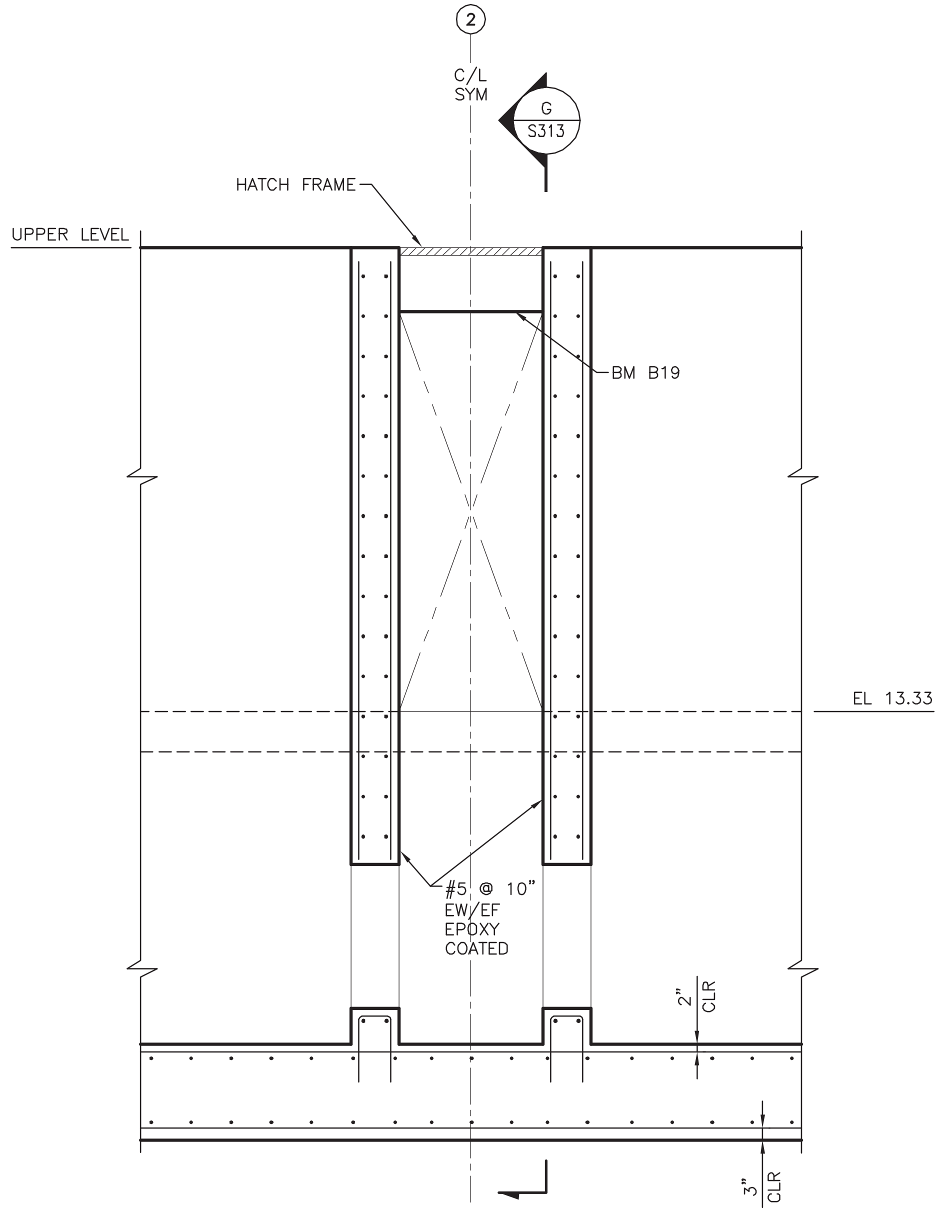
UNALASKA

CITY OF UNALASKA
WASTEWATER TREATMENT PLANT – CEPT UPGRADE

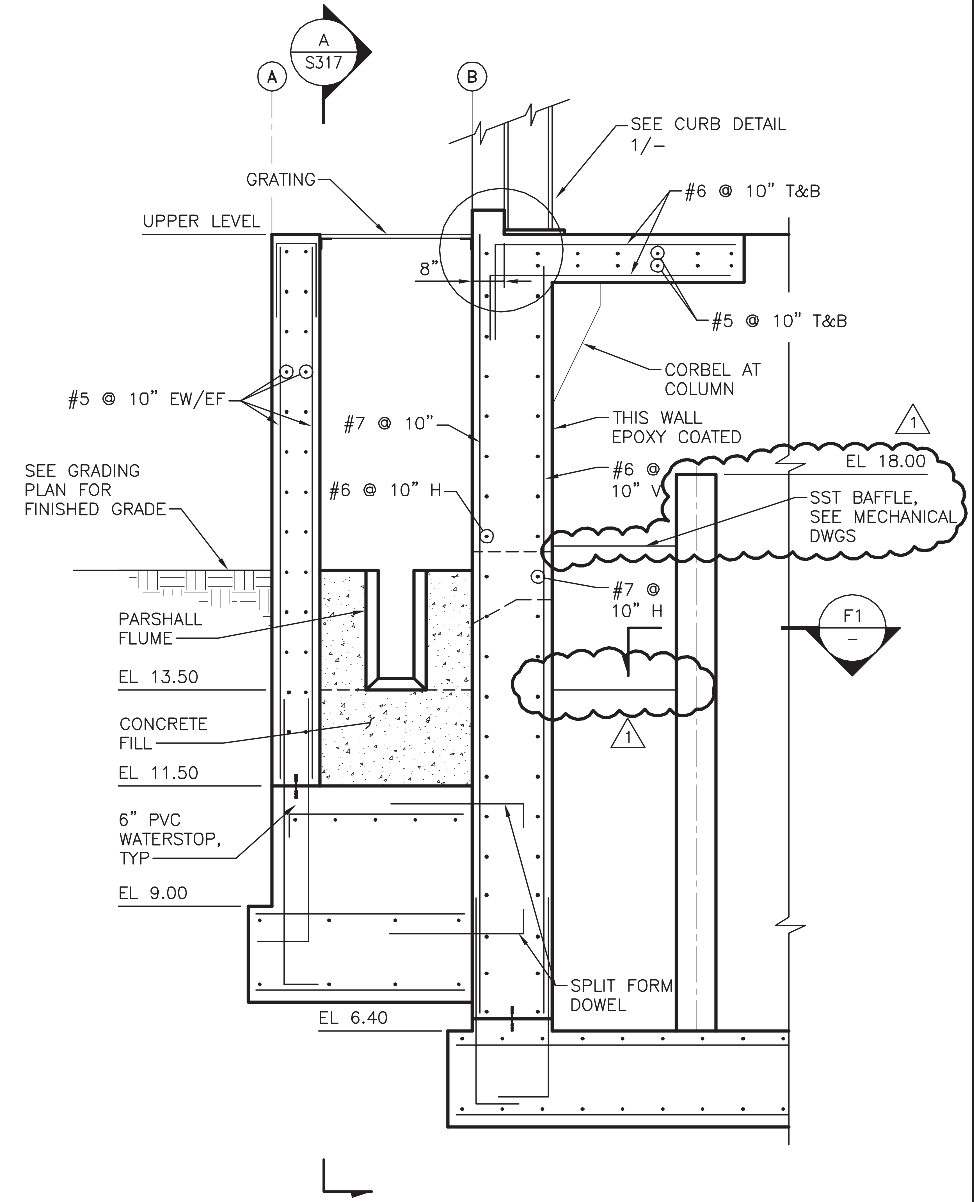
CONCRETE SECTIONS

SHEET S314

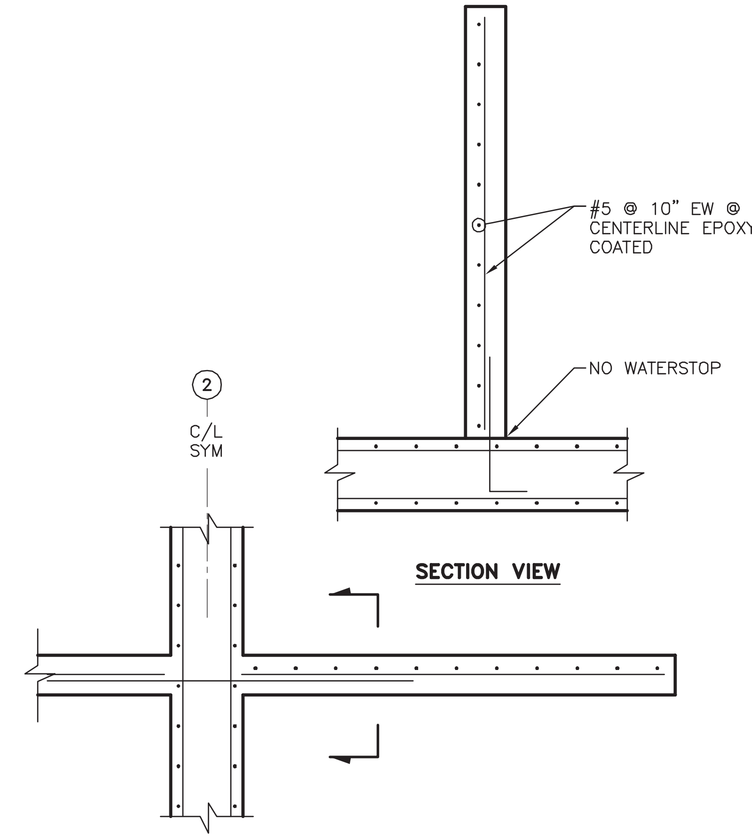
SCALE: AS NOTED | DESIGNED: JL | CHECKED: RD | DRAWN: PS | DATE: 05/30/13



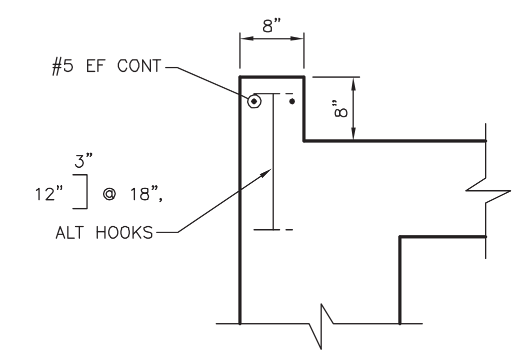
C
S302
S304
SECTION
SCALE: 1/2" = 1'-0"



F
S302
S304
SECTION
SCALE: 1/2" = 1'-0"



F1
–
SECTION
SCALE: 1/2" = 1'-0"



