RFI 56a
Pebble Project EIS

Request for Information

Title/Subject:	**Final Compensatory Mitigation Plan**
Requestor:	**Shane McCoy**
Date Transmitted:	**3/1/2019**
Recipient:	**Pebble Limited Partnership (PLP)**
Response Requested by:	**08/1/2019**
Rationale:	A compensatory mitigation plan (CMP) will be used in our determination whether the proposal is in compliance with the 404(b)(1) guidelines and the public interest review, and to inform the NEPA analysis.
Describe the Information Requested and Level of Detail:	A draft/conceptual CMP was provided by PLP and was appended to the draft EIS. We request the following: A final CMP, which describes how unavoidable impacts to waters of the US would be offset, and which is written in accordance with 33 CFR Part 332.

Recipient Response Form

Date Received from USACE:	Click here to enter text.
Response from Recipient (Describe Information Requested to the Level of Detail Requested; Provide Attachments as Needed):	Please see attached Draft Plan
List Number and Type of Response Attachments:	PLP CMP (PLP006-20-003D8) LR.pdf
Date Returned to USACE:	Click here to enter text.

AECOM Intake Form

Date Response was Received:	1/27/2020
Received by:	AECOM
Describe any Follow-up Related to this RFI:	Click here to enter text.

DRAFT REPORT

Pebble Project
DRAFT Compensatory Mitigation Plan

January 2020

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Figure 1 Geographic extent of the watershed analysis
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ACRONYMS AND ABBREVIATIONS

ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
ANCSA	Alaska Native Claims Settlement Act
ANTHC	Alaska Native Tribal Health Consortium
AWM	Alaska Wetlands Map
BBNA	Bristol Bay Native Association
CFR	Code of Federal Regulations
CMP	Compensatory Mitigation Plan
CWA	Clean Water Act
DA	Department of the Army
ECHO	Enforcement and Compliance History Online
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FPID	Fish Passage Inventory Database
HGM	Hydrogeomorphic
HUC	Hydrologic Unit Code
IHS	Indian Health Service
ILF	In-lieu Fee
MOU	Memorandum of Understanding
NLCD	National Land Cover Database
NWI	National Wetland Inventory
OCS	Outer Continental Shelf
PJD	Preliminary Jurisdictional Determination
PLP	Pebble Limited Partnership
PRM	Permittee-responsible Mitigation
RHA	Rivers and Harbors Act
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WEAR	Waste Erosion Assessment and Review
WOUS	Waters of the U.S., including wetlands

1. Introduction

Pebble Limited Partnership (PLP) submitted a Department of the Army (DA) application, pursuant to Section 404 of the Clean Water Act (CWA) and Section 10 of the Rivers and Harbors Act (RHA) of 1899 to the U.S. Army Corps of Engineers (USACE) on December 22nd, 2017 for the Pebble Project (Project) (POA-2017-271). A revised application was submitted in January 2018. The DA application proposed the development of a copper-gold-molybdenum porphyry deposit as a surface mine in Southwest Alaska. A list of relevant PLP DA application submittals and supporting documentation, including upcoming revisions, is provided in Table 1-1. The Project is located on State of Alaska and private (Alaska Native Claims Settlement Act [ANCSA] corporation) lands in Southwest Alaska near Iliamna Lake, primarily within the Lake and Peninsula Borough, with a portion of the supporting infrastructure in Cook Inlet Outer Continental Shelf (OCS) waters, and in the Kenai Peninsula Borough. The Project consists of four primary project elements: the mine site, the transportation corridor, the Amakdedori Port, and the natural gas pipeline.

The associated discharges of dredged or fill materials in Waters of the U.S. (WOUS), including wetlands, are subject to Section 404 of the CWA, except for those of the natural gas pipeline in OCS waters. The construction of Project elements in the navigable waters of Iliamna Lake and Cook Inlet are subject to Section 10 of the RHA, including those in OCS waters. Construction of the Project will permanently fill approximately 2,227 acres of WOUS, including wetlands, subject to Section 404 of the CWA.

PLP is submitting this Draft Compensatory Mitigation Plan (CMP) to the USACE in fulfillment of the requirements established by the Compensatory Mitigation for Losses of Aquatic Resources Final Rule (The Rule) issued by the USACE and the U.S. Environmental Protection Agency (EPA) on April 10, 2008. The Rule emphasized the selection of compensatory mitigation sites on a watershed basis, established the operating standards for mitigation providers, and identified three mechanisms to accomplish compensatory mitigation: 1) mitigation banks, 2) in-lieu fee (ILF) programs, and 3) permittee-responsible mitigation (PRM) plans.

This CMP follows The Rule's requirements and the requirements of the June 15, 2018 Memorandum of Understanding (2018 MOU) between USACE and EPA regarding Mitigation Sequence for Wetlands in Alaska under Section 404 of the CWA (EPA, DA 2018).

PLP's analysis of the three mechanisms to compensate for the loss of wetlands and aquatic resource functions in the watershed is presented in the following sections.

Table 1-1 PLP DA application submissions and supporting documentation to USACE

Submitted to USACE	Document Name	Remarks
December 2017	Department of the Army permit application package (POA-2017-271)	
December 2017	Preliminary Jurisdictional Determination (PJD)	Accepted by USACE on March 20th, 2018.
January 2019	Revised Department of the Army permit application package (POA-2017-271)	A revised DA application reflecting updates to the project description was submitted to USACE.
April 2019	Revised Preliminary Jurisdictional Determination (PJD R2)	Revised wetlands PJD with additional wetlands fieldwork conducted in 2018.
November 2019	Revised Preliminary Jurisdictional Determination (PJD R3)	Revised wetlands PJD with additional wetlands fieldwork conducted in 2019.
January 2019	Draft Conceptual Compensatory Mitigation Plan	*This November 2019 plan supersedes the Draft Conceptual Compensatory Mitigation Plan*

2. Proposed Project

The Pebble Project comprises four primary elements: The mine site at the Pebble deposit location; one port site in Kamishak Bay in Cook Inlet and two ferry terminals in Iliamna Lake; a road corridor connecting the mine site, ferry terminals and port; and a natural gas pipeline connecting to existing infrastructure on the Kenai Peninsula.

- Mine Site. The proposed mine site is in the Iliamna region of Southwest Alaska, approximately 200 miles southwest of Anchorage and 60 miles west of Cook Inlet. The closest communities are the villages of Iliamna, Newhalen, and Nondalton, each approximately 17 miles from the mine site in a general easterly direction. The fully developed mine site will include the open pit, tailings storage facilities, overburden stockpiles, material sites, water management ponds, milling and processing facilities, and supporting infrastructure such as the power plant, water treatment plants, camp facilities, and storage facilities.

- Transportation Corridor. The proposed transportation corridor will connect the mine site to the proposed Amakdedori Port on Cook Inlet, and includes two main components: 1) a private, double-lane road extending 35 miles south from the mine site to a ferry terminal at Eagle Bay on Iliamna Lake; and 2) a private, double-lane road extending 37 miles southeast from the south ferry terminal to the Amakdedori Port on Kamishak Bay. Separate spur roads will connect the transportation corridor to the villages of Iliamna, Newhalen, and Kokhanok.

- Port and Ferry Terminals. The port site will be located north of the Amakdedori Creek outflow into Kamishak Bay on the western shore of Cook Inlet, approximately 190 miles southwest of Anchorage and approximately 95 miles southwest of Homer. The port site will include shore-based and marine facilities for the transfer, shipment, and temporary storage of concentrate, freight, and fuel for the

Project. The marine component includes a caisson supported causeway extending out to wharf located in 15 feet of natural water depth. Copper-gold concentrate containers will be loaded onto lightering barges at the Amakdedori Port and then transported to one of two lightering locations for transfer to bulk carriers. The primary lightering location is approximately 12 miles offshore due east of the proposed Amakdedori Port, the alternative lightering location is approximately 18 miles east-northeast of the proposed Amakdedori Port between Augustine Island and the mainland. The lightering locations will consist of permanently anchored buoys for mooring the bulk carriers. Two ferry terminals, one on the north shore of Iliamna Lake (located approximately 6.0 miles east of Iliamna) and the other on the south shore of the lake (located approximately 5.1 miles west of the village of Kokhanok), would support the operation of an ice-breaking ferry to transport materials, equipment, and concentrate 28 miles across Iliamna Lake.

- Natural Gas Pipeline and Fiber Optic Cable. Natural gas will be the primary energy source for the Pebble Project. The natural gas pipeline alignment will connect to an existing natural gas pipeline, and new compressor station located north of Anchor River on the Kenai Peninsula. From there, the pipeline heads southwest across Cook Inlet before turning west to a landfall at the Amakdedori Port. The pipeline then follows the transportation corridor from the port to the south ferry terminal. At the south ferry terminal, the pipeline trends north along the lakebed of Iliamna Lake and makes landfall west of the community of Newhalen, where it continues north and rejoins the mine access road. From there, the pipeline continues west towards the mine site following the mine access road. A fiber optic cable would be co-located with the pipeline.

3. WOUS Fill Impacts from Proposed Project

Construction of the Project will require the discharge of fill material into 3,083 acres of WOUS. This includes 2,227 acres of permanent impacts and 856 acres of temporary impacts in WOUS (Table 3-1). Permanent impacts include cut and fill activities at facility locations where the fill cannot be practicably removed from WOUS. Temporary impacts occur where fill is placed into wetlands or WOUS for a limited period during construction to facilitate construction activities, then removed allowing return of wetland functions.

Two categories of temporary impacts have been identified for the Project:

1) Construction of the transportation corridor infrastructure from Amakdedori to the mine site will, in some areas, require the temporary placement of fill consisting of mixed vegetative matter and topsoil, or rock and soil from cuts, into areas adjacent to the toe of the defined roadbed and associated pipeline trench. Any such material would typically be placed on one side (the downslope side) of the road. Typical road construction through wetlands would consist of the placement of a coarse rock fill and/or geotextile and fill directly to the existing surface and should not require the temporary storage of material adjacent to the road toe. Furthermore, wetland areas would be flagged ahead of construction and reasonable efforts would be made to avoid impacts beyond the permanent road footprint. However, to address this potential for temporary construction impacts PLP has assumed a 30-foot buffer on each side of the permanently impacted footprint for the transportation corridor. These construction-related impacts to wetlands will occur over a period of approximately one year.

2) Placement of the heavy-wall pipe on the Cook Inlet seabed and Iliamna Lake lakebed has the potential to result in temporary impacts associated with pipe placement activities (i.e. trenching). These temporary construction-related impacts to wetlands will typically have a duration of a few days to a few weeks at any given location. Cross country construction of the pipeline where it is not coincident with the road will also result in temporary construction impacts and PLP has assumed a 150-foot wide construction corridor for these areas. These construction-related impacts to wetlands will occur over a period of approximately two years.

The Project has prepared a Restoration Plan that describes the processes and measures that PLP will implement to restore temporary impacted areas on land (Owl Ridge 2019).

A Preliminary Jurisdictional Determination (PJD) report was prepared for the Project (HDR 2019). As part of the data collection and mapping inventory, WOUS, including wetlands, and uplands were classified by an Enhanced National Wetlands Inventory (ENWI) classification code. The classification codes are based on the Classification of Wetlands and Deepwater Habitats of the United States (Cowardin, et al. 1979) and NWI Mapping Conventions (USFWS (U.S. Fish and Wildlife Service) 1995).

Hydrogeomorphic (HGM) coding was also applied to the mapping and was based on Hydrogeomorphic Classification for Wetlands (Brinson 1993). Lacustrine waters and riverine channel waters are HGM map codes specific to the Project. While lacustrine fringe wetlands occur adjacent to lakes, the lakes themselves are classified as lacustrine waters, and small wetlands and flowing WOUS contained within an active channel are classified as riverine channel waters (HDR 2019).

A summary of permanent and temporary WOUS impacts grouped by HGM and Cowardin classifications for each project element is provided in Table 3-2. Cowardin classification were grouped by System, Subsystem (if defined) and Class. Most permanent discharges of fill for the mine site and transportation corridor will impact slope palustrine scrub-shrub, and slope-emergent WOUS (Table 3-2).

Riverine channel waters impacted by the project include approximately 8.8 miles of anadromous streams, including 8.5 miles of permanent impacts and 0.3 miles of temporary impacts (Table 3-3).

Table 3-1 Summary of permanent and temporary WOUS impacts (acres)

Facility	Permanent	Temporary	Total Acres | %	
Mine Site	2,162.63	-	2,162.63	70.1%
Transportation Corridor	60.54	46.52	107.06	3.5%
Port and Ferry Terminals	2.33	5.02	7.35	0.2%
Natural Gas Pipeline	0.99	805.23	806.22	26.2%
Total	2,226.49	856.77	3,083.26	100.0%

Table 3-2 Summary of permanent and temporary WOUS impacts (acres) by project element

HGM and Cowardin Classification	Permanent Impacts					Temporary Impacts				
	Mine Site	Natural Gas Pipeline	Port	Transportation Corridor	Permanent Total	Natural Gas Pipeline	Port	Transportation Corridor	Temporary Total	Grand Total
DEPRESSIONAL WETLANDS	**50.33**	**-**	-	**0.87**	**51.19**	**1.75**	**-**	**1.03**	**2.78**	**53.97**
Palustrine Aquatic Bed	-	-	-	-	**-**	0.12	-	-	**0.12**	**0.12**
Palustrine Emergent	4.79	-	-	0.09	**4.87**	1.44	-	0.16	**1.60**	**6.47**
Palustrine Scrub-Shrub	6.91	-	-	0.31	**7.22**	0.02	-	0.27	**0.29**	**7.51**
Palustrine Unconsolidated Bottom	29.96	-	-	0.27	**30.23**	0.02	-	0.36	**0.38**	**30.61**
Palustrine Unconsolidated Shore	8.67	-	-	0.20	**8.87**	0.15	-	0.24	**0.39**	**9.27**
FLAT WETLANDS	**8.35**	**-**	-	**0.69**	**9.04**	**7.92**	-	**0.68**	**8.60**	**17.64**
Palustrine Emergent	2.67	-	-	0.33	**3.00**	1.64	-	0.30	**1.94**	**4.94**
Palustrine Scrub-Shrub	5.68	-	-	0.36	**6.04**	6.28	-	0.38	**6.66**	**12.69**
LACUSTRINE WATERS	-	**0.99**	-	**1.67**	**2.66**	**156.03**	-	**2.20**	**158.23**	**160.89**
Lacustrine Limnetic Unconsolidated Bottom	-	0.99	-	0.97	**1.96**	155.82	-	1.58	**157.40**	**159.36**
Lacustrine Littoral Unconsolidated Bottom	-	-	-	0.23	**0.23**	-	-	0.07	**0.07**	**0.30**
Lacustrine Littoral Unconsolidated Shore	-	-	-	0.47	**0.47**	0.21	-	0.55	**0.76**	**1.23**
LACUSTRINE FRINGE WETLANDS	**0.04**	-	-	-	**0.04**	**-**	-	-	**-**	**0.04**
Palustrine Emergent	0.04	-	-	-	**0.04**	-	-	-	**-**	**0.04**
MARINE WATERS	-	-	**2.33**	-	**2.33**	**627.12**	**5.02**	-	**632.14**	**634.47**
Marine Intertidal Unconsolidated Shore	-	-	0.07	-	**0.07**	0.90	0.78	-	**1.68**	**1.74**
Marine Subtidal Unconsolidated Bottom	-	-	2.26	-	**2.26**	626.22	4.24	-	**630.46**	**632.72**
RIVERINE WETLANDS	**125.15**	-	-	**1.72**	**126.87**	**1.51**	-	**1.45**	**2.96**	**129.83**
Palustrine Emergent	41.51	-	-	0.20	**41.71**	0.22	-	0.16	**0.38**	**42.09**
Palustrine Forested	-	-	-	0.09	**0.09**	0.42	-	0.28	**0.70**	**0.79**
Palustrine Scrub-Shrub	76.46	-	-	1.31	**77.77**	0.87	-	0.93	**1.80**	**79.57**
Palustrine Unconsolidated Bottom	7.18	-	-	0.11	**7.29**	-	-	0.09	**0.09**	**7.38**
RIVERINE CHANNEL WATERS	**49.67**	-	-	**1.76**	**51.44**	**0.32**	-	**1.57**	**1.89**	**53.32**
Riverine Intermittent Streambed	3.81	-	-	0.24	**4.05**	0.01	-	0.16	**0.17**	**4.22**
Riverine Lower Perennial Unconsolidated Bottom	-	-	-	-	**-**	-	-	0.04	**0.04**	**0.04**
Riverine Upper Perennial Unconsolidated Bottom	44.27	-	-	1.52	**45.78**	0.30	-	1.31	**1.61**	**47.40**
Riverine Upper Perennial Unconsolidated Shore	1.60	-	-	0.00	**1.60**	-	-	0.07	**0.07**	**1.67**
SLOPE WETLANDS	**1,929.09**	-	-	**53.83**	**1,982.92**	**10.59**	-	**39.59**	**50.18**	**2,033.11**
Palustrine Aquatic Bed	2.13	-	-	0.14	**2.27**	-	-	0.11	**0.11**	**2.38**
Palustrine Emergent	547.29	-	-	12.96	**560.26**	2.62	-	9.15	**11.77**	**572.03**
Palustrine Forested	-	-	-	1.88	**1.88**	-	-	1.32	**1.32**	**3.20**
Palustrine Scrub-Shrub	1,365.85	-	-	33.36	**1,399.21**	7.97	-	24.85	**32.83**	**1,432.03**
Palustrine Unconsolidated Bottom	11.63	-	-	5.41	**17.04**	-	-	4.09	**4.09**	**21.13**
Palustrine Unconsolidated Shore	2.19	-	-	0.08	**2.27**	-	-	0.06	**0.06**	**2.33**
Grand Total	**2,162.63**	**0.99**	**2.33**	**60.54**	**2,226.49**	**805.23**	**5.02**	**46.52**	**856.78**	**3,083.26**

Note: Minor discrepancies in totals are the result of rounding numbers.

Table 3-3 Miles of anadromous streams impacted by the Project

Impact in miles	Impact Duration					
	Permanent	Temporary				Grand Total
HUC10 Watershed	Headwaters Koktuli River	Iliamna Lake	Newhalen River	Upper Talarik Creek	Amakdedori Creek-Frontal Kamishak Bay	
Mine Site	8.5	--	--	--	--	8.5
Transportation Corridor	--	0.04	0.07	0.08	0.02	0.21
Natural Gas Pipeline	--	--	0.03	--	--	0.03
Grand Total	8.5	0.04	0.10	0.08	0.02	8.74

4. Compensatory Mitigation

PLP has avoided and minimized, to the extent practicable, discharges of fill into WOUS, including wetlands: avoidance and minimization measures are discussed in Block 23 of the DA Application. PLP is proposing compensatory mitigation for 2,227 acres of permanent unavoidable impacts to WOUS and aquatic resource functions in the watersheds. PLP is not proposing compensatory mitigation for 857 acres of temporary impacts (including 464 acres in OCS waters that are not subject to Section 404 of the CWA), as those WOUS and functions are expected to recover in the short term after restoration. The proposed permanent impacts are distributed among six Hydrologic Unit Code (HUC) 10 watersheds. A summary of permanent WOUS impacts grouped by HGM and Cowardin classification for each HUC 10 watershed is provided in Table 4-1. Most of the proposed WOUS impacts (97% or 2,158 acres) are in the Headwaters Koktuli River HUC 10 watershed. Impacts to 'open waters' such as streams, lakes and marine waters have been minimized to the extent practicable. Discharges of fill at the mine site would be placed in 125 acres of riverine wetland HGM with mostly palustrine scrub-shrub and emergent wetlands, and 50 acres of riverine channel water HGM, mainly palustrine upper perennial. Construction of the Amakdedori Port will discharge fill in 2.2 acres of marine water HGM, including 0.1 acre of marine intertidal WOUS and 2.1 acres of marine subtidal WOUS. Construction of the ferry terminals would require the discharge of fill into 0.04 acres of lacustrine fringe wetland HGM.

The Rule emphasizes the selection of compensatory mitigation sites using a watershed approach and established three types of compensatory mitigation mechanisms: (1) mitigation banks, (2) ILF programs, and (3) permittee-responsible mitigation plans. PLP consulted the Regulatory In-Lieu Fee and Bank Information Tracking System (RIBITS) and confirmed the existence of The Conservation Fund ILF with a service area that includes the Project (USACE 2018). However, as of October 16, 2017 the fund is no longer authorized to sell credits (USACE 2017). The Project is not located in the service area of an approved bank or ILF with appropriate credits available. In the absence of mitigation banks or an ILF program in the watersheds, 33 Code of Federal Regulation [CFR] 332.3 (b)(4) states that "permittee-responsible mitigation is the only option." Three PRM options are identified in The Rule and 2018 MOU. PRM projects using a watershed approach are most favored. Such projects consider the needs of the watershed for advancing and sustaining aquatic resource functions, such as the need for specific habitat enhancements, water quality improvements, or flood control. On-site, in-kind PRM projects replace the specific wetland functions and values that are

impacted at the same location as the fill site. Off-site, out-of-kind PRM projects focus on preserving, creating, restoring and enhancing WOUS with different functions and values than the impacted WOUS.

Table 4-1 Summary of permanent WOUS impacts (acres) by HUC 10 watershed

HGM and Cowardin Classification	Headwaters Koktuli River	Newhalen River	Iliamna Lake	Gibraltar Lake	Upper Talarik Creek	Amakdedori Creek-Frontal Kamishak Bay	Cook Inlet	Total
MARINE WATERS						**2.18**	**0.15**	**2.33**
Marine Subtidal Unconsolidated Bottom						2.11	0.15	**2.26**
Marine Intertidal Unconsolidated Shore						0.07		**0.07**
LACUSTRINE WATERS			**2.36**	**0.00**		**0.30**		**2.66**
Lacustrine Limnetic Unconsolidated Bottom			1.95	0.00		0.00		**1.96**
Lacustrine Littoral Unconsolidated Bottom						0.23		**0.23**
Lacustrine Littoral Unconsolidated Shore			0.41			0.06		**0.47**
LACUSTRINE FRINGE WETLANDS	**0.04**							**0.04**
Palustrine Emergent	0.04							**0.04**
RIVERINE WETLANDS	**125.15**	**0.63**	**0.06**		**1.03**			**126.87**
Palustrine Emergent	41.51				0.20			**41.71**
Palustrine Forested		0.09						**0.09**
Palustrine Scrub-Shrub	76.46	0.53	0.06		0.72			**77.77**
Palustrine Unconsolidated Bottom	7.18				0.11			**7.29**
RIVERINE CHANNEL WATERS	**49.68**	**0.13**	**0.69**	**0.20**	**0.16**	**0.58**		**51.44**
Riverine Intermittent Streambed	3.81		0.03	0.02	0.01	0.18		**4.05**
Riverine Upper Perennial Unconsolidated Bottom	44.27	0.13	0.66	0.18	0.15	0.40		**45.78**
Riverine Upper Perennial Unconsolidated Shore	1.60				0.00	0.00		**1.60**
FLAT WETLANDS	**8.35**	**0.29**			**0.40**			**9.04**
Palustrine Emergent	2.67				0.33			**3.00**
Palustrine Scrub-Shrub	5.68	0.29			0.07			**6.04**

HGM and Cowardin Classification	Headwaters Koktuli River	Newhalen River	Iliamna Lake	Gibraltar Lake	Upper Talarik Creek	Amakdedori Creek-Frontal Kamishak Bay	Cook Inlet	Total
SLOPE WETLANDS	**1,925.27**	**3.33**	**19.29**	**8.28**	**12.61**	**14.15**		**1,982.92**
Palustrine Aquatic Bed	2.13		0.14					**2.27**
Palustrine Emergent	546.47		5.06	2.36	1.75	4.62		**560.26**
Palustrine Forested		0.30	1.58					**1.88**
Palustrine Scrub-Shrub	1,362.85	3.03	11.14	4.95	10.85	6.39		**1,399.21**
Palustrine Unconsolidated Bottom	11.63		1.29	0.97	0.01	3.15		**17.04**
Palustrine Unconsolidated Shore	2.19		0.07	0.01				**2.27**
DEPRESSIONAL WETLANDS	**49.90**		**0.55**		**0.74**	**0.01**		**51.19**
Palustrine Emergent	4.72				0.15			**4.87**
Palustrine Scrub-Shrub	6.91		0.31					**7.22**
Palustrine Unconsolidated Bottom	29.70		0.24		0.28	0.01		**30.23**
Palustrine Unconsolidated Shore	8.57				0.31			**8.87**
Grand Total	**2,158.38**	**4.38**	**22.94**	**8.48**	**14.93**	**17.22**	**0.15**	**2,226.49**

Note: Minor discrepancies in totals are the result of rounding numbers.

5. Affected Watersheds Analysis

A watershed approach is used to establish compensatory mitigation requirements to the extent appropriate and practicable (33 CFR 332.2). The watershed approach is an analytical process for making compensatory mitigation decisions that support the sustainability or improvement of aquatic resources in a watershed. It considers watershed needs, and how locations and types of compensatory mitigation projects address those needs. A landscape perspective is used to identify the types and locations of compensatory mitigation projects that will benefit the watershed and offset losses of aquatic resource functions and services caused by activities authorized by DA permits. This section provides a summary of available data used to determine the watershed conditions.

The geographic area of the watershed analysis (Analysis Area) extends over three HUC 6 basins (Nushagak River, Kvichak-Port Heiden, and Western Cook Inlet) and includes 15 HUC 10 watersheds encompassing approximately 3,709,208 acres (Table 5-1, Figure 1 [figures are included in Attachment 1]). The Project footprint includes facilities on the Kenai Peninsula, in the Stariski Creek-Frontal Cook Inlet HUC 10 watershed, but there are no impacts to WOUS, and this watershed is excluded from the Analysis Area. Cook Inlet waters are also excluded from the Analysis Area as WOUS impacts will be minimal (approximately 0.1 acres) or temporary, and no compensatory mitigation is proposed for temporary impacts. Each watershed includes important physical features, ecological processes, and resource types for the sustainability of aquatic resource functions.

Table 5-1 HUC 10 watersheds included in the geographic area of the watershed analysis

HUC 10	Watershed	Project Element	Watershed Acres
Nushagak River (HUC 6)			
1903030211	Headwaters Koktuli River	Mine site	170,635
1903030213	Outlet Koktuli River	Transportation corridor; natural gas pipeline & fiber optic cable	120,176
1903030215	Pine Creek-Mulchatna River	Transportation corridor; natural gas pipeline & fiber optic cable	124,317
1903030217	Outlet Mulchatna River	Downstream of Mine site	232,422
1903030302	Tunravik Creek-Nushagak River	Downstream of Mine site	222,834
1903030307	Lower Klutuk Creek-Nushagak River	Downstream of Mine site	170,512
1903030309	Portage Creek-Nushagak River	Downstream of Mine site	216,422
1903030310	Scandinavian Slough-Nushagak River	Downstream of Mine site	196,184
1903030311	Little Muklung River-Nushagak River	Downstream of Mine site	204,360
1903030608	Nushagak Bay-Frontal Bristol Bay	Downstream of Mine site	329,352
Kvichak-Port Heiden (HUC 6)			
1903020514	Newhalen River	Transportation corridor	119,725
1903020609	Iliamna Lake	Transportation corridor; natural gas pipeline & fiber optic cable	1,201,978
1903020606	Gibraltar Lake	Transportation corridor; natural gas pipeline & fiber optic cable	81,594
1903020607	Upper Talarik Creek	Mine site; transportation corridor; natural gas pipeline & fiber optic cable	87,547
Western Cook Inlet (HUC 6)			
1902060212	Amakdedori Creek-Frontal Kamishak Bay	Transportation corridor; natural gas pipeline and fiber optic cable; Amakdedori Port	231,151
Total			**3,709,208**

Source: USGS Watershed Boundary Dataset, 2018

5.1 Land Cover

The National Land Cover Database (NLCD) (Jim, et al. 2011) provides a rapid estimate of land cover types for watersheds, including percent of developed areas and percent of vegetated cover.

The most abundant land cover in the Analysis Area is scrub-shrub at 39 percent (See Table 5-2). Open water is the second most abundant cover at 22 percent, most of which (90 percent) is Iliamna Lake. Dwarf shrub is the next most widely distributed vegetation types at 19 percent. Barren lands are unvegetated areas that generally occur at hill tops and shorelines and account for approximately one percent of cover types in the Analysis Area. Mixed forest, evergreen forest, and deciduous forest account for approximately 10 percent of cover types. Less than one percent is identified by the NLCD as developed areas, woody wetlands, perennial ice/snow, and moss areas (See Table 5-2). Wetlands mapped in the NLCD are generally undercounted because the data analysis process is not optimized for this purpose. Wetlands are discussed in section 5.2.

5.2 Wetlands and Other Waters

Using a consistent dataset for the calculation of wetlands is desired for equitable assessment of habitat types on a broad level. Three wetlands datasets provide varying coverage of the Analysis Area: Alaska Wetlands Mapping (AWM), National Wetlands Inventory (NWI), and PLP wetlands mapping. Only one available dataset, the AWM, covers the entire area with a uniform method of analysis and scale. The AWM is derived from L-band radar imagery acquired by Japanese Earth Resources Satellite (JERS-1) synthetic aperture radar (SAR) and is available with a resolution of 100-meter pixels. The U.S. Fish and Wildlife Service (USFWS) NWI dataset covers approximately 60 percent of the Analysis Area and would need to be supplemented by the AWM dataset. The Headwaters Koktuli River is the only watershed covered 100 percent by the NWI data. A third dataset available is the PLP wetlands mapping for the immediate vicinity of the Project footprint and includes 89 percent of the surface area in the Headwaters Koktuli River watershed. The PLP wetlands data outside the Headwaters Koktuli River watershed are generally limited to the transportation corridor and are of limited use in the evaluation of the Analysis Area.

Most of the proposed Project wetland impacts are in the Headwaters Koktuli River watershed. It is appropriate to provide and use the most accurate data for that portion of the Analysis Area. The PLP-generated data for the Headwaters Koktuli River is provided in Table 5-3. Since the PLP wetlands mapping only includes 89 percent of the surface area in the Headwaters Koktuli River watershed, NWI data were used to supplement the remaining 11 percent of the watershed (Table 5-4). The AWM dataset is the only consistent dataset for the entire Analysis Area and was used for the remainder of the watersheds and is provided in Table 5-5. The AWM provides only wetlands; therefore, other waters were calculated from the National Hydrography Dataset 1:63,360 scale mapping (USGS 2018).

The Headwaters Koktuli River watershed includes approximately 59,581 acres of wetlands, including 48,693 acres mapped by PLP and 10,888 acres mapped by the NWI. Slope palustrine scrub-shrub (42.65%), slope palustrine emergent (18.3%) and riverine palustrine scrub-shrub (12.01%) and emergent (4.44%) are the most abundant wetlands mapped by PLP in the watershed (Table 5-3). The NWI data are not grouped by HGM, but palustrine scrub-shrub (71.74%) and palustrine emergent (23.93%) are the most widely distributed wetlands (Table 5-4).

Table 5-2 NLCD Classification for the watershed Analysis Area

	Nushagak River										Kvichak-Port Heiden				Western Cook Inlet	
Land Cover Class	Headwaters Koktuli River (%)	Outlet Koktuli River (%)	Pine Creek-Mulchatna River (%)	Outlet Mulchatna River (%)	Tunravik Creek-Nushagak River (%)	Lower Klutuk Creek-Nushagak River (%)	Portage Creek-Nushagak River (%)	Scandinavian Slough-Nushagak River (%)	Little Muklung River-Nushagak River (%)	Nushagak Bay-Frontal Bristol Bay (%)	Newhalen River (%)	Iliamna Lake (%)	Gibraltar Lake (%)	Upper Talarik Creek (%)	Amakdedori Creek-Frontal Kamishak Bay (%)	Analysis Area Total (%)
Barren Land	2	<1	<1	<1	<1	<1	<1	0	<1	1	3	3	4	<1	9	1
Deciduous Forest	<1	3	3	1	3	3	2	2	3	<1	5	3	4	2	3	2
Developed, High Intensity	<1	0	0	0	0	0	0	0	0	0	<1	<1	<1	<1	<1	<1
Developed, Low Intensity	<1	0	0	0	0	0	0	0	<1	0	<1	<1	<1	<1	<1	<1
Developed, Medium Intensity	<1	0	0	0	0	0	0	0	0	0	<1	<1	<1	<1	<1	<1
Developed, Open Space	<1	0	0	0	0	0	0	0	0	0	<1	<1	<1	<1	<1	<1
Dwarf Shrub	42	22	22	19	22	17	22	23	23	6	13	12	38	47	13	19
Emergent Herbaceous Wetlands	<1	<1	<1	2	2	9	12	18	13	5	<1	<1	<1	<1	<1	6
Evergreen Forest	2	12	6	4	7	13	6	3	2	<1	11	4	<1	2	<1	5
Mixed Forest	<1	2	2	3	3	5	3	3	2	<1	11	5	1	<1	<1	3
Moss	<1	<1	0	0	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Open Water	2	1	4	5	6	7	7	6	17	74	9	57	6	2	3	22
Perennial Ice/Snow	<1	0	0	0	0	0	0	0	0	0	<1	<1	<1	<1	<1	<1
Sedge/Herbaceous	<1	<1	<1	4	4	7	9	3	<1	<1	<1	<1	<1	<1	<1	3
Shrub/Scrub	51	58	61	61	52	39	38	42	37	13	46	16	46	46	71	39
Woody Wetlands	<1	<1	<1	<1	<1	<1	1	<1	3	<1	1	<1	<1	<1	<1	<1
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Source: National Land Cover Database (Jim, et al. 2011). Differences in the acreage between the above and those shown in Table 5-1 are a result of the differences in data resolution and data types (vector versus raster data).

Table 5-3 Wetlands and other waters mapped by PLP in the Headwaters Koktuli River

HGM and Cowardin Classification	Acres	%
Lacustrine Waters	**975.0**	**2.00%**
Lacustrine Limnetic Unconsolidated Bottom	844.4	1.73%
Lacustrine Littoral Aquatic Bed	10.1	0.02%
Lacustrine Littoral Unconsolidated Bottom	33.0	0.07%
Lacustrine Littoral Unconsolidated Shore	33.8	0.07%
Palustrine Emergent	1.1	<0.01%
Palustrine Unconsolidated Bottom	51.0	0.10%
Palustrine Unconsolidated Shore	2.7	0.01%
Lacustrine Fringe Wetlands	**126.7**	**0.26%**
Lacustrine Littoral Emergent	0.3	0.00%
Lacustrine Littoral Unconsolidated Shore	9.4	0.02%
Palustrine Emergent	50.7	0.10%
Palustrine Moss-Lichen	0.2	<0.01%
Palustrine Scrub-Shrub	64.8	0.13%
Palustrine Unconsolidated Bottom	0.5	<0.01%
Palustrine Unconsolidated Shore	0.9	<0.01%
Riverine Wetlands	**8,345.6**	**17.14%**
Palustrine Aquatic Bed	1.8	<0.01%
Palustrine Emergent	2,163.4	4.44%
Palustrine Forested	38.5	0.08%
Palustrine Moss-Lichen	2.9	0.01%
Palustrine Scrub-Shrub	5,847.3	12.01%
Palustrine Unconsolidated Bottom	160.6	0.33%
Palustrine Unconsolidated Shore	67.6	0.14%
Riverine Intermittent Streambed	0.1	<0.01%
Riverine Lower Perennial Unconsolidated Bottom	41.5	0.09%
Riverine Lower Perennial Unconsolidated Shore	19.1	0.04%
Riverine Upper Perennial Aquatic Bed	<0.01	<0.01%
Riverine Upper Perennial Unconsolidated Bottom	2.2	<0.01%
Riverine Upper Perennial Unconsolidated Shore	0.5	<0.01%
Riverine Channel Waters	**1,070.0**	**2.20%**
Palustrine Aquatic Bed	1.0	<0.01%
Palustrine Emergent	0.3	<0.01%
Palustrine Unconsolidated Bottom	38.1	0.08%
Palustrine Unconsolidated Shore	6.0	0.01%
Riverine Intermittent Streambed	64.1	0.13%
Riverine Lower Perennial Aquatic Bed	19.1	0.04%
Riverine Lower Perennial Emergent	0.3	<0.01%
Riverine Lower Perennial Unconsolidated Bottom	166.6	0.34%
Riverine Lower Perennial Unconsolidated Shore	9.1	0.02%
Riverine Upper Perennial Emergent	0.1	<0.01%
Riverine Upper Perennial Unconsolidated Bottom	635.7	1.31%
Riverine Upper Perennial Unconsolidated Shore	129.6	0.27%
Flat Wetlands	**6,599.8**	**13.55%**
Palustrine Aquatic Bed	<0.1	<0.01%
Palustrine Emergent	1,623.7	3.33%
Palustrine Forested	0.2	<0.01%
Palustrine Moss-Lichen	33.7	0.07%
Palustrine Scrub-Shrub	4,917.6	10.10%

HGM and Cowardin Classification	Acres	%
Palustrine Unconsolidated Bottom	4.1	0.01%
Palustrine Unconsolidated Shore	20.3	0.04%
Riverine Intermittent	<0.1	<0.01%
Slope Wetlands	**29,813.9**	**61.23%**
Palustrine Aquatic Bed	6.1	0.01%
Palustrine Emergent	8,911.2	18.3%
Palustrine Forested	2.2	<0.01%
Palustrine Moss-Lichen	27.5	0.06%
Palustrine Scrub-Shrub	20,768.5	42.65%
Palustrine Unconsolidated Bottom	69.3	0.14%
Palustrine Unconsolidated Shore	28.3	0.06%
Riverine Upper Perennial Unconsolidated Bottom	0.3	<0.01%
Riverine Upper Perennial Unconsolidated Shore	0.5	<0.01%
Depressional Wetlands	**1,561.2**	**3.21%**
Lacustrine Littoral Unconsolidated Shore	<0.1	<0.01%
Palustrine Aquatic Bed	4.8	0.01%
Palustrine Emergent	155.3	0.32%
Palustrine Moss-Lichen	0.5	<0.01%
Palustrine Scrub-Shrub	172.7	0.35%
Palustrine Unconsolidated Bottom	913.1	1.88%
Palustrine Unconsolidated Shore	314.8	0.65%
N/A	**201.3**	**0.41%**
Palustrine Emergent	2.6	0.01%
Palustrine Scrub-Shrub	197.9	0.41%
Palustrine Unconsolidated Shore	0.9	<0.01%
Grand Total	**48,693.5**	**100%**

Source: PLP mapped wetlands. Minor discrepancies in totals are the result of rounding numbers.

Table 5-4 NWI wetlands and other waters in the Headwaters Koktuli River outside PLP mapped wetlands Analysis Area

Cowardin Classification	Acres	%
Palustrine Emergent	2,605.4	23.93%
Palustrine Scrub-Shrub	7,811.1	71.74%
Palustrine Unconsolidated Bottom	248.4	2.28%
Riverine Unknown Perennial Unconsolidated Bottom	222.8	2.05%
Grand Total	**10,887.7**	**100%**

Source: USFWS NWI mapped wetlands.

For the remaining Analysis Area watersheds, the percentage of wetlands and other waters ranges from 14 percent in the Amakdedori Creek-Frontal Kamishak Bay watershed, to 100 percent in the Lower Klutuk Creek-Nushagak River watershed (Table 5-5). The most abundant wetlands types are palustrine scrub-shrub and emergent. The Newhalen River, Iliamna Lake, Gibraltar Lake, and Upper Talarik Creek HUC 10 watersheds contain many rivers and streams that drain into Iliamna Lake. At 1,012 sq. mi, 77 miles long, up to 22 miles wide, and up to 984 feet deep, Iliamna Lake is the largest fresh-water waterbody in the Analysis Area. The Kvichak River drains from Iliamna Lake southwest into Bristol Bay.

Table 5-5 Wetlands and other waters of HUC 10 Watersheds, outside of the Headwaters Koktuli River watershed

	Nushagak River										Kvichak-Port Heiden			Western Cook Inlet	
Wetlands and Other Waters	Outlet Koktuli River	Pine Creek-Mulchatna River	Outlet Mulchatna River	Tunravik Creek-Nushagak River	Lower Klutuk Creek-Nushagak River	Portage Creek-Nushagak River	Scandinavian Slough-Nushagak River	Little Muklung River-Nushagak River	Nushagak Bay-Frontal Bristol Bay	Newhalen River	Iliamna Lake	Gibraltar Lake	Upper Talarik Creek	Amakdedori Creek-Frontal Kamishak Bay	Analysis Area Total
Estuarine															
Emergent (ac)	0	0	0	0	0	0	0	0	0	0	15	0	0	1,525	1,540
Forested (ac)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total (ac)	0	0	0	0	0	0	0	0	0	0	15	0	0	1,525	1,540
Lacustrine															
Emergent (ac)	0	0	0	0	0	0	0	0	0	116	42	0	0	035	193
Total (ac)	0	0	0	0	0	0	0	0	0	116	42	0	0	35	193
Palustrine															
Emergent (ac)	13,658	15,113	2,622	1,147	7,561	33,055	145,011	86,460	77,379	30,908	133,446	7,594	13,200	5,666	572,820
Moss-lichen (ac)	0	10	2	74	0	0	0	0	121	0	0	0	0	0	207
Forested (ac)	0	0	2,370	9,820	15,059	502	0	30	0	59	682	0	44	62	28,628
Scrub-Shrub (ac)	52,233	81,859	206,689	189,532	139,812	164,152	27,231	63,489	52	25,610	136,444	13,964	22,111	20,240	1,143,418
Total	65,891	96,982	211,683	200,573	162,432	197,709	172,242	149,979	77,552	56,577	270,572	21,558	35,355	25,968	1,745,073
Other Waters															
Ice (Glacier) (ac)	0	0	0	0	0	0	0	0	0	0	0	38	0	0	38
Lakes (ac)	955	3,780	9,281	8,941	9,805	9,186	8,700	4,383	3,986	8,075	681,658	5,331	1,680	3,960	759,721
Total (ac)	955	3,780	9,281	8,941	9,805	9,186	8,700	4,383	3,986	8,075	681,658	5,369	1,680	3,960	759,759
Streams (mi)	306	393	851	505	355	502	303	388	112	250	881	91	250	684	5,871
Summary															
Watershed Size (ac)	120,176	124,317	232,422	222,834	170,512	216,422	196,184	204,360	329,352	119,725	1,201,978	81,594	87,547	231,151	3,538,574
Wetlands (ac)	65,891	96,982	211,683	200,573	162,432	197,709	172,242	149,979	77,552	56,693	270,629	21,558	35,355	27,528	1,746,806
Wetlands (%)	55	78	91	90	95	91	88	73	24	47	23	26	40	12	49
Other Waters (ac)	955	3,780	9,281	8,941	9,805	9,186	8,700	4,383	3,986	8,075	681,658	5,369	1,680	3,960	759,759
Other Waters (%)	1	3	4	4	6	4	4	2	1	7	57	7	2	2	21
Wetlands and Other Waters (ac)	66,846	100,762	220,964	209,514	172,237	206,895	180,942	154,362	81,538	64,768	952,287	26,927	39,315	31,488	2,506,565
Wetlands and Other Waters (%)	56	81	95	94	101	96	92	76	25	54	79	33	45	14	71
Streams (mi)	306	393	851	505	355	502	303	388	112	250	881	91	250	684	5,871

Source: Wetlands – Alaska Wetlands Map; Other Waters – National Hydrography Dataset

5.3 Fish and Wildlife

The wetlands and other WOUS in the watersheds provide habitat for mammals, fish, and bird animal species, many of which are of high importance to the ecosystems they inhabit and to the local economies and subsistence lifestyles. Representative indicator animal species in the Analysis Area include:

- Caribou. Caribou (*Rangifer tarandus granti*) in this area are referred to as the Mulchatna Caribou Herd. Caribou prefer tundra habitats. Their distribution in the watersheds include the Headwaters Koktuli River, Upper Talarik Creek, Newhalen River, and the western shores of Iliamna Lake. In the mid-1990s, the caribou population peaked at about 200,000 animals, and then the herd began simultaneously declining in numbers and expanding its range north and west. This current decade the population reached a low of approximately 18,000 caribou; although in 2015 it had shown an increase to over 30,000. During the late 1990s, reported annual harvests peaked at over 5,000 caribou but during the 2010s, the reported harvest has not exceeded 466 caribou per year (Van Lanen 2018).

- Lake Seals. Iliamna Lake provides habitat to a population of freshwater seals, which are believed to be harbor seals (*Phoca vitulina*), although the exact species identification remains uncertain. These seals are unique in that freshwater seal populations are very rare in the northern hemisphere. Over the 28 years of aerial surveys, counts have ranged from zero to more than 300 seals, with the largest numbers occurring during August. The seals spend most of their time in and around the island systems of the northeast portion of the lake and during salmon season feed near the mouths of the lake's tributary rivers and streams. Approximately 3-5 seals are harvested per community per year (Van Lanen 2018).

- Fish. The Bristol Bay watershed, of which these watersheds are a part, support important commercial and sport fisheries for Pacific salmon and other fishes. The watersheds provide spawning and rearing habitat for all species of anadromous Pacific salmon (Figure 2): sockeye (*Oncorhynchus nerka*), coho (*O. kisutch*), Chinook (*O. tshawytscha*), chum (*O. keta*), and pink (*O. gorbuscha*). The most abundant species in the watersheds is sockeye salmon. Waters in the watersheds provide habitat for other fish species, including rainbow trout (*O. mykiss*), Dolly Varden (*Salvelinus malma*), Arctic char (*S. alpinus*), lake trout (*S. namaycush*), Arctic grayling (*Thymallus arcticus*), northern pike (*Esox lucius*), and humpback whitefish (*Coregonus pidschian*). These fishes occupy a variety of habitats in the watershed, from headwater streams to wetlands to large rivers and lakes. The Analysis Area includes approximately 1,120 miles of anadromous streams and 684,616 acres of anadromous waterbodies (Table 5-6).