1
–
CURB DETAIL
SCALE: NTS

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STATE OF ALASKA 49TH 3-11-13 REGISTERED PROFESSIONAL ENGINEER

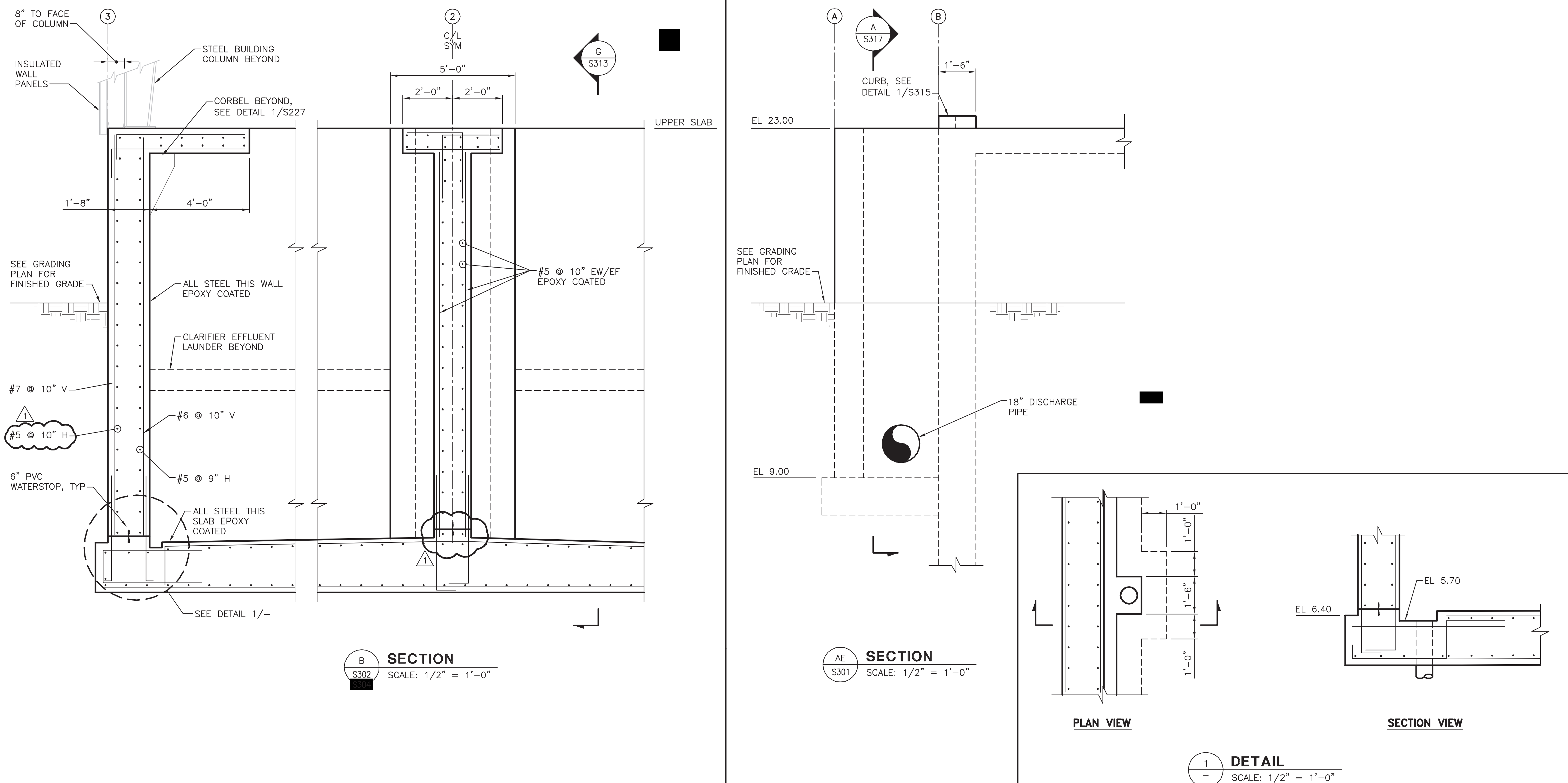
UNALASKA

CITY OF UNALASKA
WASTEWATER TREATMENT PLANT – CEPT UPGRADE

CONCRETE SECTIONS

SHEET S315

SCALE: AS NOTED | DESIGNED: JL | CHECKED: RD | DRAWN: MC | DATE: 05/30/13 | SHEET 120 OF 281



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UNALASKA

CITY OF UNALASKA
WASTEWATER TREATMENT PLANT – CEPT UPGRADE

CONCRETE SECTIONS

SHEET
S316

SCALE: AS NOTED | DESIGNED: JL | CHECKED: RD | DRAWN: MC | DATE: 05/30/13 | SHEET 121 OF 281

User: MCALDWELL Jun 04, 2013 – 1:51pm
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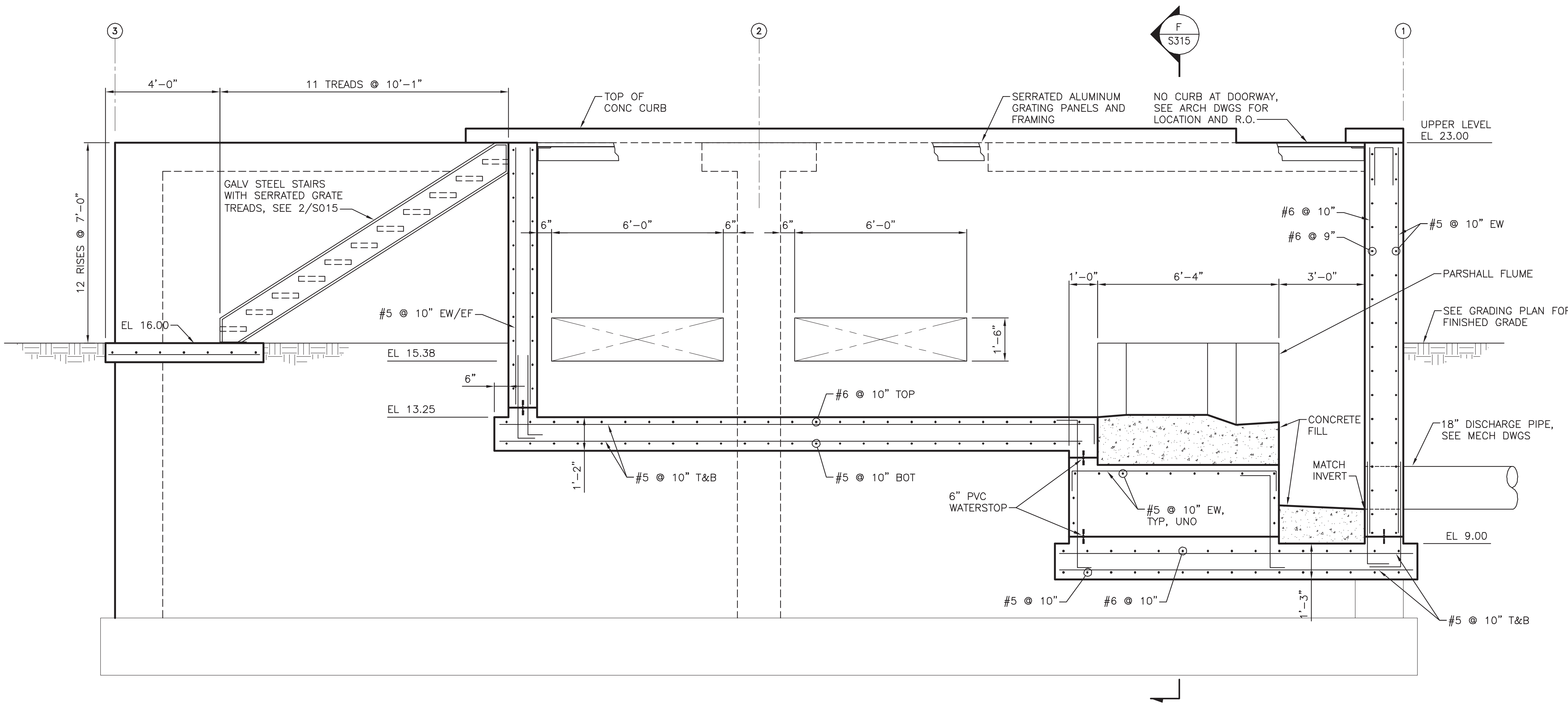
Xrefs: X11-10257_TB.DWG – Images: (DIESEL_evaluation failed)