Table 5-6 Anadromous fish habitat in the watershed Analysis Area

	Nushagak River										Kvichak-Port Heiden				Western Cook Inlet	Analysis Area
Anadromous Waters	Headwaters Koktuli River	Outlet Koktuli River	Pine Creek-Mulchatna River	Outlet Mulchatna River	Tunravik Creek-Nushagak River	Lower Klutuk Creek-Nushagak River	Portage Creek-Nushagak River	Scandinavian Slough-Nushagak River	Little Muklung River-Nushagak River	Nushagak Bay-Frontal Bristol Bay	Newhalen River	Iliamna Lake	Gibraltar Lake	Upper Talarik Creek	Amakdedori Creek-Frontal Kamishak Bay	Total
Streams (mi)	143	81	35	111	78	84	65	37	60	0	53	213	43	76	41	1,120
Lakes (acres)	428	0	0	0	0	0	0	0	0	0	5,749	656,304	3,206	35	428	666,134

Source: ADF&G Anadromous Waters Catalog *(ADF&G 2019)*.

The Headwaters Koktuli River watershed includes approximately 143 stream miles and 428 lake acres of anadromous fish habitat for Arctic char, Chinook salmon, chum salmon, coho salmon, and sockeye salmon (ADF&G 2019). Sockeye and coho salmon have the greatest distribution of any anadromous fish in the Headwaters Koktuli River watershed (Table 5-7). Sockeye salmon spawning has been documented in approximately 164 lake acres and 59 stream miles and rearing in 152 lake acres and 53 stream miles. Coho salmon spawning has been documented in approximately 79 stream miles and rearing in 187 lake acres and 123 stream miles. Chinook spawning has been documented in 64 stream miles and rearing in 83 stream miles. Chum spawning includes approximately 49 stream miles and rearing 7 stream miles. Arctic char is present in 41 stream miles.

Table 5-7 Anadromous fish habitat in the Headwaters Koktuli Watershed

Fish Species	Present	Rearing	Spawning
Arctic char			
Stream (miles)	41	--	--
Chinook salmon			
Lake (acres)	164.3	--	--
Stream (miles)	11.9	83.3	63.8
Chum salmon			
Stream (miles)	3.5	6.7	49.5
Coho salmon			
Lake (acres)	219.1	187.1	
Stream (miles)	19.4	123.3	79.0
Sockeye salmon			
Lake (acres)	52.0	151.5	164.3
Stream (miles)	14.8	52.7	58.8

Source: ADF&G Anadromous Waters Catalog (ADF&G 2019).

- Pacific Salmon Barriers. Culverts that do not mimic the characteristics of the stream, including bankfull width, slope, and depth, can impede both upstream and downstream fish movement. The Alaska Department of Fish and Game (ADF&G) maintains the Fish Passage Inventory Database (FPID) (ADF&G 2001) that stores the results of over 2,500 culverts assessed for fish passage by ADF&G since 2001. This database includes detailed physical data for each culvert evaluated, and a determination regarding each culvert's adequacy to allow passage of juvenile fish. The FPID currently includes a total of 710 culverts that are 'inadequate passage' for fish; 350 as 'unlikely passage'; and 232 that are yet to be determined. Inadequate passage culverts affect hundreds of miles of anadromous and other fish-bearing streams through western and southcentral Alaska, including communities in the Lake and Peninsula Borough, the Kenai Peninsula Borough, the Matanuska-Susitna Borough, and the Municipality of Anchorage. This database includes five 'inadequate passage' and seven 'unlikely passage' culverts on tributary streams of the Nushagak River downstream of project impacts in the community of Dillingham, affecting at least 10.5 mi of anadromous streams.

- Protected Species. Protected species in the watershed include southcentral stock northern Sea Otters (*Enhydra lutris kenyoni*), which make use of the marine shorelines of Amakdedori Creek-Frontal Kamishak Bay.

- Other. The watersheds' wetlands and aquatic resources provide habitat for large carnivores, such as brown bears (*Ursus arctos*), bald eagles (*Haliaeetus leucocephalus*), gray wolves (*Canis lupus*), ungulates such as moose (*Alces alces gigas*), and numerous species of waterfowl and small mammals. Brown

bears are abundant in the Nushagak River and Kvichak River watersheds. Moose are abundant, particularly in the Nushagak River watershed where felt-leaf willow, a preferred forage species, is plentiful.

5.4 Land Ownership

Generalized land status data to the section level (generally 1 square mile) including federal, State of Alaska, and native lands is produced by the Alaska Department of Natural Resources (ADNR 2018).

Approximately 85 percent of the 3,709,208-acre Analysis Area (3,165,848 acres) encompasses public lands, including State of Alaska (48%) and federally owned (18%) lands (Table 5-8). Overall, the State of Alaska is the largest surface landowner. Approximately 32 percent of land in the watershed are privately-owned lands (1,025,900 acres), including ANCSA lands (31%) and private or municipal lands (2%). Approximately 87,631 acres (~3%) are grouped in administrative management areas, including Katmai National Park and Preserve, Lake Clark National Park and Preserve, and the McNeil River State Game Refuge and Sanctuary (Figure 3).

5.5 Land Use

The watersheds are largely undeveloped, except for twelve rural communities—Nondalton, Iliamna, Newhalen, Pedro Bay, Pile Bay, Igiugig, Kokhanok, Dillingham, Portage Creek, Ekwok, New Stuyahok, and Koliganek. The region is remote with no road access to the State highway system. Limited roads connect Iliamna, Newhalen, and Nondalton and a 15-mile long road connects Williamsport to Pile Bay. Most communities have gravel and earth surfaced streets. Dillingham is the largest and most urbanized community in the Analysis Area. Surface access between most communities is by boat on Iliamna Lake and the Nushagak River in the summer and by snow machine along winter trails in the winter. A few small air carriers provide regular year-round, air charter, and cargo flights from regional hubs to the smaller communities (BBNA 2018).

The communities rely primarily on diesel electric generators for power. However, some communities have implemented alternative energy sources as a means to lower fuel cost (BBNA 2018) and to alleviate spill risk concerns associated with fuel transport (HDR 1998). Iliamna, Newhalen, and Nondalton have implemented hydroelectric options at Tazimina Falls about 9 miles upstream of the confluence of the Tazimina River and the Newhalen River (HDR 1998). Igiugig is experimenting with a river power system (Caldwell 2014).

The communities operate as both subsistence and cash economies. Most cash opportunities result from government development projects, commercial fishing, sport fishing, and sport hunting ventures. Iliamna Lake and the Nushagak River are noted for sport fishing; primarily rainbow trout, Pacific salmon, and Arctic grayling.

Table 5-8 Land ownership for the watershed Analysis Area

	Nushagak River											Kvichak-Port Heiden			Western Cook Inlet	Analysis Area	
Land Ownership	Headwaters Koktuli River (acres)	Outlet Koktuli River (acres)	Pine Creek-Mulchatna River (acres)	Outlet Mulchatna River (acres)	Tunravik Creek-Nushagak River (acres)	Lower Klutuk Creek-Nushagak River (acres)	Portage Creek-Nushagak River (acres)	Scandinavian Slough-Nushagak River (acres)	Little Muklung River-Nushagak River (acres)	Nushagak Bay-Frontal Bristol Bay (acres)	Newhalen River (acres)	Iliamna Lake (acres)	Gibraltar Lake (acres)	Upper Talarik Creek (acres)	Amakdedori Creek-Frontal Kamishak Bay (acres)	Areal Extent (acres)	Portion (%)
Type																	
ANCSA	0	0	0	26,760	80,511	33,174	61,874	154,046	93,794	63,263	53,583	356,724	31,866	19,037	0	974,632	31
Private or Municipal	0	0	0	0	1,589	372	0	0	13,340	9,913	4,344	21,710	0	0	0	51,268	2
State	170,632	120,176	124,317	203,787	16,494	82,692	88,415	37,304	81,476	20,875	40,630	283,807	41,864	64,664	148,642	1,525,775	48
State and ANCSA	0	0	0	1,384	4,467	6,255	3,172	2,560	0	1,868	5,516	8,117	0	0	0	33,339	1
Federal	0	0	0	0	0	0	0	0	640	17,685	15,635	531,496	7,850	3,837	3,691	580,834	18
Total	170,632	120,176	124,317	231,931	103,061	122,493	153,461	193,910	189,250	113,604	119,708	1,201,854	81,580	87,538	152,333	3,165,848	100
Administrative Boundary																	
Katmai National Park & Preserve	0	0	0	0	0	0	0	0	0	0	0	336	1,067	0	25,620	27,023	31
Lake Clark National Park & Preserve	0	0	0	0	0	0	0	0	0	0	25,192	1,913	0	0	0	27,105	31
McNeil River State Game Refuge	0	0	0	0	0	0	0	0	0	0	0	1,124	1,962	0	11,789	14,875	17
McNeil River State Game Sanctuary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18,628	18,628	21
Total	0	0	0	0	0	0	0	0	0	0	25,192	3,373	3,029	0	56,037	87,631	100

Source: Alaska Department of Natural Resources General Land Status, 2018, section level data (ADNR 2018). In some cases, the land ownership was split between State of Alaska and ANCSA owned land. In those cases, the data were not segregated and counted as "State and ANCSA". Discrepancies in the total acreage for the watershed in this table and those shown in Table 5-1 are a result of the differences in data boundaries between the Generalized Land Status and the HUC; in coastal areas, the Generalized Land Status data, and HUC 10 boundary limits do not match.

Almost all State of Alaska lands within the Analysis Area are managed for multiple use and are open to mining. The watersheds include a history of mineral exploration, but to date, no mines have been developed. The most significant placer mining districts in proximity to the Analysis Area are the Nyac (gold) 175 miles northwest of the mine site and Goodnews Bay (platinum) 235 miles west of the mine site. The Alaska Resource Data File maintained by the U.S. Geological Survey (USGS) provides a record of mines, prospects and mineral occurrences (USGS 2018). The watersheds within the Nushagak River, Kvichak-Port Heiden, and Western Cook Inlet basins include six mineral occurrences and 26 prospects for gold, copper, iron, silver, and molybdenum.

The State of Alaska closed many streams to mineral entry in the Nushagak-Mulchatna River drainage as well as streams around Iliamna Lake (Mineral Closing Order 393). This closure is aimed at protecting Pacific salmon streams, including the North Fork Koktuli River, South Fork Koktuli River, and Upper Talarik Creek.

The Analysis Area has large quantities of sand, gravel, and rock materials. There has been little use for these materials except near communities that require them for airport and road construction or upgrades.

5.6 Water Quality Contaminants

Wetlands, rivers, and streams that are free of contaminants are important for sustaining a healthy aquatic ecosystem. Potential sources of contaminants in the Analysis Area include spills of chemicals or petroleum lubricants and fuels, stormwater runoff and erosion, community sanitation facilities including landfills and sewage management systems, and marine debris. PLP has reviewed available databases to locate known potential sources of contamination in the Analysis Area. All known identified sites are listed, however remediation of sites that are the legal responsibility of a known entity may not qualify for compensatory mitigation.

- Alaska Department of Environmental Conservation (ADEC) contaminated sites. The ADEC maintains a database of contaminated sites in Alaska. The database includes 12 contaminated sites in the Analysis Area where cleanup actions have been completed, and six sites where cleanup actions are ongoing. Contaminants at these sites included oil and lubricants. There are no identified sites in the Analysis Area where clean up actions are not completed or in progress.
- ADEC Solid Waste Sites. The ADEC maintains a database of solid waste sites in Alaska. The database includes 11 solid waste sites in the Analysis Area, each located near a village. Six solid waste sites are active, one inactive, and four retired.
- ADEC Waste Erosion Assessment and Review (WEAR). The ADEC conducted the WEAR program to inventory sites that have the potential to release hazardous substances and garbage from Alaska's landfills, contaminated sites, tank farms, and other sites of environmental concern into state waters, jeopardizing water quality, fish, and wildlife (ADEC 2018). Pertinent site information from this program is included in Table 5-9.
- Environmental Protection Agency Brownfields Sites. The EPA maintains a list of brownfield sites. There are three brownfield sites located in Newhalen that resulted from large historic fuel spills on land, all near waters. Cleanup has been completed at one spill site abutting Iliamna Lake. The two remaining sites are 0.3 miles from the Newhalen River and cleanup actions are under way. Contamination at these sites resulted from a ~13,630-gallon Jet-A spill, and a ~35,000-gallon diesel spill.

Table 5-9 Selected sites of concern from WEAR 2012-2014

Site Name and Location	Description
Igiugig	
Tank Farm, 59.327258/-155.897948 (Active)	The site was constructed in 2004 for the Native Village of Igiugig and contains nine tanks with a total capacity of 111,000 gallons. The nearest source of erosion, the Kvichak River, is only 20 feet away. Erosion symptoms such as root exposure, undercutting, and slides were observed on the closest bank of the river.
Community Landfill, 59.325198/-155.905045 (Retired)	This is the location of a historical military landfill that was started in the 1950s. After the military left, the community used it as their landfill until 2001 when the new landfill was constructed. The field is 500 feet from the closest source of erosion, the Kvichak River.
Iliamna	
Landfill, 59.783836/-154.901292 (Active)	The landfill is a permitted, self-haul facility. The landfill has been in operation since at least 1986 and most waste is burned in a Summit burn unit. The landfill employs a landfill operator but would benefit from improved management of burning and special wastes. The landfill is located approximately 3.3 miles from Iliamna Lake.
Airport Crowley Tank Farm, 59.754428/-154.906141 (Active)	The Crowley tank farm is located across the street from the Iliamna Airport and is an active Contaminated Site (File ID 2560.38.012). A spill of 1,507 gallons of aviation gas occurred at the site in late 2009. 65 cubic yards of contaminated soil was excavated and landfarmed to remediate the soil beginning in 2011. After remediation, the soil was transported to and disposed of at the Newhalen Landfill in June 2013. This site is still being monitored by the Contaminated Sites Program as not all contaminated soil was excavated. The tank farm is about 0.15 acres in size and holds six tanks with a total capacity of 258,000 gallons in a fenced and locked area.
Federal Aviation Administration (FAA) Living Quarters Landfarm, 59.761161/-154.828806 (Active)	This site is part of an active Contaminated Site (File ID 2560.38.001). The landfarm is remediating contaminated soil linked to above-ground fuel tanks that used to exist in the area. The landfarm is within Iliamna Airport Tract II, near the Old FAA landfill and covers an area of approximately 0.08 acres. The site is 170 feet south of Lake Superior.
Former U.S. Post Office, 59.751424/-154.815653 (Active)	The former Iliamna U.S. Post Office was located on Iliaska Drive at this site. In November of 1999, it was reported that drums of used oil were shot and subsequently leaked. This caused the site to become an active Contaminated Site (File ID 2560.38.007). During inspection, the area appeared to be well vegetated aside from a cut in the bushes to provide access to the lake from the road. The site is no longer owned by the U.S. Postal Service and is located right on the shoreline of Roadhouse Bay.
Abandoned Fuel Tanks, 59.749782/-154.812959 (Abandoned)	These tanks, with unknown size and contents, reside in the Iliaska Subdivision in front of Lots 30 and 31. The tanks were completely surrounded by dense vegetation and are 245 feet from Iliamna Lake.
Newhalen	
Landfill, 59.731888/-154.892355 (Active)	This unpermitted landfill has been operating since its construction in 1983. Necessary equipment for the removal of chlorofluorocarbons (CFCs) from white goods was unavailable, and batteries and used oil were poorly stored. The 5.5-acre landfill is located half a mile north of Newhalen and 2,000 feet east of erosion reported along the banks of the Newhalen River.
Crowley Contaminated Soil, 59.719562/-154.891769 (Active)	This site is an active landfarm to remediate contaminated soil under the Contaminated Sites Program. The site consists of two listings Crowley Jet A Fuel Tank 471 Newhalen Tank Farm (File ID 2619.38.002) and Newhalen Bulk Fuel Storage (File ID 2619.38.001). The site is associated with numerous historic spills and a former tank farm. The site dates back to a 1983 spill reported in relation to Newhalen's old utility tank farm. There are several data gaps in the history of this site that don't allow for identification of all spills; however, additional free product was discovered near the 1983 spill during sewer cleaning operations in August 1999. Later, on October 30, 2008, there was a jet fuel spill totaling approximately 13,630 gallons from Crowley Jet A Fuel Tank 471. The majority of the spill was recovered from secondary containment, but 2,777 gallons were suspected to have breached the containment. The tank farm has since been decommissioned with the site consisting mostly of the 2.9-acre landfarm at the time of inspection. Soil staining, 55-gallon drums, piles of dirty rags, and metal debris were identified along the perimeter of the landfarm. The site is located adjacent to the current Newhalen Tank Farm, on its lakeward side, and is 1,000 feet from Iliamna Lake.
Nondalton	
Drum Cache, 59.970533/-154.851000 (Abandoned)	This site is associated with the construction of generators and a new tank for the water plant. The site is about 0.02 acres in size and is located in the middle of town. It consists of a slightly depressed region covered in black textiles with heavy staining on top of the textile. Vegetation surrounding the perimeter of the site was noted as distressed during the inspection. Several 55-gallon drums were strewn about the site with contents unknown. The site is believed to have originated around 2005 and is 250 feet from Sixmile Lake.
Airport Tanks, 59.978880/-154.836069 (Abandoned)	These empty tanks are located at the airport. There are 10 tanks in total with the labeling "Out of Service, Do Not Fill, 10-1-02" and a total capacity of 80,500 gallons. The tanks were constructed by the City of Nondalton sometime in the early 1990s with the intent that they become storage for heating fuel and gasoline to be sold to local residences and businesses. However, the project was never completed. The site is unfenced and eight of the vertical tanks rest on a geotextile liner; two of the tanks are located outside of the containment. Roughly two inches of water were seen pooling within the containment at the time of inspection. Stacked alongside one of the tanks were several 55-gallon drums and miscellaneous buckets with contents unknown. The site is 0.15 acres in size and is located 1,230 feet from Sixmile Lake.

Site Name and Location	Description
Kokhanok	
Landfill, 59.433225/-154.750637 (Active)	This unpermitted landfill is found a half mile due south of the school on a hill. It was constructed in 1992 by the U.S. Public Health Service. The landfill operates as a trench and fill with a working Tok burn unit. Metals, drums, and white goods (household appliances) are separated at the site. The inactive areas of the landfill have been covered and are revegetated. It lies 1,600 feet from Piva Lake.
Old Tank Farm, 59.441288/-154.751535 (Abandoned)	This tank farm is no longer in use since the 2003 construction of the new tank farm. It is located approximately 540 feet northwest of the school. There were 2 vertical tanks and 5 horizontal tanks, which could hold a total of 52,500 gallons of diesel. The horizontal tanks were within a lined, earthen berm, and the vertical tanks were on wooden platforms with no visible berm or liner. There was evidence of staining on the ground, and ponded water around the tanks had a visible sheen. It is located approximately 400 feet from Iliamna Lake.
Slop Bucket Lake Dump, 59.441696/-154.759466 (Abandoned)	This lake can be found 1,000 feet east of Big Lake. It was reportedly used as a dump site for many years by the community with sporadic dumping still occurring. There was visible trash on the shores and lake bottom, which ranged from bags of trash to rusted barrels and tires. It is 350 feet from Iliamna Lake.
Pedro Bay	
Landfill, 59.791717/-154.102628 (Active)	This unpermitted landfill is located on the northeast side of town 1,000 feet from the Village Council building. This one-acre site has been in operation since around 1985. An incinerator is on site but has never been used due to operational costs. A baler is also available but has not been used. Municipal waste is burned in a small pit and then mixed with dirt into a large pile that will eventually be pushed back into a trench. Batteries and other recyclables are separated out. There is a separate area for hide goods and other metals. A fence surrounds part of the landfill, but it is falling down in places. The landfill lies 2,100 feet from Iliamna Lake.

Source: ADEC Waste Erosion Assessment and Review (2018)

- EPA Superfund Sites. The EPA maintains a database of superfund cleanup sites. There are no listed superfund cleanup sites in the Analysis Area.
- Rural Sanitation. Most villages and private houses are equipped with septic tanks or a centralized sewage system. Community sanitation systems are in constant need of improvement in the Analysis Area. The Indian Health Service (IHS) through the Alaska Native Tribal Health Consortium (ANTHC) maintains a comprehensive database of sanitation and water supply improvement projects (Sanitation Tracking and Reporting System) in Alaska that are prioritized for funding. As of November 2019, approximately $1.4 billion in eligible projects are identified in the database, including multiple projects in the Analysis Area. At current funding rates even the existing list of projects will not be completed for many years. A review of EPA's Enforcement and Compliance History Online (ECHO) identified multiple wastewater discharge and reporting violations in the Analysis Area and provides evidence of ongoing water quality impacts associated with malfunctioning or underperforming sewage handling systems.
- Barge Landings. Barge and boat landings can be a source of shoreline erosion and sedimentation in Iliamna Lake. In 2009-2010 the Denali Commission funded the design of barge and boat landings for Iliamna, Kokhanok, Pedro Bay, Pile Bay, and Igiugig. Construction of these projects is pending (Denali Commision 2018).
- Marine debris. The National Oceanic Atmospheric Administration (NOAA) maintains a marine debris tracking system (NOAA 2019) that records locations of marine debris and amounts from citizen's reports and other sources. There are no mapped marine debris sites within Cook Inlet. The nearest mapped marine debris sites are nine reports along the coastlines of Shelikof Strait in the Alaska Peninsula and Kodiak. In 2015, approximately 11,169 lbs. of marine debris was removed from 17.8 mi of beaches in Katmai National Park and Preserve (NPS 2019). PLP personnel and contractors have documented large amounts of marine debris between the northern most extent of Amakdedori Beach and Amakdedulia Cove. Marine debris observations include buoys of a variety of materials (e.g. plastic, metal, or polystyrene foam), insulation materials (e.g. polystyrene foam sheets

and fragments), barrels, buckets, plastic bottles, propane canisters, fish nets and seines, rope, pallets, lumber, coolers, fish totes, pressurized cannisters of paint and lubricant, containers of waste oil, other lubricants, and anti-freeze, tarps and fabric.

5.7 Invasive Species

Invasive species pose a threat to ecosystems, including wetlands and other WOUS, by altering the functional compositions of communities and from the loss of locally abundant species (Diaz, et al. 2006). While most invasive plants have been recorded along Alaska's road network, remote communities off the road system may be increasingly and disproportionately vulnerable to harm from exposure to invasive species.

Bristol Bay residents have expressed concern about the potential impacts of invasive plants on local natural resources, including subsistence foods (Spellman and Swenson 2012). Survey data from Bristol Bay indicate relatively small populations of several high-risk invasive species exist in the area. The species include reed canarygrass (*Phalaris arundinacea*), yellow toadflax (*Linaria vulgaris Mill.*), white sweetclover (*Melilotus officinalis (L.) Lam*), bird vetch (*Vicia cracca L.*), orange hawkweed (*Hieracium aurantiacum L.*) and oxeye daisy (*Leucanthemum vulgare Lam.*) (Spellman and Swenson 2012).

Fall dandelion (*Leontodon autumnalis L.*), oxeye daisy (*Leucanthemun vulgare Lam.*), pineapple weed (*Matricaria discoidea DC.*), Kentucky bluegrass (*Poa pratensis L. ssp. irrigata*), creeping buttercup (*Ranunculus repens L.*), common sheep sorrel (*Rumex acetosella L.*) and common chickweed (*Stellaria media*) were found in Igiugig in 2010 (AKEPIC 2018). It does not appear that surveys have been conducted in most of the communities in the Analysis Area.

Reed canarygrass, which grows very well in wetlands, has a high potential for impacting important subsistence foods resources. Reed canarygrass can invade active stream channels, accelerating siltation of gravel and sand bars, reducing the active-channel area, and altering fluvial dynamics (Galatowitsch, Anderson and Ascher 1999) (Wisconsin Reed Canary Grass Management Working Group (WRCGMWG) 2009), which could affect Pacific salmon and other fishes habitat. The results of a reed canarygrass vulnerability model for the Bristol Bay region completed in 2012 projected 24 miles of salmon stream could be vulnerable in the next 30 years. From 2039 to 2069, the length of salmon streams vulnerable to reed canarygrass invasion would grow to 275 miles. The model projected that by 2099, the length of salmon streams vulnerable to potential adverse effects from reed canarygrass could total 668 miles. Modeling indicates the Iliamna area had the second greatest number of vulnerable streams for the same period (Spellman and Swenson 2012).

Reed canarygrass surveys conducted in 2006 along most primary and secondary roads in the Kenai Peninsula highlight spread and management issues. The surveys located 260 sites populated by reed canarygrass. Of this total, 51sites were in wetlands, with 14 of those adjacent to coho salmon habitats (B. Spellman 2018). Authorities have determined that reed canarygrass on the Kenai Peninsula is beyond eradication efforts, because early detection and eradication opportunities were missed. Consequently, they decided to focus reed canarygrass management efforts in sensitive areas.

During additional surveys from 2007-2009 extensive reed canarygrass infestations were documented in four streams had: Kenai River, Bishop Creek, North Fork Anchor River, and Beaver Creek. In an approximately 20 mile-reach of the North Fork Anchor River, reed canary grass was found in 256 sites, including sites directly along the active channel. Eradication efforts have had mixed results, in part because of the extensive distribution of the reed canarygrass (B. Spellman 2018). Although prevention of invasive species is the best

management practice, early detection and eradication are crucial to fighting invasive species once established in an ecosystem.

5.8 Summary of Watershed Conditions

This watershed analysis has characterized conditions within the Analysis Area. The following is a summary of these conditions and provides general watershed improvement opportunities that could benefit aquatic functions in the watersheds.

The majority of the Analysis Area is undeveloped and wetlands and aquatic resources have little to no degradation. The principal sources of land development in the Analysis Area are those associated with residential housing, fishing and hunting cabins and lodges, sanitation systems, community energy, and the limited transportation infrastructure associated with the villages. Development accounts for less than 1 percent of land use in the Analysis Area.

Wetlands and other waters are widely distributed in the Analysis Area. The Headwaters Koktuli River watershed includes more than 59,581 acres of wetlands and other waters. The other watersheds encompass a combined total of 1,136,689 acres of wetlands and other waters. Dominant wetlands include palustrine scrub-shrub and emergent, whereas estuarine and lacustrine emergent wetlands are rare.

Generalized land ownership in the Analysis Area is split between the State of Alaska (48%), federal government (18%), native owned lands (31%), and private and municipal lands (2%). Roughly 3 percent of the Analysis Area includes the Katmai and Lake Clark national parks and is permanently protected from development. Although State of Alaska lands are open to multiple uses, including mining, the Alaska Department of Natural Resources has closed many streams to mineral entry in the Nushagak-Mulchatna River drainage, as well as streams around Iliamna Lake, to protect Pacific salmon fish habitat. Regardless of land ownership and the occurrence of minerals in the watershed, the potential for development, other than the proposed Project, is low.

Aquatic habitats, though plentiful, do face potential threats from fish barriers and pollution associated with community growth, marine debris, or invasive species. Known fish barriers in the Analysis Area include five 'inadequate passage' and seven 'unlikely passage' culverts in the community of Dillingham, impacting more than 10.5 miles of Pacific salmon streams. Most of the communities have documented contamination from fuel and lubricant spills and under-performing village sanitation systems, such as landfills and wastewater treatment and collection systems, and these are a continuing source of water quality impacts. Large amounts of marine debris have been reported in Kamishak Bay. Invasive species are a threat to aquatic resources in the Analysis Area, but much of the area remains un-surveyed.

6. Project Effects on Aquatic Resources

The discharge of fill proposed by the project will permanently impact 2,227 acres of WOUS. Most of these impacts (2,158 acres) would occur in the Headwaters Koktuli River watershed (Table 6-1). The remaining permanent impacts to wetlands and other aquatic resources (68 acres) are divided among the Newhalen River, Iliamna Lake, Gibraltar River, Upper Talarik Creek, Amakdedori Creek-Frontal Kamishak Bay watersheds, and Cook Inlet watersheds (Table 6-2), and the Cook Inlet watershed (<1 acre [0.15 acre]).

The greatest impact would be to slope wetland HGM aquatic resources which would be reduced by 6.46 percent. Slope palustrine unconsolidated bottom would be reduced by 16.78 percent, slope palustrine scrub-shrub would be reduced by 6.56 percent, slope palustrine emergent would be reduced by 6.13 percent and palustrine aquatic bed and unconsolidated shore would be reduced 34.95 and 7.73 percent respectively. Riverine wetland and riverine channel water HGM aquatic resources will experience a 1.50 percent and 4.64 percent loss respectively. Most impacts to the riverine channel waters are to upper perennial streams unconsolidated bottom with a 6.96 percent reduction. Riverine channel intermittent streambed would experience a 5.94 percent reduction. Slope wetland HGM palustrine scrub-shrub and emergent wetlands are the most widely distributed aquatic resource in the watershed with approximately 20,769 acres and 8,911 acres respectively. These wetlands are broadly used by ungulates such as moose and caribou.

Construction of the mine facilities within Headwaters Koktuli River would permanently remove 8.5 miles of anadromous streams in the North Fork Koktuli (NFK) River, a tributary of the Koktuli River (Owl Ridge 2019). These are narrow, steep, and higher gradient headwater streams. This loss equates to approximately 17 acres of low Pacific salmon use habitat (R2 Resource Consultants 2019). The loss would be permanent, but the impacts in the context of Pacific salmon species use by life stage and density is low and localized when compared to the higher quantity and higher use Pacific salmon habitat immediately downstream in the NFK River (Owl Ridge 2019). The larger, downstream reaches more heavily used by Pacific salmon for spawning and rearing would not be directly impacted. Indirect effects, such as alterations to water flow and nutrient transport, could have further indirect impacts in downstream reaches of NFK River and South Fork Koktuli River in designated aquatic habitat for Chinook salmon, coho salmon, sockeye salmon, and chum salmon (Owl Ridge 2019). Low numbers of rearing Chinook salmon and coho salmon and spawning and developing embryonic coho salmon would be permanently removed in areas with low salmon densities and lower habitat value characteristics (Owl Ridge 2019).

Table 6-1 Summary of aquatic resources (acres) in the HUC 10 Headwaters Koktuli River

	Baseline		Impacts to WOUS	Reduction
HGM and Cowardin Classification	**Acres**	**%**	**Acres**	**%**
LACUSTRINE WATERS	**975.00**	**1.64%**	**--**	**--**
Lacustrine Limnetic Unconsolidated Bottom [1]	844.40	1.42%	--	--
Lacustrine Littoral Aquatic Bed [1]	10.10	0.02%	--	--
Lacustrine Littoral Unconsolidated Bottom [1]	33.00	0.06%	--	--
Lacustrine Littoral Unconsolidated Shore [1]	32.80	0.06%	--	--
Palustrine Emergent [1]	1.10	<0.01%	--	--
Palustrine Unconsolidated Bottom [1]	51.00	0.09%	--	--
Palustrine Unconsolidated Shore [1]	2.70	<0.01%	--	--
LACUSTRINE FRINGE WETLANDS	**126.70**	**0.21%**	**0.04**	**0.03%**
Lacustrine Littoral Emergent [1]	0.30	<0.01%	--	--
Lacustrine Littoral Unconsolidated Shore [1]	9.40	0.02%	--	--

HGM and Cowardin Classification	Baseline		Impacts to WOUS	Reduction
	Acres	%	Acres	%
Palustrine Emergent [1]	50.70	0.09%	0.04	0.07%
Palustrine Moss-Lichen [1]	0.20	<0.01%	--	--
Palustrine Scrub-Shrub [1]	64.80	0.11%	--	--
Palustrine Unconsolidated Bottom [1]	0.50	<0.01%	--	--
Palustrine Unconsolidated Shore [1]	0.90	<0.01%	--	--
RIVERINE WETLANDS	**8,345.60**	**14.01%**	**125.15**	**1.50%**
Palustrine Aquatic Bed [1]	1.80	<0.01%	--	--
Palustrine Emergent [1]	2,163.40	3.63%	41.51	1.92%
Palustrine Forested [1]	38.50	0.06%	--	--
Palustrine Moss-Lichen [1]	2.90	<0.01%	--	--
Palustrine Scrub-Shrub [1]	5,847.30	9.81%	76.46	1.31%
Palustrine Unconsolidated Bottom [1]	160.60	0.27%	7.18	4.47%
Palustrine Unconsolidated Shore [1]	67.60	0.11%	--	--
Riverine Intermittent Streambed [1]	0.10	<0.01%	--	--
Riverine Lower Perennial Unconsolidated Bottom [1]	41.50	0.07%	--	--
Riverine Lower Perennial Unconsolidated Shore [1]	19.10	0.03%	--	--
Riverine Upper Perennial Aquatic Bed [1]	<0.1	<0.01%	--	--
Riverine Upper Perennial Unconsolidated Bottom [1]	2.20	<0.01%	--	--
Riverine Upper Perennial Unconsolidated Shore [1]	0.50	<0.01%	--	--
RIVERINE CHANNEL WATERS	**1,070.00**	**1.80%**	**49.68**	**4.64%**
Palustrine Aquatic Bed [1]	1.00	<0.01%	--	--
Palustrine Emergent [1]	0.30	<0.01%	--	--
Palustrine Unconsolidated Bottom [1]	38.10	0.06%	--	--
Palustrine Unconsolidated Shore [1]	6.00	0.01%	--	--
Riverine Intermittent Streambed [1]	64.10	0.11%	3.81	5.94%
Riverine Lower Perennial Aquatic Bed [1]	19.10	0.03%	--	--
Riverine Lower Perennial Emergent [1]	0.30	<0.01%	--	--
Riverine Lower Perennial Unconsolidated Bottom [1]	166.60	0.28%	--	--
Riverine Lower Perennial Unconsolidated Shore [1]	9.10	0.02%	--	--
Riverine Upper Perennial Emergent [1]	0.10	<0.01%	--	--
Riverine Upper Perennial Unconsolidated Bottom [1]	635.70	1.07%	44.27	6.96%
Riverine Upper Perennial Unconsolidated Shore [1]	129.60	0.22%	<0.00	<0.00%
FLAT WETLANDS	**6,599.80**	**11.08%**	**8.35**	**0.13%**
Palustrine Aquatic Bed [1]	<0.1	<0.01%	--	--
Palustrine Emergent [1]	1,623.70	2.73%	2.67	0.16%
Palustrine Forested [1]	0.20	<0.01%	--	--
Palustrine Moss-Lichen [1]	33.70	0.06%	--	--
Palustrine Scrub-Shrub [1]	4,917.60	8.25%	5.68	0.12%
Palustrine Unconsolidated Bottom [1]	4.10	0.01%	--	--
Palustrine Unconsolidated Shore [1]	20.30	0.03%	--	--
Riverine Intermittent Streambed [1]	<0.1	<0.01%	--	--
SLOPE WETLANDS	**29,813.90**	**50.04%**	**1925.27**	**6.46%**
Palustrine Aquatic Bed [1]	6.10	0.01%	2.13	34.95%
Palustrine Emergent [1]	8,911.20	14.96%	546.47	6.13%
Palustrine Forested [1]	2.20	<0.01%	--	--
Palustrine Moss-Lichen [1]	27.50	0.05%	--	--
Palustrine Scrub-Shrub [1]	20,768.50	34.86%	1362.85	6.56%
Palustrine Unconsolidated Bottom [1]	69.30	0.12%	11.63	16.78%
Palustrine Unconsolidated Shore [1]	28.30	0.05%	2.19	7.73%
Riverine Upper Perennial Unconsolidated Bottom [1]	0.30	<0.01%	--	--
Riverine Upper Perennial Unconsolidated Shore [1]	0.50	<0.01%	--	--
DEPRESSIONAL WETLANDS	**1,561.20**	**2.62%**	**49.90**	**3.20%**
Lacustrine Littoral Unconsolidated Shore [1]	<0.1	<0.01%	--	--
Palustrine Aquatic Bed [1]	4.80	0.01%	--	--

HGM and Cowardin Classification	Baseline		Impacts to WOUS	Reduction
	Acres	%	Acres	%
Palustrine Emergent [1]	155.30	0.26%	4.72	3.04%
Palustrine Moss-Lichen [1]	0.50	<0.01%	--	--
Palustrine Scrub-Shrub [1]	172.70	0.29%	6.91	4.00%
Palustrine Unconsolidated Bottom [1]	913.10	1.53%	29.70	3.25%
Palustrine Unconsolidated Shore [1]	314.80	0.53%	8.57	2.72%
N/A	**11,089.00**	**18.61%**	**--**	**--**
Palustrine Emergent [1, 2]	2,608.00	4.38%	--	--
Palustrine Scrub-Shrub [1, 2]	8,009.00	13.44%	--	--
Palustrine Unconsolidated Shore [1]	0.90	<0.01%	--	--
Palustrine Unconsolidated Bottom [2]	248.40	0.42%	--	--
Riverine Unknown Perennial Unconsolidated Bottom [2]	222.80	0.37%	--	--
Grand Total	**59,581.20**	**100%**	**2,158.38**	**3.62%**

Source: (1) PLP mapped wetlands, (2) NWI mapped wetlands.

Project impacts from fill discharges to aquatic resources in the Newhalen River, Iliamna Lake, Gibraltar Lake, Upper Talarik Creek, and Amakdedori Creek-Frontal Kamishak Bay Watersheds would be small relative to the abundance of wetlands and other waters in each watershed and the footprint of project impacts (Table 6-2). The largest reduction in aquatic resources (<0.05%) outside of the Headwaters Koktuli watershed would take place in the Amakdedori Creek-Frontal Kamishak Bay watershed. Within the Newhalen River, Iliamna Lake, Gibraltar Lake, Upper Talarik Creek, and Amakdedori Creek-Frontal Kamishak Bay watersheds the aquatic resources most impacted include palustrine, lacustrine, and marine subtidal habitats, all of which are abundant. Fills will impact riverine aquatic resources that provide habitat to Pacific salmon and other fishes in the watersheds, but this will be minimized by including bridges and culverts designed to allow for fish passage.

Table 6-2 Summary of aquatic resources (acres) in the HUC 10 Newhalen River, Iliamna Lake, Gibraltar Lake, Upper Talarik Creek, and Amakdedori Creek-Frontal Kamishak Bay watersheds

	Kvichak-Port Heiden				Western Cook Inlet	Total
	Newhalen River	Iliamna Lake	Gibraltar Lake	Upper Talarik Creek	Amakdedori Creek-Frontal Kamishak Bay	
Baseline Aquatic Resources						
Estuarine (ac.)	--	15	--	--	1,525	1,540
Lacustrine (ac.)	116	42	<0.01	<0.01	35	193
Palustrine (ac.)	56,577	270,572	21,558	35,355	25,968	431,995
Ice (Glacier) (ac.)	--	--	38	--	--	99
Lakes (ac.)	8,075	681,658	5,331	1,680	3,960	702,863
Streams (mi.)	250	881	91	250	684	2,713
Total Aquatic Resources (ac.)	**64,768**	**952,287**	**26,926**	**37,036**	**31,487**	**1,112,504**
Impacts to Aquatic Resources						
Lacustrine (ac.)	0.00	2.36	0.00	0.00	0.30	**2.66**
Palustrine (ac.)	4.25	19.90	8.28	14.77	14.16	**61.36**
Riverine (ac.)	0.13	0.69	0.20	0.16	0.58	**1.76**
Marine (ac.)	0.00	0.00	0.00	0.00	2.18	**2.18**
Total Impact to Aquatic Resources (ac.)	**4.38**	**22.94**	**8.48**	**14.93**	**17.22**	**67.96**
Reduction of Aquatic Resources (%)	**<0.01%**	**<0.00%**	**<0.03%**	**<0.04%**	**<0.05%**	**<0.01%**

7. Mitigation Opportunities Evaluated

When the results of each of the watershed analysis sections are considered and synthesized it becomes apparent that: 1) wetlands and other waters in the Analysis Area are abundant and in a natural state, 2) the existing threats to aquatic resources in the affected watersheds are minimal and arise from impacts associated with contaminated sites, community sanitary systems, fish passage barriers, and marine debris, and 3) discharges of fill from the Project will result in the loss of 8.4 miles of documented Pacific salmon habitat in the Koktuli River Headwaters Watershed and Pacific salmon are an important component of the local aquatic environment and economies,

Consequently, PLPs approach to compensate for the permanent loss of wetlands and aquatic habitat in the Analysis Area resulting from the Project will prioritize on opportunities that benefit anadromous fish habitat, including improvements to water quality. The following factors will be used to evaluate compensatory mitigation options:

- Location. On-site opportunities will be given preference versus off-site opportunities. If needed, mitigation sites will be ranked according to their location using the following preference order:

  1) HUC 10 watersheds that intersect with the Project wetlands impacts;

  2) HUC 10 watersheds downstream of Project wetlands impacts;

  3) HUC 8 watersheds that intersect with the Project wetlands impacts;

  4) HUC 6 watersheds that intersect with the Project wetlands impacts; and

  5) HUC 4 watersheds that intersect with the Project wetlands impacts.

- Watershed health impacts. Sites within watersheds that are experiencing or may experience water quality or other impacts due to development and human activity.

- Environmental significance. Selected sites will be ranked according to the aquatic resources that are impacted or threatened and can be returned to health or protected by mitigation projects. Sites with wetlands, streams, and other waters that provide regionally significant support to fish will be given higher priority consistent with the results of the watershed analysis.

- Practicability. Practicability will be evaluated in consideration of engineering feasibility, authorization for the construction work, and construction costs.

Compensatory mitigation may be performed using methods of restoration (re-establishment or rehabilitation), establishment (creation), enhancement, and/or in certain circumstances, preservation of wetlands and other waters. Restoration as re-establishment opportunities for aquatic resources in the Analysis Area are unavailable because development in the Analysis Area is limited, and all existing developments are in use or needed. However restoration as rehabilitation, may be possible in the affected watersheds through repair, enhancement, or replacement of underperforming sanitation systems that would result in water quality improvements to WOUS and, through removal of marine debris, would restore coastal marine wetlands and marine habitat by removing wildlife hazards. Establishment of wetlands is not highly desirable as wetlands are

already abundant in the Analysis Area. Lastly, preservation opportunities are limited due to the land status and unjustifiable due to the lack of foreseeable development threat to existing wetlands and aquatic resources in the Analysis Area.

PLP has evaluated multiple wetland mitigation leads or opportunities (Attachment 2) and determined that opportunities with community wastewater projects, Pacific salmon fish passage improvement projects, and marine debris removal opportunities were practicable as mitigation for the project and were further developed into permittee-responsible mitigation (PRM) plans.

7.1 Water Quality Improvement Projects

The goal of the water-quality-improvement PRM plan (Attachment 3) is to enhance water quality in the affected watersheds by improving the quality of discharges from wastewater treatment systems in drainages with identified needs. Discharges from properly designed wastewater management systems have little or no adverse effect on water quality and the biota that thrives in the aquatic system. Furthermore, discharges from properly designed systems could improve the quality of water in poorly functioning drainages downstream of the discharges. Consequently, improving under-performing treatment systems would improve overall water quality in the region.

PLP is proposing to perform wastewater management improvement projects in three communities adjacent to the project, namely Kokhanok, Newhalen, and Nondalton. The objectives of the improvements include:

- Increase treatment and storage capacity of the sewage lagoon in Kokhanok.
- Increase treatment and storage capacity of the sewage lagoon in Newhalen.
- Reduce wastewater treatment volume by reducing sewage collection system infiltration and improving operational reliability of the lift station unit.

The projects were identified and prioritized based on information provided in the IHS/ANTHC database and in discussions with the Lake and Peninsula Borough and with the affected communities. PLP would perform the required mitigation in coordination with the affected communities and would retain responsibility for ensuring that required compensatory mitigation activities are completed and successful.

7.2 Removal of Pacific Salmon Passage Barriers

PLP's PRM Plan for the Removal of Pacific salmon Passage Barriers (Attachment 4) proposes to rehabilitate up to 8.5 miles of Pacific salmon habitat. During planning, PLP consulted with ADF&G personnel to better align the plan's objectives with those of ADF&G's Fish Passage Improvement Program. The Fish Passage Improvement Program is one of the resources identified by the EPA as a potential source of Compensatory Mitigation projects (EPA 2019).

The removal of fish passage barriers satisfies PLP's compensatory mitigation approach of seeking opportunities that enhance or restore fish habitat. PLP has proposed fill placement in riverine channel waters that are considered regionally important in the watershed based on their connection to important fish and wildlife species (AECOM 2019). PLP's proposed discharge of fill material will result in the permanent removal of approximately 8.5 miles of Pacific salmon habitat within the headwater streams of the Koktuli

River, a tributary to the Nushagak River. The proposed PRM Plan will compensate the riverine channel waters losses by rehabilitating 8.5 miles of streams containing Pacific Salmon habitat through replacement of undersized or damaged culverts.

Approximately 6 miles of Pacific salmon habitat in stream tributaries to the Nushagak River near the community of Dillingham, located downstream of the project impacts, have already been degraded by undersized culverts associated with local road infrastructure. PLP expects that all fish passage improvement projects will take place outside (off-site) of the Analysis Area. PLP's proposed plan prioritizes culverts based on their location (e.g., watersheds downstream of project impacts and in proximity to the project) and potential for Pacific salmon habitat gains.

7.3 Marine Debris Removal at Kamishak Bay

PLP's PRM Plan for Marine Debris Removal at Kamishak Bay (Attachment 5) proposes to rehabilitate 7.4 miles of coastal habitat in Kamishak Bay by removing marine debris currently accumulated in large amounts at local beaches. Marine debris has several documented impacts to habitats and natural resources. It can cause physical damage to shoreline, marshes, and the benthos. Marine debris can also cause injury to wildlife from entanglement and ingestion. The removal of debris will result in ecosystem service benefits to beach habitats in Kamishak Bay and adjacent marine habitat that are currently used by marine wildlife, including protected species under the ESA.

8. Conclusion

Construction of the Project will require the dredge or discharge of fill material into 3,083 acres of WOUS. This includes 2,227 acres of permanent impacts and 857 acres of temporary impacts to WOUS. PLP plans to restore the 857 acres of temporarily impacted wetlands post-construction. The proposed impacts will take place in HUC-10 watersheds with large expanses of wetlands that are at low risk of being cumulatively degraded.

33 CFR Part 320.4 (r)(2) states that all compensatory mitigation will be for significant resource losses of importance to the human or aquatic environment. The majority of the proposed WOUS impacts would occur within the HUC-10 Headwaters Koktuli Watershed and would affect headwater streams and wetlands. Headwater WOUS are important ecosystem components because they deliver water, sediments, and organic material to downstream waters and contribute to the nutrient cycling and water quality. When natural flow regimes of headwater streams are altered, downstream water quality is often impaired (Colvin, et al. 2019). Direct impacts to anadromous streams are estimated at approximately 8.5 miles. Therefore, PLP believes compensatory mitigation should focus on opportunities that benefit anadromous streams and water quality in the watershed.

Consideration of compensatory mitigation options over a larger watershed scale beyond the HUC-10 Analysis Area is necessary given that compensatory mitigation options are limited at the smaller, local watershed scale. There are no Mitigation Banks or In-Lieu Fee program opportunities within the impacted watersheds, and PRM compensatory mitigation opportunities are similarly unavailable due to the remoteness and lack of disturbance in the watersheds.

PLP has identified three approaches to mitigate for the project's WOUS impacts. The first is off-site, out-of-kind water quality restoration opportunities that will enhance water quality in the Bristol Bay region by improving wastewater collection and treatment systems in drainages with identified needs. Discharges from properly designed wastewater management systems have little or no adverse effect on water quality and the biota that thrives in the aquatic system. Discharges from properly designed systems could improve the quality of water in poorly functioning drainages downstream of the discharges. Consequently, improving under-performing treatment systems would improve overall water quality in the region. The PRM plan is included as Attachment 3. PLP believes this to be a practical approach, capable of meeting the compensatory mitigation requirements stated in 33 CFR Part 332.

The second approach is removing Pacific salmon fish passage barriers associated with undersized or damaged culverts. This approach is promising because of the large amount of Pacific salmon habitat that can be restored through a single fish passage improvement. The proposed PRM Plan will compensate the Project's riverine wetlands losses by rehabilitating up to 8.5 mi of streams containing Pacific Salmon habitat through replacement of undersized or damaged culverts. The removal of these fish passage barriers also satisfies PLP's compensatory mitigation approach of seeking opportunities that enhance or restore fish habitat. The PRM plan is included as Attachment 4.

The third approach is removing and properly disposing of marine debris accumulated on beaches in Kamishak Bay. Marine debris pose hazards to wildlife through entanglement and ingestion and can damage

habitat. This PRM (Attachment 5) will result in the rehabilitation of 7.4 mi of coastal marine wetlands and marine habitat in Kamishak Bay.

PLP believes this combination of PRM plans including, wastewater facility improvement projects in Kokhanok, Newhalen, and Nondalton, the restoration of 8.5 mi of fish habitat from repair of fish passage barriers, and cleanup of marine debris in 7.4 mi of coastal habitats in Kamishak, are a practical approach, capable of meeting the compensatory mitigation requirements stated in 33 CFR Part 332.

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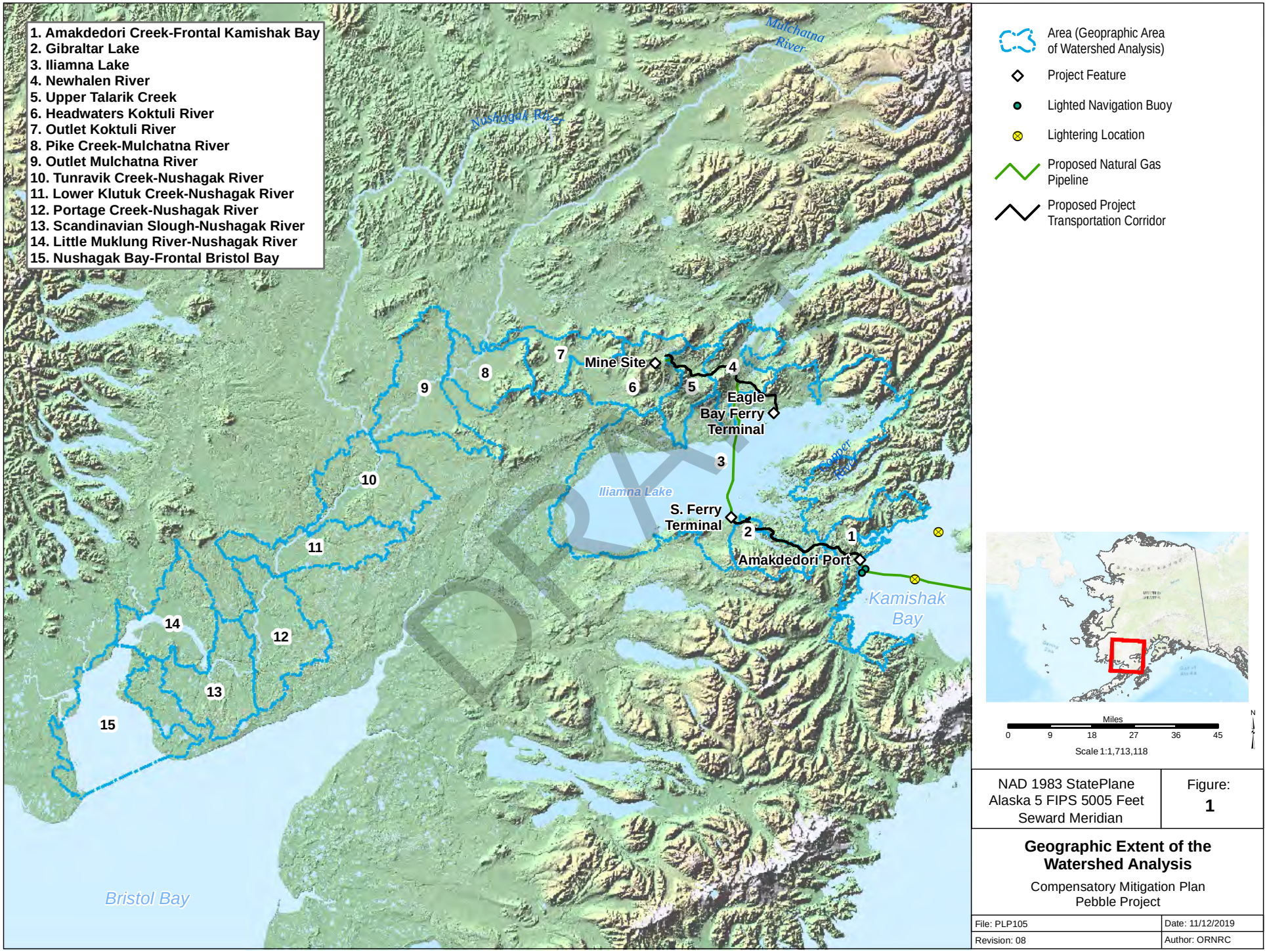
Attachments

Attachment 1 – Figures



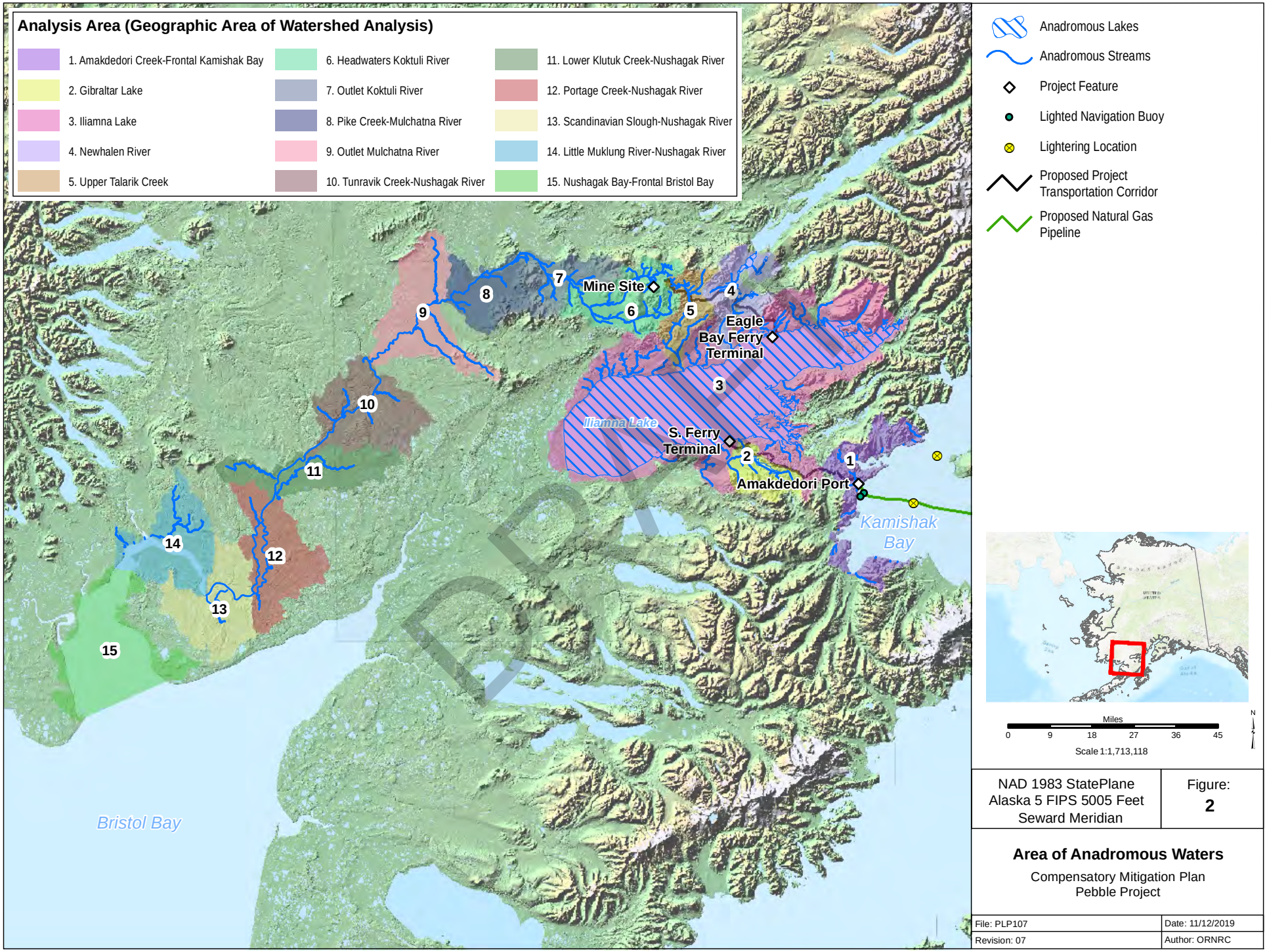
NAD 1983 StatePlane Alaska 5 FIPS 5005 Feet Seward Meridian

Figure: **1**

Geographic Extent of the Watershed Analysis

Compensatory Mitigation Plan
Pebble Project

File: PLP105	Date: 11/12/2019
Revision: 08	Author: ORNRC



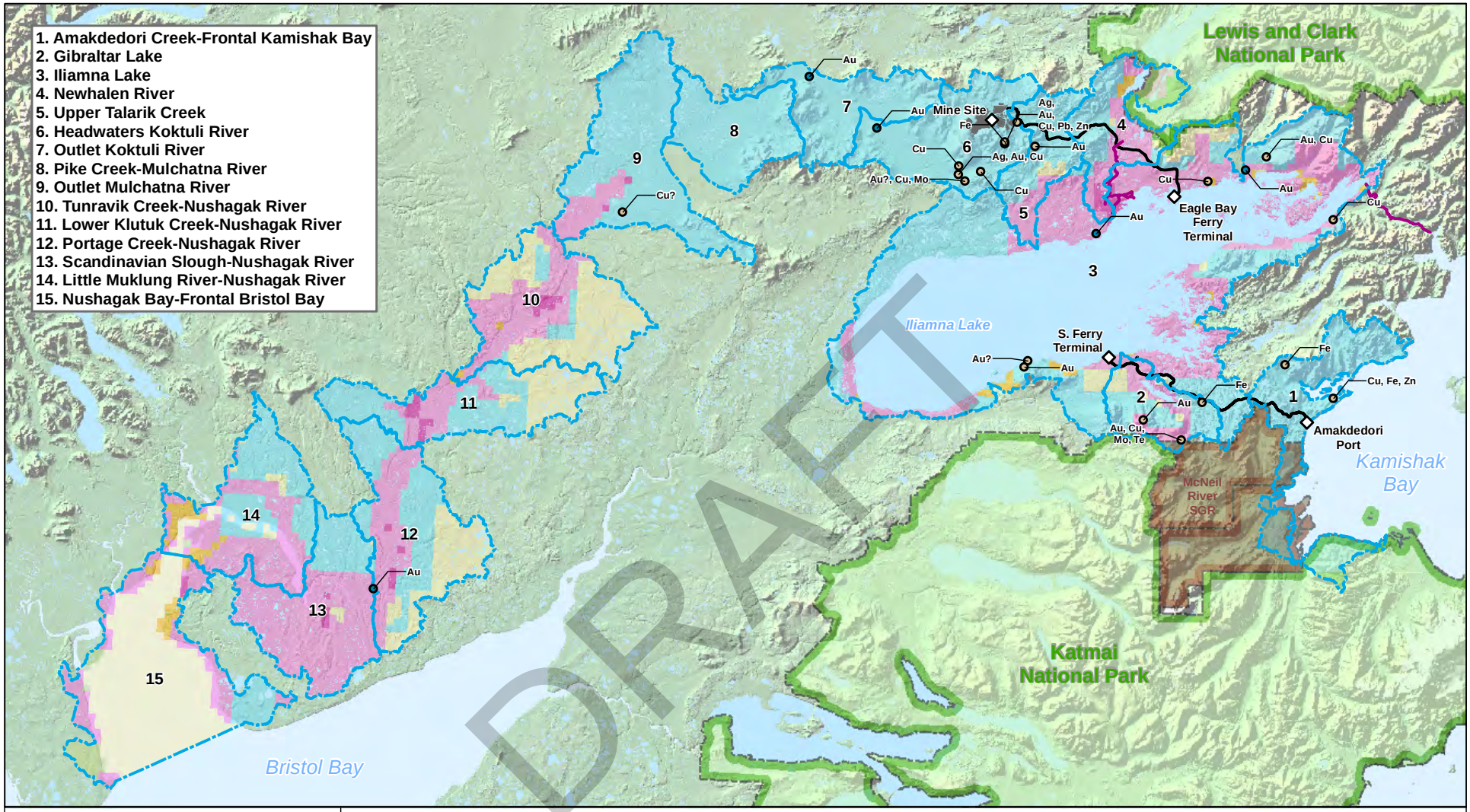
NAD 1983 StatePlane Alaska 5 FIPS 5005 Feet Seward Meridian

Figure: **2**

Area of Anadromous Waters

Compensatory Mitigation Plan
Pebble Project

File: PLP107	Date: 11/12/2019
Revision: 07	Author: ORNRC



Miles
0 7 14 21 28 35
N
Scale 1:1,291,103

Analysis Area (Geographic Area of Watershed Analysis)
Project Feature
Resource Occurrence
Prospect
Existing Road
Proposed Project Transportation Corridor

Section Level Land Status
BLM
National Park Service
State
State and ANCSA
ANCSA
Private or Municipal

Administrative Boundaries
National Park
State Game Sanctuary and Refuge

NAD 1983 StatePlane Alaska 5 FIPS 5005 Feet Seward Meridian	Figure: **3**

Land Ownership and Land Use

Compensatory Mitigation Plan
Pebble Project

File: PLP106	Date: 11/12/2019
Revision: 07	Author: ORNRC

Attachment 2 – Potential Compensatory Mitigation Projects Evaluated

Potential Mitigation Project	Watershed health impacts	Environmental significance	Practicability	Location
Existing Mitigation Banks and In-Lieu Fee Programs			Not practical - There are no active permitted Mitigation Banks or In-Lieu Fee programs within the HUC-10 watersheds that would be impacted by the project. Mitigation banks would be available at a HUC4 or HUC 2 level.	
Removal of Pacific salmon Passage Barriers (e.g. culvert barrier removal)	Hundreds of miles of anadromous fish habitat have been degraded throughout Alaska by undersized or damaged culverts that limit the passage of Pacific salmon. Healthy anadromous fish habitat is of high importance to residents who rely on Pacific salmon for subsistence. Approximately 6 miles of anadromous stream are impacted in the Analysis area.	Anadromous habitat can be returned to health by simply upgrading the undersized or damaged culvert. Benefits could extend for many miles upstream of the replaced culvert and have regional significance.	Practical - Generally, most sites will practicable as long and the land or right-of-way owner authorizes the construction activity, and cost are reasonable. There are virtually hundreds of miles of degraded streams that could be candidates for restoration.	There are no opportunities in the HUC-10 affected watershed, and few opportunities downstream of project impacts. There are abundant opportunities in waters connected to Upper Cook Inlet.
Restoration of Abandoned Fish Canneries	Wetlands or river shoreline on the Kvichak has been lost or are degraded by construction of the canneries. It is likely that canneries may include contaminants such as lead-based paint, asbestos, and oil-and lubricants contaminations.	Removal of the canneries and potential contamination could restore wetlands and improve water quality near the sites.	Not practical - the sites' lack of site assessment data on recognized environmental conditions, complex title history and mixed land ownership, historic values, and remoteness made it unfeasible to determine a practical approach to mitigation. Potential would be for a few acres of wetlands.	Outside the HUC-10 watersheds affected by the project.
ADEC Contaminated Sites	Reviewed spills are in improved locations (developed) sites. Clean up spills is unlikely to result in wildlife habitat gains, or habitat may continue to be degraded even after restoration is complete.	Wetlands, rivers, and streams that are free of contaminants are important for sustaining a healthy aquatic ecosystem.	Not practical - All contaminated sites (fuel spills) within the affected watersheds appear to have clean up actions in progress and are the legal responsibility of known entities. Contaminated sites are generally small and would result in few acres of benefit, and even fewer wetlands.	The database includes 12 contaminated sites in the Analysis Area where cleanup actions have been complete, and six sites where cleanup actions are undergoing.
ADEC Solid Waste Sites	Abandoned solid was sites are capped and expect to be generally upland locations. Further improvement are unlikely to result in wetland habitat gains.	Wetlands, rivers, and streams that are free of contaminants are important for sustaining a healthy aquatic ecosystem.	Not practical - Retired solid waste sites appear to be properly closed and operating solid waste sites appear to generally employee measures protective of the environment, with minor enhancements needed. There is little room for improvements that would result in either habitat or wildlife benefits. Solid waste sites are generally small and would result in few acres of benefit, and even fewer wetlands.	The database includes 11 solid waste sites in the Analysis Area located in the proximity of villages. Six solid waste sites are active, one inactive, and four retired.
ADEC Waste Erosion Assessment and Review (WEAR)	The ADEC conducted the WEAR program to inventory sites that have the potential to release hazardous substances and garbage from Alaska's landfills, contaminated sites, tank farms, and other sites of environmental concern into state waters, jeopardizing water quality, fish and wildlife.	Reviewed WEAR sites are in improved locations (developed) sites. Restoration is unlikely to result in wildlife habitat gains, or habitat may continue to be degraded even after restoration is complete due.	Not practical. There is much overlap between the ADEC WEAR program and other ADEC lists including the contaminated sites and solid waste sites databases. Similar practicability limitations discussed for ADEC contaminated sites and solid waste sites applies. WEAR sites are generally small and would result in few acres of benefit, and even fewer wetlands.	WEAR sites are present within the Analysis Area.
Environmental Protection Agency (EPA) Brownfields Sites	Potential source of water pollutants. There are 5 contaminated Brownfield sites in the Analysis Area.	Wetlands, rivers, and streams that are free of contaminants are important for sustaining a healthy aquatic ecosystem.	Not practical due to lack of opportunities. Cleanup has been completed at one spill site abutting Iliamna Lake. The two remaining sites are 0.3 miles the Newhalen River and cleanup actions are underway. Currently, not potential to generate any compensatory mitigation due to the lack of sites.	There are three brownfield sites located in Newhalen that resulted from large historic fuel spills on land, all near waters.
EPA Superfund Sites	Potential source of water pollutants, however there are no listed superfund cleanup sites in the Analysis Area.	Wetlands, rivers, and streams that are free of contaminants are important for sustaining a healthy aquatic ecosystem.	Not practicable due the lack of opportunities.	There are no listed superfund cleanup sites in the Analysis Area.
Rural Sanitation	Wastewater collection and treatment systems in the region need upgrades or improvements. Some systems are underperforming introducing pollutants into aquatic habitats.	Wetlands, rivers, and streams that are free of contaminants are important for sustaining a healthy aquatic ecosystem. Improvement in sanitation systems may result in water quality improvement.	Practical. Community sanitation systems are in constant need of improvement in the Analysis Area. The Alaska Native Tribal Health Consortium (ANTHC) is working on building a sludge disposal site for the sludge that is pumped from the individual septic tanks at Iliamna, but funding to complete the project is insufficient. Kokhanok, Nondalton, and Newhalen recently received approval for their water and wastewater feasibility study (ADEC 2018). Would not result in area increases, but functions would be improved	In Analysis Area
Barge Landings	Barge and boat landings can be a source of shoreline erosion and sedimentation in Iliamna Lake.	Barge landing improvements may result in localized lake habitat improvement by reducing suspended sediment in the water from boat activity. However, necessary improvements would likely result in additional habitat loss.	Not practicable as improvement projects are already under way: In 2009-2010 the Denali Commission funded the design of barge and boat landings for Iliamna, Kokhanok, Pedro Bay, Pile Bay, and Igiugig. Construction of these projects is pending (Denali Commision 2018).	In Analysis Area

Attachment 3 – Permittee-Responsible Mitigation Plan for Water Quality Improvement Projects

DRAFT REPORT

Pebble Project
Permittee-Responsible Mitigation Plan for Water Quality Improvement Projects

January 2020

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Exhibit A. Concept design memorandums

ACRONYMS AND ABBREVIATIONS

AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ANTHC	Alaska Native Tribal Health Consortium
AWC	Anadromous Waters Catalog
BOD	Biological Oxygen Demand
CMP	Compensatory Mitigation Plan
DA	Department of the Army
EPA	Environmental Protection Agency
ER	Environmental Report
HUC	Hydrologic Unit Code
IHS	Indian Health Service
NMFS	National Marine Fisheries Service
O&M	Operation and Maintenance
PER	Preliminary Engineering Report
PLP	Pebble Limited Partnership
PRM	Permittee-responsible Mitigation
STARS	Sanitation Tracking and Reporting System
SWTR	Surface Water Treatment Rule
TSS	Total Suspended Solids
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
VSW	Village Safe Water
WOUS	Waters of the U.S., including wetlands

1. Objectives

The Pebble Limited Partnership (PLP) is proposing this permittee-responsible mitigation (PRM) plan for water quality improvement projects as compensation for the unavoidable losses to aquatics resources that would result from the Pebble Project's proposed discharges of dredge or fill material into waters of the U.S. (WOUS), including wetlands. Wetlands improve water quality by intercepting surface runoff and removing or retaining inorganic nutrients, processing organic wastes, and reducing suspended sediments before they reach open water. The removal of wetlands can reduce the watershed's ability to perform these functions and improve water quality.

Current sources of water pollutants in the project's watersheds include community wastewater treatment systems. Poorly performing wastewater collection and treatment systems can introduce large volumes of pollutants (excrement, detergents, chlorine, and other chemicals) into the environment (NMFS 2017), degrading water quality and aquatic habitats. Discharges from properly designed and managed wastewater management systems have little or no adverse effect on water quality and the biota that thrives in the aquatic system.

The goal of this PRM plan is to rehabilitate water quality in the project watersheds by reducing pollutants in discharges from wastewater collection and treatment systems. PLP is proposing to conduct wastewater improvement projects located within project watersheds that will address deficiencies and result in the rehabilitation of water quality in the communities of Kokhanok, Newhalen, and Nondalton.

Objectives of this PRM include:

- Increase treatment and storage capacity of the sewage lagoon in Kokhanok.
- Increase treatment and storage capacity of the sewage lagoon in Newhalen
- Reduce wastewater treatment volume by reducing sewage collection system infiltration and improving operation reliability of the lift station unit in Nondalton.

PLP would be responsible for implementing this PRM, including ensuring that required compensatory mitigation activities are completed and successful. This type of mitigation project is not unique in Alaska. The U.S. Army Corps of Engineers (USACE) has previously accepted wastewater treatment facility improvements as compensatory mitigation for unavoidable losses resulting from discharges to WOUS (USACE 2019).

2. Site Selection

PLP's site selection process considered current wastewater collection and treatment needs within the project watersheds. Most wastewater collection and treatment systems serving communities in the project watersheds typically consist of a combination of piped gravity systems, sewage lagoons, individual septic tanks, and privies.

Treated wastewater that meets federal and state requirements is vital for preventing disease and protecting the environment. Individual privies and septic tanks can seep into the underground water tables and pollute water. Failing septic systems are a consequence of urban development. EPA estimates that 10 to 25 percent of all individual septic systems are failing at any one time, introducing contaminants into the environment

(NMFS 2017). Sewage may contain significant amounts of organic matter that exert a biochemical oxygen demand (BOD) and cause immune suppression in fish (Arkoosh, et al. 2001). Piped gravity systems that store, treat, and discharge wastewater provide better protection for the environment in rural communities. However, successful operation of these facilities is often hampered by inadequate training and a lack of funding for preventive maintenance (U.S. Congress 1994).

Federal and state agencies have programs to provide essential capital funds for repairing existing facilities and building new ones. The funding for proper operation and maintenance (O&M) of sanitation facilities is not traditionally part of any federal or state plan. Recognizing this deficiency, Congress amended the Indian Health Care Improvement Act of 1976 by passing the Indian Health Amendments of 1992, authorizing the Indian Health Service (IHS) to provide, for the first time, up to 80 percent of the O&M funding needed by economically deprived Native communities.

The IHS Division of Sanitation Facilities Construction maintains the Sanitation Tracking and Reporting System (STARS) database to track sanitation facilities' projects (Indian Health Services 2019). Similarly, the Alaska Department of Environmental Conservation (ADEC) Village Safe Water (VSW) Program maintains a multi-year project list to identify where funding is needed for the next several years. Projects are added to the list when communities submit applications that receive high overall ADEC review scores. Scoring is based primarily on critical health-related needs and local capacity to operate and maintain existing facilities. Sanitation projects are also funded and supported by the Alaska Native Tribal Health Consortium (ANTHC). Wastewater sanitation projects in rural areas often require the joint participation of IHS, ADEC's VSW Program, and ANTHC. Table 1 identifies rural sanitation projects for communities in the project affected watersheds listed in the STARS database as of November 11, 2019.

IHS and VSW projects are initiated and completed based on their priority and the availability of funds. The project list is constantly evolving as new projects are added and projects are completed. Federal and state funds need to be stretched to complete as many projects as possible across Alaska. Table 1 includes ANTHC identified projects in the project watersheds that were considered by PLP.

In 2019, the Lake and Peninsula Borough (LPB) manager approached PLP to explore potential financing opportunities for community wastewater improvement projects within the framework of PLP's compensatory mitigation plans. The LPB and PLP engaged in planning discussions and collaborated in the selection of potential wastewater projects from those listed in Table 1 that would meet the water quality goal of reducing pollutants in wastewater discharges, offsetting unavoidable losses to aquatic resources. Projects were selected based on their location within the potentially affected watershed, environmental significance, and practicability. Wastewater improvement project opportunities in the communities of Kokhanok, Newhalen and Nondalton are in proximity to the proposed discharges of fill material into WOUS and in the same watershed as the proposed mine facilities and transportation infrastructure.

PLP reviewed the wastewater treatment systems' deficiencies identified by IHS, ADEC and LPB for the communities of Kokhanok, Newhalen, and Nondalton. In general, these deficiencies affect wastewater treatment storage and capacity, and result in discharges of wastewater that have undergone little removal of contaminants or have the potential to bypass treatment entirely. Key deficiencies identified include:

- *Kokhanok wastewater treatment system*. The wastewater treatment demands exceed the system's design capacity and the sewage treatment and storage lagoon is at risk of overtopping the berms. The percolation cell is undersized and has been damaged due to the excess demand. The wastewater

system does not meet EPA's Surface Water Treatment Rule for turbidity requirements. The wastewater system is adjacent to Big Lake, which discharges into Iliamna Lake.

- ***Newhalen wastewater treatment system***. The wastewater treatment plant is undersized to handle the current wastewater volume and has reached the limit of its useful life. The plant is equipped with two septic tanks that are at a high risk of imminent failure (collapse). Raw sewage passes through these tanks substantially untreated. Removal of the septic tanks will require expansion of the sewage lagoon. This wastewater system is proximity 750 feet from Iliamna Lake.

- ***Nondalton wastewater treatment system***. The wastewater treatment plant is undersized to handle the current wastewater volume which has increased as a result of significant stormwater infiltrations (hydraulic overloading) and debris intrusion in the sewage collection system. The lift station operates almost continuously (up to 80,000 gallons of wastewater per day) in order to meet the community's wastewater demand and discharges to a lagoon designed to receive 12,300 gallons per day. The infiltration is a consequence of manholes that have experienced separation from their concrete bases due to frost jacking. Compounding the hydraulic overloading, the lift station components are severely deteriorated, causing the unit to be frequently offline. The increased flow and lift station conditions have caused back-ups to occur at lower elevation manholes, which could spill into adjacent Sixmile Lake waters. There are 17 manholes located within approximately 300 feet of Sixmile Lake, including the three closest to the lift station which are within 150 feet of Sixmile Lake. The lift station is located approximately 100 feet from Sixmile Lake.

In December 2019 PLP contactors conducted in-depth reviews and site visits of wastewater facilities in Kokhanok, Newhalen, and Nondalton to confirm facility and site conditions and to initiate the development of conceptual wastewater improvement designs. The Concept Design Memorandums for each project are included in Exhibit A. Based on the review of site conditions and construction cost estimates, PLP has determined these conceptual plans to be practical, and capable of meeting the water quality rehabilitation goals of this PRM.

Table 1. Potential sewer, water treatment, and solid waste projects at specific communities[1]

Community Project Name (IHS #)	Existing Deficiencies	Proposed Facilities[2]
Iliamna Lake and Sixmile Lake Communities		
Igiugig Sewage Lagoon Improvements (AK15429-2001)	The Igiugig sewage lagoon was constructed over 25 years ago and consists of two lagoon cells. Cell one and cell two were designed with berm heights of 10 feet and 4 feet. Deficiencies include: • The lagoon berms were constructed with native silt material and have settled approximately 2-3 feet. • The wire perimeter mesh fencing surrounding the lagoons is in disrepair. • The cell one liner has degraded due to ultraviolet (UV) light exposure.	This project would: • Repair lagoon dike settlement and reshape the lagoon berms. • Replace the wire mesh fencing with chain-link fencing and fence posts. • Patch the lagoon liner.
Kokhanok Water Treatment Plant (AK15455-1002)	The facility is over 20 years old and has severely degraded in the extreme weather that comes off Iliamna Lake. The existing surface water treatment plant is not capable of meeting EPA's Surface Water Treatment Rule (SWTR). Deficiencies include: • The existing facility is too small to be retrofitted to meet the SWTR. • Existing filtration does not meet SWTR turbidity requirements. • The solo-valve on the pressure sand filter, has frozen in the past and the internal orifices within the valve have broken, creating an internal cross-connection problem in the filter piping. • During heavy snow conditions, snow drifts bury the facility.	Construct a new surface water treatment plant that complies with the current SWTR, including: • Dual multimedia filters for direct filtration and polymer injection. • Dual boilers for adding heat to cold lake water being pumped to the water storage tank and water distribution system. • A small laboratory, bathroom, office, storage, and O&M workspace. • A concrete foundation, 2x6 insulated wall, metal siding and metal roof structure.
Kokhanok Sewage Lagoon Expansion (AK15455-2003)	The existing sewage lagoon was constructed in 1995 and is undersized. • Limited capacity in cell one causes sewage overflows into cell two, the percolation cell. • The undersized percolation cell has been damaged due to overloaded demand. The percolation rate in cell two has slowly decreased over time and during certain times of the year, the incoming flow rates are greater than cells one and two can treat. • A 2016 sanitation survey reported local source water streams close to the lagoon were at risk of contamination due to the overflow.	This project would construct an additional 14,000 square-foot percolation cell for expansion of the sewage lagoon.

Community Project Name (IHS #)	Existing Deficiencies	Proposed Facilities[2]
Kokhanok Individual Wastewater System Replacement (AK15455-2004)	The Kokhanok wastewater system was installed in the early 1990s and has exceeded its design life. Wastewater flows to the community's lagoon by either a conventional gravity sewer main with individual sewer services or a sewer force main working in conjunction with Residential Effluent Pump (REP) units. The 10 to 15-year design life of REP units has been exceeded. • Many of the existing pumps and controls have failed causing some residents to manually turn on their pumps for wastewater discharge. Others have resorted to using honey buckets for their wastewater needs. • The failed systems have led to sewage regularly backing up into residential toilets, tubs, and sinks, exposing homeowners to raw sewage and creating a health hazard. • Steel septic tanks and pump vaults have rusted through causing wastewater to surface on residential property. The Kokhanok Tribe and homeowners have attempted to replace the pumps and control panels throughout the system, however due to the age of the system, replacing only these components does not solve the deficiency.	This project would replace the individual REPS and sewer service lines for 15 homes.
Newhalen Water Treatment Plant (AK15400-1001)	The existing groundwater treatment plant is over 34 years old and at the end of its useful life. Although still capable of meeting current water quality standards, the plant deficiencies include: • Extremely deteriorated, which precludes safe and normal operation and maintenance on the piping and components. • O&M costs are high due to significant structure energy deficiencies and it needs to be replaced.	Construct a new groundwater treatment plant.
Newhalen Sewage Lagoon Expansion (AK15440-2003)	The existing sewage lagoon is only approved as an effluent lagoon and is not permitted for or capable of handling raw sewage. During the development of the current sewage lift station project, it was assumed that the lagoon would be able to handle raw sewage, thereby eliminating the two failing septic tanks and failing wet well/dry well lift station. ADEC reviewed the proposed expansion plans and are requiring that in order to connect to the new sewage lift station and accept raw sewage the existing sewage lagoon must be expanded. The existing failing septic tanks would be left in place until the lagoon is expanded.	This proposed project would upgrade an existing sanitation component that cannot meet capacity requirements and if unresolved, would jeopardize the health benefits of the system. Improvements include: • Expand and permit the existing sewage lagoon to connect to a new sewage lift station and permit and accept raw sewage. • Retain existing failing septic tanks in place until the lagoon is

Community Project Name (IHS #)	Existing Deficiencies	Proposed Facilities[2]
		expanded and permitted to accept raw sewage.
Nondalton Lift Station Replacement (AK15442-2001)	The lift station has deteriorated over time and no longer functions as designed. Deficiencies include: • Broken pump rails that make it impossible to provide operation and maintenance or replacement of the lift station pumps. • Malfunctioning electrical controls, including those for the ventilation fans • Electrical controls are housed in the same room as the wet well and are not explosion proof as required by National Electrical Manufacturers Association. • The lift station operates almost continuously (up to 80,000 gallons of wastewater per day) in order to meet the community's wastewater demand and discharges to a lagoon designed to receive 12,300 gallons per day. • The lift station is located less than 100 ft from the high-water level of Sixmile Lake, a violation of the State of Alaska's separation distance requirements.	Remove the existing lift station structure, pumps, wet well, and electrical, and replace the lift station with a new structure, wet well, submersible pumps, and new electrical. Replace the failed 20+ year old lift station.
Nondalton Sewage Lagoon (AK15442-2105)	• The sewage lagoon is undersized for the flow it receives and discharges without a discharge permit more than 10% of the time. • Effluent is discharged to a lined primary cell; an overflow structure on the south side of the primary cell connects to an unlined percolation cell. The percolation cell has an overflow pipe that discharges into woods east of the lagoon. Wastewater flows from this overflow discharge pipe to a lowland area and eventually to Sixmile Lake, the community's drinking water source.	• Construct an additional 3 acres of lagoon cell(s) at the existing sewage lagoon site. • Upgrade components that intermittently compromise or are likely to compromise the health benefits of the system.
Nondalton Sewer Collection (AK15442-4006)	• The sewer system's polyvinyl chloride (PVC) mains and service lines have become brittle over the years, causing breaks, specifically at connection points where the main meets a service line or manhole. • Existing corrugated metal manholes have experienced separation from their concrete bases due to frost jacking. • Sediment and debris have built up in the manhole inverts and many of the manholes and covers are below grade making access for maintenance difficult. • Infiltration caused by the system's deficiencies has led to a significant increase in the system's wastewater flow causing the community lift station to work overtime.	The project would replace existing system components where structural integrity has been compromised and currently jeopardizes the health benefits of the system. • Replace the existing PVC arctic gravity sewer collection mains with 8-inch high density polyethylene (HDPE) insulated arctic pipe. • Replace the existing arctic manholes with 4-foot diameter concrete manholes.

Community Project Name (IHS #)	Existing Deficiencies	Proposed Facilities[2]
		• Replace arctic boxes and service lines at each home.
Koliganek Onsite Water and Sewer for Two Homes (AK15433-2003)	Water: Two homes have no interior or exterior water facilities. Homeowners haul water for residential use. Sewer: Two homes have no interior or exterior sewer facilities.	Water: This project would provide two un-served homes with in-home plumbing and onsite wells. Sewer: This project would provide two un-served homes with in-home plumbing and onsite wastewater facilities.
Ekwok Sewage Lagoon Improvements (AK15428-2003)	• Fencing is in disrepair. • Lagoon seepage estimated at over 10 times the current applicable standard. The first cell was designed as a percolating cell, and a second cell was subsequently added. The first cell is undersized and is functioning as a cesspool, with uncontrolled sewage flow into the ground and overland to the second cell. • The lagoon receives periodic deliveries of septage; most homes use on-site systems.	The project would rehabilitate the lagoon by expanding and lining the first cell, rehabilitating the second cell and, as necessary, replacing/repairing fencing.

1 Source: Indian Health Services, Sanitation Tracking and Reporting System (STARS), https://wstars.ihs.gov/index.cfm?fuseaction=Reports.selectCommunityForPublicSdsSummary, November 6, 2019, unless otherwise noted.
2 The project as summarized in STARS.

Abbreviations: Preliminary Engineering Report (PER); Environmental Report (ER); Alaska Native Tribal Health Consortium (ANTHC), Indian Health Service (IHS)

3. Determination of Credits

PLP's proposal to fund village wastewater collection and treatment projects at Kokhanok, Newhalen, and Nondalton would improve local wastewater management systems in project watersheds; the resulting outcomes would be the rehabilitation of receiving WOUS water quality or prevention of further degradation. This rehabilitation would not result in a gain of aquatic resources area for purposes of tracking "no net loss" of wetlands; however, it can still be used to compensate for a loss in resource area.

4. Mitigation Work Plan

PLP has prepared conceptual plans, including concept design requirements and preliminary engineering drawings, for the proposed wastewater improvements at Kokhanok, Newhalen, and Nondalton (Exhibit A). Proposed wastewater improvements include:

- Kokhanok wastewater system improvements.
    - Construct a new groundwater treatment plant with a three-cell lagoon having a total surface area of approximately 4 acres to meet required wastewater storage and adequate percolation.
- Newhalen wastewater system improvements.
    - Construct a new groundwater treatment plant with a three-cell lagoon having a total surface area of approximately 2.1 acres to meet required wastewater storage and adequate percolation.
- Nondalton wastewater system improvements.
    - Remove the existing lift station structure, pumps, wet well, and electrical, and replace the lift station with a new structure, wet well, submersible pumps, and new electrical.
    - Replace the existing 21 arctic manholes with 4-foot diameter concrete manholes.

The work plan to complete the proposed wastewater improvements includes:

- Complete final coordination with village administration and operations and maintenance (O&M) personnel to ensure planned upgrades and repairs address identified problems and are compatible with O&M capabilities.
- Coordinate with ADEC and ANTHC to ensure plans are compatible with existing systems and current standards for village community sewage systems.
- Complete comprehensive assessment of the existing wastewater infrastructure.
- Confirm current wastewater volumes and calculate projected volumes through project design life.
- Prepare system upgrade engineering plans for review by agencies and villages.
- ADEC plan review and final approval obtained.

- Prepare final project plans and specifications and release for bid.
- Construct wastewater system upgrades and commission systems.
- ADEC issues final approval to operate (FATO).
- Villages accept upgrades and assume maintenance and operations responsibility.
- Prepare a report of wastewater improvements completed and provide copies of the ADEC issued final approval to operate certificates to the USACE for review; document achievement of performance goals.

5. Maintenance Plan

Wastewater collection and treatment systems would be operated and maintained by the community or tribal entity served by the system and would be subject to state and federal regulatory oversight and reporting requirements. PLP is not proposing maintenance of the facilities or systems other than as necessary to correct potential system construction or design deficiencies for a period of five years after performance standards are achieved. The local wastewater treatment operators would continue to be responsible for maintaining their facilities. Therefore, no specific maintenance plan has been developed.

6. Performance Standards

The performance standard for wastewater projects is:

- Wastewater system improvements will receive the required "final approval to operate (FATO)" from the ADEC.

7. Monitoring Requirements

The proposed wastewater treatment systems will be subject to state and federal regulatory oversight, monitoring, and reporting requirements. The community or tribal entity would continue to be responsible for their facilities. PLP will conduct annual post-construction inspections to document integrity of improvements for a period of five years.

8. Long-term Management Plan

Long-term management of the wastewater treatment system by PLP is not warranted because PLP would not be the owner or operator of the system.

9. Adaptive Management Plan

This PRM proposes wastewater improvement projects for the communities of Kokhanok, Newhalen, and Nondalton. The timing to start construction of these projects is dependent on the USACE's approval of PLP's Department of the Army permit application, and PLP's decision to proceed with construction of the overall Pebble Project. The proposed improvements are critically needed by the communities to resolve

existing deficiencies and have already been identified by ADEC, IHS, and ANTHC. It is possible that if funding becomes available from ANTHC or another party, the proposed wastewater improvements could be completed without PLP's involvement prior to execution of this plan. If the proposed wastewater improvements become impractical for any reason, PLP will research and propose similar scope project(s) within the potentially affected watershed, or outside if required. Such a change would require the revision of the PRM objectives and performance standards, which would be submitted to the USACE for review and approval.

Project design changes, necessary to meet regulatory requirements and the plan objectives and performance standards, will be completed by PLP without approval from USACE.

10. Financial Assurances

PLP will establish a performance bond to ensure the PRM projects are satisfactorily constructed and all performance criteria are met. PLP is responsible for:

- All permit acquisition and compliance.
- Project design, set-up, management, planning, support, and execution of the PRM plan.
- Site inventory, data collection, and monitoring.
- Reporting to USACE.

The bond will be closed once all PRM objectives and performance standards are met, and a final sign-off on the PRM plan has been provided by the USACE.

11. Other Information

No other information is provided.

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Exhibit A

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Concept Design Memorandum

TO: Alaska Peninsula Corporation

SUBJECT: Kokhanok Sewage Lagoon Improvements

DATE: 1/23/2020

BY: Steven Hebnes, PE, Civil Engineer

CRW Engineering Group, LLC (CRW) is providing subcontract services with the Alaska Peninsula Corporation (APC) to assess various sanitation needs in the community of Kokhanok as a component of the mitigation planning for the Pebble Project. As a part of the evaluation effort, CRW has reviewed current Sanitation Deficiency System (SDS) documentation provided by Alaska Native Tribal Health Consortium (ANTHC), performed a site assessment, interviewed community members familiar with the system operation, and reviewed record documents for past specific projects, including previous design reports, field assessments, and related correspondence. The community of Kokhanok is served by ANTHC for addressing public sanitation needs. ANTHC has summarized various sanitation needs in Kokhanok for seeking Indian Health Service (IHS) funding through the SDS program. The Kokhanok wastewater lagoon project has been summarized in SDS reporting, but does not rank high enough for securing IHS funding.

Existing Conditions

The community of Kokhanok wastewater system includes a piped sewer collection system with a community percolation sewage lagoon used for wastewater treatment and disposal. The existing sewage lagoon in the community of Kokhanok was constructed in 1995 and has been found to be significantly undersized for current wastewater hydraulic and BOD loading rates. The sewage lagoon currently features a two-cell system: a primary cell and a smaller percolation cell. Both the primary and percolation cells are undersized. The percolation rate of the underlying soils have apparently diminished due to biochemical oxygen demand (BOD) overloading and solids overloading. BOD represents the amount of oxygen needed by aerobic organisms to break down organic material and reduce/remove organic solids. It has been noted by ANTHC and the community that percolation rates appear to be slower during the wetter and colder seasons of the year, and as a result, incoming flow rates often exceed the treatment rate of the lagoon. Lagoon overflows have been associated with these conditions. During CRW's October 2019 site visit, the regional State of Alaska Remote Maintenance Worker (RMW) was on-site and indicated that portions of the liner in Cell #1 occasionally float up above the water surface, possibly

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reducing the water capacity in Cell 1. Visible liners are typically a sign of off-gassing from decaying organics below the liner, or that the liner is compromised. High groundwater may also exacerbate this condition.

As part of this evaluation, CRW traveled to Kokhanok in early December 2019 and dug 3 test pits in the vicinity of the existing wastewater lagoon to identify the potential for percolation cell expansion, and also identify a potential site for a new wastewater lagoon. During the inspection, groundwater was found approximately 2 to 3 feet below the ground surface near the existing lagoon. The testing information and the geotechnical memo from this effort is attached.

Having a high potential for future overtopping and with a compromised liner, it is evident that the lagoon is failing and is in need of system improvements. Upgrades to the lagoon are necessary to meet current and future treatment capacity requirements.

Risk to the Environment from the Current Wastewater System Deficiencies

The existing sewage lagoon is at risk of overtopping. If the sewage lagoon continues to operate with the current deficiencies, it is expected that raw sewage will continue to be conveyed into the undersized primary treatment and percolation cells, and will continue to overtop the lagoon berms when incoming flow rates are greater than the diminishing treatment capacity of the existing lagoon. The result of a wastewater lagoon breach could create a substantial release of wastewater into the adjacent wetlands and waterbodies, as much as the daily volume of 18,750 gallons per day. Untreated releases of wastewater into the surrounding environment can impose threats to community health and damage aquatic habitats from high BOD, pathogens and other contaminants.

Recommended Improvement

The recommended improvement for the community of Kokhanok is to increase the treatment capacity of the sewage lagoon to meet ADEC standards for treating raw sewage. Further, the improvements should also provide adequate percolation and hydraulic storage capacity. This recommendation is consistent with ANTHC's findings from reviewing the lagoon's deficiencies.