A
S302
[redacted]

SECTION

SCALE: 1/2" = 1'-0"

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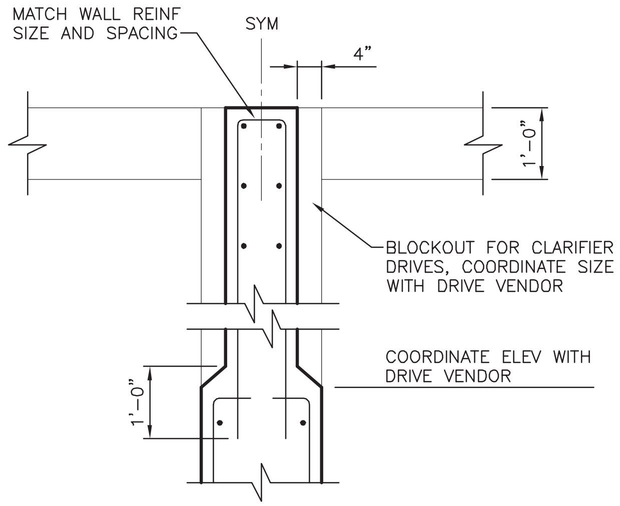
UNALASKA

CITY OF UNALASKA
WASTEWATER TREATMENT PLANT – CEPT UPGRADE

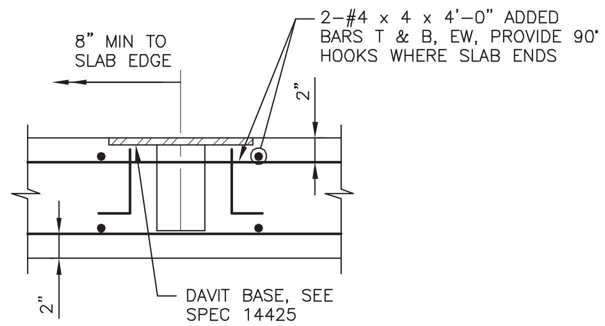
CONCRETE SECTIONS

SHEET S317

SCALE: AS NOTED | DESIGNED: JL | CHECKED: RD | DRAWN: MC | DATE: 05/30/13 | SHEET 122 OF 281



A / S318 **SECTION**
SCALE: 3/4" = 1'-0"



1 / S318 **DETAIL**
SCALE: 1 1/2" = 1'-0"

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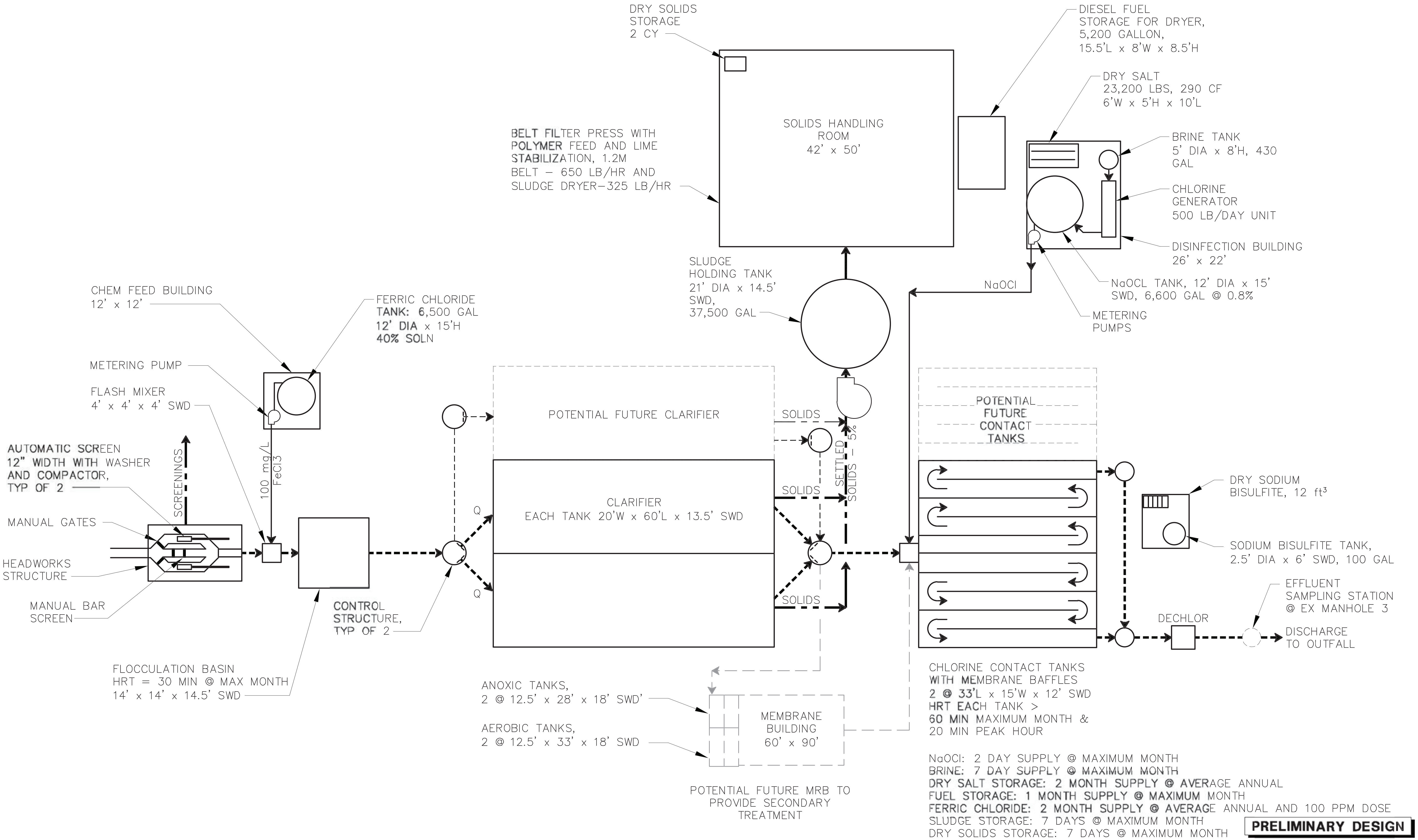
CONCRETE SECTIONS