With these improvements, the treatment of domestic wastewater would be performed in a three-cell lagoon having a total surface area of approximately 173,000 SF (4.0 acres). The lagoon would be bounded by berms constructed from local granular fill. The berms would be built in one-foot lifts to create 3:1 interior and exterior slopes. A vegetative cover on the exterior slopes would be graded at a 4:1 slope. The new berm height would be 8 feet above the existing grade. The primary treatment cells berm height provide a 3-foot freeboard height above the liquid

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volume, and a 1.0-foot depth for sludge storage (220,000 gallons), in accordance with the ADEC design criteria. Improvements for existing Cells #1 and #2 would be limited to regrading existing berm slopes and adding fill as required. Two feet of additional fill is anticipated. Secondary treatment and percolation would be performed in Cell #3, and would be constructed similar to Cell's #1 and #2, but to a lower berm height of 6 feet. The new percolation cell would be located in an undisturbed area, and would require full grading and berm development. With this geometry, the berm construction would require approximately 12,000 CY of granular fill. Approximately 1 foot of organic material would cap the exterior slopes, to be vegetated for erosion control and bank stability.

Conceptual Design Requirements

- Lagoon Design Criteria:
  - 18,750 GPD [1]
  - Percolation Rate: 0.25 gal/SF/day (ADEC reduced rate due to high groundwater).
  - Maximum Organic Loading: 20-30 lb/acre [2]
  - Minimum Primary Treatment Wetted Surface Area: 1.42 acres.
  - Total Effective Volume: 4,410,000 Gallons
- Upgrade existing Primary Cell #1 and Percolation Cell #2 berms to meet ADEC primary treatment surface area requirements based on the calculated organic loading [3]:
  - Repair the failed liner from Cell #1.
  - Upgrades to the existing cells:
    - Cell #1 would provide an effective operating volume of 2,390,000 gallons and a wetted surface area of 1.15 acres.
    - Cell #2 would provide an effective operating volume of 767,000 gallons and a wetted surface area of 0.45 acres.
- Design of a new percolation Cell #3 based on design percolation rate with a minimum winter volume storage capacity of 120 days:

[1] GV Jones and Associates, *Kokhanok Wastewater Feasibility Study, 2011,* ANTHC.
[2] Heath Research, Inc., Health Education Services Division, *Recommended Standards for Wastewater Facilities, 2004,* Member States and Province.
[3] Heath Research, Inc., Health Education Services Division, *Recommended Standards for Wastewater Facilities, 2004,* Member States and Province.

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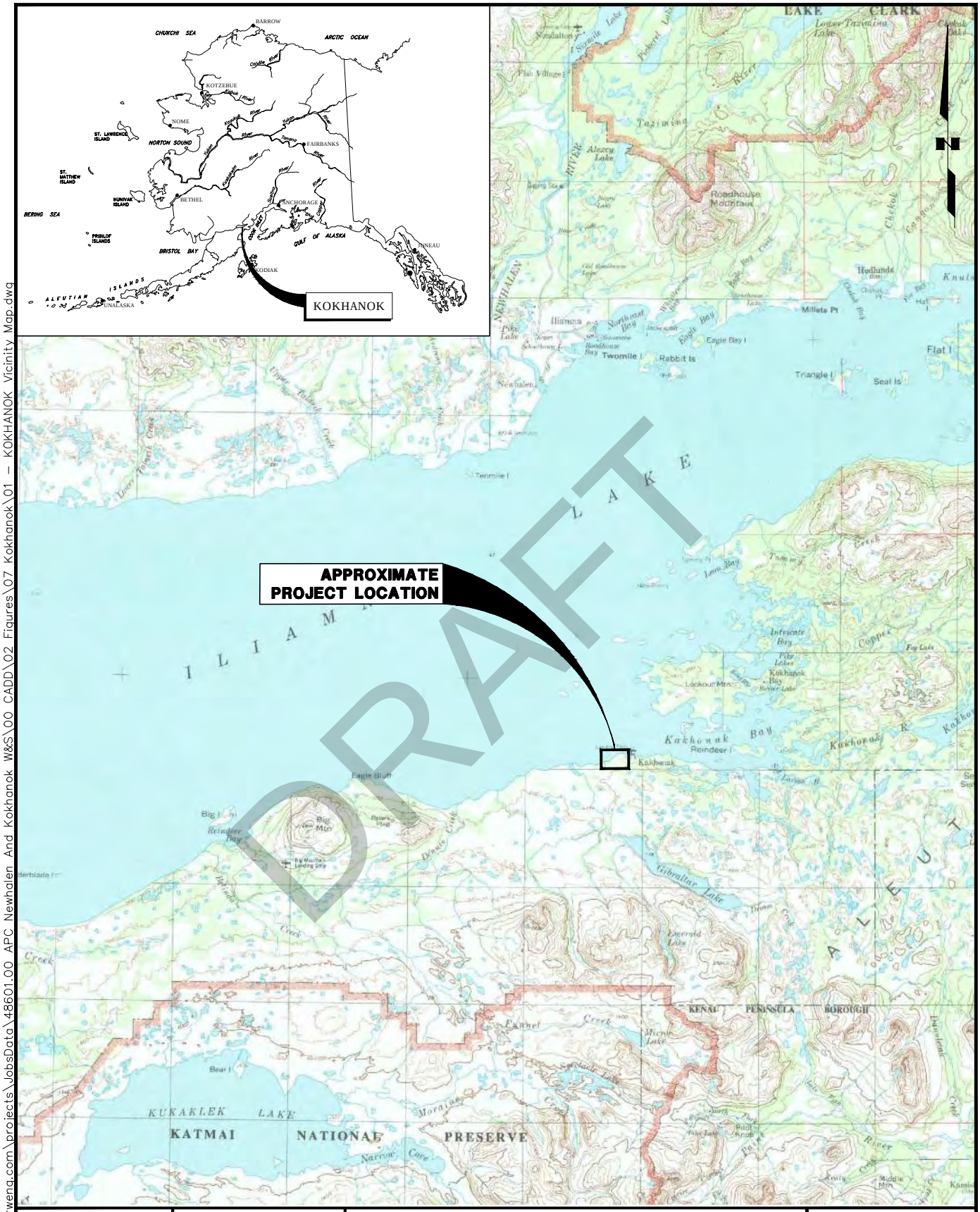
- The new percolation Cell #3 will provide an effective winter storage capacity of 2,350,000 gallons, percolation surface area of 84,000 square feet and a wetted surface area of 2.04 acres (area not included for Organic Loading requirements).

The proposed action would result in the construction of a fully-permitted community sewage treatment system, would will protect the environment and public health from the hazards identified.

Conceptual Construction Drawings

Kokhanok Sewage Lagoon Photos – October 2019

Geotechnical Report: Kokhanok W&S Scoping Assessment – January 2020



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KOKHANOK, ALASKA

VICINITY MAP

Project No:	48601.00
Drawn By:	MCH
Scale:	NTS
Date:	1/18/20
Figure:	1

FILE NAME: \\crweng.com\projects\JobsData\46801.00 APC Newhalen And Kokhanok W&S\00 CADD\02 Figures\07 Kokhanok\02 – KOKHANOK Community Overview.dwg

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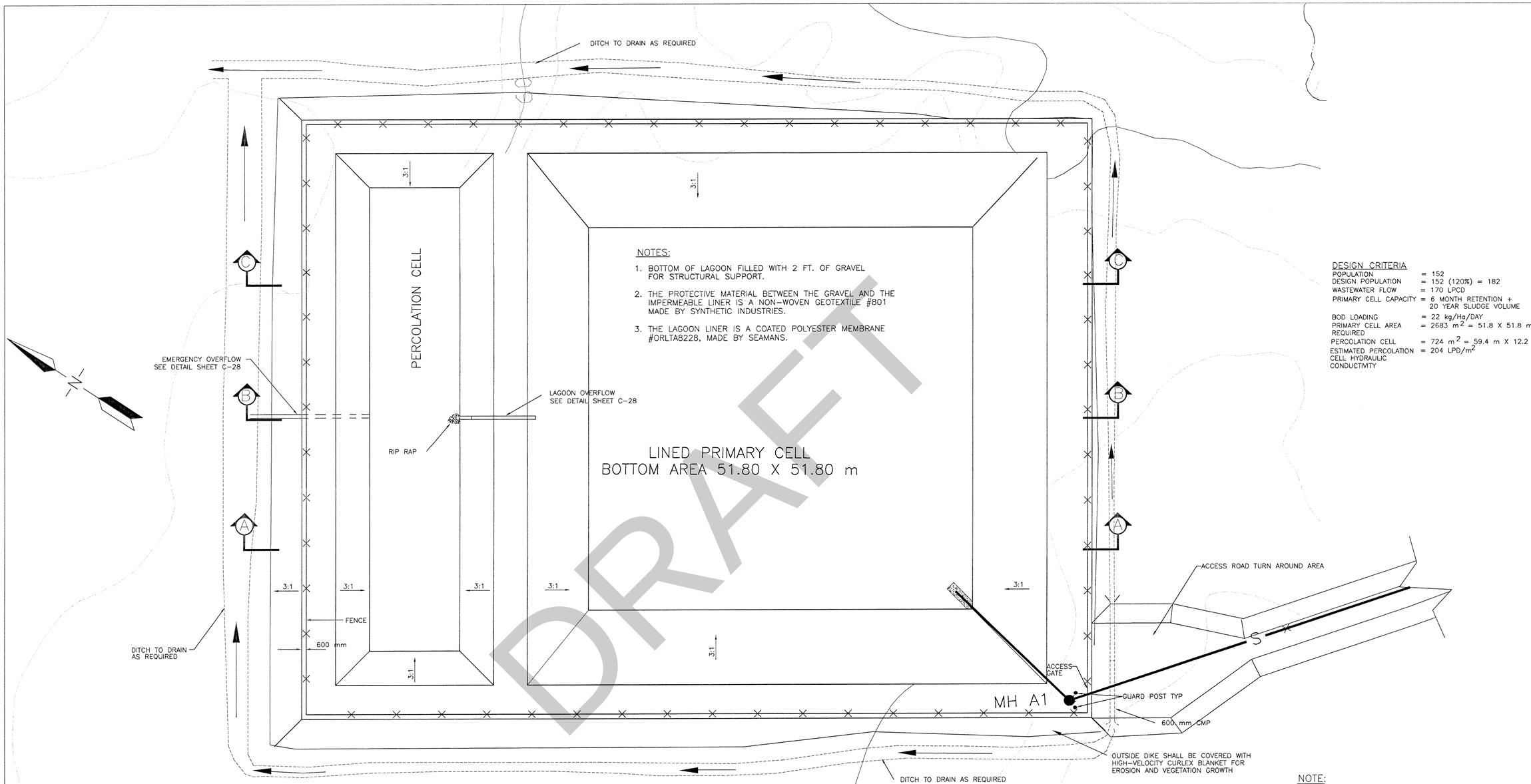
KOKHANOK, ALASKA

COMMUNITY OVERVIEW

LAGOON IMPROVEMENT PLAN

Project No:	46801.00
Drawn By:	MCH
Scale:	GRAPHIC
Date:	01/18/2020
Figure:	2

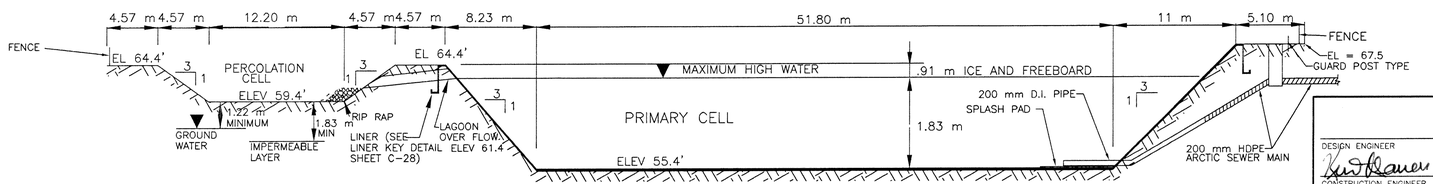


SEWAGE LAGOON PLAN

N.T.S.

DESIGN CRITERIA

POPULATION	= 152
DESIGN POPULATION	= 152 (120%) = 182
WASTEWATER FLOW	= 170 LPCD
PRIMARY CELL CAPACITY	= 6 MONTH RETENTION + 20 YEAR SLUDGE VOLUME
BOD LOADING	= 22 kg/Ha/DAY
PRIMARY CELL AREA REQUIRED	= 2683 m^2 = 51.8 X 51.8 m
PERCOLATION CELL	= 724 m^2 = 59.4 m X 12.2 m
ESTIMATED PERCOLATION CELL HYDRAULIC CONDUCTIVITY	= 204 LPD/m^2



SECTION A – A

N.T.S.

NOTE:
ALL DIMENSIONS ARE MILLIMETERS (mm) UNLESS OTHERWISE NOTED

DATE	REVISIONS	INITIALS
01-01	FINAL AS-BUILT	BJH

U.S. DEPARTMENT OF HEALTH & HUMAN SERVICES
PUBLIC HEALTH SERVICE
INDIAN HEALTH SERVICE

KOKHANOK, ALASKA
SEWAGE LAGOON PLAN AND PROFILE DETAILS

PUBLIC LAW 86-121 PROJECT
PROJECT NO. AN-92-682

SHEET NO. C-42
OF
47
TOTAL SHEETS

RECORD DRAWINGS

STATE OF ALASKA 49TH DANIEL D. REITZ No. 7928 REGISTERED PROFESSIONAL ENGINEER

THESE DRAWINGS REFLECT RECORDED INFORMATION OBTAINED DURING CONSTRUCTION.

INFORMATION PROVIDED HEREIN IS ACCURATE TO THE BEST OF MY KNOWLEDGE.

NAME _____ DATE 2-1-01

DESIGN ENGINEER

CONSTRUCTION ENGINEER

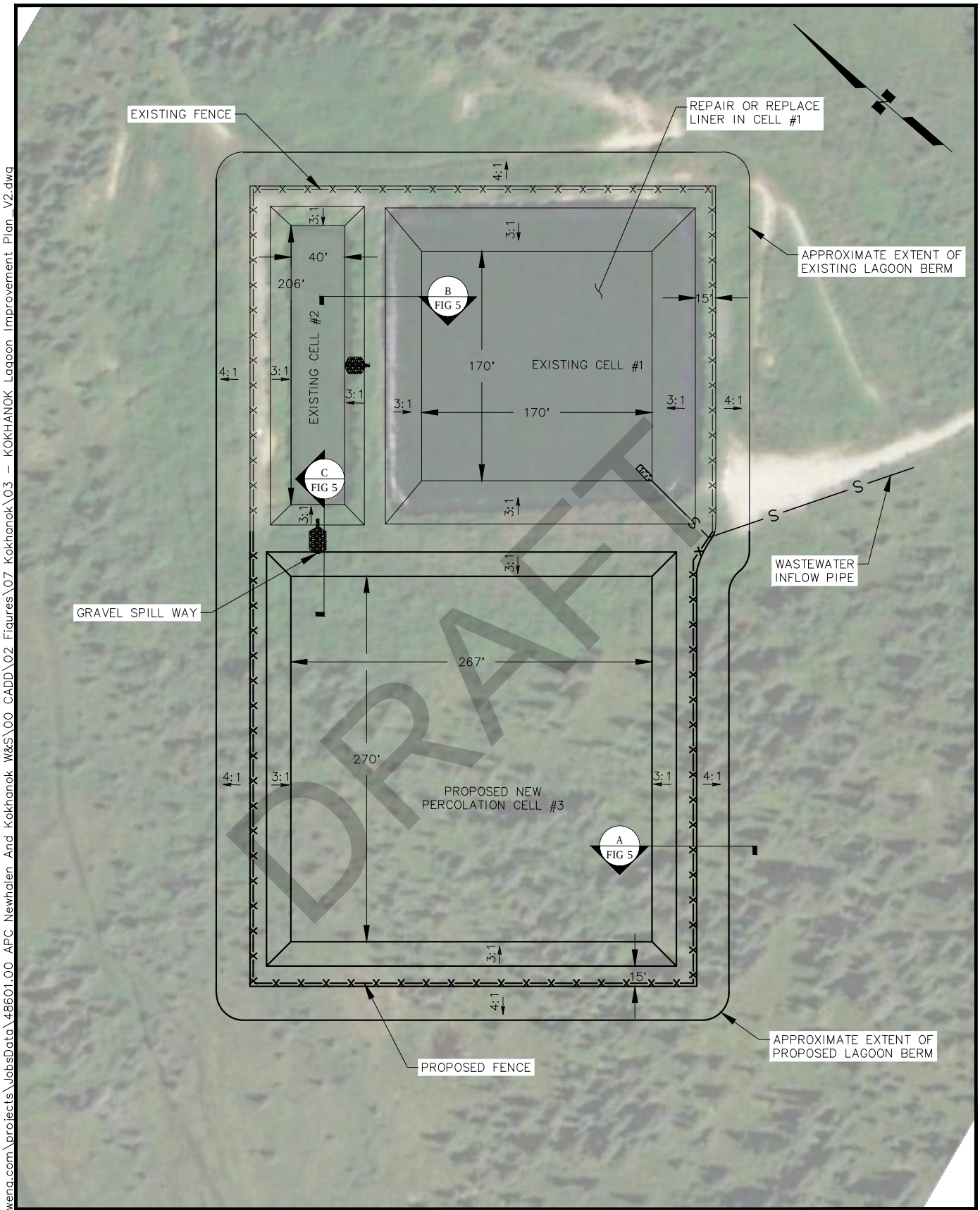
O&M CONSULTANT

STATE OF ALASKA 49TH STEPHEN R. BOLAN CE-8993 REGISTERED PROFESSIONAL ENGINEER

DRAWN BY: JAQ
DATE: 5-94
FILE NAME: 682-C42AB
PLOT SCALE: FIT

SANITATION FACILITIES CONSTRUCTION BRANCH
OFFICE OF ENVIRONMENTAL HEALTH AND ENGINEERING
ALASKA AREA NATIVE HEALTH SERVICE
ANCHORAGE, ALASKA

FIG 3



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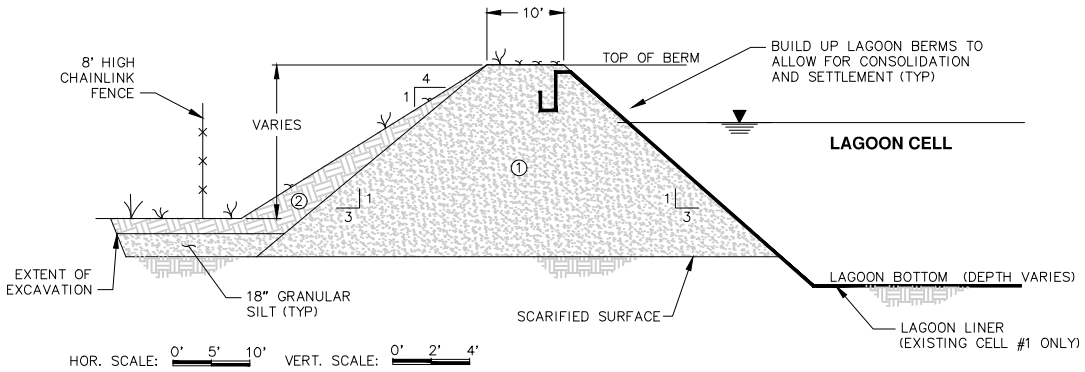
KOKHANOK, ALASKA

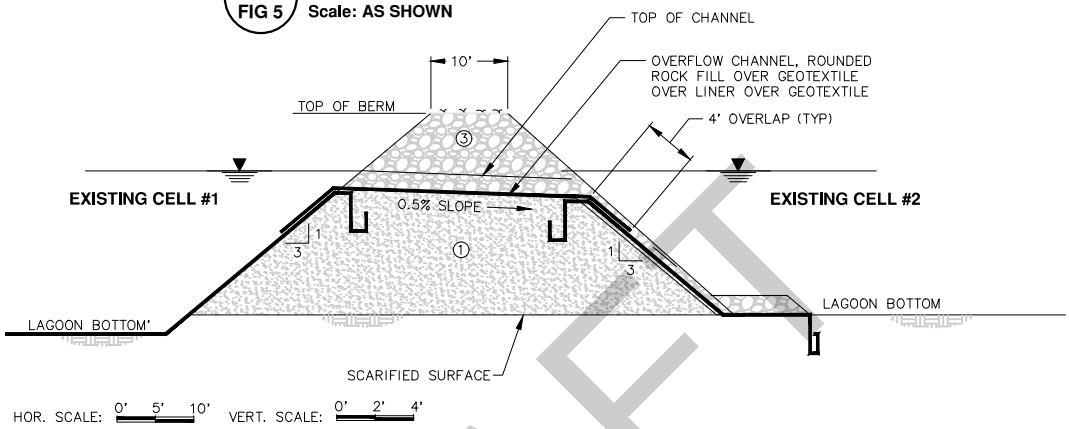
PROPOSED SEWAGE LAGOON

LAGOON IMPROVEMENT PLAN

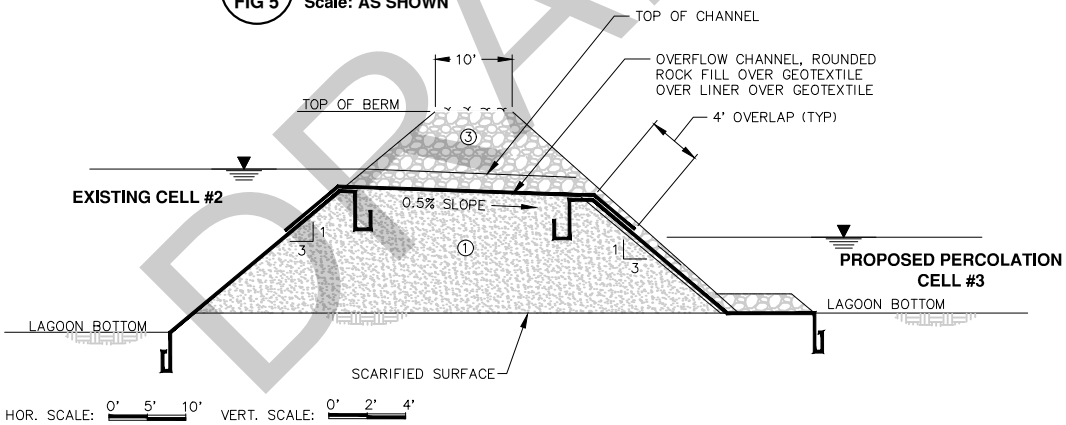
Project No:	46801.00
Drawn By:	MCH
Scale:	GRAPHIC
Date:	01/18/2020
Figure:	4



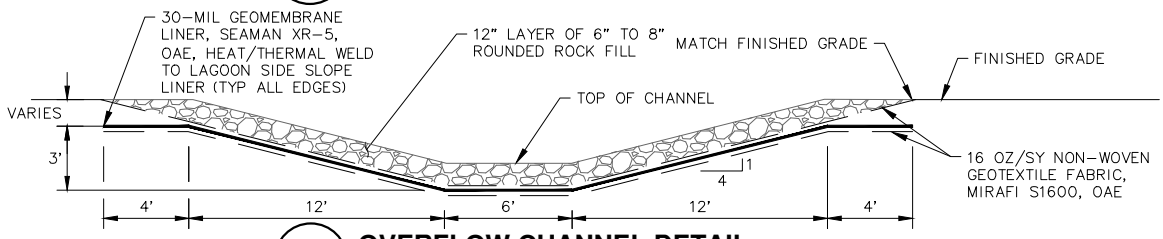
A / FIG 5 — TYPICAL BERM SECTION A
Scale: AS SHOWN



B / FIG 5 — TYPICAL BERM SECTION B
Scale: AS SHOWN



C / FIG 5 — TYPICAL BERM SECTION C
Scale: AS SHOWN



- / FIG 5 — OVERFLOW CHANNEL DETAIL
Scale: NOT TO SCALE

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KOKHANOK, ALASKA

LAGOON SECTIONS

LAGOON IMPROVEMENT PLAN

Project No:	46801.00
Drawn By:	MCH
Scale:	GRAPHIC
Date:	01/18/2020
Figure:	5

FILE NAME: \\crweng.com\projects\JobsData\46801.00 APC Newhalen And Kokhanok W&S\00 CADD\02 Figures\07 Kokhanok\04 - KOKHANOK Lagoon Sections.dwg

Kokhanok Lagoon
Site Investigation Photos

Photo	Description
	Lagoon Cell #1 with liner visible. – October 29, 2019
	Lagoon Cell #1, view two. – October 29, 2019

Kokhanok Lagoon
Site Investigation Photos

Photo	Description
	Lagoon Cell #2 – October 29, 2019
	Berm between Cell #1 (right) and Cell #2 (left) – October 29, 2019

Geotechnical Report

Kokhanok W&S Scoping Assessment

January 2020

Contact
Steven Halcomb, PE, GE
shalcomb@crweng.com

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Geotechnical Report

Kokhanok Water and Sewer Scoping Assessment

Submitted To:

Mr. David McAlister
Alaska Peninsula Corporation
301 Calista Court, Suite 101
Anchorage, AK 99513

Submitted By:

CRW Engineering Group, LLC
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[DRAFT – NO SIGNATURES]

_____

Steven Halcomb, PE, GE, D.GE

Senior Geotechnical Engineer

January 2020
CRW Project Number 48601.00

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2. Site Description 1
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Appendix A – Test Pit Logs
Appendix B – Laboratory Results
Appendix C – Site Investigation Photos

1. Introduction and Project Description

CRW Engineering Group, LLC (CRW) is pleased to present this geotechnical report to support the design and construction of a new lagoon in Kokhanok, Alaska (see Figure 1). This report summarizes our geotechnical investigation and existing subsurface conditions.

The project consists of the expansion of the existing lagoon for the Village of Kokhanok. The locations evaluated for the new lagoon were to the east and south of the existing lagoon and a new site approximately 0.43 miles north-northeast of the existing lagoon (see Figure 2).

Our scope of work included:

- Performing a geotechnical investigation which included excavating four test pits.
- Percolation testing.
- Overseeing laboratory testing of recovered soil samples including moisture content, grain size distribution, and Atterberg Limits.
- Analysis of field observations and testing results.
- Preparing the geotechnical data report.

2. Site Description

The project site is located in Kokhanok, Alaska, which is on the southern shoreline of Lake Iliamna, 22 miles south of the City of Iliamna, and 88 miles northeast of the City of King Salmon. The topography of the area is generally flat with some rolling hills, and benches with mountains to the southeast. Peat bogs occur in some of the lowland areas and consist of organic and silty soils with surface water or shallow groundwater present.

3. Subsurface Investigation

A geotechnical investigation was completed on December 16th and 17th of 2019 to assess existing subsurface conditions. The investigation included four test pit (TP-01 thru 03 and HDTP-01).

Test pit locations were determined by CRW and field-adjusted as needed. Final test pit location are shown on Figure 2.

Excavation services were provided by the Native Village of Kokhanok, using a Case 580 rubber-tired backhoe. Backhoe-completed test pits were excavated to depths ranging from 5 to 8 feet below the ground surface (BGS). One hand-dug test pit (HDTP-01) was completed to a depth of 2 feet BGS using a square-nosed shovel and gardening spade. Test pit logs are presented in Appendix A.

Field operations were supervised by a CRW geotechnical engineer, who logged the recovered soils, collected samples, and directed the excavation operation. Photos from the exploration are presented in Appendix C.

3.1 Test Pit Sample Collecting

Representative samples were collected from the backhoe bucket as the test pits were excavated or as grab samples from the excavation. Recovered samples were visually classified in the field before being individually sealed in double plastic bags. Visual classification was performed following the Unified Soils Classification System (USCS) according to ASTM D2487/D2488. Samples will be retained for up to 6 months for future testing if requested.

3.1.1 Test Pit Completion

Upon completion, the test pits were filled and compacted with the backhoe bucket or shovel to closely match original grade.

3.2 Percolation Test

One in-situ falling head percolation test was performed (PERC-01) in TP-03. The groundwater table was observed to be too shallow in TP-01, TP-02, and HDTP-01 to perform percolation testing. Results from the percolation tests are presented on the test pit log and shown in Table 1 below. The tests were performed in accordance with the Onsite Wastewater Treatment and Disposal System Design Manual (EPA, 1980). The percolation test location is shown in Figure 2.

Table 1 – Percolation Rates

Percolation Pit	PERC-01
Percolation Rate (minutes per inch)	0.98

4. Laboratory Testing and Results

Soil laboratory tests to evaluate index properties of representative samples were performed by Alaska Testlab at their Anchorage facility. The laboratory tests were performed in accordance with the test methods of ASTM International. In total, 8 samples were submitted for testing. The laboratory testing consisted of soil index tests to determine: water content, grain-size distribution, organic content, and Atterberg Limits.

All samples were tested for their water content per ASTM D2216. Water contents varied from 8 to 33 percent.

Five samples were selected for grain-size distribution testing in accordance with ASTM D6913 and/or D422. Four samples were classified as poorly graded sand and gravel with varying fines content, with one sample being silty sand with gravel.

Two samples were washed through the No. 200 mesh sieve in accordance with ASTM D1140. The coarse fraction of the remaining soil was then dried and sieved through the No. 4 sieve to determine the sand and gravel content. This method is termed the Limited Mechanical Analysis (LMA). The LMA is a means to determine the percentage of coarse and fine soil in a sample without having to perform full gradations. These two samples were classified as silty sand and silty gravel.

One sample was tested for its Atterberg Limits in accordance with ASTM D4318. The result of this test determined the plasticity to be non-plastic.

One sample was tested for its organic content in accordance with ASTM D2974. The organic and ash content was determined to be 5.3 and 94.7 percent, respectively.

Results of the laboratory testing are presented in Appendix B.

5. Site Conditions

5.1 Soil Lithology

Kokhanok is primarily underlain by beach deposits of estuarine and lacustrine origin, potential glacial drift, and bedrock (Detterman and Reed, 1973).

A thin organic mat approximately 3 inches thick was observed in the test pits. The organic mat was brown, moist, and had up to 1 inch fibrous roots.

The subsurface conditions around the existing lagoon generally consisted of poorly graded sand to silty sand. The sand was brown to dark gray in color and moist to wet with water contents ranging from 11 to 33 percent. The fines content of the sand ranged from 1 to 24 percent and was noted to be non-plastic. The sand content ranged from 41 to 99 percent, with a size range of coarse-to-fine. The gravel content ranged from 0 to 35 percent with a size range of coarse-to-fine and maximum particle size of 3 inches.

Significant organic content was observed in TP-01, in addition to variation in color of the sand compared to TP-02 and HDTP-01. It is most likely that the material encountered in TP-01 was from the construction of the existing lagoon and not necessarily reflective of the native in-situ soils.

The subsurface condition at TP-03 was observed to be 1 foot of brown, moist organic silt underlying the organic mat. Below the organic silt was a brown, moist, clean poorly graded gravel to a depth of 7 feet BGS. The moisture content of the gravel varied from 7.6 to 9.2 percent. The gravel content was noted to decrease with depth during the excavation. Below the poorly graded gravel was a silty gravel with sand until 8 feet BGS at which point the excavator bucket encountered refusal.

Cobbles were observed in the test pits and ranged from 8 to 11 inches in diameter though less than 5 percent of the soil matrix by volume.

5.2 Groundwater

Groundwater was observed in the test pits from 2 to 7 feet BGS. A summary of the depth of groundwater is presented in Table 2 below.

Table 2 – Groundwater Depths

Test Pit	Depth, feet
TP-01	3
TP-02	1
TP-03	7
HDTP-01	2

5.3 Permafrost

The project area is located in a region known to have isolated to absent permafrost (INE, 2008). Recovered samples were all observed to be in a thawed state. We therefore conclude that no permafrost is present at the site.

5.4 Bedrock

Local bedrock is of volcanic origin, found near the surface and in visible outcrops consisting of volcanic flows and tuffs including Mesozoic porphyry and Tertiary basalts (Martin, G.C., and Katz, F.P., 1912). The bedrock is not metamorphosed and is generally overlain at the lower altitudes by terrace gravels and small amounts of glacial till. The area has been heavily glaciated with glacial deposits prevalent throughout (Detterman and Reed, 1973).

6. Limitations and Closure

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

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

This report was prepared by CRW Engineering Group, LLC for use on this project and is not intended for use on other projects. CRW is not responsible for conclusions, opinions, or recommendations made by others based on data presented in this report.

7. References

Detterman, R.L. and Reed, B.L., 1973. Surficial Deposits of the Iliamna Quadrangle, Alaska. U.S. Geological Survey Bulletin 1368-A, p. A1-A64.

Institute of Northern Engineering (INE), 2008. Permafrost Characteristics of Alaska Map. University of Alaska Fairbanks, December 2008.

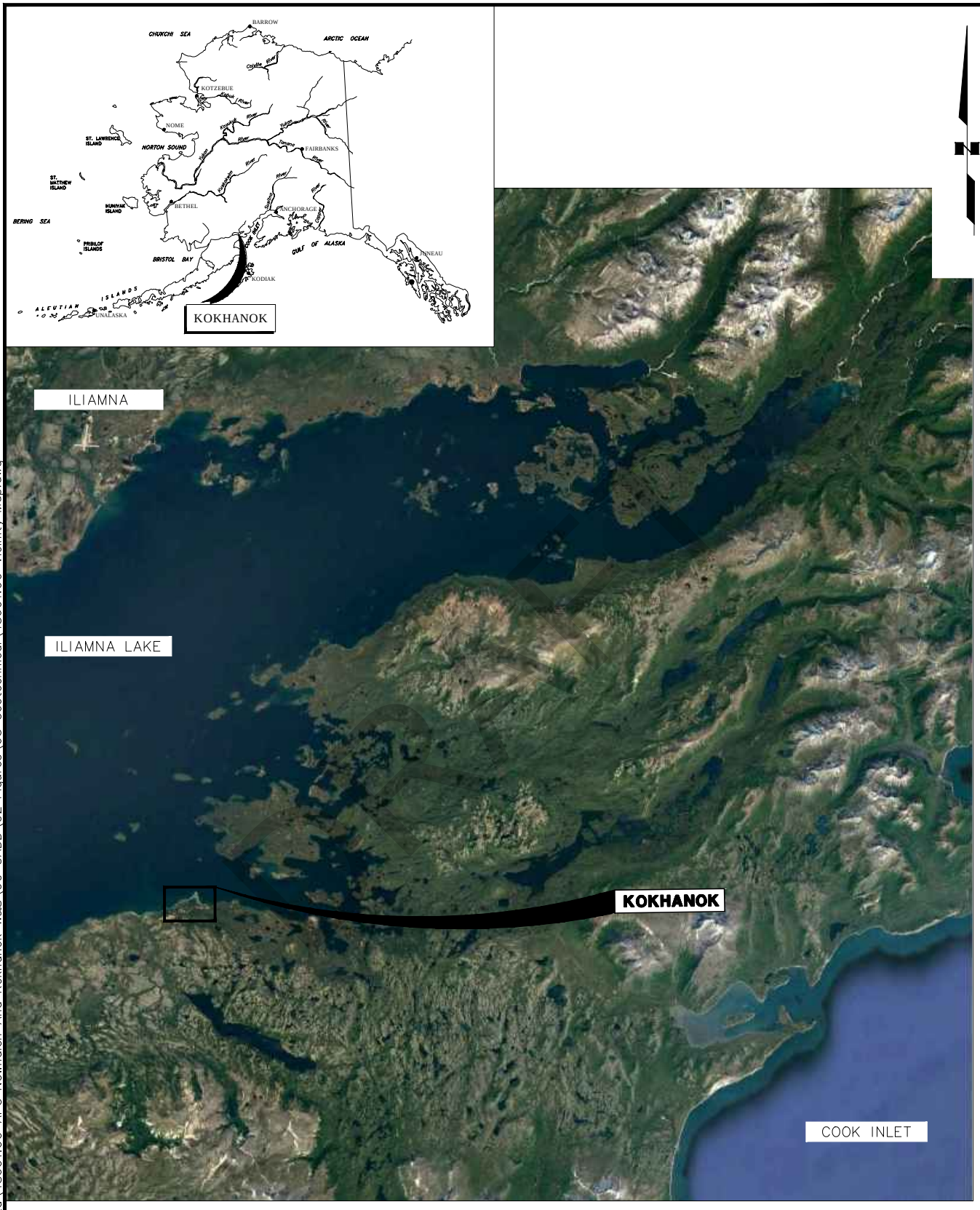
Martin, G.C. and Katz, F.J., 1912. A Geologic Reconnaissance of the Iliamna Region, Alaska. U.S. Geological Survey Bulletin 485, p.144.

Otis, R., W. Boyle, E. Clements, AND C. Schmidt. Design Manual: Onsite Wastewater Treatment and Disposal Systems. U.S. Environmental Protection Agency, Washington, D.C., EPA/625/1-80/012 (NTIS PB83219907), 1980.

Figures

Included in this section:

1) Vicinity Map
2) Test Pit Locations



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APC KOKHANOK W&S SCOPING ASSESSMENT
GEOTECHNICAL INVESTIGATION

VICINITY MAP

Project No:	48601.00
Drawn By:	SMH
Scale:	NTS
Date:	1/6/2020
Figure:	1

LEGEND

⊕ APPROXIMATE LOCATION OF TEST PITS.

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APC KOKHANOK W&S SCOPING ASSESSMENT
GEOTECHNICAL INVESTIGATION

TESTPIT LOCATIONS

Project No:	48601.00
Drawn By:	SMH
Scale:	NTS
Date:	1/6/2020
Figure:	2

FILE NAME: J:\JobsData\48601.00 APC Newhalen And Kokhanok W&S\00 CADD\02 Figures\05 Geotechnical\48601.00 Vicinity Map.dwg

Appendix A

Test Pit Logs

Included in this section:

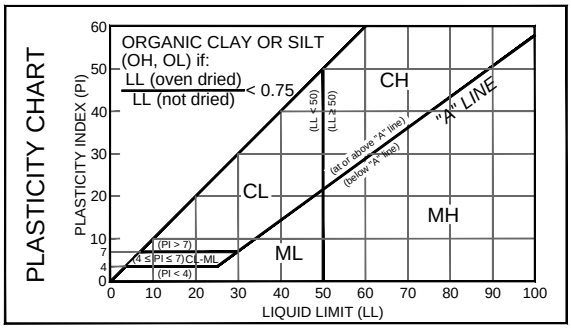
1) Test Pit Log Legend
2) Test Pit Logs (TP-01 thru 03 and HDTP-01)

UNIFIED SOIL CLASSIFICATION (ASTM D 2487)

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

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

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



COMPONENT DEFINITIONS BY GRADATION

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

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

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

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

DESCRIPTIVE TERMINOLOGY FOR PERCENTAGES (ASTM D 2488)

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

CRITERIA FOR DESCRIBING MOISTURE CONDITION (ASTM D 2488)

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

SAMPLER ABBREVIATIONS

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

LABORATORY TEST ABBREVIATIONS

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

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FIELD AND LABORATORY TEST ABBREVIATIONS

FIGURE A-1

FILE NAME: M:\Engineering_References\Tech_Geotechnical\CRW Geotechnical Report Template\Borehole Log Legend\Geotech.dwg

FROZEN SOIL CLASSIFICATION (ASTM D 4083)

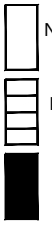
1. DESCRIBE SOIL INDEPENDENT OF FROZEN STATE	CLASSIFY SOIL BY THE UNIFIED SOIL CLASSIFICATION SYSTEM				
	MAJOR GROUP		SUBGROUP		
	DESCRIPTION	DESIGNATION	DESCRIPTION		DESIGNATION
2. MODIFY SOIL DESCRIPTION BY DESCRIPTION OF FROZEN SOIL	Segregated ice not visible by eye	N	Poorly bonded of friable		N_f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

FROST DESIGN SOIL CLASSIFICATION[1]

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

(1) From the U.S. Army Corps of Engineers (USACE), EM 1110-3-138, "Pavement Criteria for Seasonal Frost Conditions", April 1984
(2) USACE frost groups directly correspond to frost groups in Municipality of Anchorage (MOA) Design Criteria Manual (DCM).
(3) Non-frost susceptible
(4) Possibly frost susceptible, requires lab test for void ratio to determine frost design classification.
(5) Consistent with MOA Definition.

ICE BONDING SYMBOLS



DEFINITIONS

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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FROZEN SOIL CLASSIFICATION / LEGEND

FIGURE A-2

FILE NAME: M:\Engineering_References\Tech_Geotechnical\Alaska Geotechnical Reports\Geotech.dwg

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BOREHOLE HDTP-01

CLIENT Alaska Peninsula Corporation
PROJECT NAME Kokhanok W&S Scoping Assessment
PROJECT NUMBER 48601.00
PROJECT LOCATION Kokhanok, AK
DATE STARTED 12/17/19 **COMPLETED** 12/17/19
GROUND ELEVATION
DRILLING CONTRACTOR None
GROUND WATER LEVELS:
DRILLING METHOD Handdug
AT TIME OF DRILLING 2.00 ft
LOGGED BY SMH **CHECKED BY** SMH
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	ICE BOND	PID	OTHER TESTS	▲ SPT N VALUE ▲ 10 20 30 40
0.0	PT		ORGANIC MAT, (PT) brown, moist, organic odor, fiberous								
	SM		SILTY SAND, (SM) 26% gravel, 60% sand, 14% fines, brown, fine to medium grained, moist	G 1						SA	PL MC LL 10 20 30 40

Bottom of borehole at 2.0 feet.

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TEST PIT TP-01

CLIENT Alaska Peninsula Corporation
PROJECT NAME Kokhanok W&S Scoping Assessment
PROJECT NUMBER 48601.00
PROJECT LOCATION Kokhanok, AK
DATE STARTED 12/17/19 **COMPLETED** 12/17/19
GROUND ELEVATION
EXCAVATION CONTRACTOR Village of Kokhanok
GROUND WATER LEVELS:
EXCAVATION METHOD Case 580N
AT TIME OF EXCAVATION 3.00 ft
LOGGED BY SMH **CHECKED BY** SMH
AT END OF EXCAVATION ---
NOTES
AFTER EXCAVATION ---

DEPTH (ft)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	ICE BOND	PID	OTHER TESTS	▲ SPT N VALUE ▲ 10 20 30 40 / PL MC LL 10 20 30 40
0.0	PT		ORGANIC MAT, (PT) brown, moist, 1 inch fiberous roots								
			POORLY GRADED SAND WITH SILT AND GRAVEL, (SP-SM) 38% gravel, 54% sand, 8% fines, brown to dark gray, moist, organic odor, fiber/roots to 1 foot depth, cobbles up to 10 inches approximately 5% by volume, organic content = 5.3%, ash content = 94.7%	G 1	100					OLI	
2.5	SP-SM		▽								
				G 2	100					SA	
5.0			Fiberous roots up to 2 inch in diameter								
	SM		SILTY SAND, (SM) 35% gravel, 41% sand, 24% fines, gray, wet, non plastic	G 3	100					AL, LMA	

Bottom of test pit at 7.0 feet.

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TEST PIT TP-02

CLIENT Alaska Peninsula Corporation
PROJECT NAME Kokhanok W&S Scoping Assessment
PROJECT NUMBER 48601.00
PROJECT LOCATION Kokhanok, AK
DATE STARTED 12/16/19 **COMPLETED** 12/17/19
GROUND ELEVATION
EXCAVATION CONTRACTOR Village of Kokhanok
GROUND WATER LEVELS:
EXCAVATION METHOD Case 580N
AT TIME OF EXCAVATION 1.00 ft
LOGGED BY SMH **CHECKED BY** SMH
AT END OF EXCAVATION ---
NOTES
AFTER EXCAVATION ---

DEPTH (ft)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	ICE BOND	PID	OTHER TESTS	▲ SPT N VALUE ▲ 10 20 30 40
0.0	PT		ORGANIC MAT, (PT) brown, moist, 1 inch fiberous roots								
			POORLY GRADED SAND, (SP) 0% gravel, 99% sand, 1% fines, brown, wet, cobbles up to 11 inches approximately 5% by volume	G 1	100					SA	PL MC LL 10 20 30 40
2.5	SP										
			Test pit sloughing at 4.5 feet. Went an additional 6 inches then test pit collapsed								
5.0			Gray layer observed at 5 feet but no sample due to caving of test pit								
			Bottom of test pit at 5.0 feet.								

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TEST PIT TP-03 (Perc-01)

CLIENT Alaska Peninsula Corporation
PROJECT NAME Kokhanok W&S Scoping Assessment
PROJECT NUMBER 48601.00
PROJECT LOCATION Kokhanok, AK
DATE STARTED 12/16/19 **COMPLETED** 12/16/19
GROUND ELEVATION
EXCAVATION CONTRACTOR Village of Kokhanok
GROUND WATER LEVELS:
EXCAVATION METHOD Case 580N
AT TIME OF EXCAVATION 7.00 ft
LOGGED BY SMH **CHECKED BY** SMH
AT END OF EXCAVATION ---
NOTES
AFTER EXCAVATION ---

DEPTH (ft)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	ICE BOND	PID	OTHER TESTS	▲ SPT N VALUE ▲ 10 20 30 40 / PL MC LL 10 20 30 40	WELL DIAGRAM
0.0	PT		ORGANIC MAT, (PT) brown, moist, 1 inch fiberous roots									
	OL		ORGANIC SOIL, (OL) brown, moist									
	GP		POORLY GRADED GRAVEL, (GP) 82% gravel, 14% sand, 4% fines, brown, moist, cobbles up to 8 inches approximately 5% by volume	G 1	100					SA		Percolation Test Excavation
2.5												
	GP		POORLY GRADED GRAVEL, (GP) 57% gravel, 41% sand, 2% fines, brown, moist, cobbles up to 8 inches approximately 5% by volume	G 2	100					SA		Percolation Rate = 0.98 minutes per inch (12/16/19)
5.0												
	GM		SILTY GRAVEL WITH SAND, (GM) 47% gravel, 36% sand, 17% fines, gray, wet	G 3	100					LMA		
7.5			Excavator bucket refusal at 8 feet									
			Bottom of test pit at 8.0 feet.									

Appendix B

Laboratory Results

Included in this section:

1) Laboratory Results from Alaska TestLab

Alaska Testlab

Testing Report Summary

Date Sample Recv'd: 12/20/2019

Client: CRW Engineering Group
W.O. #: 753
Project: APC Kokhanok W&S
Lab #: 1483
Location: TP-01 through TP-03

Samples will be kept for 30 days before being disposed. Please contact us if you would like the remaining material returned.

Test Performed
Moisture Content, ASTM D2216

Sample ID	Results (%)	Sample ID	Results (%)	Sample ID	Results (%)
TP-01, Sample 1	22	TP-02, Sample 1	25.3	TP-03, Sample 1	9.2
TP-01, Sample 2	19.7			TP-03, Sample 2	7.6
TP-01, Sample 3	10.7			TP-03, Sample 3	8.4
HDTP-01, Sample 1	33.4				

If you have questions regarding this summary report or the test procedures, please contact us.

Oscar

Oscar Lage
Laboratory Supervisor

Alaska Testlab

Client: CRW Engineering Group, LLC
Project: Kokhanok W&S
Work Order: 753

Particle Size Distribution

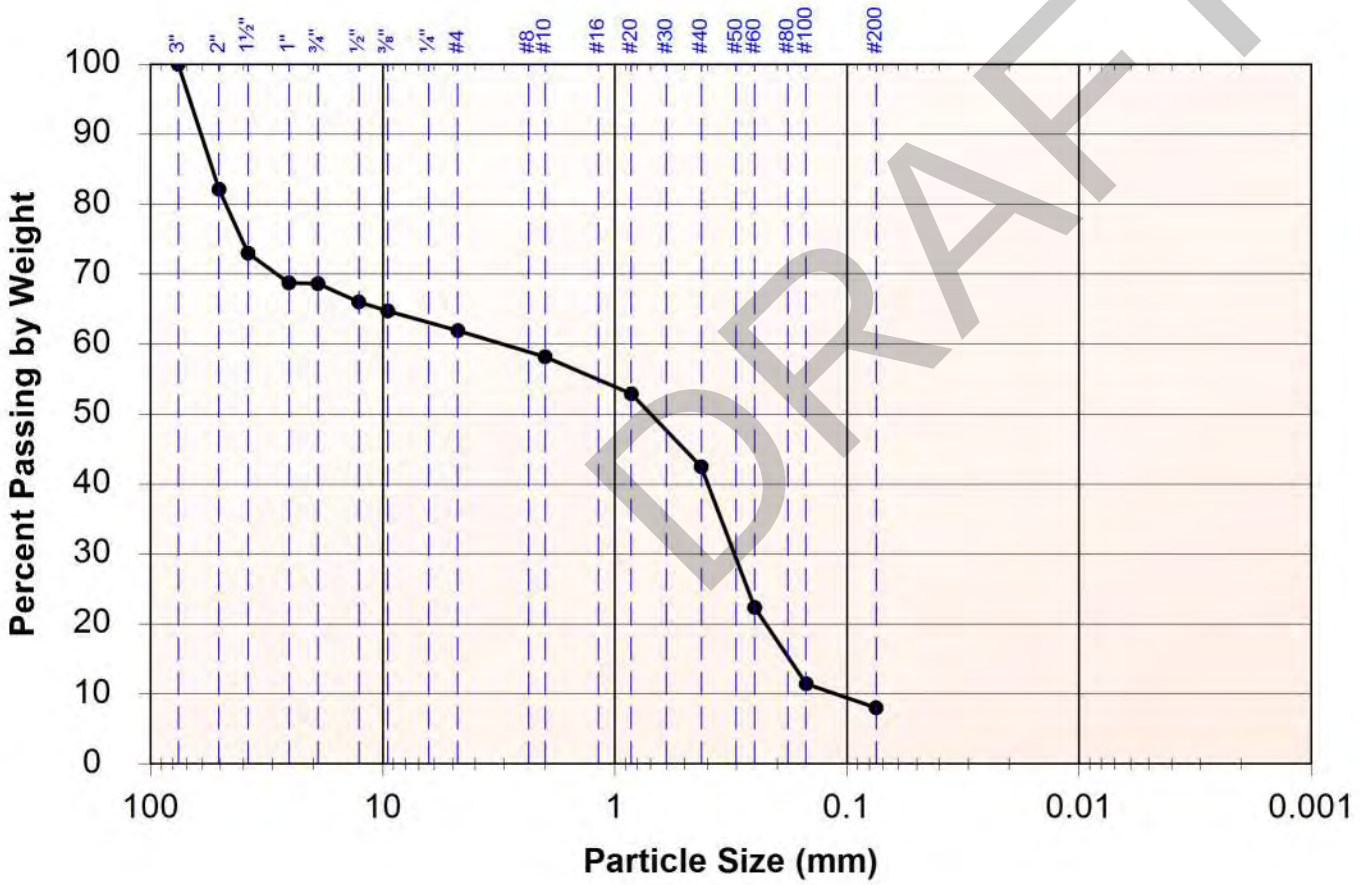
ASTM D422

Location: TP-01, Sample 2

Lab Number	2019-1485
Received	12/20/2019
Reported	12/31/2019

Engineering Classification: **Poorly Graded Sand with Silt and Gravel, SP-SM**

Frost Classification: **Not Measured**



Size	Passing	Specification
3"	100%	
2"	82%	
1½"	73%	
1"	69%	
¾"	69%	
½"	66%	
⅜"	65%	
#4	62%	
Total Weight of Sample 2288.9g		
#10	58%	
#20	53%	
#40	42%	
#60	22%	
#100	11%	
#200	8.0%	
Total Weight of Fine Fraction 413g		

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Alaska Testlab

Client: CRW Engineering Group, LLC
Project: Kokhanok W&S
Work Order: 753

Particle Size Distribution

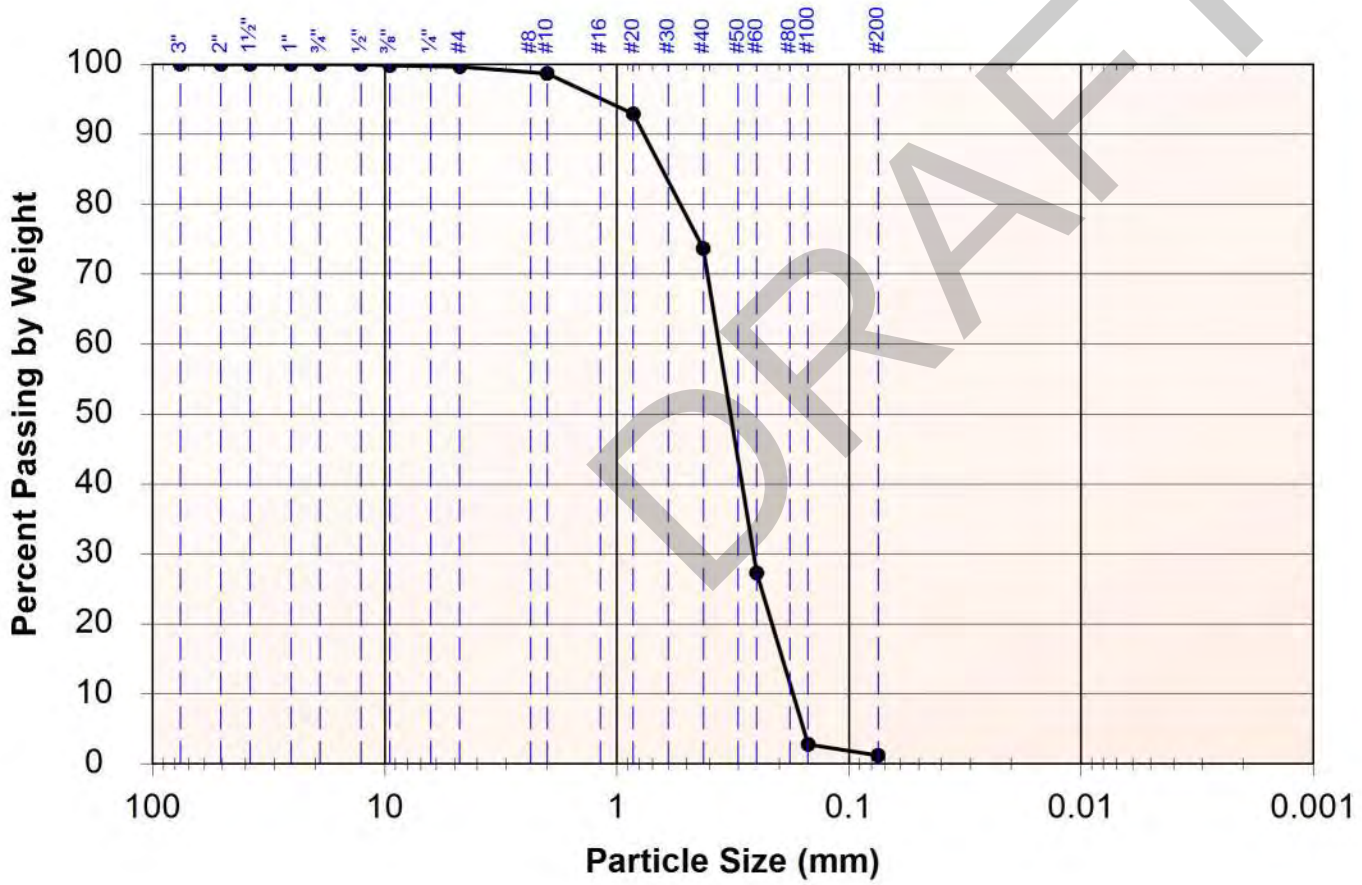
ASTM D422

Location: TP-02, Sample 1

Lab Number	2019-1487
Received	12/20/2019
Reported	12/31/2019

Engineering Classification: **Poorly Graded Sand, SP**

Frost Classification: **NFS**



Size	Passing	Specification
3"	100%	
2"	100%	
1½"	100%	
1"	100%	
¾"	100%	
½"	100%	
⅜"	100%	
#4	100%	
Total Weight of Sample 1428.5g		
#10	99%	
#20	93%	
#40	74%	
#60	27%	
#100	3%	
#200	1.2%	
Total Weight of Fine Fraction 317.6g		

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Alaska Testlab

Client: CRW Engineering Group, LLC
Project: Kokhanok W&S
Work Order: 753

Particle Size Distribution

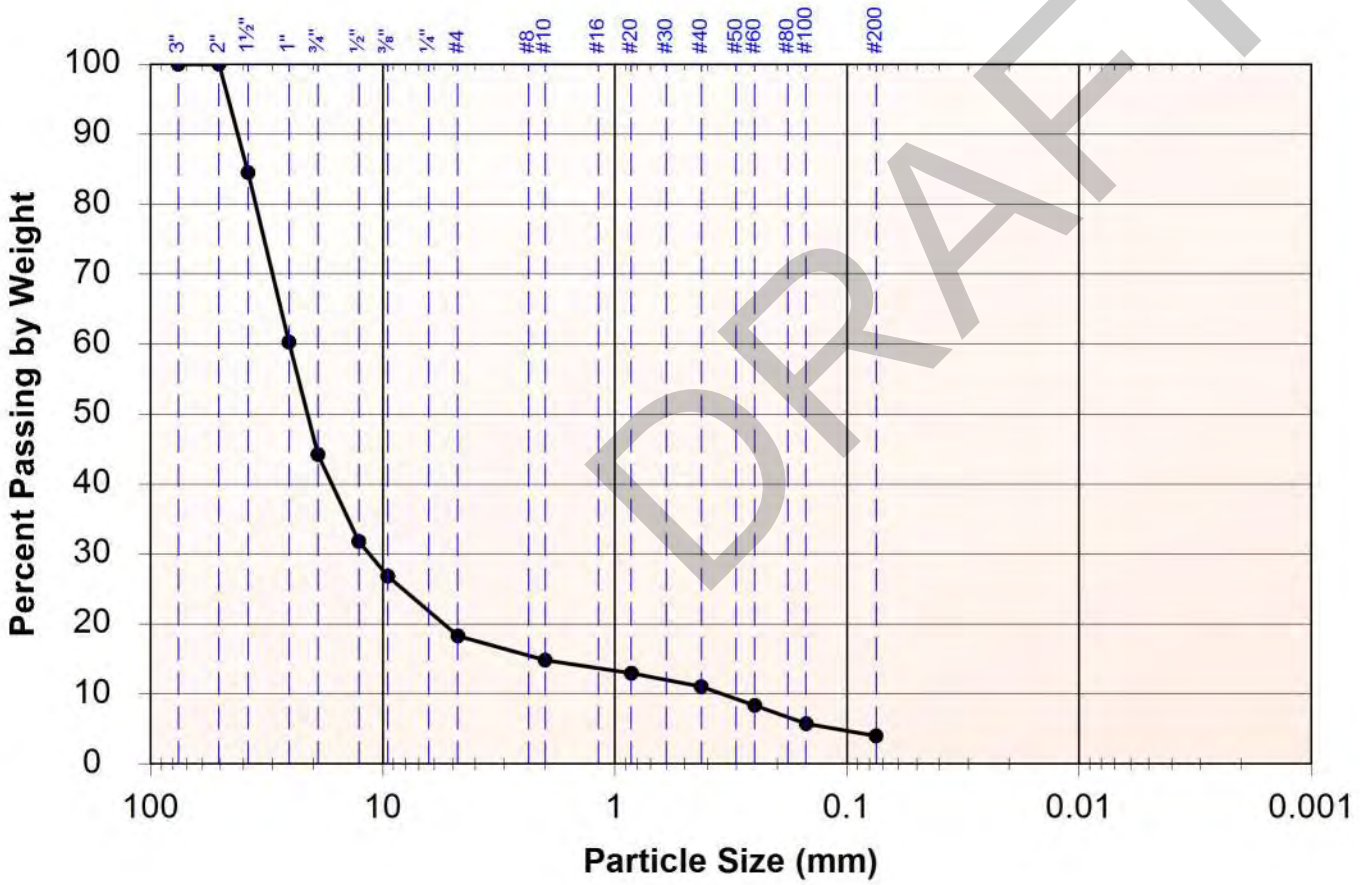
ASTM D422

Location: TP-03, Sample 1

Lab Number	2019-1488
Received	12/20/2019
Reported	12/31/2019

Engineering Classification: **Poorly Graded Gravel, GP**

Frost Classification: **Not Measured**



Size	Passing	Specification
3"	100%	
2"	100%	
1½"	85%	
1"	60%	
¾"	44%	
½"	32%	
⅜"	27%	
#4	18%	
Total Weight of Sample 2679.3g		
#10	15%	
#20	13%	
#40	11%	
#60	8%	
#100	6%	
#200	4.0%	
Total Weight of Fine Fraction 489.3g		

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Alaska Testlab

Client: CRW Engineering Group, LLC
Project: Kokhanok W&S
Work Order: 753

Particle Size Distribution

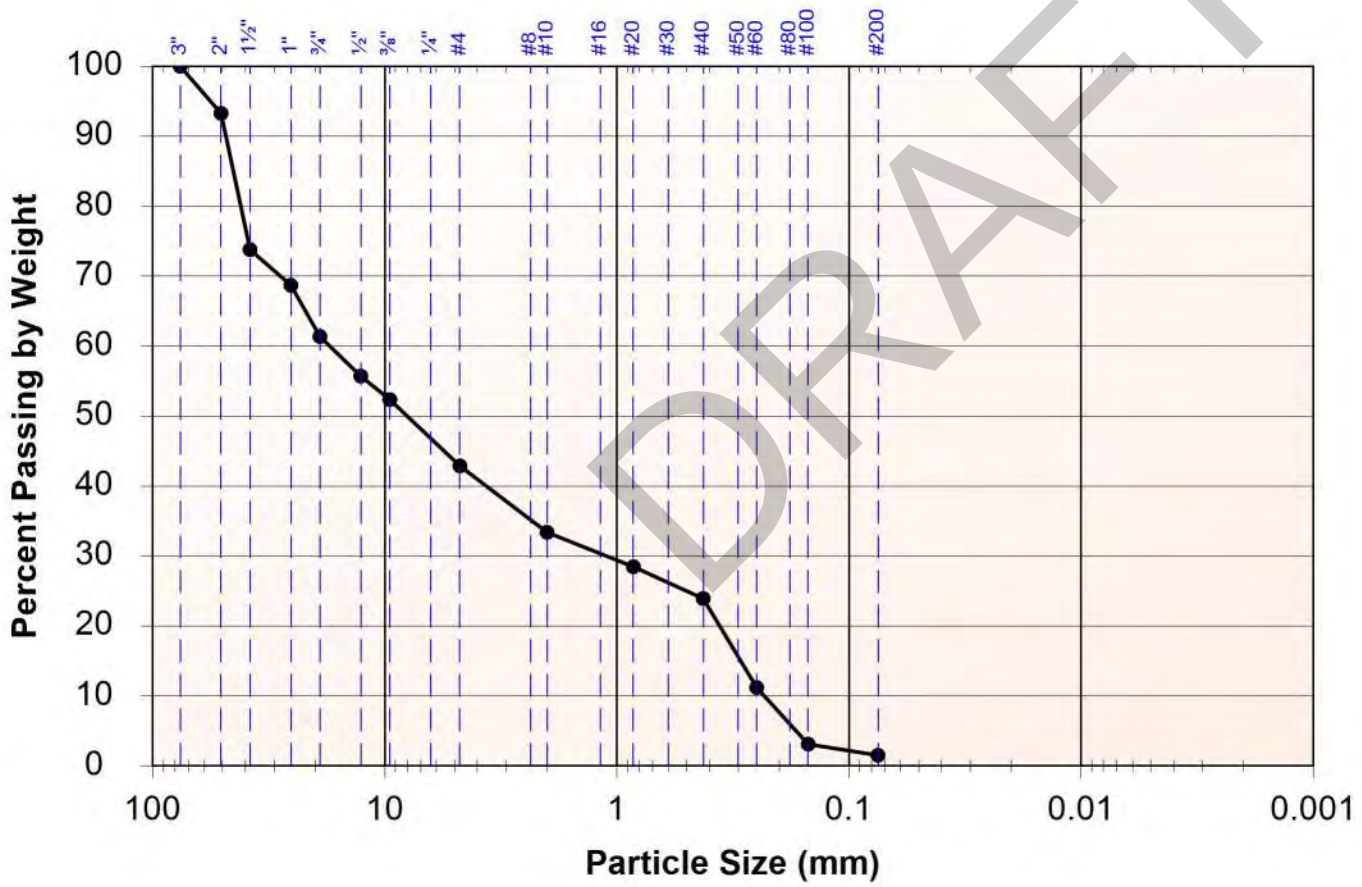
ASTM D422

Location: TP-03, Sample 2

Lab Number	2019-1489
Received	12/20/2019
Reported	12/31/2019

Engineering Classification: **Poorly Graded Gravel with Sand, GP**

Frost Classification: **NFS**



Size	Passing	Specification
3"	100%	
2"	93%	
1½"	74%	
1"	69%	
¾"	61%	
½"	56%	
⅜"	52%	
#4	43%	
Total Weight of Sample 3121.8g		
#10	33%	
#20	28%	
#40	24%	
#60	11%	
#100	3%	
#200	1.5%	
Total Weight of Fine Fraction 313.1g		

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Alaska Testlab

Client: CRW Engineering Group, LLC
Project: Kokhanok W&S
Work Order: 753

Particle Size Distribution

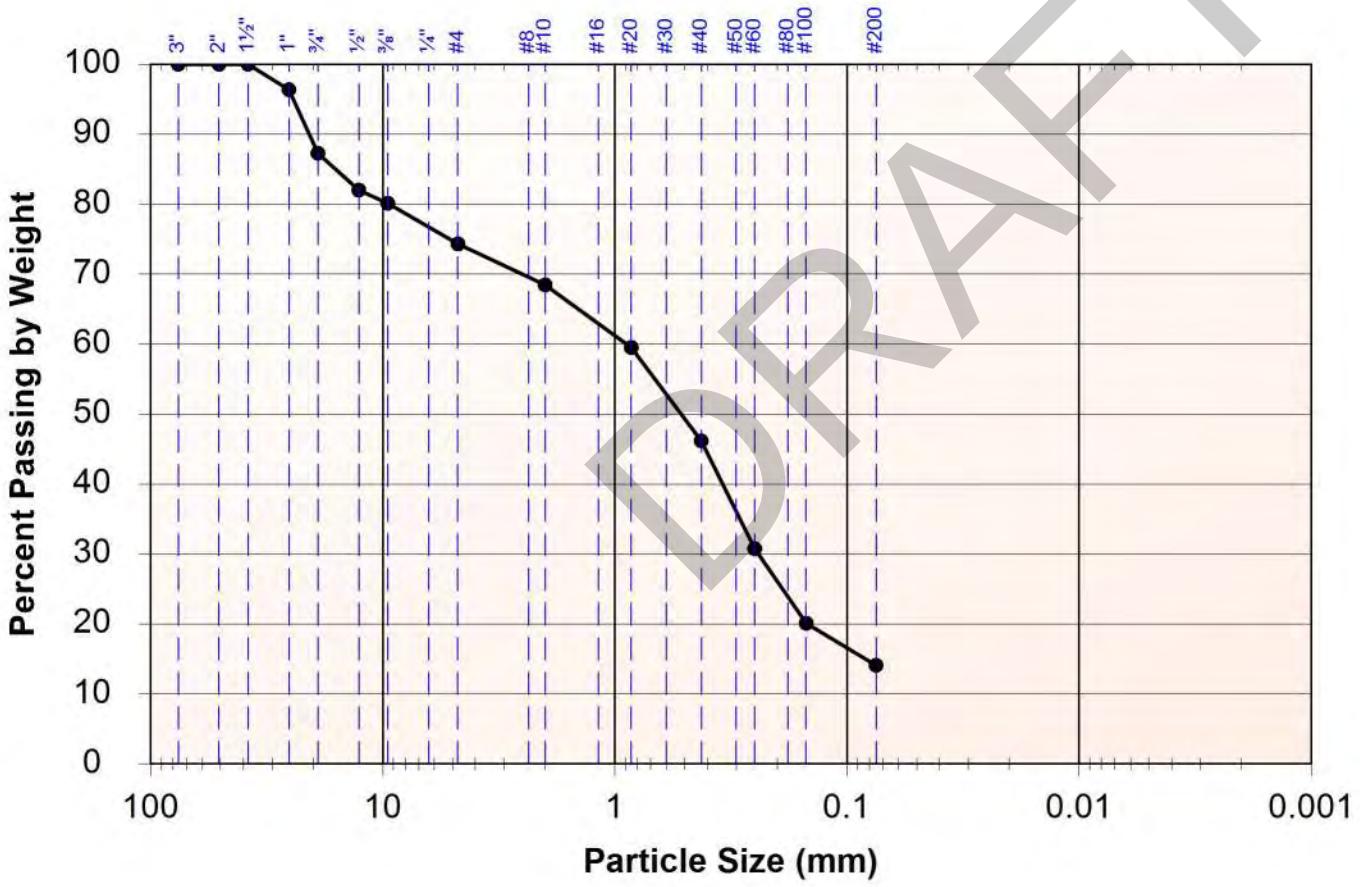
ASTM D422

Location: HDTP-01, Sample 1

Lab Number	2019-1491
Received	12/20/2019
Reported	12/31/2019

Engineering Classification: **Silty Sand with Gravel, SM**

Frost Classification: **Not Measured**



Size	Passing	Specification
3"	100%	
2"	100%	
1½"	100%	
1"	96%	
¾"	87%	
½"	82%	
⅜"	80%	
#4	74%	
Total Weight of Sample 1353.5g		
#10	68%	
#20	59%	
#40	46%	
#60	31%	
#100	20%	
#200	14.1%	
Total Weight of Fine Fraction 387g		

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Alaska Testlab

Testing Report Summary

Date Sample Recv'd: 12/20/2019

Client: CRW Engineering Group
W.O. #: 753
Project: APC Kokhanok W&S
Lab #: See Below
Location: TP-01, TP-03

Test Performed
Limited Mechanical Analysis
Results (%)

Sample ID	Gravel	Sand	Silt	USCS
TP-01, S3 (ATL#1486)	35	41	24	SM
TP-03, S3 (ATL#1490)	47	36	17	GM

If you have questions regarding this summary report or the test procedures, please contact us.

Oscar
Oscar Lage
Laboratory Supervisor

Alaska Testlab

Testing Report Summary

		Date Sample Recv'd	12/20/2019
Client	CRW Engineering Group	W.O. #	753
Project	APC Kokhanok W&S	Lab #	1486
Location	TP-01, Sample 3		

All results will be posted to the website for your access and convenience. Samples will be kept for 30 days before being disposed. Please contact us if you would like the remaining material returned.

Sample ID	Test Performed	Test Method	Results		USCS of Finer Fraction
TP-01, SA 3 Lab No. 1486	Plasticity Index	ASTM D4318	Liquid Limit	NP	ML
			Plastic Limit	NP	
			Plasticity Index	NP	

If you have questions regarding this summary report or the test procedures, please contact us.

Oscar
Oscar Lage
Laboratory Supervisor

Alaska Testlab

Testing Report Summary

Date Sample Recv'd 12/20/2019

Client	CRW Engineering Group	W.O. #	753
Project	APC Kokhanok W&S	Lab #	1484
Location	TP-01, Sample 1		

All results will be posted to the website for your access and convenience. Samples will be kept for 30 days before being disposed. Please contact us if you would like the remaining material returned.

Sample ID	Test Performed	Test Method	Results	
TP-01, SA 1 Lab No. 1484	Moisture, Ash & Organic Matter of Peat Materials	ASTM D2974	% Organics (by weight)	5.3
			% Ash	94.7
			% Moisture	33.2

If you have questions regarding this summary report or the test procedures, please contact us.

oscar

Oscar Lage
Laboratory Supervisor

Appendix C

Site Investigation Photos

Included in this section:

1) Select Site Photos

Kokhanok Water and Sewer
Site Investigation Photos

Photo	Description
	Excavation of TP-01.
	Excavation of TP-02.

Kokhanok Water and Sewer
Site Investigation Photos

Photo	Description
	Excavation of TP-03.
	Excavation of HDTP-01

Kokhanok Water and Sewer
Site Investigation Photos

Photo	Description
	Completion of percolation test PERC-01.
	Example of cobble

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www.crweng.com

Concept Design Memorandum

TO: Alaska Peninsula Corporation

SUBJECT: Newhalen Sewage Treatment Improvements

DATE: 1/23/2020

BY: Steven Hebnes, PE, Civil Engineer

CRW Engineering Group, LLC (CRW) is providing subcontract services with the Alaska Peninsula Corporation (APC) to assess various sanitation needs in the community of Newhalen as a component of the mitigation planning for the Pebble Project. As a part of the evaluation effort, CRW has reviewed current Sanitation Deficiency System (SDS) documentation provided by Alaska Native Tribal Health Consortium (ANTHC), performed a site assessment, interviewed community members familiar with the system operation, and reviewed record documents for past specific projects, including previous design reports, field assessments, and related correspondence. The community of Newhalen is served by ANTHC for addressing public sanitation needs. ANTHC has summarized various sanitation needs in Newhalen for seeking Indian Health Service (HIS) funding through the SDS program. The Newhalen wastewater lagoon project has been developed to a preliminary design level by ANTHC, and is in need of funding to finalize the design and construct the facility.

Existing Conditions

About 40% of Newhalen's population is served by a community piped sewer system and community percolation sewage lagoon, which is used for wastewater treatment and disposal. The remaining population utilizes on-site wastewater disposal systems. Prior to 2016, it was discovered that the existing community septic tanks and sewage lift station were failing. The existing pump station was reportedly no longer reliably operating and consequently was backing up the sewage system. The existing septic tanks are also reportedly of steel construction and have experienced significant corrosion and are leaking. In this condition, these septic tanks have a high collapse potential and potentially for introducing contaminates to the soil and/or groundwater.

In 2016, ANTHC designed and constructed a new sewage lift station for the community system. In the design of this facility, it was assumed that the existing percolation lagoon would be able to receive and treat raw sewage, thereby eliminating the need for the two existing septic tanks. During a plan review conducted by the Alaska Department of Environmental Conservation

(ADEC), it was determined that the existing sewer lagoon was originally approved only as an effluent lagoon, and was not permitted to handle or treat raw sewage. Based on this determination, ADEC conditionally-approved the new lift station design, contingent to the existing effluent lagoon being enlarged to receive and treat raw sewage. Currently, the failing septic tanks have been left in place until the lagoon work can be permitted and completed to accept raw sewage. Based on this current evaluation, it is evident that wastewater system improvements are necessary to upgrade failing components that do not meet current and future capacity requirements. Additionally, the community does not currently have the ability to maintain the septic tanks, as both pumper trucks are not operational. Consequently, there is a high likelihood that raw sewage is being introduced into the percolation lagoon.

Risk to the Environment from the Current Wastewater System Deficiencies

The existing community septic tanks are at risk of collapsing. The result of a septic tank breach could create a substantial release of wastewater into the adjacent wetlands and waterbodies, as much as the daily volume of 6,000 gallons per day. Untreated releases of wastewater into the surrounding environment can impose threats to community health and damage aquatic habitats from high BOD, pathogens and other contaminants. Furthermore, if the existing septic tanks continue to operate with the current deficiencies, then raw sewage will continue to pass through them substantially untreated. The solids that would otherwise be captured in the septic tank would eventually be introduced to the undersized percolation lagoon, wherein sludge deposits would reduce the percolation rate and ultimately cause the lagoon to overtop.

Recommended Improvement

The recommended improvement for the community of Newhalen is to increase the treatment capacity of the sewage lagoon to meet ADEC standards for treating raw sewage. Further, the improvements should also provide adequate percolation and hydraulic storage capacity.

With these improvements, the treatment of domestic wastewater would be performed in a three-cell lagoon having a total surface area of approximately 90,000 SF (2.1 acres). Primary treatment would be performed in Cells #1 and #2. The lagoon would be bounded by berms constructed from local granular fill. The berms would be built in one-foot lifts to create 3:1 interior and exterior slopes. A vegetative cover on the exterior slopes would be graded at a 4:1 slope. The new berm height would be 8 feet above the existing grade. The top-of-berm elevation for the primary treatment cells would provide a 3-foot freeboard height above the liquid volume and a 6-inch depth for sludge storage (67,000 gallons), in accordance with the ADEC design criteria.

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Improvements to Cells #1 and #2 would be limited to regrading their berm slopes and adding fill as required (2 feet of additional fill anticipated). Cell #1 currently features a liner which provides 1 foot of freeboard volume. The additional berm height around Cell #1 would not necessitate the replacement of this liner. However, installation of a liner in Cell #2 is recommended to prevent short-circuiting of wastewater flow before treatment is sufficiently achieved. Percolation will occur in Cell #3, and be constructed similar to Cell's #1 and #2. The new percolation cell is anticipated to replace the existing sludge disposal area, which has not been used. Full surface grading and berm development is anticipated in this area. With the upgraded geometry, the berm construction will require approximately 10,000 CY of granular fill. Approximately 1 foot of organic material will cap the exterior slopes to be vegetated for erosion control and bank stability.

Concept Design Requirements

- Lagoon Design Criteria:
  - 6,000 GPD [1]
  - Percolation Rate: 0.5 gal/SF/day (ADEC conventional rate).
  - Maximum Organic Loading: 20-30 lb/acre [2]
  - Minimum Wetted Surface Area for BOD Treatment: 0.54 acres.
  - Total Effective Volume: 1,220,000 gallons.
- Upgrade existing polishing Cell #1 and Cell #2 berms to meet ADEC primary treatment surface area requirements based on the calculated organic loading [3]:
  - Cell #1 would provide an effective operating volume of 96,000 gallons and wetted surface area of 0.1 acres.
  - Cell #2 would provide an operating volume of 633,000 gallons and wetted surface area of 0.67 acres.
  - A liner would be installed in Cell #2.
- Design of a new percolation Cell #3 based on design percolation rate with a minimum winter volume storage capacity of 90 days:

[1] Alaska Native Tribal Health Consortium, Environmental Health & Engineering; *Newhalen, Alaska Waste Water Upgrades Record Drawings (Phase One) NHL-14-001; November 13, 2019.*
[2] Heath Research, Inc., Health Education Services Division, *Recommended Standards for Wastewater Facilities, 2004,* Member States and Province.
[3] Heath Research, Inc., Health Education Services Division, *Recommended Standards for Wastewater Facilities, 2004,* Member States and Province.

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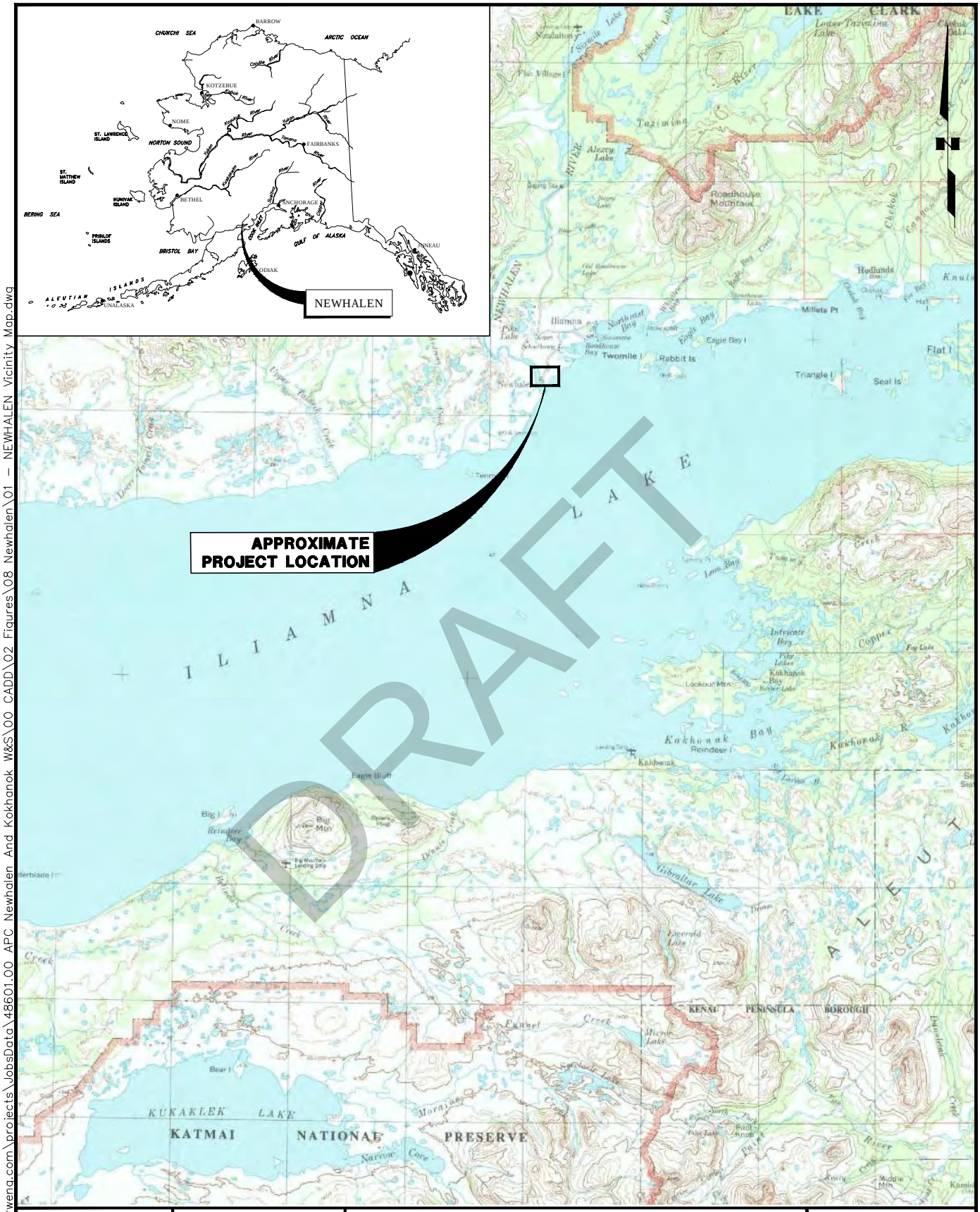
- The new percolation Cell #3 would provide an effective winter storage capacity of 600,000 gallons, percolation surface area of 17,000 SF and a wetted surface area of 0.45 acres (area not included for organic loading requirements).

The proposed action would result in the construction of a fully-permitted community sewage treatment system, which would protect the environment and public health from the hazards identified.

Conceptual Construction Drawings

Newhalen Sewage Lagoon Site Photos – October 2019



FILE NAME: \\crweng.com\projects\JobsData\48601.00 APC Newhalen And Kokhanok W&S\00 CADD\02 Figures\08 Newhalen\01 – NEWHALEN Vicinity Map.dwg

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NEWHALEN, ALASKA

VICINITY MAP

Project No:	48601.00
Drawn By:	MCH
Scale:	NTS
Date:	1/18/20
Figure:	1

FILE NAME: \\crweng.com\projects\JobsData\46801.00 APC Newhalen And Kokhanok W&S\00 CADD\02 Figures\08 Newhalen\02 - NEWHALEN Community Overview.dwg

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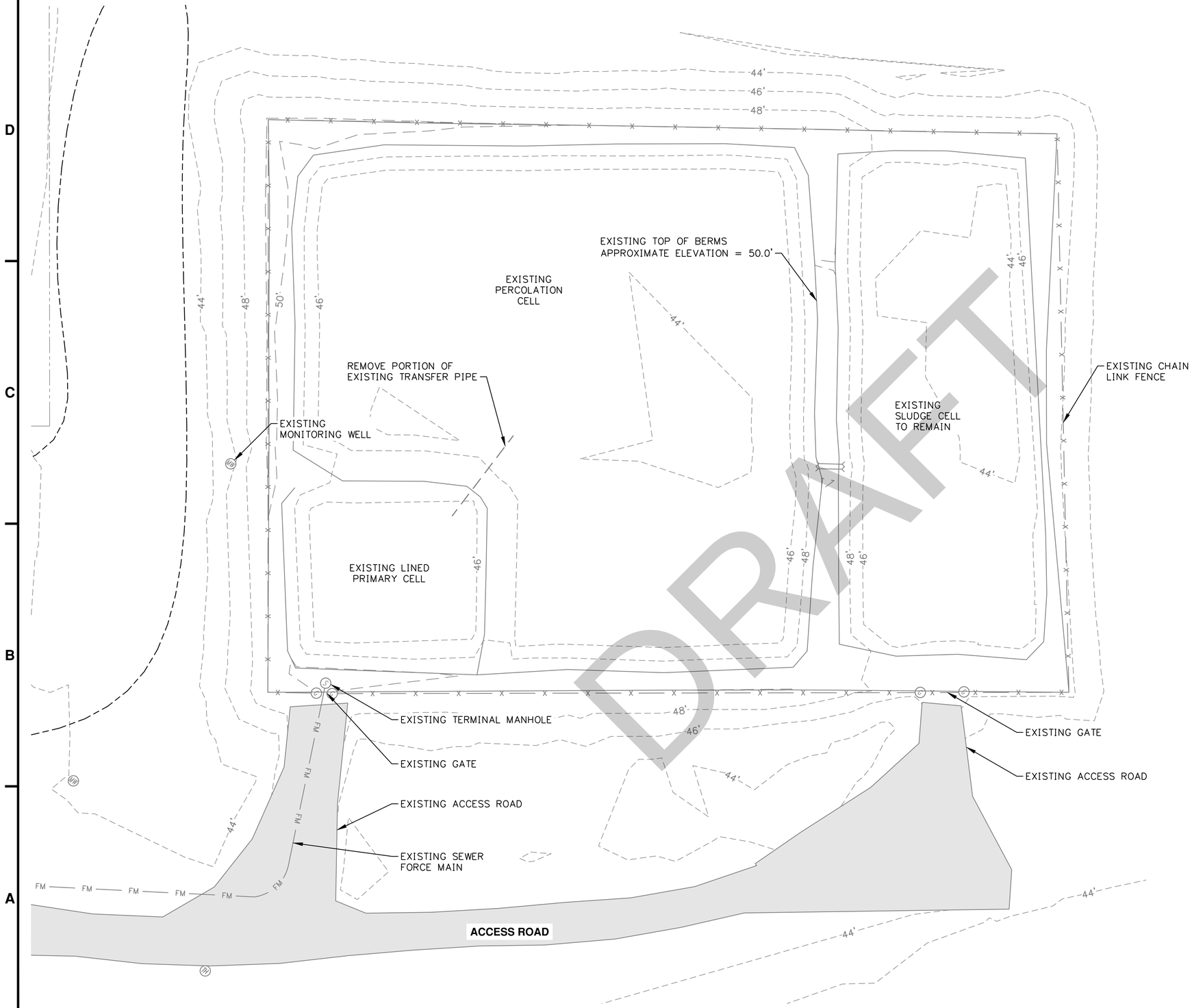
0 250 500

NEWHALEN, ALASKA

COMMUNITY OVERVIEW

LAGOON IMPROVEMENT PLAN

Project No:	46801.00
Drawn By:	MCH
Scale:	GRAPHIC
Date:	01/18/2020
Figure:	2



RECORD DRAWINGS CERTIFICATION

THESE DRAWINGS REFLECT RECORDED AS-BUILT INFORMATION OBTAINED DURING CONSTRUCTION. I (OR AN INDIVIDUAL UNDER MY DIRECT SUPERVISION) HAVE CONDUCTED PERIODIC CONSTRUCTION OBSERVATIONS AND REVIEWED AS-BUILT INFORMATION RECORDED BY OTHERS. TO THE BEST OF MY KNOWLEDGE ALL WORK THAT HAS BEEN INSTALLED IS IN ACCORDANCE WITH THESE DRAWINGS.