SHEET
S318

SCALE: AS NOTED | DESIGNED: JL | CHECKED: RD | DRAWN: MC | DATE: 05/30/13

Appendix G
2011 Facility Plan Future Improvements Process Diagram, Hydraulic Profile and Site Plan



PRELIMINARY DESIGN

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Xrefs: BR22X34BR_UNAK.DWG – Images: BHCLOGO_BW.JPG

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UNALASKA

CITY OF UNALASKA

PREFERRED ALTERNATIVE CEPT PROCESS DIAGRAM

SHEET **FIG 8-1**

SCALE: NTS | DESIGNED: FJV | CHECKED: FJV | DRAWN: DES | DATE: 10/2011 | PAGE NO. 103

EXISTING PLANT FLOW DATA:

AVERAGE FLOW, MILLION GALLONS PER DAY (MGD) 0.8 MGD

MINIMUM FLOW 0.3 MGD

MAXIMUM DAILY FLOW 1.5 MGD

PEAK HYDRAULIC FLOW 2.0 MGD

FLOW DATA FROM CH2MHILL UNALASKA WASTEWATER TREATMENT PLANT UPGRADE, PRELIMINARY DESIGN REPORT, SEPTEMBER 1997

YEAR 2030 FLOW DATA:

AVERAGE DAY MAXIMUM MONTH 1.02 MGD

PEAK HOUR 2.80 MGD

TIDAL DATA:

HIGHEST TIDE OBSERVED (JAN. 7, 1960) 6.2'

MEAN HIGH WATER 3.72'

MEAN TIDE LEVEL 1.85'