NAME _____ DATE 11/13/

A1 EXISTING SEWAGE LAGOON

1" = 20'

0 10' 20' 40'

ALASKA NATIVE TRIBAL HEALTH CONSORTIUM

Division of Environmental Health and Engineering
4500 Diplomacy Drive
Anchorage, Alaska 99508
(907) 729-3600

0 1"

BAR IS ONE INCH ON ORIGINAL DRAWING, IF NOT ADJUST SCALES ACCORDINGLY

NEWHALEN, AK
WASTE WATER UPGRADES
ISSUED FOR CONSTRUCTION

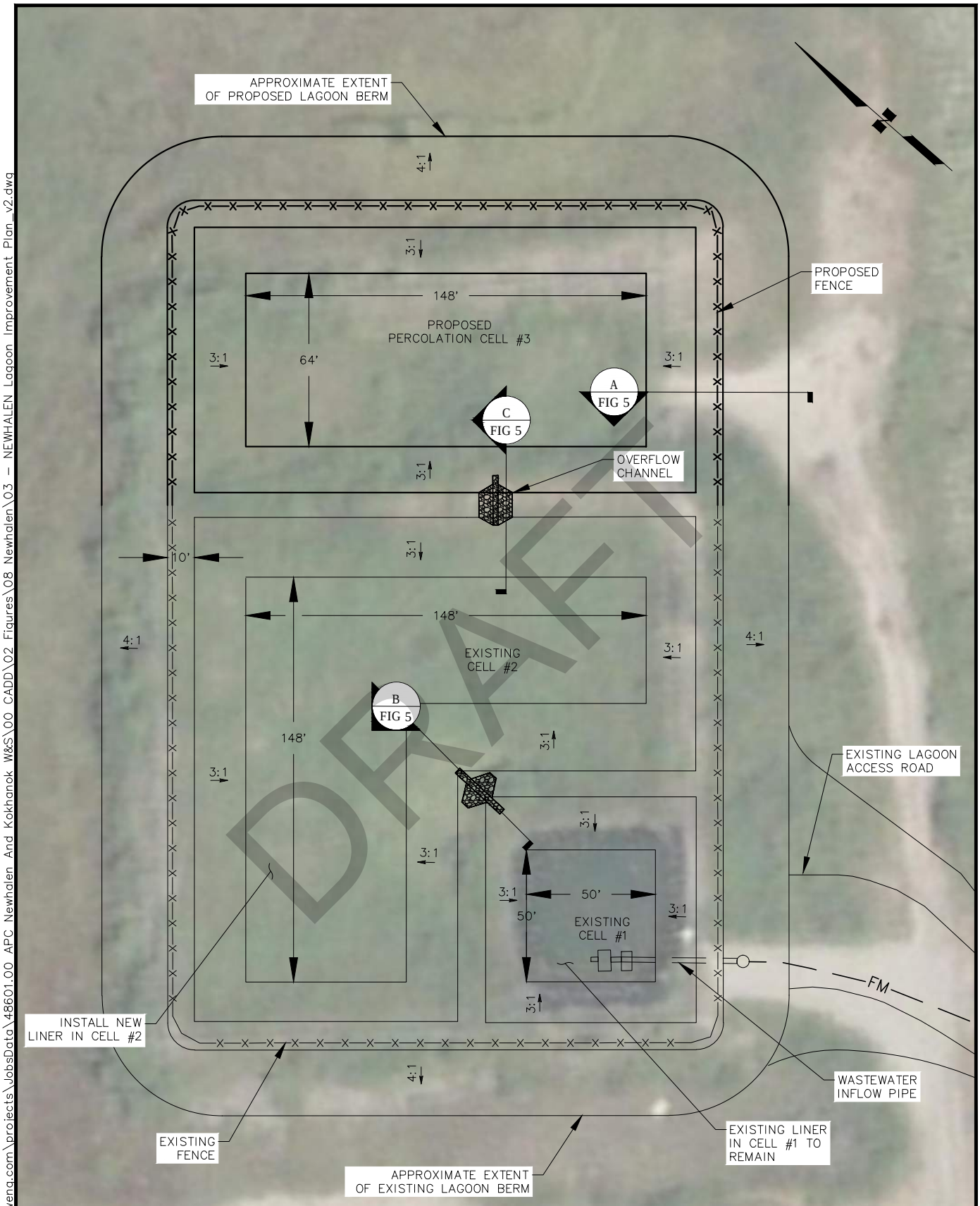
	INIT	DESCRIPTION	DATE	MRK

PLAN SET:	NHL-14-001
PROJ MGR:	KS
PROJ ENG:	SAE
DRUMS ENG:	PC
DRAWN BY:	SSM

SHEET TITLE

EXISTING SEWAGE LAGOON

FIGURE 3



FILE NAME: \\crweng.com\projects\JobsData\46601.00 APC Newhalen And Kokhanok W&S\00 CADD\02 Figures\08 Newhalen\03 - NEWHALEN Lagoon Improvement Plan_v2.dwg

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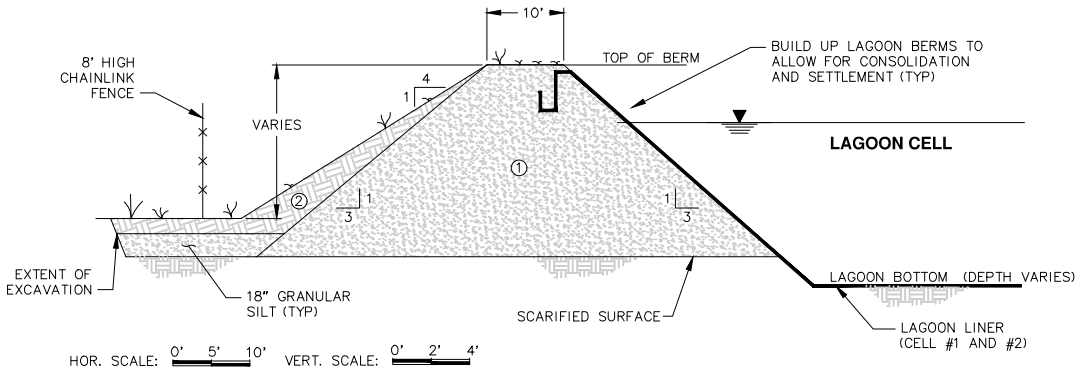
0 25 50

NEWHALEN, ALASKA

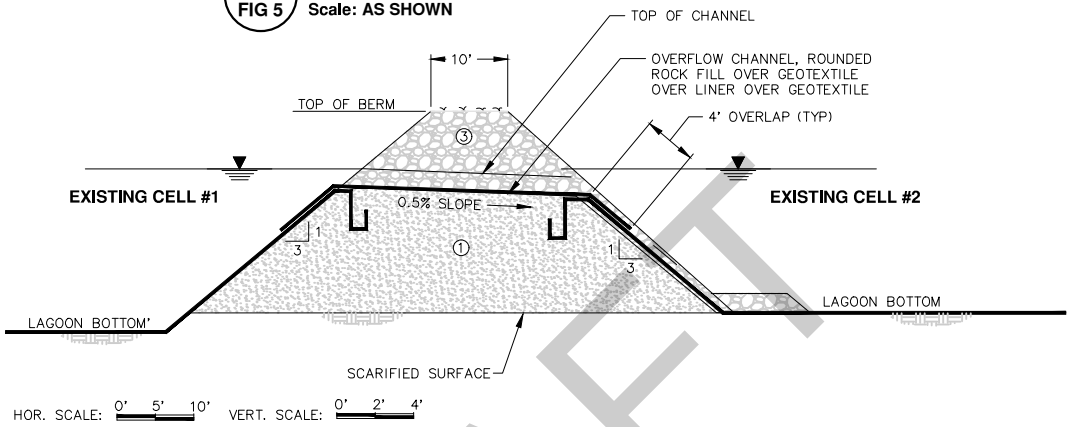
PROPOSED SEWAGE LAGOON

LAGOON IMPROVEMENT PLAN

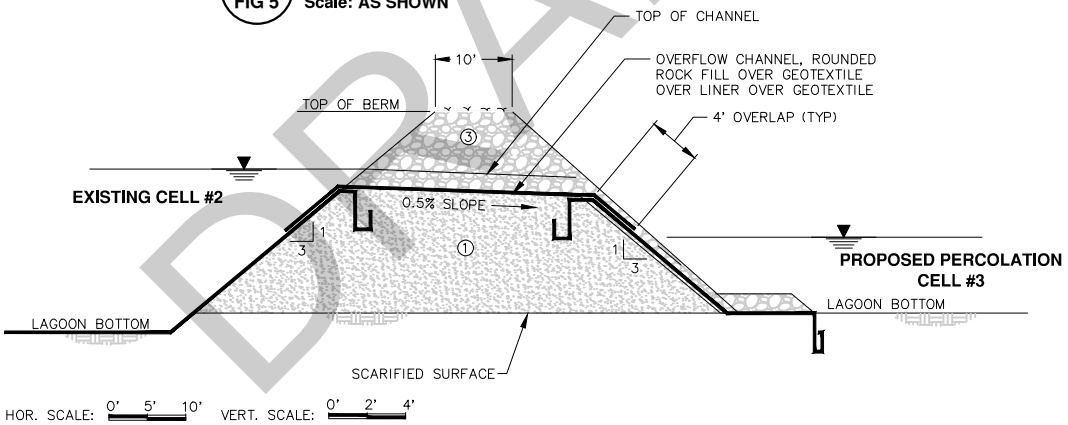
Project No:	46801.00
Drawn By:	MCH
Scale:	GRAPHIC
Date:	01/18/2020
Figure:	4



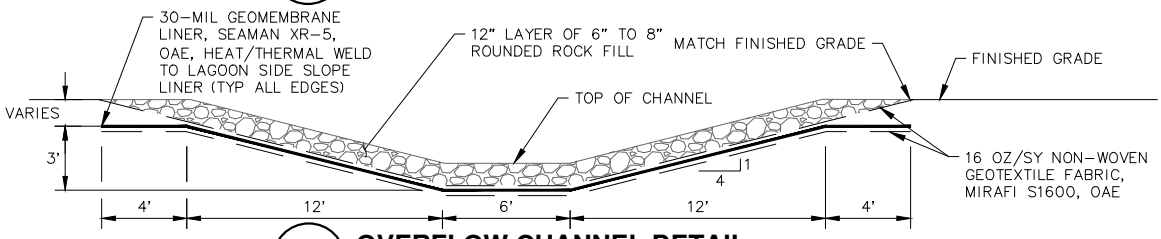
A / FIG 5 — TYPICAL BERM SECTION A
Scale: AS SHOWN



B / FIG 5 — TYPICAL BERM SECTION B
Scale: AS SHOWN



C / FIG 5 — TYPICAL BERM SECTION C
Scale: AS SHOWN



- / FIG 5 — OVERFLOW CHANNEL DETAIL
Scale: NOT TO SCALE

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DRAFT

LAGOON IMPROVEMENT PLAN

Project No:	46801.00
Drawn By:	MCH
Scale:	GRAPHIC
Date:	01/18/2020
Figure:	5

FILE NAME: \\crweng.com\projects\JobsData\46801.00 APC Newhalen And Kokhanok W&S\00 CADD\02 Figures\08 Newhalen\04 - NEWHALEN Lagoon Sections.dwg

Newhalen Lagoon
Site Investigation Photos

Photo	Description
	Existing Cell #1. – October 30, 2019
	Existing Cell #1 with liner visible. – October 30, 2019

Newhalen Lagoon Site Investigation Photos	
Photo	Description
	Existing Cell #2. – October 30, 2019
	Existing Cell #2, view two. – October 30, 2019

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Concept Design Memorandum

TO: Alaska Peninsula Corporation

SUBJECT: Nondalton Sewer Collection System Improvements

DATE: 1/23/2020

BY: Steven Hebnes, PE, Civil Engineer

CRW Engineering, LLC (CRW) is providing subcontract services currently under contract with the Alaska Peninsula Corporation (APC) to assess various sanitation needs in the community of Nondalton as a component of the mitigation planning for the Pebble Project. For the evaluation effort, CRW performed a site assessment of the community wastewater system, held discussions with community members, reviewed record documents provided by the State of Alaska Remote Maintenance Worker (RMW) program for specific past projects, and performed sewer manhole assessments. Nondalton is a community served by Alaska Native Tribal Health Consortium (ANTHC), which was planning to evaluate the community sewer system for Indian Health Service (IHS) funding through its Sanitation Deficiency System (SDS) program.

Existing Conditions

About 90 percent of Nondalton's population is served by a community sewer system, and the remaining population utilizes on-site wastewater disposal systems. The sewer system is a gravity collection system comprised of over 30 manholes and which drains into a central lift station. From the lift station, wastewater is discharged through a force main into a percolating treatment lagoon. The sewer system was originally installed prior to 1980 and included 17 original manholes. The system has had four expansions with various types of manhole configurations, and now features a total of 31 manholes. The community has reported that the manholes are in a state of significant deterioration.

Table 1. Sewer System Expansions and Associated Manhole Construction

Sewer System Expansion	Manholes Constructed
Original	MH1-MH15, MH7A
#1	MH7B

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#2	MH3A-MH3D
#3	MH7C-MH7E
#4	MH14A-14F

As part of the evaluation effort, CRW traveled to Nondalton in early January 2020 to examine the sewer system manholes and identify the extent of deterioration and need for replacement. This effort revealed that the condition of the manholes from the original construction and first two expansions are in poor-to-failing condition. Manhole issues include: generally-aging infrastructure, missing lids, disintegrating concrete tops and bases, infiltration, gravel and solids buildup in the base, and separation between the base and barrel. In some manholes, service lines were also found to be directly connected, which is a discouraged practice due to a high potential of plugging those service lines with manhole debris. Sewer main inlets and outlets are primarily insulated PCV pipe and appeared to be in fair condition with no obvious signs of collapsed or breached pipes.

Manholes from the 3rd and 4th system expansions were observed to be in fair-to-good condition. Sewer main piping in these areas consist of insulated HDPE, and are in good condition.

In their current condition, the degraded manholes allow excessive inflow and infiltration, which can overload the sewage lift station and lagoon, result in overflows at manholes, reduced wastewater treatment capability and lagoon berm overtopping. Additionally, the degraded manholes allow debris and rocks to enter the system, which constricts wastewater flow, causes substantial blockages and damages pumps, all of which increase the potential for sewage to back-up, overflow into surrounding areas and contaminate surface water and groundwater. During the manhole assessment it was observed that, due to relatively flat pipe slopes, sewer back-ups are experienced in Manholes 6 through 14 due the existing lift station's failure to operate as intended. Manholes 1 through 15 are located along Main Street, and are all located about 150 feet or less from Six Mile Lake per the Record Drawings. Manholes with missing lids create a significant safety hazard, as people, animals and/or vehicles could fall into open or plywood-covered manholes. Many of these manholes were very difficult to locate in this assessment, so falls could occur inadvertently.

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Based on the current evaluation it is evident that wastewater system improvements are necessary to upgrade the failing manholes to eliminate unnecessary hydraulic overloading and gravel intrusion that currently burden the community's ability to collect, convey and treat its wastewater.

Potential Hazards

Failure to perform these improvements will diminish the community's ability to treat and dispose of its wastewater and increases the risk of environmental and health hazards. Excess infiltration from the degraded manholes increases the potential for untreated wastewater overtopping the lagoon. As manholes continue to deteriorate, the potential for build-up and blockages increases, which causes flow restrictions and wastewater back-ups in manholes, which in turn increases the risk of wastewater spillages in the community and associated contamination of nearby water bodies. In addition, manholes without sufficient lids present safety hazards to the public.

Recommended improvement

The recommended improvement for the community of Nondalton is to replace 21 aging manholes from the original construction and first two sewer system expansions that are in poor-to-failed condition with new manholes that conform to the ANTHC design standards.

Concept Design Requirements

- Sewer Manholes Design Criteria[1]:
    - Placement of manholes: at changes in the sewer main alignment and at no more than 400 foot intervals.
    - Concrete barrel and base with 48-inch inside diameter.
    - Eccentric cones for manholes deeper than 4 feet; and flat tops for manholes less than 4 feet deep.
    - Ladder rungs installed in all manholes deeper than 4 feet.
    - Manhole tops in isolated areas should be 6 inches to 12 inches above the ground surface.
    - Grouted channels/beaver slides should be used in manholes with drops less than 24 inches where grade adjustment is not possible.

[1] Alaska Native Health Consortium, Environmental Health and Engineering; *Technical Directive 18-3 – Standard Design Criteria for Sanitation Facilities; July 11, 2018*.

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  - Service lines will not be connected directly into manholes.
- Manholes in straight run sections should be replaced upstream of the existing manholes within 10 feet so the existing sewer main alignment are not impacted.
- Intersection Manholes with 3 or more sewer main connections should be replaced in-place.
- Wastewater flow will need to be maintained during construction. This can be accomplished with temporary bypass pumping.

Conceptual Construction Drawings

Manhole Inspection Reports – January 2020

FILE NAME: J:\JobsData\48601.00 APC Newhalen And Kokhanok W&S\00 CADD\02 Figures\06 Nondalton\NONDALTON Vicinity Map.dwg

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NONDALTON, ALASKA

VICINITY MAP

Project No:	48601.00
Drawn By:	MCH
Scale:	NTS
Date:	JAN 2020
Figure:	1

MH–14C
CITY OFFICE
MH–14B
MH–14A
MH–14F
MH–14E
MH–14D
SCHOOL
MH–7D
MH–7E
MH–7B
MH–7C
MH–7A
WTP
MH–3B
MH–3C
MH–3D
AIRPORT
WASTEWATER FLOW TO LAGOON
MH–15
MH–14
MH–13
MH–12
MH–11
MH–10
MH–9
MH–8
MH–7
LIFT STATION
MH–6
MH–6A
MH–5
COMMUNITY WELLS
MH–4
MH–3
MH–3A
CLINIC
MH–2
MH–1
SIXMILE LAKE

LEGEND
- MH TO BE REPLACED
- MH TO REMAIN IN PLACE
- WELL

250' 0 250' 500'

PROJECT: 48601.00
STATUS: DRAFT

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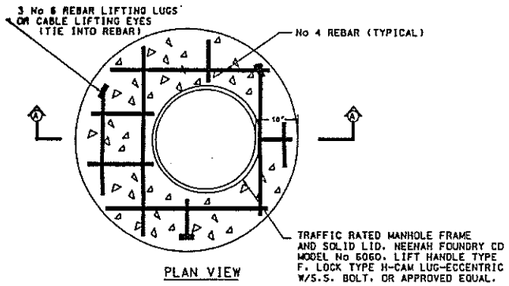
NONDALTON, ALASKA
SEWER SYSTEM IMPROVEMENT PLAN
MANHOLE LOCATION AND CONDITION

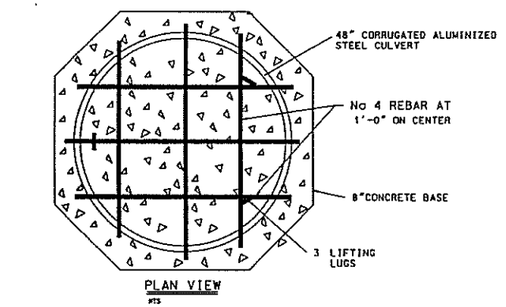
DATE: JAN 2020
SCALE: GRAPHIC
FIGURE: 2

File: J:\JobsData\48601.00 APC Newhalen And Kokhanok W&S\00 CADD\02 Figures\06 Nondalton CDR\03 – NONDALTON_Exiting_System_V2a.dwg

ORIGIONAL MANHOLE CONSTRUCTION DETAILS



TYPICAL LONG LEAD ORDER
PRECAST MANHOLE COVER
1 NTS

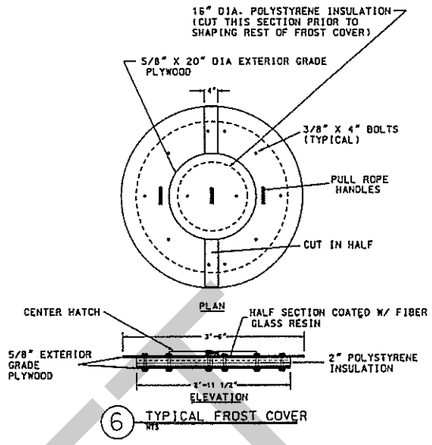


TYPICAL LONG LEAD ORDER
PRECAST MANHOLE BASE WITH CULVERT SECTION
2 NTS

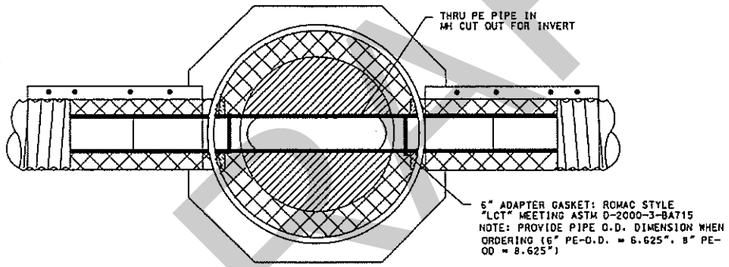
3

NOTES:

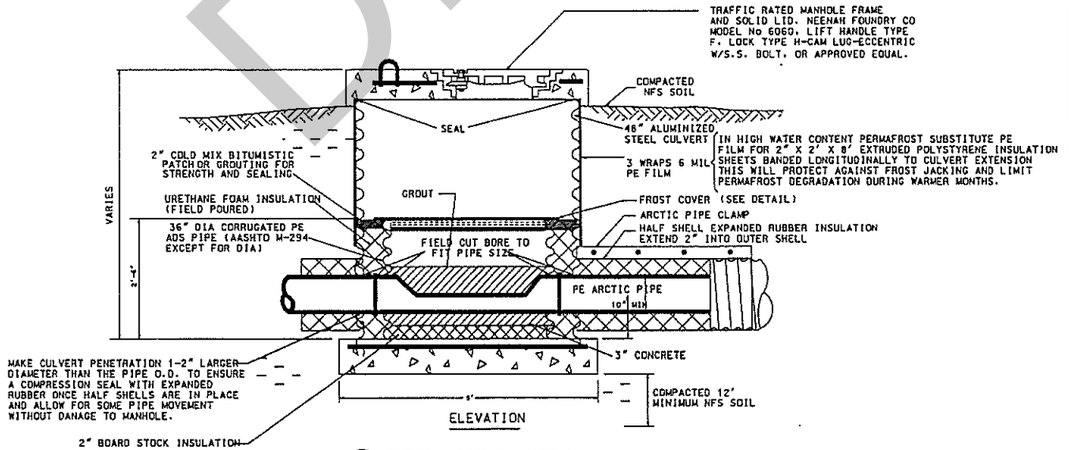
1. INSTALLER SHALL PROVIDE AS-BUILT DRAWING FOR ALL MANHOLES IN ACCORDANCE WITH SANITATION FACILITES SECTION GUIDELINE D-9
2. A MINIMUM INVERT ELEVATION DROP OF THREE-TENTHS (0.3) OF A FOOT FROM THE ENTRANCE TO THE OUTLET SHALL BE PROVIDED IN ALL MANHOLES WHERE THERE IS A CHANGE IN DIRECTION. STRAIGHT THRU MANHOLES ELEVATION DROP SHALL FOLLOW THE GRADE OF THE SEWER MAIN OR 0.1 FOOT MIN., THE GREATER OF THE TWO SHALL BE USED.
3. DROP INSIDE THE MANHOLE SHALL NOT EXCEED TWO FEET, MEASURED FROM THE INVERT OF THE INLET PIPE TO THE INVERT OF ITS CORRESPONDING CHANNEL.
4. CUT OFF MANHOLE COVER LIFTING LUGS AFTER INSTALLATION IS COMPLETED.
5. PROVIDE 2 EACH LADDERS OF SUFFICIENT SIZE TO ACCESS ALL MANHOLES TO THE O&M DEPARTMENT. NOTE MUTUALLY AGREEABLE LOCATION ON AS BUILT PLANS.
6. FOR INSTALLION IN GRAVEL TRAVELED WAYS, LID ELEVATION SHALL BE 6-INCHES BELOW GRADE.
7. IN OTHER THAN TRAVELED WAYS LID ELEVATION SHOULD BE 6-18- INCHES ABOVE GRADE OR THE FLOOD PLAIN (WHICH EVER IS HIGHER) WHERE EVER FEASIBLE. IN ANY EVENT FINAL SITE GRADING SHALL DIRECT SURFACE RUNOFF AWAY FROM THE MANHOLES TO LIMIT INFILTRATION.
8. IN HIGH WATER CONTENT PERMAFROST SUBSTITUTE PE FILM FOR 2" X 2" X 8' EXTRUDED POLYSTYRENE INSULATION SHEET BANDED LONGITUDINALLY TO CULVERT EXTENSION THIS WIL PROTECT AGAINST FROST JACKING AND LIMIT PERMAFROST DEGRADATION DURING WORMER MONTHS



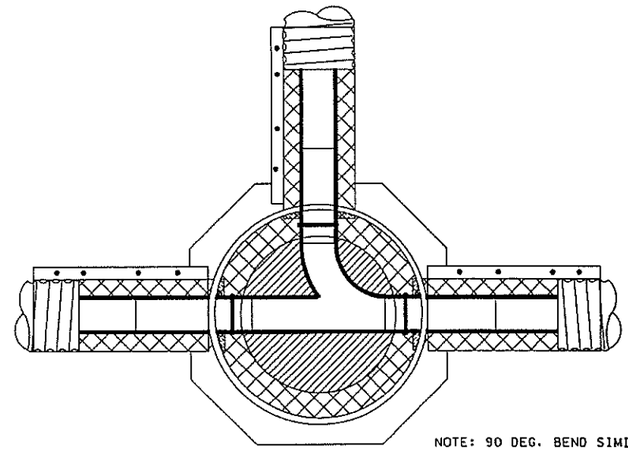
TYPICAL FROST COVER
6 NTS



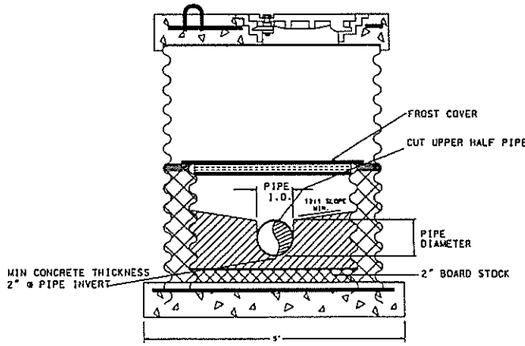
STRAIGHT THRU MANHOLE
NTS



TYPICAL ARCTIC MANHOLE
4 NTS



NTS



SIDE INLET MANHOLE
5 NTS

DATE	REVISIONS	INIT

U.S. DEPARTMENT OF HEALTH & HUMAN SERVICES
PUBLIC HEALTH SERVICE
INDIAN HEALTH SERVICE

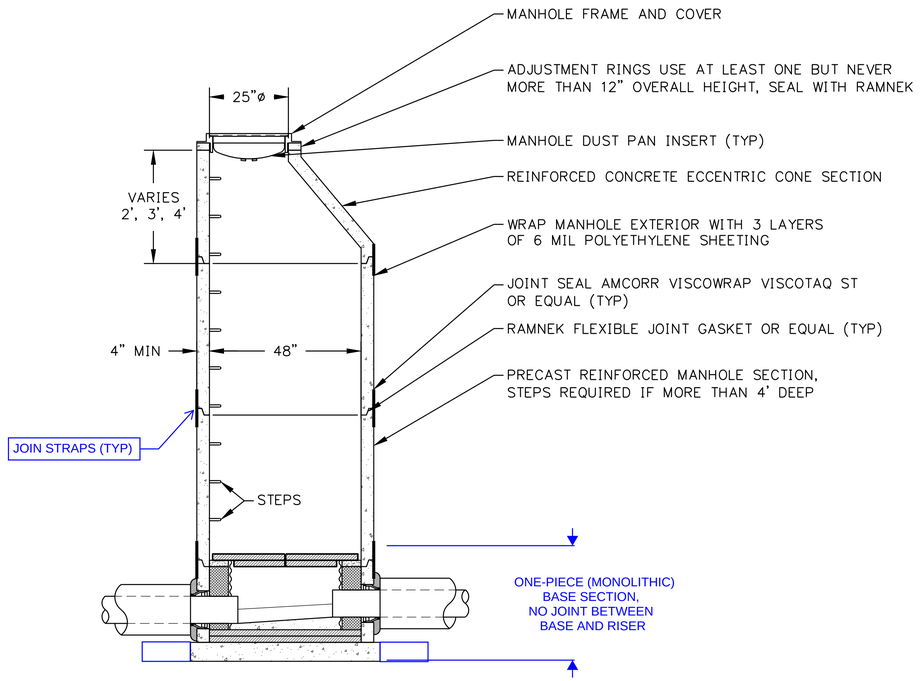
NONDALTON, ALASKA
NITATION FACILITIES
YPICAL ARCTIC MANHOLE DETAIL
PUBLIC LAW 86-121 PROJECT
PROJECT NO. 93-A14

SHEET NO. C-4
OF 9 SHEETS

WN BY: PH
E: 7/93
CHECKED BY:
DATE:

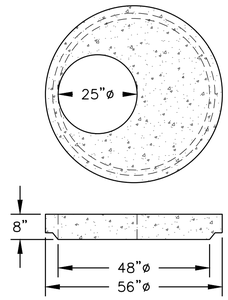
FIG 3

PROPOSED MANHOLE CONSTRUCTION DETAILS



C1 ARCTIC MANHOLE

1/2" = 1'-0"

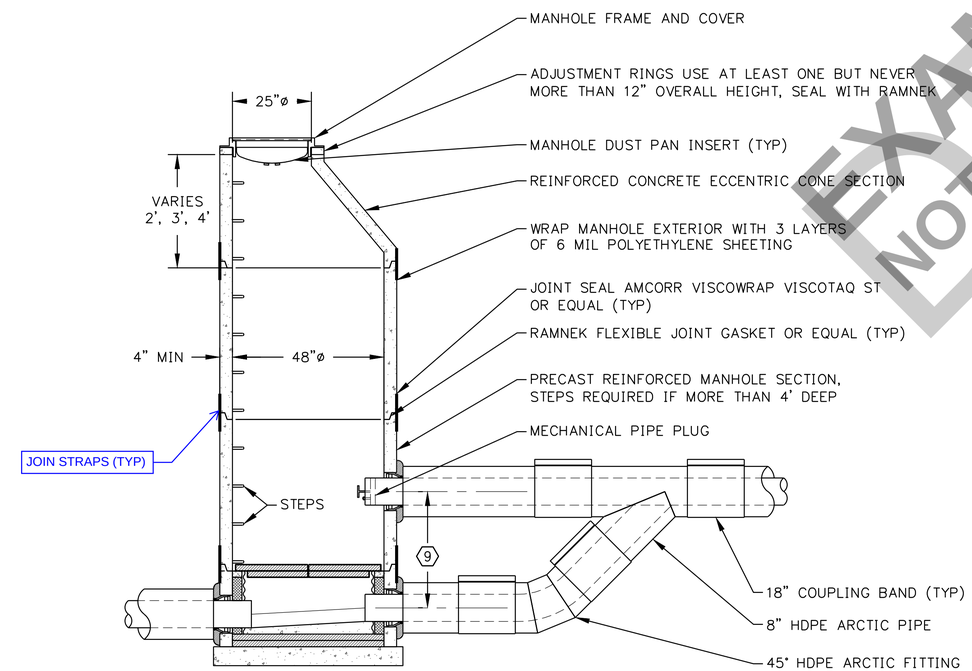


D3 MANHOLE FLAT TOP

1/2" = 1'-0"

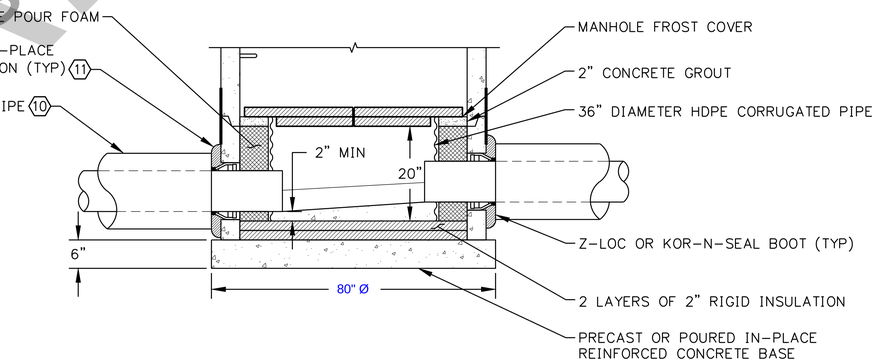
NOTES:

1. DUST PANS (MANHOLE INSERTS) SHALL BE INSTALLED IN ALL MANHOLES.
2. MANHOLE AND CLEAN-OUT FRAMES AND COVERS SHALL BE INSTALLED AS NOTED UNDER MANHOLE HEIGHTS.
3. ALL SEWER MAIN LINE STUB-OUTS SHALL BE PLUGGED AND MARKED WITH A 2X4 PRESSURE TREATED WOOD POST PAINTED GREEN. THE POST SHALL EXTEND APPROXIMATELY 24" ABOVE GRADE.
4. MANHOLE RISER SECTIONS SHALL BE FASTENED TO RESIST PULLING APART DUE TO FROST HEAVE BY INSTALLING 3 EACH HOT DIPPED GALVANIZED STEEL BARS (2" x 10" x 1/4") PER JOINT AND FASTENED TO THE CONCRETE USING 5/8" DIAMETER ANCHOR BOLTS (REDHEAD OR EQUAL) – 2 PER BAR.
5. PIPE INVERT FOR INSULATED MANHOLES SHALL BE PLACED 6" ABOVE THE INTERIOR BASE SLAB.
6. CHECK BUOYANCY OF MANHOLE IN HIGH GROUNDWATER CONDITIONS.
7. ALL MANHOLE BASES SHALL BE 24" HIGH UNLESS OTHERWISE SPECIFIED..
8. SEE PLAN AND PROFILE SHEETS FOR ORIENTATION OF PIPE PENETRATIONS AND INVERT ELEVATIONS.
9. USE A BEAVER SLIDE FOR DROP WHEN DISTANCE BETWEEN INVERTS IS LESS THAN 33".
10. SEE ARCTIC PIPE SPECIFICATION AND DETAILS.
11. SEAL GAP WITH POUR-IN-PLACE INSULATION (TYP), INSTALL 2" THICK CONCRETE GROUT LEVELING COURSE ON TOP OF INSULATION.



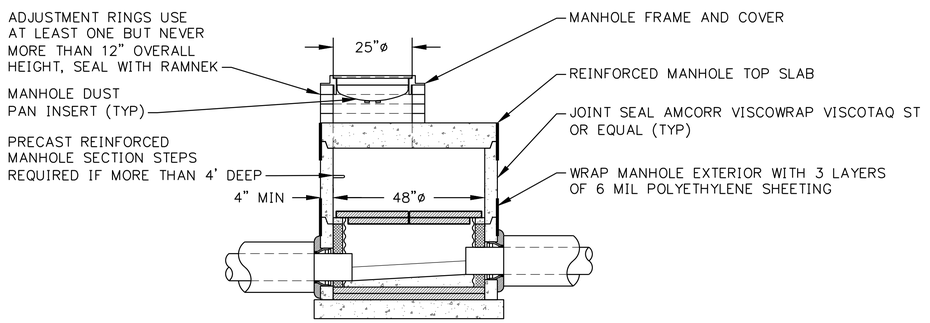
A1 ARCTIC DROP CONNECTION MANHOLE

1/2" = 1'-0"



B3 INSULATED MANHOLE BASE

3/4" = 1'-0"



A3 ARCTIC SHALLOW MANHOLE

1/2" = 1'-0"

Division of Environmental Health and Engineering
4500 Diplomacy Drive
Anchorage, Alaska 99508
(907) 729-3600

ARCTIC CONCRETE MANHOLE

STANDARD DETAIL

0 1"

BAR IS ONE INCH ON ORIGINAL DRAWING, IF NOT ADJUST SCALES ACCORDINGLY

FIG 4

SEWER MANHOLE FIELD INSPECTION FORM
NONDALTON, ALASKA

INSPECTION DATE:	1/4/2020	INSPECTION TIME:	11:30am
WEATHER:	-15°F	INSPECTED BY:	CRW SH/MH
MANHOLE NUMBER:	1	FIRST PHOTO NUMBER:	

APPROXIMATE LOCATION: Northeast part of the community. See Figure 2.

CONDITION	POOR	←	→	GOOD
CONDITION OF LID	1	2	3	4
CONDITION OF BASE	1	2	3	4
CONDITION OF BARREL	1	2	3	4
CONDITION OF LADDER (not applicable)	1	2	3	4
CONDITION OF PIPE INLETS/OUTLETS	1	2	3	4

PRESENCE OF SOLIDS OR BUILDUP: Yes

PRESENCE OF INFILTRATION/INFLOW: No

DIAMETER OF MANHOLE: 42 inches

MANHOLE CONSTRUCTION TYPE: CMP w/ concrete base

SEWER PIPING MATERIALS: STEP (PVC) and outlet PVC(?)

DEPTH TO BOTTOM: 4 feet

MANHOLE CONDITION NOTES:

Plywood cover with insulation approximately below lid.

STEP systems feed into this MH.

Base appears to be attached.

Gravel and sludge at base.

MH1 from road.

Insulation plug in MH1.

Insulation plug open, MH1.

MH1 interior.

STEP service line into MH1.

MH1 outlet.

SEWER MANHOLE FIELD INSPECTION FORM
NONDALTON, ALASKA

INSPECTION DATE: 1/4/2020 INSPECTION TIME: 11:40am

WEATHER: -15°F INSPECTED BY: CRW SH/MH

MANHOLE NUMBER: 2 FIRST PHOTO NUMBER:

APPROXIMATE LOCATION: Northeast part of the community. See Figure 2.

CONDITION	POOR	←	→	GOOD
CONDITION OF LID	1	2	3	4
CONDITION OF BASE	1	2	3	4
CONDITION OF BARREL	1	2	3	4
CONDITION OF LADDER (not applicable)	1	2	3	4
CONDITION OF PIPE INLETS/OUTLETS	1	2	3	4

PRESENCE OF SOLIDS OR BUILDUP: Yes

PRESENCE OF INFILTRATION/INFLOW: Yes

DIAMETER OF MANHOLE: 42 inches

MANHOLE CONSTRUCTION TYPE: CMP w/ concrete base

SEWER PIPING MATERIALS: steel (?)

DEPTH TO BOTTOM: 5.9 feet

MANHOLE CONDITION NOTES:

Concrete top with metal lid.

No insulation.

Portion of concrete lid was covered with snow, portion uncovered showed signs of deterioration.

Base appears to be attached.

Some gravel in bottom.

Barrel shows some degradation.

Uncovering MH2.

View into MH2.

MH2 looking north.

MH2 looking south.

SEWER MANHOLE FIELD INSPECTION FORM
NONDALTON, ALASKA

INSPECTION DATE:	1/4/2020	INSPECTION TIME:	12:05pm
WEATHER:	-15°F	INSPECTED BY:	CRW SH/MH
MANHOLE NUMBER:	3	FIRST PHOTO NUMBER:	

APPROXIMATE LOCATION: See Figure 2.

CONDITION	POOR ←			→ GOOD
CONDITION OF LID	1	2	3	4
CONDITION OF BASE	1	2	3	4
CONDITION OF BARREL	1	2	3	4
CONDITION OF LADDER (not applicable)	1	2	3	4
CONDITION OF PIPE INLETS/OUTLETS	1	2	3	4

PRESENCE OF SOLIDS OR BUILDUP: Yes

PRESENCE OF INFILTRATION/INFLOW: Yes

DIAMETER OF MANHOLE: 42 inches

MANHOLE CONSTRUCTION TYPE: CMP w/ concrete base

SEWER PIPING MATERIALS: PVC

DEPTH TO BOTTOM: 9.5 feet

MANHOLE CONDITION NOTES:

Rope in MH to help catch rocks, should have been removed prior to winter.

Some separation at base.

Ricco (City maintenance employee) reports that gravel needs to be cleaned out of this MH frequently.

Concrete lid with metal cover.

MH3 concrete lid.

MH3 concrete lit with metal cover.

View into MH3.

MH3 service connection entering from east.

MH3 view to north.

MH3 view to south.

SEWER MANHOLE FIELD INSPECTION FORM
NONDALTON, ALASKA

INSPECTION DATE:	1/4/2020	INSPECTION TIME:	11:57am
WEATHER:	-15°F	INSPECTED BY:	CRW SH/MH
MANHOLE NUMBER:	3A	FIRST PHOTO NUMBER:	

APPROXIMATE LOCATION: See Figure 2.

CONDITION	POOR	←		→	GOOD
CONDITION OF LID	1	2	3		4
CONDITION OF BASE	1	2	3		4
CONDITION OF BARREL	1	2	3		4
CONDITION OF LADDER (not applicable)	1	2	3		4
CONDITION OF PIPE INLETS/OUTLETS	1	2	3		4

PRESENCE OF SOLIDS OR BUILDUP: Yes

PRESENCE OF INFILTRATION/INFLOW: Yes

DIAMETER OF MANHOLE: 42 inches

MANHOLE CONSTRUCTION TYPE: CMP w/ concrete base

SEWER PIPING MATERIALS: PVC

DEPTH TO BOTTOM: 9.5 feet

MANHOLE CONDITION NOTES:

Disintegrated concrete lid with metal cover.

No insulation.

Inlet might enter MH at elevation lower than outlet.

Manhole barrel might have been set on top of connecting pipes.

MH3A from road.

View into MH3A.

MH3A view east.

MH3A.

SEWER MANHOLE FIELD INSPECTION FORM
NONDALTON, ALASKA

INSPECTION DATE:	1/4/2020	INSPECTION TIME:	11:20am
WEATHER:	-15°F	INSPECTED BY:	CRW SH/MH
MANHOLE NUMBER:	3B	FIRST PHOTO NUMBER:	

APPROXIMATE LOCATION: See Figure 2.

CONDITION	POOR ←			→ GOOD
CONDITION OF LID	1	2	3	4
CONDITION OF BASE	1	2	3	4
CONDITION OF BARREL	1	2	3	4
CONDITION OF LADDER (not applicable)	1	2	3	4
CONDITION OF PIPE INLETS/OUTLETS	1	2	3	4

PRESENCE OF SOLIDS OR BUILDUP: Yes

PRESENCE OF INFILTRATION/INFLOW: Yes

DIAMETER OF MANHOLE: 42 inches

MANHOLE CONSTRUCTION TYPE: CMP w/ concrete base

SEWER PIPING MATERIALS: PVC

DEPTH TO BOTTOM: 9 feet

MANHOLE CONDITION NOTES:

"Concrete" top with metal lid.

Concrete top is almost fully disintegrated. Lid was not removed as it likely would have fallen into the MH in the process of removal, and would not have been able to readily replace.

No insulation.

Separation at base.

Has a collapsed pipe or notch in barrel to accommodate entry of one connecting pipe.

MH3B from road.

View into MH3B.

MH3B collapsed pipe or nonexistent pipe with barrel notch.

MH3B rocks in bottom of MH.

MH3B.

SEWER MANHOLE FIELD INSPECTION FORM
NONDALTON, ALASKA

INSPECTION DATE:	1/4/2020	INSPECTION TIME:	11:10am
WEATHER:	-15°F	INSPECTED BY:	CRW SH/MH
MANHOLE NUMBER:	3C	FIRST PHOTO NUMBER:	

APPROXIMATE LOCATION: See Figure 2.

CONDITION	POOR ←			→ GOOD
CONDITION OF LID	1	2	3	4
CONDITION OF BASE	1	2	3	4
CONDITION OF BARREL	1	2	3	4
CONDITION OF LADDER (not applicable)	1	2	3	4
CONDITION OF PIPE INLETS/OUTLETS	1	2	3	4

PRESENCE OF SOLIDS OR BUILDUP: Yes

PRESENCE OF INFILTRATION/INFLOW: Yes

DIAMETER OF MANHOLE: 42 inches

MANHOLE CONSTRUCTION TYPE: CMP w/ concrete base

SEWER PIPING MATERIALS: PVC

DEPTH TO BOTTOM: 7 feet

MANHOLE CONDITION NOTES:

Concrete top with metal cover.

Concrete is deteriorating.

Separation at bottom.

Not insulated.

 MH3C from Road.	 Opening MH3C.
 View into MH3C.	 MH3C collapsed pipe or nonexistent pipe with barrel notch..

SEWER MANHOLE FIELD INSPECTION FORM
NONDALTON, ALASKA

INSPECTION DATE:	1/4/2020	INSPECTION TIME:	11:30am
WEATHER:	-15°F	INSPECTED BY:	CRW SH/MH
MANHOLE NUMBER:	3D	FIRST PHOTO NUMBER:	
APPROXIMATE LOCATION:	See Figure 2.		

CONDITION	POOR ←			→ GOOD
CONDITION OF LID	1	2	3	4
CONDITION OF BASE	1	2	3	4
CONDITION OF BARREL	1	2	3	4
CONDITION OF LADDER (not applicable)	1	2	3	4
CONDITION OF PIPE INLETS/OUTLETS	1	2	3	4

PRESENCE OF SOLIDS OR BUILDUP: No

PRESENCE OF INFILTRATION/INFLOW: No

DIAMETER OF MANHOLE: 42 inches

MANHOLE CONSTRUCTION TYPE: CMP w/ concrete base

SEWER PIPING MATERIALS: PVC

DEPTH TO BOTTOM: 7 feet

MANHOLE CONDITION NOTES:
Plywood cover.

PVC line comes in from west.

Rebuilt 3 years ago.

Bottom has some separation.

Some infiltration.

MH3D from Road.

MH3D another view from Road.

View into MH3D.

MH3D looking east.

MH3D looking south.

MH3D looking south zoomed in.

SEWER MANHOLE FIELD INSPECTION FORM
NONDALTON, ALASKA

INSPECTION DATE:	1/4/2020	INSPECTION TIME:	12:15pm
WEATHER:	-15°F	INSPECTED BY:	CRW SH/MH
MANHOLE NUMBER:	4	FIRST PHOTO NUMBER:	

APPROXIMATE LOCATION: See Figure 2.

CONDITION	POOR ←			→ GOOD
CONDITION OF LID	1	2	3	4
CONDITION OF BASE	1	2	3	4
CONDITION OF BARREL	1	2	3	4
CONDITION OF LADDER (not applicable)	1	2	3	4
CONDITION OF PIPE INLETS/OUTLETS	1	2	3	4

PRESENCE OF SOLIDS OR BUILDUP: Yes

PRESENCE OF INFILTRATION/INFLOW: Yes

DIAMETER OF MANHOLE: 42 inches

MANHOLE CONSTRUCTION TYPE: CMP w/ concrete base

SEWER PIPING MATERIALS: PVC

DEPTH TO BOTTOM: 8 feet

MANHOLE CONDITION NOTES:

Concrete lid has almost completely disintegrated. As such, did not take cover off.

Rope installed in MH for rock catching.

Hose and snow inside MH.

MH4 from Road.

MH4 lid view.

View into MH4.

MH4 looking east.

SEWER MANHOLE FIELD INSPECTION FORM
NONDALTON, ALASKA

INSPECTION DATE: 1/4/2020 INSPECTION TIME: 12:25pm

WEATHER: -15°F INSPECTED BY: CRW SH/MH

MANHOLE NUMBER: 5 FIRST PHOTO NUMBER:

APPROXIMATE LOCATION: See Figure 2.

CONDITION	POOR	←	→	GOOD
CONDITION OF LID	1	2	3	4
CONDITION OF BASE	1	2	3	4
CONDITION OF BARREL	1	2	3	4
CONDITION OF LADDER (not applicable)	1	2	3	4
CONDITION OF PIPE INLETS/OUTLETS	1	2	3	4

PRESENCE OF SOLIDS OR BUILDUP: No

PRESENCE OF INFILTRATION/INFLOW: No

DIAMETER OF MANHOLE: 42 inches

MANHOLE CONSTRUCTION TYPE: CMP w/ concrete base

SEWER PIPING MATERIALS: PVC

DEPTH TO BOTTOM: 6.5 feet

MANHOLE CONDITION NOTES:
Concrete lid with metal cover.

No insulation.

MH5 from Road.

MH5 lid view.

View into MH5.

MH5 looking north.

MH5 looking south

SEWER MANHOLE FIELD INSPECTION FORM
NONDALTON, ALASKA

INSPECTION DATE:	1/4/2020	INSPECTION TIME:	2:43pm
WEATHER:	-15°F	INSPECTED BY:	CRW SH/MH
MANHOLE NUMBER:	6	FIRST PHOTO NUMBER:	

APPROXIMATE LOCATION: See Figure 2.

CONDITION	POOR ←			→ GOOD
CONDITION OF LID	1	2	3	4
CONDITION OF BASE	Full of water – did not observe			
CONDITION OF BARREL	1	2	3	4
CONDITION OF LADDER (not applicable)	1	2	3	4
CONDITION OF PIPE INLETS/OUTLETS	Full of water – did not observe			

PRESENCE OF SOLIDS OR BUILDUP: Not observable.

PRESENCE OF INFILTRATION/INFLOW: Not observable.

DIAMETER OF MANHOLE: 42 inches

MANHOLE CONSTRUCTION TYPE: CMP w/ concrete base

SEWER PIPING MATERIALS: PVC

DEPTH TO BOTTOM: 5 feet to top of water.

MANHOLE CONDITION NOTES:
Plywood cover with no insulation.

Water was present in manhole and obscured view of the bottom.

 MH6 from Road.	 View into MH6,.

SEWER MANHOLE FIELD INSPECTION FORM
NONDALTON, ALASKA

INSPECTION DATE: 1/4/2020 INSPECTION TIME: 2:45pm

WEATHER: -15°F INSPECTED BY: CRW SH/MH

MANHOLE NUMBER: 6A FIRST PHOTO NUMBER:

APPROXIMATE LOCATION: See Figure 2.

CONDITION	POOR ←			→ GOOD
CONDITION OF LID	1	2	3	4
CONDITION OF BASE	Full of water – did not observe.			
CONDITION OF BARREL	1	2	3	4
CONDITION OF LADDER (not applicable)	1	2	3	4
CONDITION OF PIPE INLETS/OUTLETS	Full of water – did not observe.			
PRESENCE OF SOLIDS OR BUILDUP	Not observable.			
PRESENCE OF INFILTRATION/INFLOW	Not observable.			

DIAMETER OF MANHOLE: 42 inches

MANHOLE CONSTRUCTION TYPE: CMP w/ concrete base

SEWER PIPING MATERIALS: PVC

DEPTH TO BOTTOM: Not observable.

MANHOLE CONDITION NOTES:
No cover.

Unfrozen wastewater was observed in MH. Fluid level nearly full. MH appears to be surcharged from lift station not operating.

 MH6A behind MH6.	

SEWER MANHOLE FIELD INSPECTION FORM
NONDALTON, ALASKA

INSPECTION DATE: 1/4/2020 INSPECTION TIME: 4:00pm

WEATHER: -15°F INSPECTED BY: CRW SH/MH

MANHOLE NUMBER: 7 FIRST PHOTO NUMBER:

APPROXIMATE LOCATION: Figure 2.

CONDITION	POOR ←			→ GOOD
CONDITION OF LID	1	2	3	4
CONDITION OF BASE	1	2	3	4
CONDITION OF BARREL	1	2	3	4
CONDITION OF LADDER (not applicable)	1	2	3	4
CONDITION OF PIPE INLETS/OUTLETS	Full of water - not observed.			
PRESENCE OF SOLIDS OR BUILDUP	Yes			
PRESENCE OF INFILTRATION/INFLOW	Yes			

DIAMETER OF MANHOLE: 42 inches

MANHOLE CONSTRUCTION TYPE: CMP w/ concrete base

SEWER PIPING MATERIALS: Not observable.

DEPTH TO BOTTOM: 5 feet

MANHOLE CONDITION NOTES:
Plywood cover.

No insulation.