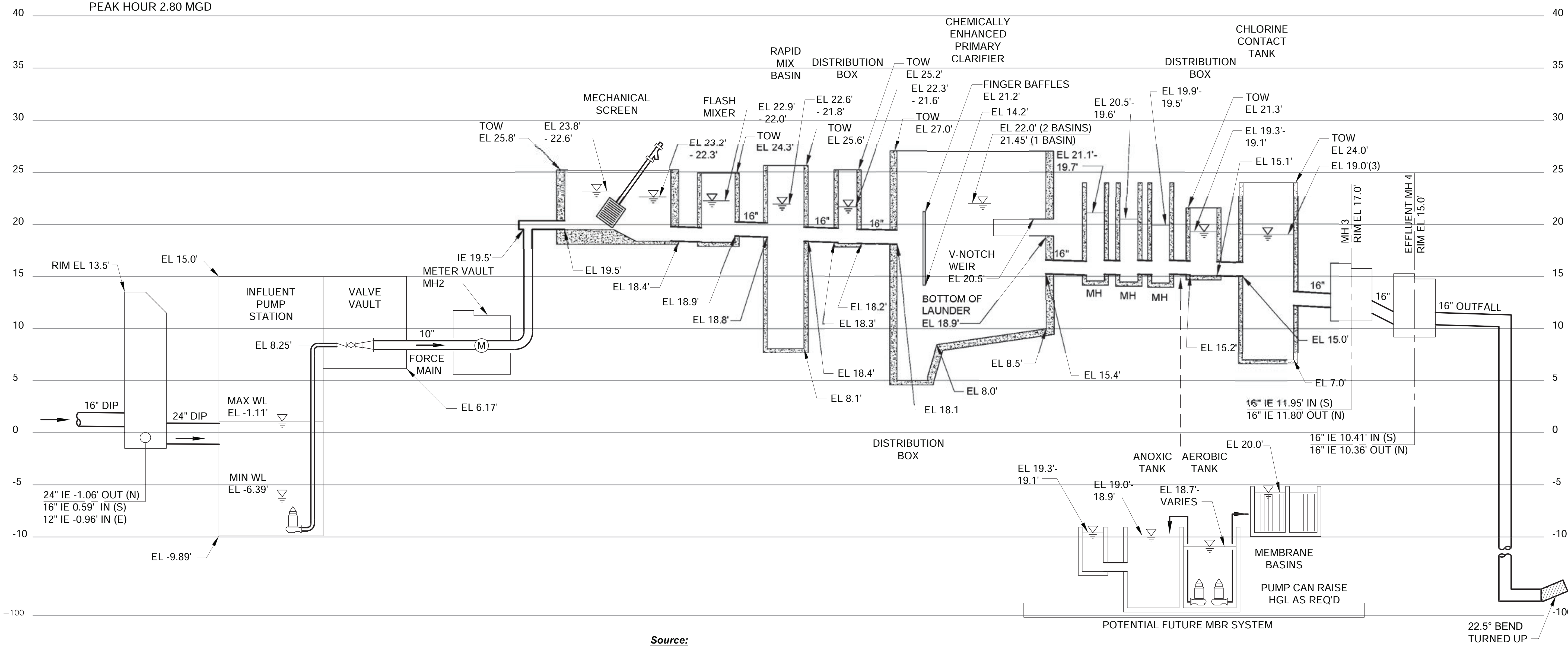
MEAN LOW WATER 0.00'

LOWEST TIDE OBSERVED (DEC. 18, 1971) -2.6'

TIDE DATA FROM SOUTHWEST ALASKA 9462620, U.S. DEPT. OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL OCEAN SURVEY.

GENERAL NOTES:

1. VERTICAL DATUM, MEAN LOW WATER (MLW), EL 0.00'.
2. EXISTING PLANT ELEVATIONS TAKEN FROM 12/84 UNALASKA SEWERAGE FACILITIES RECORD DRAWINGS, GENERAL CONSTRUCTION NOTE 1., VERTICAL DATUM, NOAA TIDAL BENCH MARK 15 (1955), 8.63' ABOVE MEAN LOW WATER.
3. 19.0' IS ASSUMED TO BE THE CONTROL ELEVATION IN THE CHLORINE CONTACT TANK REQUIRED TO MAINTAIN THE OUTFALL CAPACITY. BASED ON THE ELEVATION OF OUTLET AT UV SYSTEM. (CONFIRM DURING DESIGN)
4. WATER SURFACE ELEVATIONS - PEAK HOURS SHOWN ABOVE, AVERAGE DAY MAXIMUM MONTH BELOW.



Source:

City of Unakaska Department of Public Utilities Wastewater Treatment Plant Upgrade Hydraulic Profile, April 01 1999, Regan Engineering

PRELIMINARY DESIGN

NO.	DATE	BY	DESCRIPTION

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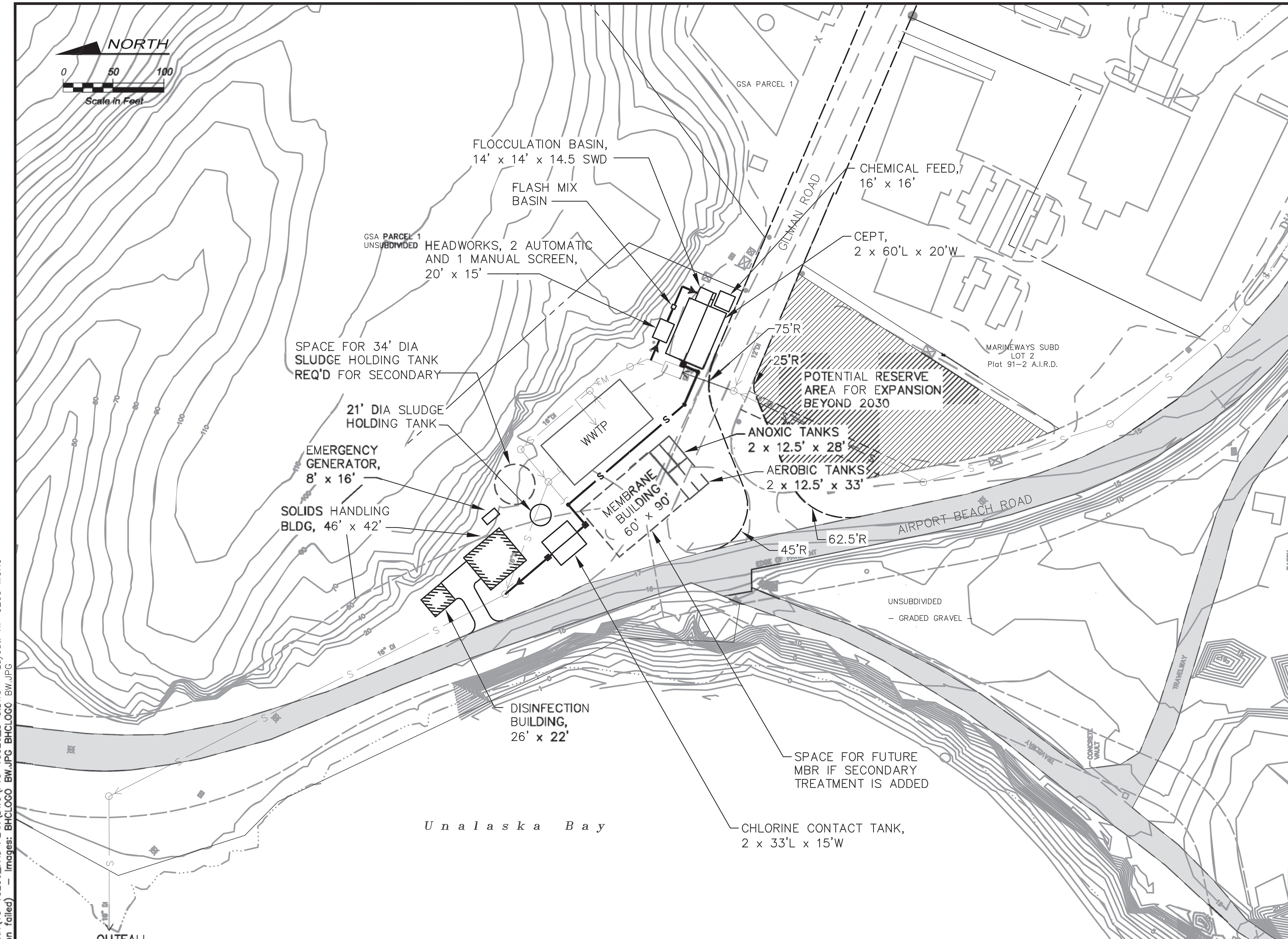
UNALASKA

CITY OF UNALASKA

PREFERRED ALTERNATIVE CEPT HYDRAULIC PROFILE

SHEET **FIG 8-2**

SCALE: NTS | DESIGNED: JF | CHECKED: | DRAWN: MTC | DATE: 10/2011 | PAGE NO. 104



NOTES:

1. THE FOLLOWING ITEMS ARE NOT SHOWN FOR CLARITY:
   - WATER LINES, VALVES AND HYDRANTS
   - UNDERGROUND ELECTRICAL LINES
   - UNDERGROUND TELEPHONE LINES

SURVEY NOTES:

THIS MAP WAS DEVELOPED USING THE FOLLOWING SOURCES.

1. AEROMAP U.S., INC DATED 8-27-1994.
2. SEGESSER SURVEYS DATED SEPTEMBER 2005.
3. ELEVATIONS FOR THE EXISTING SEWER SYSTEM ARE BASED ON RECORD INFORMATION SHOWN ON REGAN ENGINEERING DRAWING: WASTEWATER TREATMENT PLANT UPGRADE, SHEET C-2, SITE PLAN, REV. 1 ASBUILT DATE, 04-01-2001.
4. CITY OF UNALASKA SURVEY OF WWTP SITE DATED DECEMBER 2010.

LEGEND:

○	SEWER MANHOLE
——S——	SEWER MAIN
——FM——	SEWER FORCE MAIN

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UNALASKA

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PREFERRED ALTERNATIVE CEPT SITE PLAN

SHEET **FIG 8-3**

SCALE: NTS | DESIGNED: JF | CHECKED: | DRAWN: MTC | DATE: 10/2011 | PAGE NO. 105

User: PSIMON Oct 03, 2011 - 2:36pm
Drawing: S:\CAD\UNALASKA\10-10206_FAC PLAN\DWG\F10-10026_8-3.DWG - Layout: HP 5200 MONO
Xrefs: (DIESEL evaluation failed) - Images: BHCLOGO BW.JPG BHCLOGO BW.JPG