Base full of wastewater and sludge. Bottom was not observable.

 MH7 lid.	 MH7 view from inside.

NONDALTON, ALASKA

INSPECTION DATE:	1/5/2020	INSPECTION TIME:	11:15am
WEATHER:	-15°F	INSPECTED BY:	CRW SH/MH
MANHOLE NUMBER:	7A	FIRST PHOTO NUMBER:	

APPROXIMATE LOCATION: See Figure 2.

CONDITION	POOR ←			→ GOOD
CONDITION OF LID	1	2	3	4
CONDITION OF BASE	1	2	3	4
CONDITION OF BARREL	1	2	3	4
CONDITION OF LADDER (not applicable)	1	2	3	4
CONDITION OF PIPE INLETS/OUTLETS		Not observable.		
PRESENCE OF SOLIDS OR BUILDUP	No			
PRESENCE OF INFILTRATION/INFLOW	Yes			
DIAMETER OF MANHOLE:	42 inches			
MANHOLE CONSTRUCTION TYPE:	CMP w/ concrete base			
SEWER PIPING MATERIALS:	PVC			
DEPTH TO BOTTOM:	7.5 feet			

MANHOLE CONDITION NOTES:
Concrete lid with metal cover.

Concrete base is separating from MH barrel.

Concrete lid is deteriorating.

MH7A lid.

MH7A Lid.

MH7A view from above

MH7A view east.

MH7A view west.

MH7A north service.

SEWER MANHOLE FIELD INSPECTION FORM
NONDALTON, ALASKA

INSPECTION DATE:	1/5/2020	INSPECTION TIME:	11:02am
WEATHER:	-17°F	INSPECTED BY:	CRW SH/MH
MANHOLE NUMBER:	7B	FIRST PHOTO NUMBER:	

APPROXIMATE LOCATION: See Figure 2.

CONDITION	POOR ←			→ GOOD
CONDITION OF LID	1	2	3	4
CONDITION OF BASE	1	2	3	4
CONDITION OF BARREL	1	2	3	4
CONDITION OF LADDER (not applicable)	1	2	3	4
CONDITION OF PIPE INLETS/OUTLETS	1	2	3	4

PRESENCE OF SOLIDS OR BUILDUP: Yes

PRESENCE OF INFILTRATION/INFLOW: Yes

DIAMETER OF MANHOLE: 42 inches

MANHOLE CONSTRUCTION TYPE: CMP w/ concrete base

SEWER PIPING MATERIALS: HDPE

DEPTH TO BOTTOM: 6 feet

MANHOLE CONDITION NOTES:

Concrete lid with metal cover.

Concrete base is separating from MH barrel.

Concrete lid is deteriorating.

Service line runs directly to MH.

MH7B from road.

MH7B north view.

MH7B lid.

MH7B view from above.

MH7B north.

MH7B, west service.

SEWER MANHOLE FIELD INSPECTION FORM
NONDALTON, ALASKA

INSPECTION DATE: 1/5/2020 INSPECTION TIME: 1:20pm

WEATHER: -17°F INSPECTED BY: CRW SH/MH

MANHOLE NUMBER: 7C FIRST PHOTO NUMBER:

APPROXIMATE LOCATION: See Figure 2.

CONDITION	POOR	←		→	GOOD
CONDITION OF LID	1	2	3		4
CONDITION OF BASE	1	2	3		4
CONDITION OF BARREL	1	2	3		4
CONDITION OF LADDER (not applicable)	1	2	3		4
CONDITION OF PIPE INLETS/OUTLETS	1	2	3		4

PRESENCE OF SOLIDS OR BUILDUP: No

PRESENCE OF INFILTRATION/INFLOW: No

DIAMETER OF MANHOLE: 42 inches

MANHOLE CONSTRUCTION TYPE: CMP w/ concrete base

SEWER PIPING MATERIALS: PVC

DEPTH TO BOTTOM:

MANHOLE CONDITION NOTES:

Galvanized metal hatch cover.

Insulation plug present, near bottom.

Newer construction.

Due to insulation plug, was not able to get good photos of MH bottom.

MH7C from road.

MH7C insulation plug.

MH7C from above.

MH7C south.

SEWER MANHOLE FIELD INSPECTION FORM
NONDALTON, ALASKA

INSPECTION DATE:	1/4/2020	INSPECTION TIME:	9:59am
WEATHER:	-15°F	INSPECTED BY:	CRW SH/MH
MANHOLE NUMBER:	7D	FIRST PHOTO NUMBER:	

APPROXIMATE LOCATION: See Figure 2.

CONDITION	POOR	←		→	GOOD
CONDITION OF LID	1	2	3		4
CONDITION OF BASE	1	2	3		4
CONDITION OF BARREL	1	2	3		4
CONDITION OF LADDER (not applicable)	1	2	3		4
CONDITION OF PIPE INLETS/OUTLETS	1	2	3		4

PRESENCE OF SOLIDS OR BUILDUP: No

PRESENCE OF INFILTRATION/INFLOW: No

DIAMETER OF MANHOLE: 42 inches

MANHOLE CONSTRUCTION TYPE: CMP w/ concrete base

SEWER PIPING MATERIALS: PVC

DEPTH TO BOTTOM: 11.36 feet to bottom, 10 feet to top of insulation.

MANHOLE CONDITION NOTES:
Galvanized metal hatch cover.

Insulation plug present, near bottom.

Newer construction.

Due to insulation plug, was not able to get good photos of MH bottom.

MH7D from road.

MH7D insulation plug.

SEWER MANHOLE FIELD INSPECTION FORM
NONDALTON, ALASKA

INSPECTION DATE:	1/4/2020	INSPECTION TIME:	10:11am
WEATHER:	-15°F	INSPECTED BY:	CRW SH/MH
MANHOLE NUMBER:	7E	FIRST PHOTO NUMBER:	

APPROXIMATE LOCATION: See Figure 2.

CONDITION	POOR	←		GOOD
CONDITION OF LID	1	2	3	4
CONDITION OF BASE	1	2	3	4
CONDITION OF BARREL	1	2	3	4
CONDITION OF LADDER (not applicable)	1	2	3	4
CONDITION OF PIPE INLETS/OUTLETS	1	2	3	4

PRESENCE OF SOLIDS OR BUILDUP: No

PRESENCE OF INFILTRATION/INFLOW: No

DIAMETER OF MANHOLE: 48 inches

MANHOLE CONSTRUCTION TYPE: CMP w/ concrete base

SEWER PIPING MATERIALS: HDPE

DEPTH TO BOTTOM: 9.75 feet

MANHOLE CONDITION NOTES:

Galvanized metal hatch cover.

Insulation plug present, near bottom.

No trash in MH.

 MH7Efrom road.	 MH7E Barrel
 MH7Efrom above.	 MH7E view north.
 MH7E view south.	

SEWER MANHOLE FIELD INSPECTION FORM
NONDALTON, ALASKA

INSPECTION DATE:	1/4/2020	INSPECTION TIME:	3:48pm
WEATHER:	-15°F	INSPECTED BY:	CRW SH/MH
MANHOLE NUMBER:	8	FIRST PHOTO NUMBER:	

APPROXIMATE LOCATION: See Figure 2.

CONDITION	POOR ←			→ GOOD
CONDITION OF LID	1	2	3	4
CONDITION OF BASE	1	2	3	4
CONDITION OF BARREL	1	2	3	4
CONDITION OF LADDER (not applicable)	1	2	3	4
CONDITION OF PIPE INLETS/OUTLETS	1	2	3	4

PRESENCE OF SOLIDS OR BUILDUP: No

PRESENCE OF INFILTRATION/INFLOW: Yes

DIAMETER OF MANHOLE: 42 inches

MANHOLE CONSTRUCTION TYPE: CMP w/ concrete base

SEWER PIPING MATERIALS: PVC

DEPTH TO BOTTOM: Approx 5 feet

MANHOLE CONDITION NOTES:
Concrete lid with metal cover.

Concrete base is separating from MH barrel.

Barrel seems to not be plumb—leaning towards road.

MH8 from road.

Using camera in MH8.

MH8 view from above

MH8 view north.

MH8 view south.

SEWER MANHOLE FIELD INSPECTION FORM
NONDALTON, ALASKA

INSPECTION DATE: 1/4/2020 INSPECTION TIME: 3:10pm

WEATHER: -15°F INSPECTED BY: CRW SH/MH

MANHOLE NUMBER: 9 FIRST PHOTO NUMBER:

APPROXIMATE LOCATION: See Figure 2.

CONDITION	POOR	←	→	GOOD
CONDITION OF LID	1	2	3	4
CONDITION OF BASE	1	2	3	4
CONDITION OF BARREL	1	2	3	4
CONDITION OF LADDER (not applicable)	1	2	3	4
CONDITION OF PIPE INLETS/OUTLETS	1	2	3	4

PRESENCE OF SOLIDS OR BUILDUP: No

PRESENCE OF INFILTRATION/INFLOW: No

DIAMETER OF MANHOLE: 42 inches

MANHOLE CONSTRUCTION TYPE: CMP w/ concrete base

SEWER PIPING MATERIALS: PVC with HDPE service

DEPTH TO BOTTOM: 6 feet

MANHOLE CONDITION NOTES:
Concrete lid with metal cover.

No insulation.

Located in front of two-story house.

MH9 from road.

MH9 view from above.

MH9 with lid open.

MH9 view north.

MH9 view south.

SEWER MANHOLE FIELD INSPECTION FORM
NONDALTON, ALASKA

INSPECTION DATE:	1/4/2020	INSPECTION TIME:	3:33pm
WEATHER:	-15°F	INSPECTED BY:	CRW SH/MH
MANHOLE NUMBER:	10	FIRST PHOTO NUMBER:	

APPROXIMATE LOCATION: See Figure 2.

CONDITION	POOR ←			→ GOOD
CONDITION OF LID	1	2	3	4
CONDITION OF BASE	1	2	3	4
CONDITION OF BARREL	1	2	3	4
CONDITION OF LADDER (not applicable)	1	2	3	4
CONDITION OF PIPE INLETS/OUTLETS	1	2	3	4

PRESENCE OF SOLIDS OR BUILDUP: No

PRESENCE OF INFILTRATION/INFLOW: Yes

DIAMETER OF MANHOLE: 42 inches

MANHOLE CONSTRUCTION TYPE: CMP w/ concrete base

SEWER PIPING MATERIALS: PVC

DEPTH TO BOTTOM: 8.3 feet

MANHOLE CONDITION NOTES:
Plywood lid with insulation.

Concrete base is separating from MH barrel.

Infiltration present.

Cracked PVC on south inlet.

MH10 from road.

MH10 view with insulation on lid.

MH10 view from above.

MH10 insulated lid.

MH10 north view.

MH10 south view.

SEWER MANHOLE FIELD INSPECTION FORM
NONDALTON, ALASKA

INSPECTION DATE:	1/4/2020	INSPECTION TIME:	4:10pm
WEATHER:	-15°F	INSPECTED BY:	CRW SH/MH
MANHOLE NUMBER:	11	FIRST PHOTO NUMBER:	
APPROXIMATE LOCATION:	See Figure 2.		

CONDITION	POOR ←			→ GOOD
CONDITION OF LID	1	2	3	4
CONDITION OF BASE	1	2	3	4
CONDITION OF BARREL	1	2	3	4
CONDITION OF LADDER (not applicable)	1	2	3	4
CONDITION OF PIPE INLETS/OUTLETS	1	2	3	4

PRESENCE OF SOLIDS OR BUILDUP: Yes

PRESENCE OF INFILTRATION/INFLOW: Yes

DIAMETER OF MANHOLE: 42 inches

MANHOLE CONSTRUCTION TYPE: CMP w/ concrete base

SEWER PIPING MATERIALS: PVC

DEPTH TO BOTTOM: 6 feet

MANHOLE CONDITION NOTES:

Concrete lid with metal cover.

Concrete is falling apart. We did not remove lid as it did not look re-installable.

Surface infiltration from road.

Rocks in base.

Concrete base is separating from MH barrel.

MH11 from road.

MH11 cement deterioration.

MH11 view from above.

MH11 north view.

MH11 south view.

SEWER MANHOLE FIELD INSPECTION FORM
NONDALTON, ALASKA

INSPECTION DATE:	1/4/2020	INSPECTION TIME:	3:05pm
WEATHER:	-15°F	INSPECTED BY:	CRW SH/MH
MANHOLE NUMBER:	12	FIRST PHOTO NUMBER:	

APPROXIMATE LOCATION: See Figure 2.

CONDITION	POOR ←			→ GOOD
CONDITION OF LID	1	2	3	4
CONDITION OF BASE	1	2	3	4
CONDITION OF BARREL	1	2	3	4
CONDITION OF LADDER (not applicable)	1	2	3	4
CONDITION OF PIPE INLETS/OUTLETS	1	2	3	4

PRESENCE OF SOLIDS OR BUILDUP: Yes

PRESENCE OF INFILTRATION/INFLOW: Yes

DIAMETER OF MANHOLE: 42 inches

MANHOLE CONSTRUCTION TYPE: CMP w/ concrete base

SEWER PIPING MATERIALS: PVC

DEPTH TO BOTTOM:

MANHOLE CONDITION NOTES:

Plywood cover (vehicle impacted 60-inch collar and it broke off)

Lid frozen in place—had to chip away snow and ice to open.

Surface infiltration from road.

Rocks in base of MH.

Concrete base is separating from MH barrel.

MH12 from road.

MH12 from road view 2.

MH12 view from above.

MH12 with lid propped open.

MH12 north view.

MH12 south view.

SEWER MANHOLE FIELD INSPECTION FORM
NONDALTON, ALASKA

INSPECTION DATE: 1/4/2020 INSPECTION TIME: 2:46pm

WEATHER: -15°F INSPECTED BY: CRW SH/MH

MANHOLE NUMBER: 13 FIRST PHOTO NUMBER:

APPROXIMATE LOCATION: See Figure 2.

CONDITION	POOR	←	→	GOOD
CONDITION OF LID	1	2	3	4
CONDITION OF BASE	1	2	3	4
CONDITION OF BARREL	1	2	3	4
CONDITION OF LADDER (not applicable)	1	2	3	4
CONDITION OF PIPE INLETS/OUTLETS	1	2	3	4

PRESENCE OF SOLIDS OR BUILDUP: Yes

PRESENCE OF INFILTRATION/INFLOW: No

DIAMETER OF MANHOLE: 42 inches

MANHOLE CONSTRUCTION TYPE: CMP w/ concrete base

SEWER PIPING MATERIALS: PVC

DEPTH TO BOTTOM: 6 feet

MANHOLE CONDITION NOTES:
Concrete lid with metal cover.

Water in base obscured view of beaver slide.

Lid buried slightly.

No insulation.

Fencing in MH.

Debris in MH.

 MH13 with cover open.	 MH13 with fence inside.
 MH13 view north.	 MH13 view south.

SEWER MANHOLE FIELD INSPECTION FORM
NONDALTON, ALASKA

INSPECTION DATE: 1/4/2020 INSPECTION TIME: 2:32pm

WEATHER: -15°F INSPECTED BY: CRW SH/MH

MANHOLE NUMBER: 14 FIRST PHOTO NUMBER:

APPROXIMATE LOCATION:

CONDITION	POOR			GOOD
CONDITION OF LID	1	2	3	4
CONDITION OF BASE	1	2	3	4
CONDITION OF BARREL	1	2	3	4
CONDITION OF LADDER (not applicable)	1	2	3	4
CONDITION OF PIPE INLETS/OUTLETS	1	2	3	4

PRESENCE OF SOLIDS OR BUILDUP Yes

PRESENCE OF INFILTRATION/INFLOW Yes

DIAMETER OF MANHOLE: 42 inches

MANHOLE CONSTRUCTION TYPE: CMP w/ concrete base

SEWER PIPING MATERIALS: HDPE (West) /PVC

DEPTH TO BOTTOM: 8.5 feet

MANHOLE CONDITION NOTES:

Plywood cover.

60” top culvert top with 42-inch barrel.

Barrel is separated halfway up at joint.

Some ice buildup in bottom.

Opening MH14.

MH14 with 60” Lid and 42” barrel..

MH14 view from above.

MH14 view west

MH14 view north.

MH14 view southwest

SEWER MANHOLE FIELD INSPECTION FORM
NONDALTON, ALASKA

INSPECTION DATE: 1/5/2020 INSPECTION TIME: 10:36am

WEATHER: -17°F INSPECTED BY: CRW SH/MH

MANHOLE NUMBER: 14A FIRST PHOTO NUMBER:

APPROXIMATE LOCATION: See Figure 2.

CONDITION	POOR			GOOD
CONDITION OF LID	1	2.5	3	4
CONDITION OF BASE	1	2	3	4
CONDITION OF BARREL	1	2	3	4
CONDITION OF LADDER	1	2	3	4
CONDITION OF PIPE INLETS/OUTLETS	1	2	3	4

PRESENCE OF SOLIDS OR BUILDUP: No

PRESENCE OF INFILTRATION/INFLOW: No

DIAMETER OF MANHOLE: 42 inches

MANHOLE CONSTRUCTION TYPE: CMP w/ concrete base

SEWER PIPING MATERIALS: HDPE (West) /PVC

DEPTH TO BOTTOM: 10 feet

MANHOLE CONDITION NOTES:

Metal cover with grade ring.

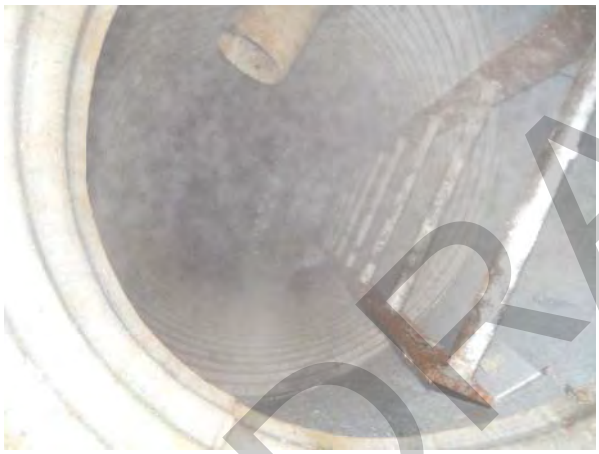
Metal cover is a little slanted/not level.

Has insulated plug.

Inlet PVC pipe might be service from school.

Opening MH14A.

MH14A view from above with PVC inlet in view.



MH14A view from above.

MH14A view east.

MH14A view west, high PVC service.

MH14A view west.

SEWER MANHOLE FIELD INSPECTION FORM
NONDALTON, ALASKA

INSPECTION DATE:	1/5/2020	INSPECTION TIME:	10:20am
WEATHER:	-17°F	INSPECTED BY:	CRW SH/MH
MANHOLE NUMBER:	14B	FIRST PHOTO NUMBER:	

APPROXIMATE LOCATION: See Figure 2.

CONDITION	POOR	←		→	GOOD
CONDITION OF LID	1		2.5	3	4
CONDITION OF BASE	1		2	3	4
CONDITION OF BARREL	1		2	3	4
CONDITION OF LADDER	1		2	3	4
CONDITION OF PIPE INLETS/OUTLETS	1		2	3	4

PRESENCE OF SOLIDS OR BUILDUP: No

PRESENCE OF INFILTRATION/INFLOW: No

DIAMETER OF MANHOLE: 42 inches

MANHOLE CONSTRUCTION TYPE: CMP

SEWER PIPING MATERIALS: HDPE

DEPTH TO BOTTOM: 6 feet

MANHOLE CONDITION NOTES:
Metal cover with grade ring.

NO insulated plug.

In base seems to be few inch grade change between inlet and outlet.

Opening MH14B.

MH14B view from above with lid.

MH14B view east.

MH14B ladder.

MH14B view west.

SEWER MANHOLE FIELD INSPECTION FORM
NONDALTON, ALASKA

INSPECTION DATE: 1/5/2020 INSPECTION TIME: 10:20am

WEATHER: -17°F INSPECTED BY: CRW SH/MH

MANHOLE NUMBER: 14C FIRST PHOTO NUMBER:

APPROXIMATE LOCATION: See Figure 2.

CONDITION	POOR			GOOD
CONDITION OF LID	1	2.5	3	4
CONDITION OF BASE	1	2	3	4
CONDITION OF BARREL	1	2	3	4
CONDITION OF LADDER	1	2	3	4
CONDITION OF PIPE INLETS/OUTLETS	1	2	3	4

PRESENCE OF SOLIDS OR BUILDUP: No

PRESENCE OF INFILTRATION/INFLOW: No

DIAMETER OF MANHOLE: 42 inches

MANHOLE CONSTRUCTION TYPE: CMP

SEWER PIPING MATERIALS: HDPE

DEPTH TO BOTTOM: 10 feet

MANHOLE CONDITION NOTES:

Metal cover with grade ring.

With insulated plug.

In base seems to be few inch grade change between inlet and outlet.

 Opening MH14C.	 MH14C with lid and insulation plug.
 MH14C view from above.	 MH14C view east.
 MH14C view south.	 MH14C view of barrel.

SEWER MANHOLE FIELD INSPECTION FORM
NONDALTON, ALASKA

INSPECTION DATE:	1/5/2020	INSPECTION TIME:	9:56am
WEATHER:	-17°F	INSPECTED BY:	CRW SH/MH
MANHOLE NUMBER:	14D	FIRST PHOTO NUMBER:	

APPROXIMATE LOCATION: See Figure 2.

CONDITION	POOR	←			GOOD
CONDITION OF LID	1		2.5	3	4
CONDITION OF BASE	1		2	3	4
CONDITION OF BARREL	1		2	3	4
CONDITION OF LADDER	1		2	3	4
CONDITION OF PIPE INLETS/OUTLETS	1		2	3	4

PRESENCE OF SOLIDS OR BUILDUP: No

PRESENCE OF INFILTRATION/INFLOW: No

DIAMETER OF MANHOLE: 42 inches

MANHOLE CONSTRUCTION TYPE: CMP

SEWER PIPING MATERIALS: HDPE

DEPTH TO BOTTOM: 9.5 feet

MANHOLE CONDITION NOTES:
Metal cover.

Has insulated plug.

Lid is crooked and at ground level.

Barrel has slight bulging.

May have put too much concrete in bottom.

Barrel axis does not appear to be plumb.
Steamy inside—difficult to take clear pictures.

Opening MH14D.

MH14D view from above.

MH14D view north.

MH14D south.

SEWER MANHOLE FIELD INSPECTION FORM
NONDALTON, ALASKA

INSPECTION DATE: 1/5/2020 INSPECTION TIME: 9:48am

WEATHER: -17°F INSPECTED BY: CRW SH/MH

MANHOLE NUMBER: 14E FIRST PHOTO NUMBER:

APPROXIMATE LOCATION: See Figure 2.

CONDITION	POOR			GOOD
CONDITION OF LID	1	2.5	3	4
CONDITION OF BASE	1	2	3	4
CONDITION OF BARREL	1	2	3	4
CONDITION OF LADDER(applicable)	1	2	3	4
CONDITION OF PIPE INLETS/OUTLETS	1	2	3	4

PRESENCE OF SOLIDS OR BUILDUP: No

PRESENCE OF INFILTRATION/INFLOW: No

DIAMETER OF MANHOLE: 42 inches

MANHOLE CONSTRUCTION TYPE: CMP

SEWER PIPING MATERIALS: HDPE

DEPTH TO BOTTOM: 6.8 feet

MANHOLE CONDITION NOTES:
Metal cover with grade ring.

With insulated plug.

MH14E from road.

Opening MH14E.

MH14E view from above.

MH14E ladder.

MH14E view north.

MH14E view south.

SEWER MANHOLE FIELD INSPECTION FORM
NONDALTON, ALASKA

INSPECTION DATE: 1/5/2020 INSPECTION TIME: 9:37am

WEATHER: -17°F INSPECTED BY: CRW SH/MH

MANHOLE NUMBER: 14F FIRST PHOTO NUMBER:

APPROXIMATE LOCATION: See Figure 2.

CONDITION	POOR	←	→	GOOD
CONDITION OF LID	1	2.5	3	4
CONDITION OF BASE	1	2	3	4
CONDITION OF BARREL	1	2	3	4
CONDITION OF LADDER	1	2	3	4
CONDITION OF PIPE INLETS/OUTLETS	1	2	3	4

PRESENCE OF SOLIDS OR BUILDUP: No

PRESENCE OF INFILTRATION/INFLOW: No

DIAMETER OF MANHOLE: 42 inches

MANHOLE CONSTRUCTION TYPE: CMP

SEWER PIPING MATERIALS: HDPE

DEPTH TO BOTTOM: 8 feet

MANHOLE CONDITION NOTES:
Metal cover.

With insulated plug.

MH14F from road.

Opening MH14F and removing insulation plug.

MH14F view from above.

MH14F view north.

MH14F view south.

SEWER MANHOLE FIELD INSPECTION FORM
NONDALTON, ALASKA

INSPECTION DATE: 1/5/2020 INSPECTION TIME: 10:55am

WEATHER: -17°F INSPECTED BY: CRW SH/MH

MANHOLE NUMBER: 15 FIRST PHOTO NUMBER:

APPROXIMATE LOCATION: See Figure 2.

CONDITION	POOR ←			→ GOOD
CONDITION OF LID	1	2.5	3	4
CONDITION OF BASE	1	2	3	4
CONDITION OF BARREL	1	2	3	4
CONDITION OF LADDER	1	2	3	4
CONDITION OF PIPE INLETS/OUTLETS	1	2	3	4

PRESENCE OF SOLIDS OR BUILDUP

PRESENCE OF INFILTRATION/INFLOW

DIAMETER OF MANHOLE:

MANHOLE CONSTRUCTION TYPE:

SEWER PIPING MATERIALS:

DEPTH TO BOTTOM:

MANHOLE CONDITION NOTES:

Could not locate this manhole. Yard had many sheds and raised garden beds. Attempted to use metal detector to find. However, the yard had metal tanks and other metal debris. Hence, we were not able to use the metal detector to locate.

 Looking for MH15 in yard.	 Looking for MH15 in yard.

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www.crweng.com

Concept Design Memorandum

TO: Alaska Peninsula Corporation

SUBJECT: Nondalton Lift Station Improvements

DATE: 1/23/2020

BY: Steven Hebnes, PE, Civil Engineer

CRW Engineering, LLC (CRW) is providing subcontract services currently under contract with the Alaska Peninsula Corporation (APC) to assess various sanitation needs in the community of Nondalton as a component of the mitigation planning for the Pebble Project. For the evaluation effort, CRW performed a site assessment of the community wastewater system, held discussions with community members, reviewed record documents provided by the State of Alaska Remote Maintenance Worker (RMW) program for specific past projects, and performed sewer manhole assessments. Nondalton is a community served by Alaska Native Tribal Health Consortium (ANTHC), which was planning to evaluate the community sewer system for Indian Health Service (IHS) funding through its Sanitation Deficiency System (SDS) program.

Existing Conditions

About 90 percent of Nondalton's population is served by a community sewer system, and the remaining population utilizes on-site wastewater disposal systems. The sewer system is a gravity collection system comprised of over 30 manholes and which drains into a central lift station. From the lift station, wastewater is discharged through a force main into a percolating treatment lagoon. The lift station was constructed in 1984 for a design population of 246 people and 12,300 GPD average flow. The lift station is substantially aged and suffering from significant deterioration and equipment failure. On multiple occasions during our two community visits, the existing lift station pumps were found to not be operating when the wet well was filled with wastewater. This condition has required the operators to frequently reset the pump controls. The cause of the pump failures has yet not been determined, but may be a result of a deteriorated electrical system, pump hydraulic deficiencies, flow constrictions or other reasons.

During the sewage manhole assessments it was very apparent that when the lift station pumps were not operational, wastewater backs up in the sewage collection system. This condition has a relatively high potential for wastewater overtopping manholes or backing up into homes. The existing lift station alarm system is also no longer operational, so problems with the lift station are often realized only when residents notify the operators of strong sewer odors. During the

manhole inspection, we witnessed Manhole 6A filling to within 8 inches below the top of the manhole. If the lift station pumps had not started at the time, the overtopping of Manhole 6A would've been likely. Manhole 6A is the first upstream manhole from the lift station, and is located 110 feet up hill of Six Mile Lake and 190 feet from community well #1 per the Record Drawings. The elevation of Six Mile Lake varies significantly, based on the 2006 Google Earth image where the lift station was approximately 150 feet from Six Mile Lake but in the 2019 Google Earth image the lift station was approximately 75 feet from Six Mile Lake. During the manhole assessment it was observed that, due to relatively flat pipe slopes, sewer back-ups are experienced in Manholes 6 through 14. Manholes 1 through 15 are located along Main Street, and are all located about 150 feet or less from Six Mile Lake per the Record Drawings.

Potential Hazards

Failure to replace the community sewage lift station will continue to reduce the community's ability to treat and dispose of wastewater. When the lift station fails to convey wastewater, sewer system back-ups occur, which increases the potential for overflows at the lower manholes. The lowest point of the system appears to be at Manhole 6A. Overflows at Manhole 6A have a potential to flow into Six Mile Lake, in addition to exposing the community and local environment to contamination. All the community manholes along Main Street are accessible to the public and could result in human exposure to contaminated water in these areas.

Recommended Improvement

The recommended improvement for the community of Nondalton is to replace the existing lift station with a new facility that conforms to the ANTHC standard lift station details and standard design criteria.

Concept Design Requirements

- Lift Station Design Criteria[1]:
    - Sewage Flow Requirements - 12,300 GPD[2]
        - The 1984 design population was 246 people.

[1] Alaska Native Health Consortium, Environmental Health and Engineering; *Technical Directive 18-3 – Standard Design Criteria for Sanitation Facilities; July 11, 2018*.
[2] US Department of Health and Human Services, Public Health Service, Indian Health Service, *Construction Plans Sanitation Facilities, Nondalton, Alaska, Public Law 86-121, Project Number AN-82-275C; Wastewater Feasibility Study, June 6, 1984*.

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- Based on census information taken between 1940 and 2018, the population has varied significantly, and is currently at a low level.
- Keeping the design population of 246 people would represent a 1.05% growth rate since 1980 and is recommended for future design considerations.

  - Community lift station must feature a duplex pump system, with each pump capable of handling the maximum flows expected with one pump out of service.
  - Pump intake size must pass 3-inch diameter solids.
  - Flow Velocities:
    - Vertical Pipe -5 fps minimum.
    - Horizontal Pipe - 3.5 fps minimum.
  - Maximum pump starts: 10 per hour.
  - Maximum wet well detention time: 20 minutes. Small systems may allow for increased detention times.
  - Lift station wet wells are considered confined spaces and the surrounding working space is a classified electrical safety area. These spaces are hazardous environments. Designs must therefore minimize the operator's need to enter these hazardous areas and in a lift station facility should include two separated rooms: a control room and a wet well room.

- Lift Station setbacks requirements[3] [4]:
  - 100 feet from mean annual high water level of a lake.
  - 200 feet from Community Well.
- Additional inflow and infiltration base flow consideration: 10,000 GPD.
  - The existing collection system currently experiences significant inflow and infiltration due to deteriorated manholes. The lift station design should anticipate the need to convey additional flow if it is constructed prior to the repair or replacement of the manholes.
  - Annual precipitation is comprised of 23.1 inches of rain in the summer and 80.9 inches of snow in the winter. A high daily rain/snow melt has been assumed at 1 inch/day, with a runoff coefficient of 0.3, over a basin area of 90 acres, with total

[3] State of Alaska, Department of Environmental Conservation; *18 AAC 72, Wastewater Disposal; November 7, 2017*.
[4] State of Alaska, Department of Environmental Conservation; 18 AAC 80, Drinking Water; May 3, 2019.

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infiltration area percentage of 1.3% (fifteen 3-foot diameter manhole openings over a 3,200-foot width of drainage front).

The proposed action would result in the construction of a sewage lift station that would prevent system back-ups and would facilitate the proper disposal and treatment of the community's wastewater, which would protect the environment and public health from the hazards identified.

Conceptual Construction Drawings

Sewage Lift Station Photos – January 2020

FILE NAME: J:\JobsData\48601.00 APC Newhalen And Kokhanok W&S\00 CADD\02 Figures\06 Nondalton\NONDALTON Vicinity Map.dwg

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

FINAL

NONDALTON, ALASKA

VICINITY MAP

Project No:	48601.00
Drawn By:	MCH
Scale:	NTS
Date:	JAN 2020
Figure:	1

MH–14C
CITY OFFICE
MH–14B
MH–14A
MH–14F
MH–14E
MH–14D
SCHOOL
WASTEWATER FLOW TO LAGOON
MH–15
MH–14
MH–13
MH–12
MH–11
MH–10
MH–9
MH–8
MH–7
LIFT STATION
MH–6
MH–6A
MH–5
COMMUNITY WELLS
MH–4
MH–3
MH–3A
CLINIC
MH–2
MH–1
MH–7D
MH–7E
SEE FIGURE 3
MH–7B
MH–7C
MH–7A
WTP
MH–3B
MH–3C
MH–3D
AIRPORT
SIXMILE LAKE

LEGEND
- MH TO BE REPLACED
- MH TO REMAIN IN PLACE
- WELL

250' 0 250' 500'

PROJECT: 48601.00
STATUS: FINAL

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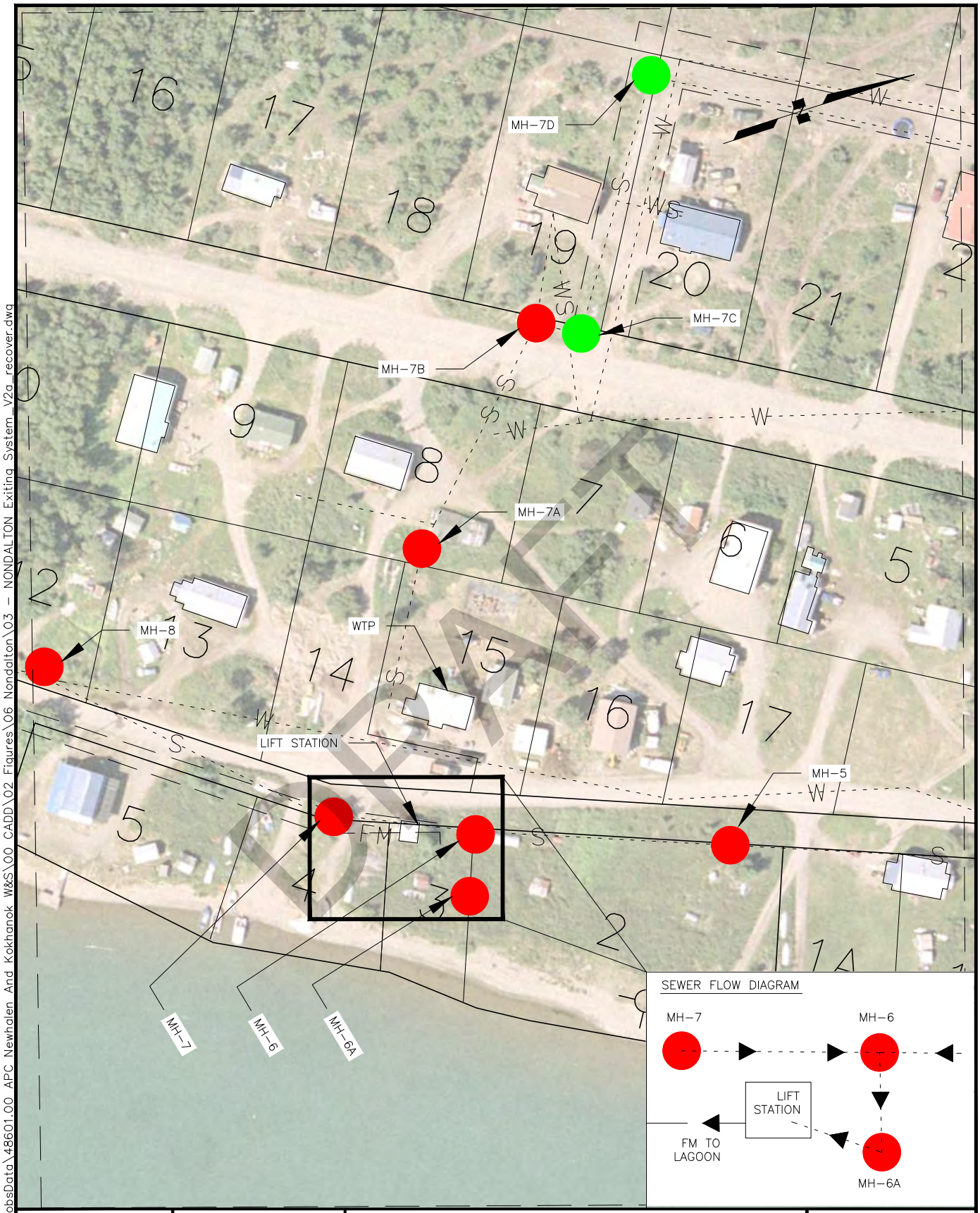
NONDALTON, ALASKA
SEWER SYSTEM IMPROVEMENT PLAN
COMMUNITY MAP

DATE: JAN 2020
SCALE: GRAPHIC
FIGURE: 2

File: J:\JobsData\48601.00 APC Newhalen And Kokhanok W&S\00 CADD\02 Figures\06 Nondalton\03 – NONDALTON Existing System_V2a_recover.dwg



FILE NAME: J:\JobsData\48601.00 APC Newhalen And Kokhanok W&S\00 CADD\02 Figures\06 Nondalton\03 - NONDALTON Exiting System_V2a_recover.dwg

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FINAL

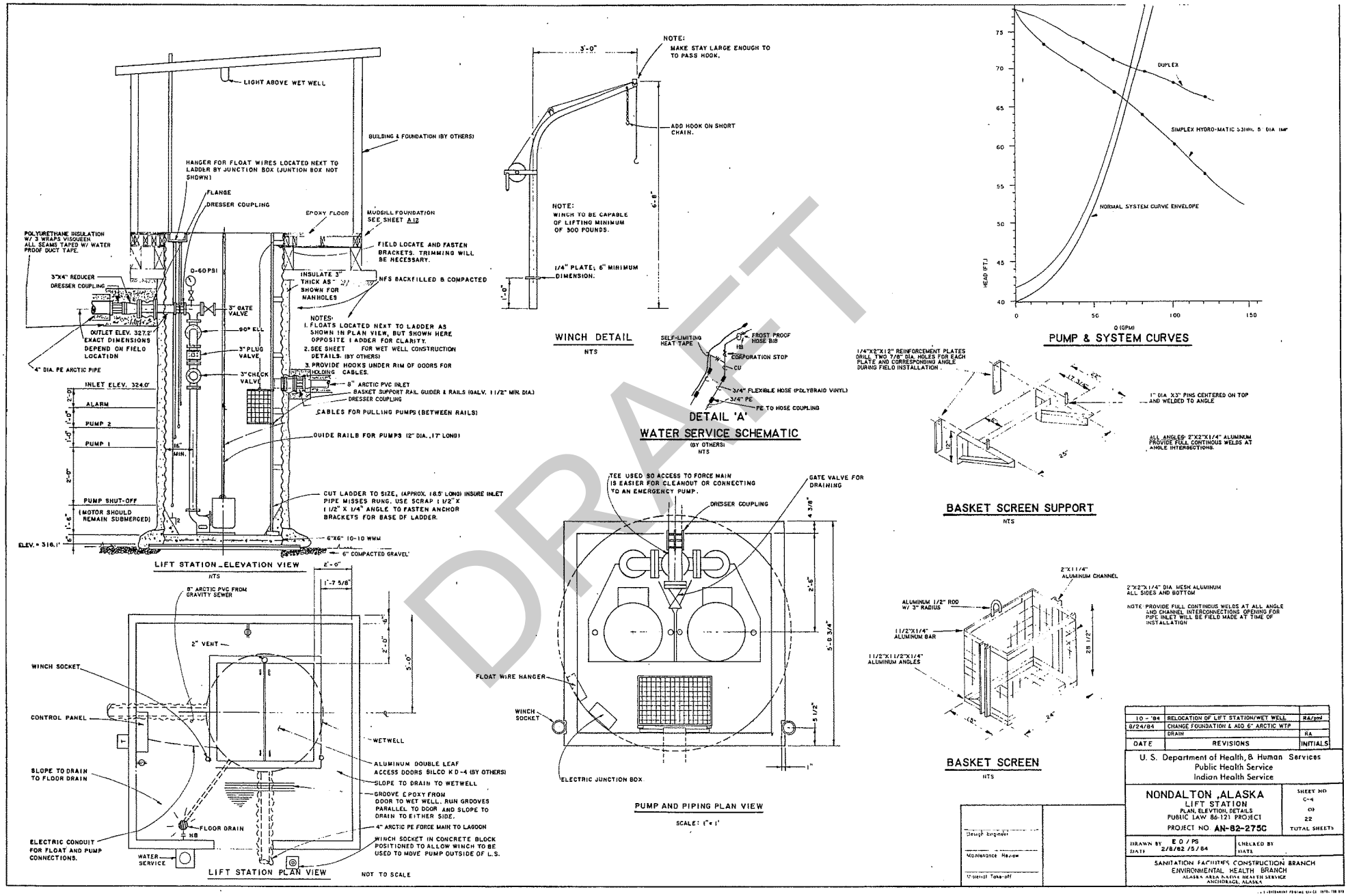
0 50 100

NONDALTON, ALASKA

LIFT STATION VICINITY

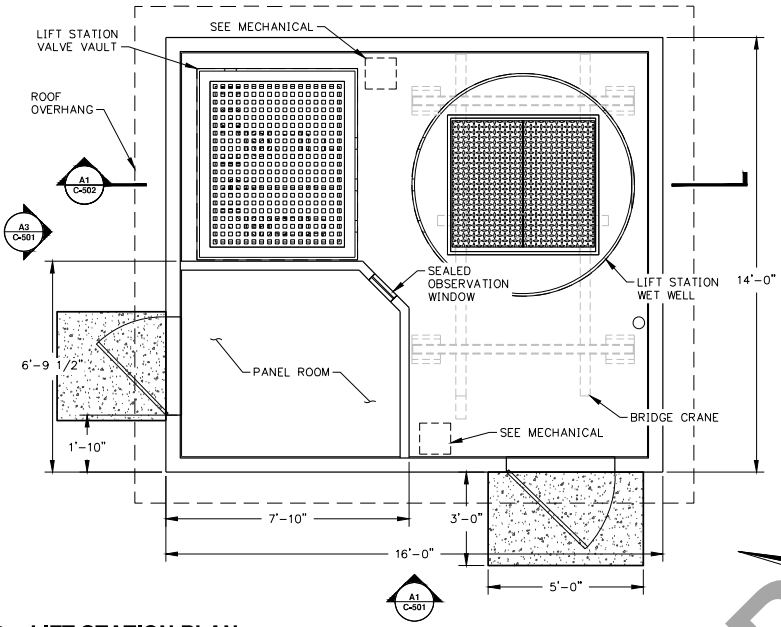
SEWER SYSTEM IMPROVEMENT PLAN

Project No:	48601.00
Drawn By:	MCH
Scale:	GRAPHIC
Date:	01/19/2020
Figure:	3



EXISTING LIFT STATION RECORD DRAWINGS

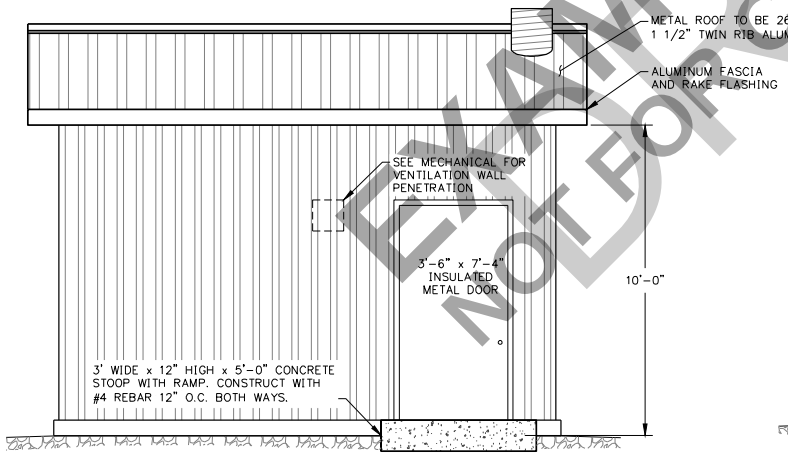
FIG 4



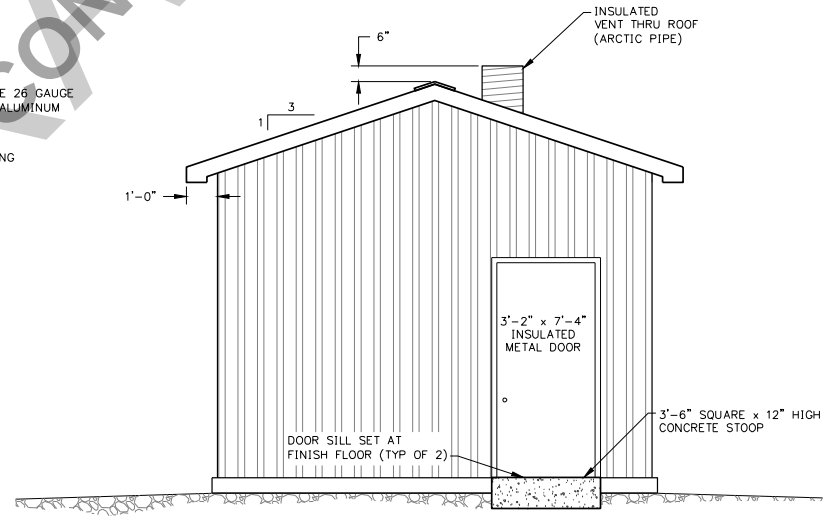
C1 **LIFT STATION PLAN**
1/2" = 1'-0"

NOTES:

1. BUILDING TO BE PRE-FABRICATED, INSULATED STEEL BUILDING 6" WALLS. THE MANUFACTURER IS TO PROVIDE SHOP DRAWINGS.
2. SEE ELECTRICAL FOR POWER, LIGHTING, AND CONTROLS.
3. SEE MECHANICAL FOR VENTILATION.
4. FOR INTERIOR LOCATIONS WHERE ELECTRICAL AND MECHANICAL EQUIPMENT IS TO BE WALL MOUNTED, PROVIDE 5/8" PLYWOOD BACKING FOR EQUIPMENT MOUNTING SUPPORT.



A1 **LIFT STATION FRONT ELEVATION**
1/2" = 1'-0"



A3 **LIFT STATION SIDE ELEVATION**
1/2" = 1'-0"

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BAR IS ONE INCH ON ORIGINAL DRAWING, IF NOT ADJUST SCALES ACCORDINGLY

NEWHALEN, AK
WASTE WATER UPGRADES
ISSUED FOR CONSTRUCTION

MRK	DATE	DESCRIPTION	INIT

PLAN SET:	NHL-14-001
PROJ MGR:	KS
PROJ ENG:	SAE
DRUMS ENG:	PC
DRAWN BY:	SSM

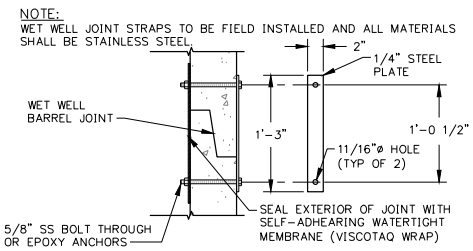
SHEET TITLE
BUILDING PLAN AND ELEVATIONS - PREFABRICATED

C-501
SHEET 5 OF 14

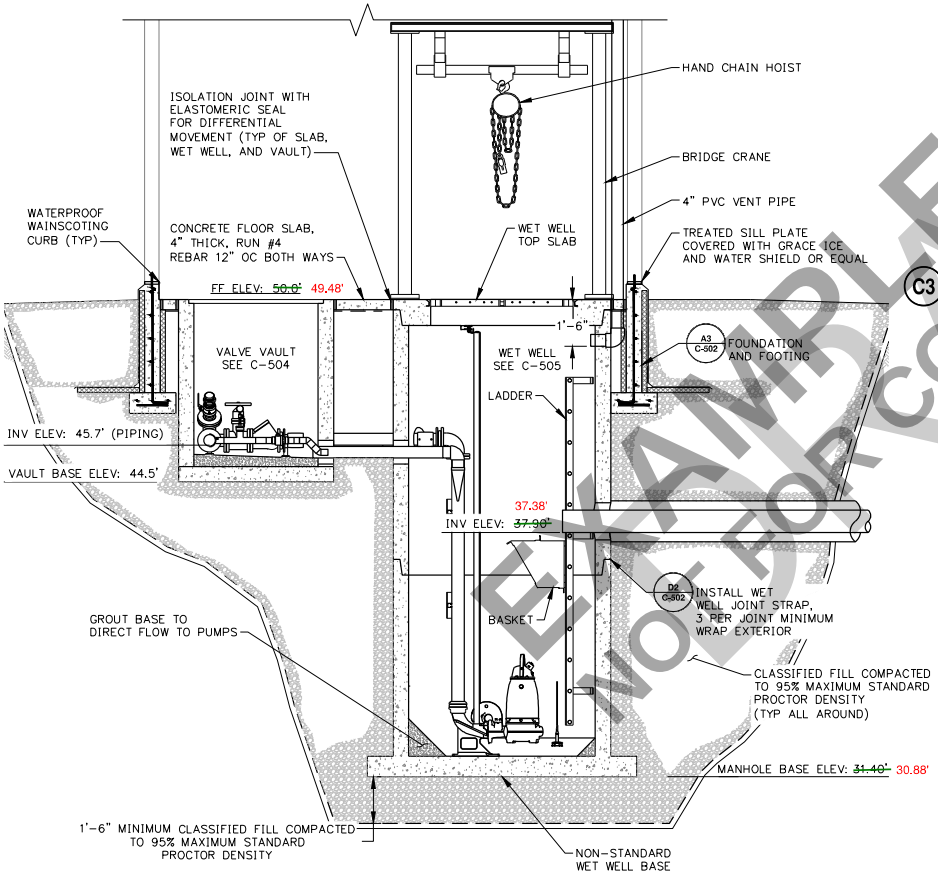
USER: SSMOTSINGER PRODUCT: Autodesk AutoCAD Civil 3D 2016 - English FILE: P:\Newhalen\NHL_Design\NHL-14-001\Civil\NHL-C-FPBLDG.dwg LAYOUT: FPBLDG_1 PRINTED: 4/21/2016 2:19:44 PM
15 OF 51 TOTAL SHEETS

ANTHC STANDARD LIFT STATION

FIG 5

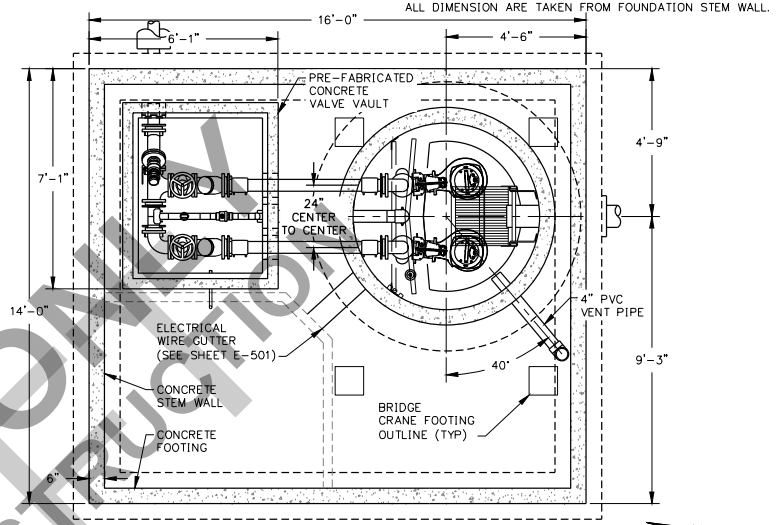


D2 **WET WELL JOINT STRAP**
1 1/2" = 1'-0"

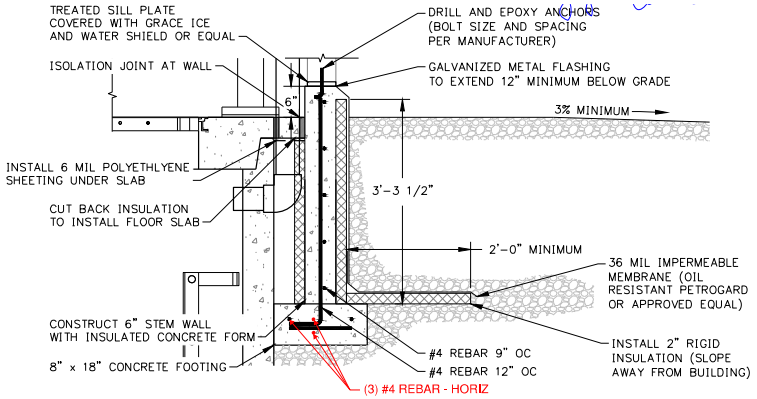


A1 **LIFT STATION FOUNDATION ELEVATION**
1/2" = 1'-0"

NOTE:
ALL DIMENSION ARE TAKEN FROM FOUNDATION STEM WALL.



C3 **LIFT STATION VAULT AND WELL PLAN**
1/2" = 1'-0"



A3 **FOUNDATION CONNECTION AND FOOTING INSULATION**
1" = 1'-0"

Division of Environmental Health and Engineering
4500 Diplomacy Drive
Anchorage, Alaska 99508
(907) 729-3600

BAR IS ONE INCH ON ORIGINAL DRAWING, IF NOT ADJUST SCALES ACCORDINGLY

NEWHALEN, AK
WASTE WATER UPGRADES
ISSUED FOR CONSTRUCTION

MRK	DATE	DESCRIPTION	INIT

PLAN SET:	NHL-14-001
PROJ MGR:	KS
PROJ ENG:	SAE
DRUMS ENG:	PC
DRAWN BY:	SSM

SHEET TITLE
WET WELL, VAULT, AND FOUNDATION PLAN AND ELEVATION

C-502
SHEET 6 OF 14

USER: SSMOTSINGER PRODUCT: Autodesk AutoCAD Civil 3D 2016 – English FILE: P:\Newhalen\NHL_Design\NHL-14-001\Civil\NHL-C-FPLSTA.dwg LAYOUT: FPLSTA_1 PRINTED: 4/21/2016 2:19:56 PM
16 OF 51 TOTAL SHEETS

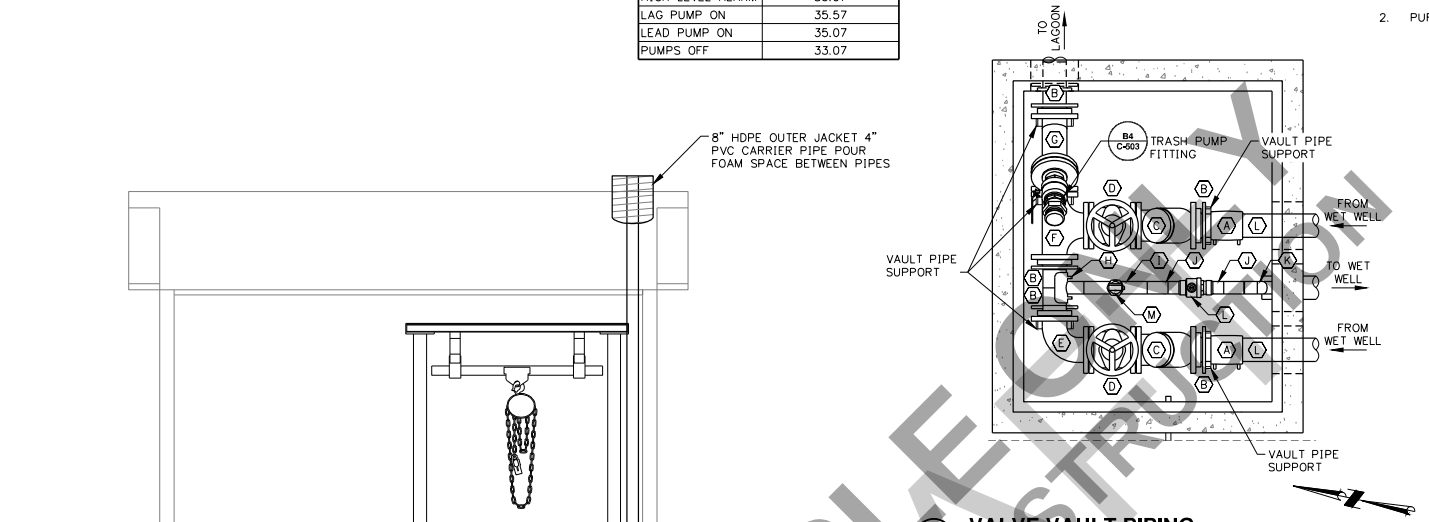
ANTHC STANDARD LIFT STATION **FIG 6**

PUMP CONTROL DATA	
CONTROL	ELEVATION
HIGH LEVEL ALARM	36.07
LAG PUMP ON	35.57
LEAD PUMP ON	35.07
PUMPS OFF	33.07

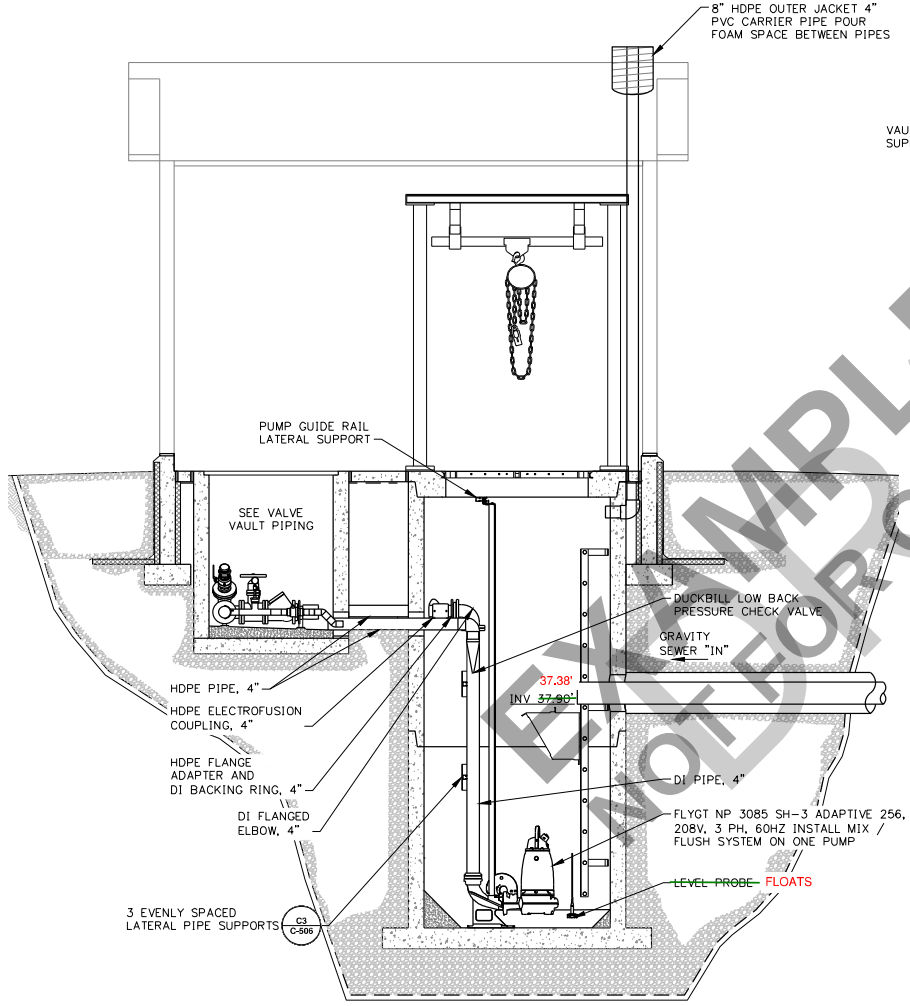
NOTES:

1. FLYGHT TOP FIBERGLASS SUMP INSERT AN OPTIONAL ALTERNATIVE.
2. PURCHASE 3 EACH PUMPS, ONE TO SERVE AS A BACKUP.

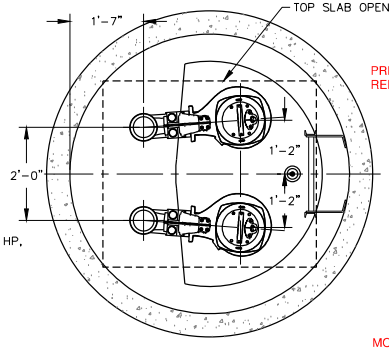
PARTS LIST	
TAG	DESCRIPTION
A	HDPE ELECTROFUSION COUPLING, 4"
B	HDPE FLANGE ADAPTER AND DI BACKING RING, 4"
C	~~BALL CHECK VALVE, 4" (FLYGT OR APPROVED EQUAL)~~ 4" SWING CHECK VALVE W/ WEI
D	RESILIENT SEATED GATE VALVE, 4" (M&H OR APPROVED EQUAL)
E	DI FLANGED ELBOW, 4"
F	DI FLANGED TEE, 4"
G	DI FLANGED WYE WITH TAPPED BLIND FLANGE, 4" (SEE TRASH PUMP FITTING)
H	ELECTROFUSION SERVICE SADDLE, 4" x 2" TAP BRANCH (ROMAC 202 OR APPROVED EQUAL)
I	HDPE POLYCAM, 2" 914
J	HDPE POLYCAM 914
K	HDPE 45° ELBOW, 2"
L	2" FB500-7-NL BALLCORP FORD
M	PRESSURE GAUGE ASSEMBLY, SEE DETAIL A4, THIS SHEET



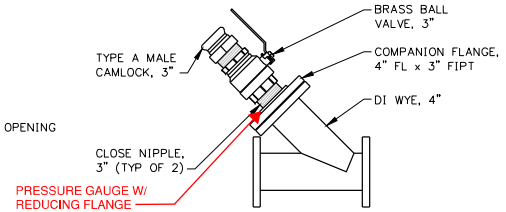
C3 VALVE VAULT PIPING 1" = 1'-0"



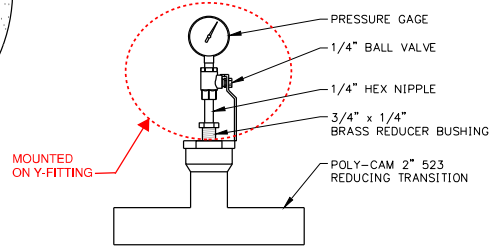
A1 LIFT STATION PIPING ELEVATION 1/2" = 1'-0"



A3 LIFT STATION PUMP INSTALLATION 3/4" = 1'-0"



B4 TRASH PUMP FITTING 1 1/2" = 1'-0" (PROVIDED AS SPARE PART)



A4 PRESSURE GAUGE 1" = 1'

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4500 Diplomacy Drive
Anchorage, Alaska 99508
(907) 729-3600

0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING, IF NOT ADJUST SCALES ACCORDINGLY

NEWHALEN, AK
WASTE WATER UPGRADES
ISSUED FOR CONSTRUCTION

MRK	DATE	DESCRIPTION	INIT

PLAN SET:	NHL-14-001
PROJ MGR:	KS
PROJ ENG:	SAE
DRUMS ENG:	PC
DRAWN BY:	SSM

SHEET TITLE
PIPING PLAN AND ELEVATION

C-503
SHEET 7 OF 14

USER: SSMOTSINGER PRODUCT: Autodesk AutoCAD Civil 3D 2016 - English FILE: P:\Newhalen\NHL_Design\NHL-14-001\Civil\NHL-C-FPLSTA.dwg LAYOUT: FPLSTA_2 PRINTED: 4/21/2016 2:20:01 PM
17 OF 51 TOTAL SHEETS

ANTHC STANDARD LIFT STATION

FIG 7

Nondalton Lift Station
Site Investigation Photos

Photo	Description
	Lift Station.
	Interior of Lift Station.

Nondalton Lift Station
Site Investigation Photos

Photo	Description
	Lift Station wetwell.
	Lift Station control panels.

Nondalton Lift Station
Site Investigation Photos

Photo	Description
	MH-6 with wastewater in bottom on 1/4/2020 at 3:00pm.
	MH-6A nearly full on 1/5/2020 at 2:00pm.

Attachment 4 – Permittee-Responsible Mitigation Plan for the Removal of Pacific Salmon Passage Barriers

DRAFT REPORT

Pebble Project
Permittee-Responsible Mitigation Plan for the Removal of Pacific Salmon Passage Barriers

January 2020

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Figure 5. PRM Culverts Beluga-Tyonek Area
Figure 6. PRM Culverts King Salmon Area
Figure 7. PRM Culverts Susitna River Area
Figure 8. PRM Culverts Mat-Su Area

ACRONYMS AND ABBREVIATIONS

ADF&G	Alaska Department of Fish and Game
AWC	Anadromous Waters Catalog
CFR	Code of Federal Regulations
CMP	Compensatory Mitigation Plan
DA	Department of the Army
FPID	Fish Passage Inventory Database
HUC	Hydrologic Unit Code
PLP	Pebble Limited Partnership
PRM	Permittee-responsible Mitigation
ROW	Right-of-way
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
WOUS	Waters of the U.S., including wetlands

1. Objectives

The Pebble Limited Partnership (PLP) is proposing this permittee-responsible mitigation (PRM) plan to restore Pacific salmon habitat as compensatory mitigation for the unavoidable losses to aquatics resources that would result from the Pebble Project's discharges to waters of the U.S., including wetlands (WOUS). The goal of this PRM plan is to rehabilitate 8.5 miles of Pacific salmon habitat by removing or replacing culverts that limit the passage of juvenile and/or adult Pacific salmon.

Properly designed culverts have little or no adverse effect on fish, aquatic organisms, and other riverine animals, but when culverts do not mimic the characteristics of the stream, including bankfull width, slope, and depth, they can impede both upstream and downstream fish movement (Eisenman and O'Doherty 2004) and degrade aquatic habitats. Undersized culverts cause channel constriction at the culvert inlet, in turn causing upstream ponding, increased bank erosion and suspended sediment loads, and reduced water quality. Channel constriction increases flow velocity within the culvert structure, a potential barrier to fish passage. High flow velocities result in high energy at the culvert outlet that can erode or "scour" the streambed downstream. Downstream scour further contributes to water quality degradation, as well as dewatering of wetlands and, in some cases, results in an elevation drop at the culvert outlet that compounds the problem of fish passage. The replacement of an undersized culvert with a properly sized and well-designed structure can restore stream connectivity and improve the environmental quality of riparian habitats (O'Hanley 2011).

The removal of fish passage barriers meets the goals of PLP's Compensatory Mitigation Plan. The proposed Pebble Project wetland impacts will occur in remote watersheds with large expanses of relatively undisturbed wetlands, and the remaining wetlands are at low risk of being cumulatively degraded. The impacted wetlands in the affected watersheds are not rare or unique; however, construction would place fill in Pacific salmon streams and adjacent wetlands, which are an important resource to the economies and subsistence activities of local communities. PLP's proposed discharge of fill material will result in the removal of 8.5 miles of Pacific salmon habitat within the headwater streams of the Koktuli River, a tributary to the Nushagak River. The city of Dillingham is located downstream of the project site at the mouth of the Nushagak River. Approximately 6 miles of Pacific salmon habitat in streams that are tributaries to the Nushagak River near Dillingham, have already been degraded by undersized culverts associated with local infrastructure. Consistent with the watershed approach outlined in 33 CFR Part 332.3(c) and 40 CFR Part 230.93(c), PLP's watershed analysis concludes that compensatory mitigation opportunities that benefit water quality and fish habitat, would best meet the watershed needs. This PRM plan targets those needs by rehabilitating 8.5 miles of Pacific salmon stream habitat through the replacement of undersized culverts. This quantification of restoration includes only upstream benefits of replaced culverts, as benefits downstream would be difficult to quantify.

PLP is proposing to implement this PRM through ad hoc payments to private individuals, and non-governmental or governmental organizations (partners) that would perform the culvert replacement activity that would provide the compensatory mitigation for PLP. PLP would retain responsibility for ensuring that required compensatory mitigation activities are completed and successful, and any long-term management of the compensatory mitigation project as described in Section 10 of this plan. The selection of specific culvert replacement projects would occur after receipt of the approved Department of the Army (DA) Permit for the Pebble Project, in coordination with the Alaska Department of Fish and Game (ADF&G), interested land or Right-of-Way (ROW) owners, and partners.

2. Site Selection

The ADF&G maintains the Fish Passage Inventory Database (FPID) (ADF&G 2001) that stores the results of over 2,500 stream crossings assessed for fish passage by ADF&G since 2001. This database includes detailed physical data for each culvert evaluated, and a determination regarding the culverts adequacy to allow passage of juvenile fish. The database is updated annually to reflect the results of ongoing mitigation efforts by the State of Alaska and other entities. PLP's site selection process will consider all current culvert sites identified by ADF&G as limiting fish passage. Sites will then be prioritized based on their location, restoration potential, and practicability.

- Location. Sites closer to the proposed impacted watersheds will be given higher priority over more distant sites when all other factors are equal. PLP has established five Preference Areas based on proximity to the location of proposed impacts (Dillingham, King Salmon, Beluga-Tyonek, Kenai Peninsula, and Matanuska-Susitna) and organized by hydrologic unit code (HUC) watersheds (a national system of water resource classifications based on geographic area). Table 1 summarizes potential candidates projects for rehabilitation as of March 2019. The FPID includes a total of 710 culverts with a fish passage rating of 'inadequate passage'; 350 as 'unlikely passage'; and 232 that are yet to be determined in preference areas 1 – 5 (Table 1). Exhibit A lists the locations and site information of potential candidate culverts that were reviewed by PLP to assess restoration potential for the Program. Figure 1 provides an overview of potential candidate culverts by preference area and figures 2 – 8 provide a detailed view for each preference area.

Table 1 – Preference area by ADF&G Culvert Fish Passage Rating as of March 2019.

Preference Area	Description	ADF&G Culvert Fish Passage Rating[1]		
		Inadequate Passage	Unlikely Passage	Insufficient Information
1	HUC 10 watersheds that intersect with the Pebble Project wetlands impacts	0	0	0
2	HUC 10 watersheds downstream of the Pebble Project wetlands impacts	2	2	6
3	HUC 8 watersheds that intersect with the Pebble Project wetlands impacts	0	0	0
4	HUC 6 watersheds that intersect with the Pebble Project wetlands impacts	20	15	4
5	HUC 4 watersheds that intersect with the Pebble Project wetlands impacts	688	333	222
	Grand Total	**710**	**350**	**232**

1. Source: Fish Passage Inventory Database (FPID), ADF&G 2019

- Restoration potential. Upstream Pacific salmon rehabilitation habitat will be calculated for each potential fish barrier project site. Projects with the larger potential to rehabilitate Pacific salmon habitat that are practicable will be given priority, when other factors are equal.

- Practicability. Practicability will be evaluated in consideration of engineering feasibility, authorization by land or ROW owners for the construction work, and construction costs.

PLP will evaluate proposals from partners, or PLP's own selections, using the above criteria for location, restoration potential, and practicability. A list of potential culvert replacement projects has been prepared (Exhibit A). However, the final selection of culvert replacement projects would occur after receipt of the

approved DA Permit Application for the Pebble Project, in coordination with interested partners. As an alternative PLP could select culvert replacement projects and perform the culvert replacement activity.

3. Site Protection Instrument

PLP is not proposing site protection for the fish habitats enhanced, other than protections that are already in place through compliance with local, state, and federal regulations, which includes compliance with current ADF&G fish passage design practices.

4. Baseline Information

The following studies will be completed to gather the ecological characteristics of the proposed mitigation sites:

- Hydrology and hydraulics study. This study will describe area drainage patterns and provide culvert design information.

- Stream habitat inventory study. This study will provide baseline information on Pacific salmon habitat upstream of the culvert locations. Data sources will include the Anadromous Waters Catalog (AWC) (ADF&G 2018), field site observations, and detailed stream mapping. Field observations on Pacific salmon presence or absence may be used to update the AWC. In addition to identifying fish passage issues, this study will also include information on additional actions that would benefit the stream (e.g., bank stabilization).

5. Determination of Credits

The replacement of undersized culverts will restore or enhance at least 8.5 miles of streams that contain Pacific salmon habitat. The total linear feet of habitat restoration and enhancement will be calculated by adding the linear feet of Pacific salmon aquatic habitat identified upstream of the culvert as determined through monitoring.

6. Mitigation Work Plan

The mitigation work plan includes the following items:

- Geographic boundaries. Sites will be selected from Preference Areas 1-5 (See section 2).

- Construction methods. Existing culvert structures will be replaced with structures designed to restore the hydrologic functioning of the streams being crossed, and that mimic the natural stream characteristics, including juvenile fish passage, and connectivity of wetlands and riparian areas adjacent to the stream channels to the greatest extent possible. Structure design would conform to the Fish Passage Guidelines (U.S. Fish Wildlife Service 2018) and would be reviewed by ADF&G during the permitting process. Construction activity will require in-water work using heavy equipment such as excavators, and support equipment such as trucks. Typical construction requirements for in-water work include silt curtains or cofferdams and temporary diversion channels or bypass pumping to isolate work areas from the flowing water of a stream or river. Temporary

stream diversions, if required, would provide a sufficient quantity of water and a slope and velocity approximating that of the original stream to provide for both upstream and downstream travel of fish. Disturbed areas in the construction sites will be stabilized and erosion and sediment control measures will be installed to direct stormwater away from fish bearing waterbodies.

- Timing. Culvert replacement construction would be timed to occur prior to or concurrent with Project construction activities. The installation of culverts will be timed to avoid sensitive fish life stages such as spawning and/or migration periods as required by permit conditions.

- Water source(s). Existing flow at each mitigation site is sufficient to support Pacific salmon habitat.

- Methods for establishing the desired plant community. Plant communities will be established consistent with species and methods described in the Alaska Coastal Revegetation & Erosion Control Guide (Wright and Czapla 2011), and the Streambank Revegetation and Protection (Muhlberg, et al. 2005).

- Plans to control invasive plant species. Invasive species control methods for each species will be selected in accordance with an invasive species management plan that will be developed for the project.

- Grading plan. Site-specific grading plans would be developed for each location.

7. Maintenance Plan

PLP will maintain the mitigation sites on an as-needed basis to resolve erosion problems, wood debris removal, vegetation planting, etc. or to correct structural issues that affect juvenile fish passage, if discovered during a site inspection. The frequency of site inspections is addressed in sections 9 and 10.

8. Performance Standards

Performance standards will be met when both of the following conditions are satisfied:

- Final stabilization of the construction site is achieved. This is defined as: "all soil disturbing activities are completed, and the exposed soil has been stabilized with at least a 70 percent vegetative cover with a uniform density, or by equivalent means (e.g., concrete, rip rap, gravel, asphalt), over the entire site to prevent soil failure."

- Site conditions at the culvert are adequate to pass juvenile salmon, as determined using techniques employed by ADF&G (Eisenman and O'Doherty 2004).

9. Monitoring Requirements

The following monitoring will be conducted for each site:

- Site inspections. During construction and until final site stabilization is achieved, each site will be inspected for signs of erosion once every 7 days, or once every 14 days, and after a 0.25-inch storm event, consistent with applicable stormwater management regulations.

- Fish passage assessment. Fish passage will be assessed at each rehabilitated site after final site stabilization is achieved using the same techniques employed by ADF&G (Eisenman and O'Doherty 2004).

  Adaptive management will be implemented if:

  - Changes to stormwater controls are needed to avoid and minimize stormwater runoff to facilitate final site stabilization, or
  - The fish passage assessment results in "inadequate" or "unlikely" fish passage.

- Fish habitat use assessment. After fish passage is determined adequate, aquatic monitoring will be conducted to determine the length of stream habitat used by Pacific salmon. This number will be used to determine the number of miles of stream habitat rehabilitated.

- Monitoring report. PLP will submit a monitoring report to the U.S. Army Corps of Engineers (USACE) by December 31st of each year monitoring occurs. The monitoring report will include all data collected from the year's monitoring events and will be used to compare the PRM site's progress toward meeting the performance standards found in Section 8. Additionally, reports would include a detailed discussion of maintenance and management activities conducted during that year, along with a proposed maintenance schedule for the following year based upon the results of the yearly monitoring. The report should also include discussion of all activities that took place at the PRM sites. At a minimum, monitoring reports should also include the following:

  - Photos taken at each site to document overall conditions.
  - A description of the general condition of the culvert structure, including inlet/outlet protection, and embankment as applicable.
  - Copies of the fish passage assessment for each site.
  - A description of the general condition of the seedlings, including survival and mortality, and if applicable, a discussion of likely causes for mortality.
  - A description of vegetative communities developing at each site.
  - A corrective action plan or explanation to address any Performance Standards that have not been achieved if applicable.

10. Long-term Management Plan

PLP will monitor the PRM sites for five years to demonstrate compliance with the Performance Standards:

- Post Construction Annual Inspection: The sites will be monitored for signs of erosion, culvert and fish passage integrity annually during ice and snow free conditions.

11. Adaptive Management Plan

Selection of culvert replacement projects would occur after receipt of the approved DA Permit Application for the Pebble Project, in coordination with interested partners. PLP will submit a list of project and supporting baseline data to the USACE for review an approval.

If performance standards have not been achieved at a site after the year five post-construction monitoring event, PLP will develop a "Remedial Plan" for the agency(s) which discusses the likely reasons for failing to meet requirements, corrective actions, an assessment of risks, and a schedule for conducting the remedial work. Once approved, the "Remedial Plan" will be implemented according to the approved schedule.

12. Financial Assurances

PLP will establish a performance bond to ensure the PRM site construction is complete and all performance criteria are met. PLP is responsible for:

- All permit acquisition and compliance.
- Project design, set up, management, planning, support, and execution of the PRM plan.
- Site inventory, data collection, and monitoring.
- Reporting to USACE.

The bond will be closed once all PRM objectives and performance standards are met, and a final sign-off on the PRM site has been provided by the USACE.

13. Other Information

Not Applicable.

14. References

ADF&G. 2018. *Anadromous Waters Catalog.* Alaska Department of Fish and Game. Juneau, Alaska. Accessed October 2, 2018. https://www.adfg.alaska.gov/sf/SARR/AWC/index.cfm?ADFG=main.home.

—. 2001. *Fish Passage Invetory Database (FPID) - Inventory & Assessment.* Accessed January 25, 2019. https://adfg.maps.arcgis.com/apps/webappviewer/index.html?id=f5aac9a8e4bb4bf49dc39db33f950bbd.

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Muhlberg, Gay, Nancy Moore, Frances Inoue, Jeanne Water, and Dean Hughes. 2005. *Streambank Revegetation and Protection: A Guide for Alaska. Revised 2015.* Alaska Department of Fish and Game.

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O'Hanley, Jesse. 2011. "Open rivers: Barrier removal planning and the restoration of free-flowing rivers." *Journal of Environmental Management* 92 (12): 3112-3120.

Tyonek Tribal Conservation Distric (TTCD). Unkonwn. "The Tyonek Area Watershed Action Plan."

U.S. Fish Wildlife Service. 2018. "Fish Passage Design Guidelines: U.S. Fish and Wildlife Service Alaska Fish Passage Program."

Washington Trout. 2004. *Evaluation of Fisheries Benefits Arising from the Repair, Replacement and Removal of Culverts for Selected Projects Funded by the National Fish and Wildlife Foundation.* Washington Trout.

Wright, Stoney J., and K. Philip Czapla. 2011. *Alaska Coastal Revegetation & Erosion Control Guide.* State of Alaska Plant Materials Center.

Exhibits

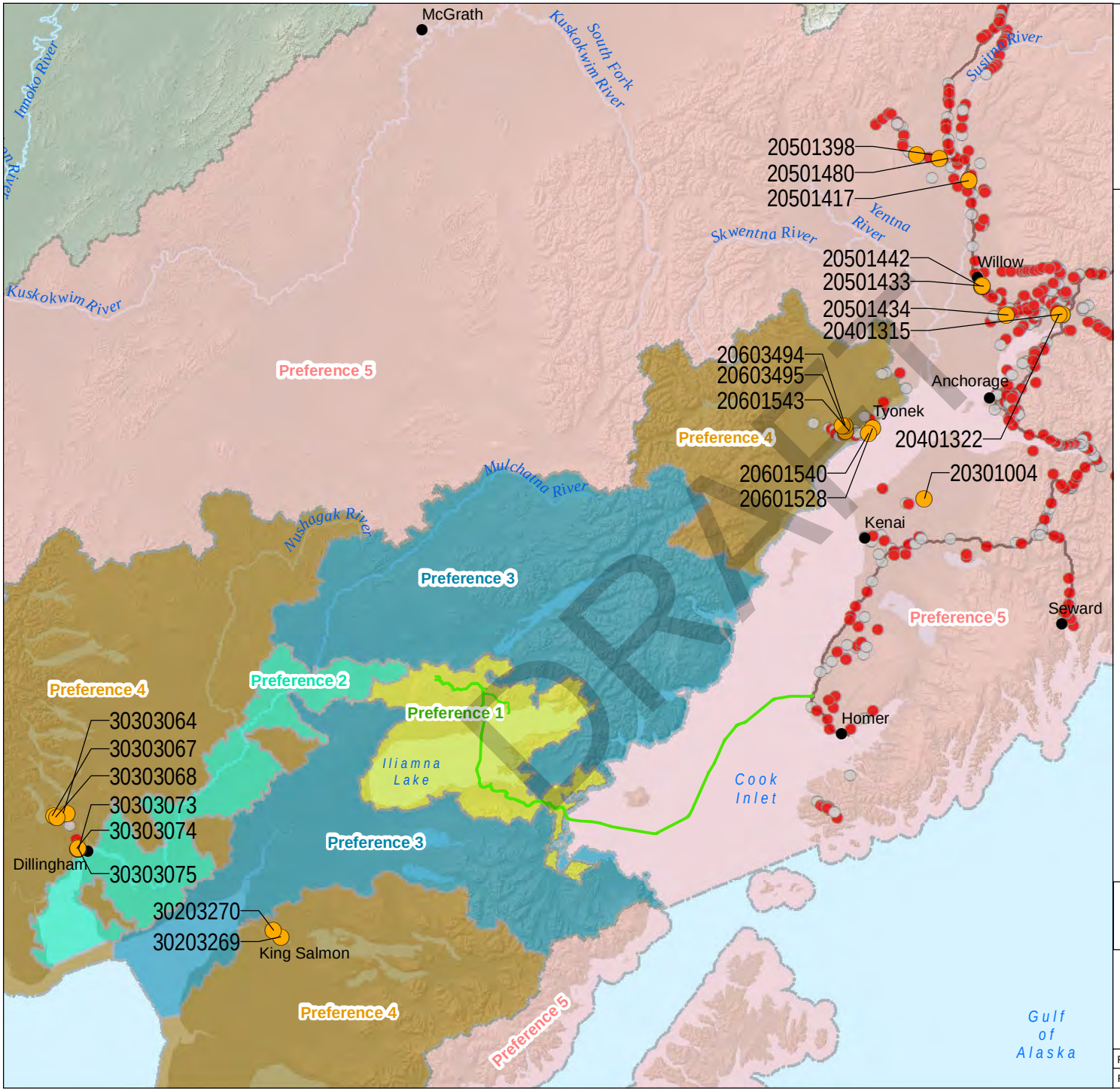
Exhibit A. Potential culvert replacement projects

This list includes a selection of current potential culvert replacement projects. Additional potential projects can be viewed on the ADF&G Fish Passage Inventory Database[1]. The final selection of culvert replacement projects will occur after receipt of the approved DA Permit Application for the Pebble Project, in coordination with interested partners.

Location	River System	Preference Area / Figure	Culverts	Stream Habitat (mi)	Lake Habitat (ac)
Dillingham	Wood River	4 / Figure 3	30303064	2.0	
Dillingham	Snake River	4 / Figure 3	30303067	2.3	
Dillingham	Squaw Creek	4 / Figure 3	30303073 30303074 30303075	5.56	
Dillingham	Otter Creek Trib.	4 / Figure 3	30303068 (DOT&PF[2])	0.67	
King Salmon	Naknek Unknown Trib.1	4 / Figure 6	30203270	0.36	
King Salmon	Eskimo Creek	4 / Figure 6	30203269	1.26	
Beluga-Tyonek	Old Tyonek Creek	4 / Figure 4	20601543 (KPB[3]) 20603494 (MHT[4]) 20603495 (MHT)	1.7	444.2
Beluga-Tyonek	Indian Creek	4 / Figure 5	20601528	1.53	60.1
Beluga-Tyonek	Tyonek Creek	4 / Figure 5	20601540	11.74	
Kenai	Swanson R.	5 / Figure 2	20301004 (USFWS[5])	2.29	1,100.0
Mat-Su	Lily Creek	5 / Figure 8	20501433 20501442	6.17	12.9
Mat-Su	Various Susitna River tribs. (E. Petersville Rd.)	5 / Figure 7	20501398 (DOT&PF) 20501480 (DOT&PF)	4.64	
Mat-Su	Answer Creek	5 / Figure 7	20501417 (DOT&PF)	8.17	
Mat-Su	Lucile Creek	5 / Figure 8	20501434 (DOT&PF or MSB[6])	12.47	
Mat-Su	Various Wasilla Creek Tribs. (Nelson Rd./ Matanuska Old Town Site Rd.)	5 / Figure 8	20401315 (ARR[7]) 20401322 (SOA[8])	3.68	
				64.54	**1,617.2**

Notes:
1. http://www.adfg.alaska.gov/index.cfm?adfg=fishpassage.database
2. DOT&PF – Alaska Department of Transportation and Public Facilities
3. KPB – Kenai Peninsula Borough
4. MHT – Alaska Mental Health Trust
5. USFWS - U.S. Fish and Wildlife Service
6. MSB – Matanuska-Susitna (Mat-Su) Borough
7. ARR – Alaska Railroad
8. SOA – State of Alaska

Figures



THE pebble PARTNERSHIP

- Proposed Pebble Project
- Culverts Reviewed by PLP
- Existing Access

Other Potential Culverts by Rating

- Gray
- Red

Prioritized Mitigation Areas

- Preference 1
- Preference 2
- Preference 3
- Preference 4
- Preference 5

Miles
0 10 20 30 40 50

Scale 1:2,972,586

N

NAD 1983 StatePlane Alaska 5 FIPS 5005 Feet Seward Meridian	Figure: 1

Potential Culvert Replacement Project

Pebble Project

File: PLP149	Date: 1/23/2020
Revision: 08	Author: ORNRC

THE pebble PARTNERSHIP

- Culverts Reviewed by PLP
- Anadromous Waters

Other Potential Culverts by Rating

- Gray
- Red

N

Miles

0 0.65 1.3 1.95 2.6

Scale 1:68,110

NAD 1983 StatePlane
Alaska 5 FIPS 5005
Seward Meridian

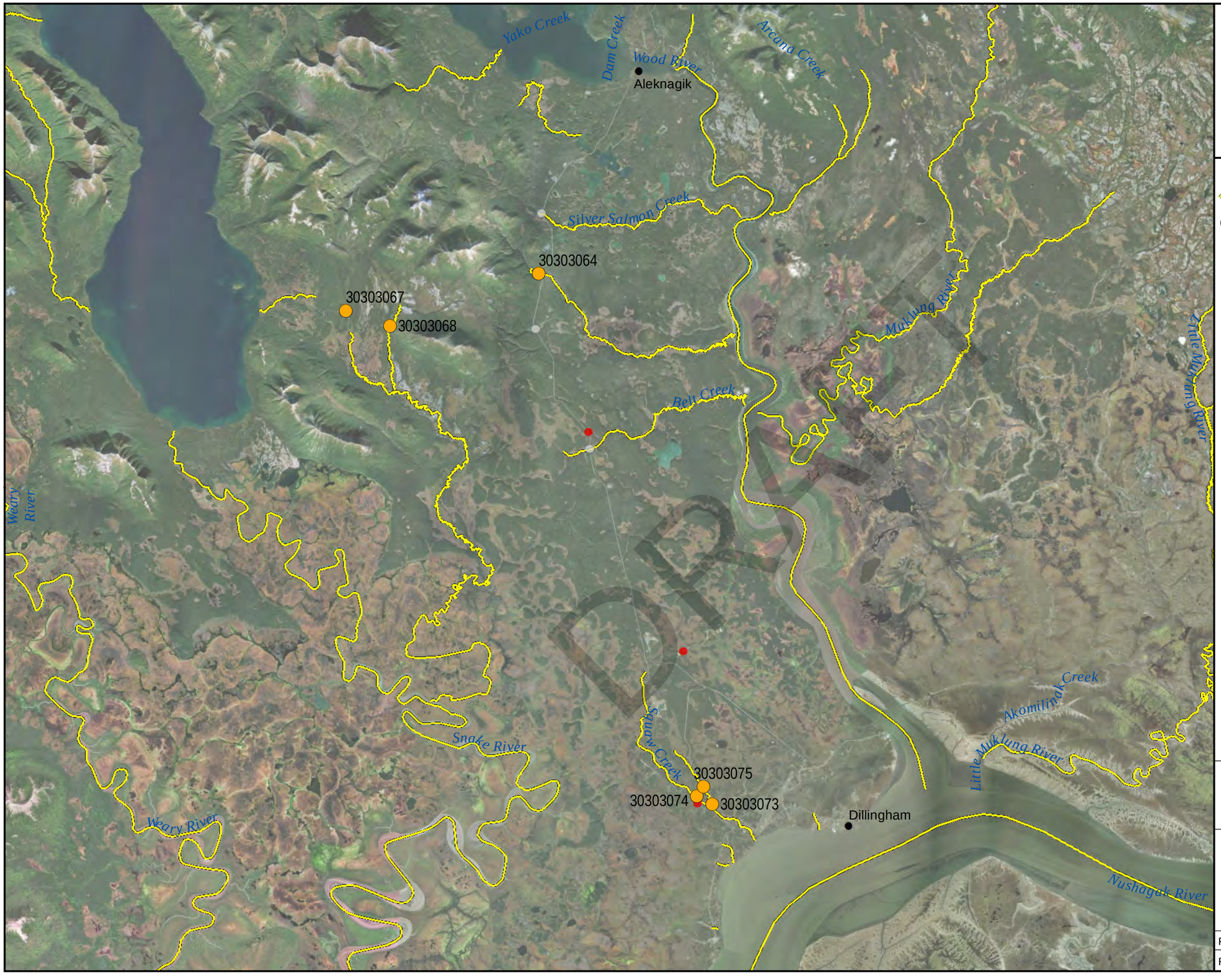
Figure:
2

PRM Culverts
Kenai Area

Pebble Project

File: PLP164	Date: 1/23/2020
Revision: 04	Author: ORNRC

Document Path: G:\Pebble\ARC_Proj\MXD\PLP164.mxd



THE pebble PARTNERSHIP

- Culverts Reviewed by PLP
- Anadromous Waters

Other Potential Culverts by Rating

- Gray
- Red

N

Miles

0 1 2 3 4

Scale 1:134,130

NAD 1983 StatePlane Alaska 5 FIPS 5005 Seward Meridian	Figure: **3**

PRM Culverts
Dillingham Area

Pebble Project

File: PLP164	Date: 1/23/2020
Revision: 04	Author: ORNRC

Document Path: G:\Pebble\ARC Proj\MXD\PLP164.mxd

THE pebble PARTNERSHIP

- Culverts Reviewed by PLP
- Anadromous Waters

Other Potential Culverts by Rating

- Gray
- Red

N

Miles

0 0.5 1 1.5 2

Scale 1:50,980

NAD 1983 StatePlane Alaska 5 FIPS 5005 Seward Meridian	Figure: **4**

PRM Culverts
Beluga-Tyonek Area

Pebble Project

File: PLP164	Date: 1/23/2020
Revision: 04	Author: ORNRC

Document Path: G:\Pebble\ARC_Proj\MXD\PLP164.mxd

THE pebble PARTNERSHIP

- Culverts Reviewed by PLP
- Anadromous Waters

Other Potential Culverts by Rating

- Gray
- Red

N

Miles

0 0.5 1 1.5 2

Scale 1:51,230

NAD 1983 StatePlane Alaska 5 FIPS 5005 Seward Meridian	Figure: **5**

PRM Culverts
Beluga-Tyonek Area

Pebble Project

File: PLP164	Date: 1/23/2020
Revision: 04	Author: ORNRC

Document Path: G:\Pebble\ARC Proj\MXD\PLP164.mxd

THE pebble PARTNERSHIP

- Culverts Reviewed by PLP
- Anadromous Waters

Other Potential Culverts by Rating

- Gray
- Red

N

Miles

0 0.9 1.8 2.7 3.6

Scale 1:92,950

NAD 1983 StatePlane
Alaska 5 FIPS 5005
Seward Meridian

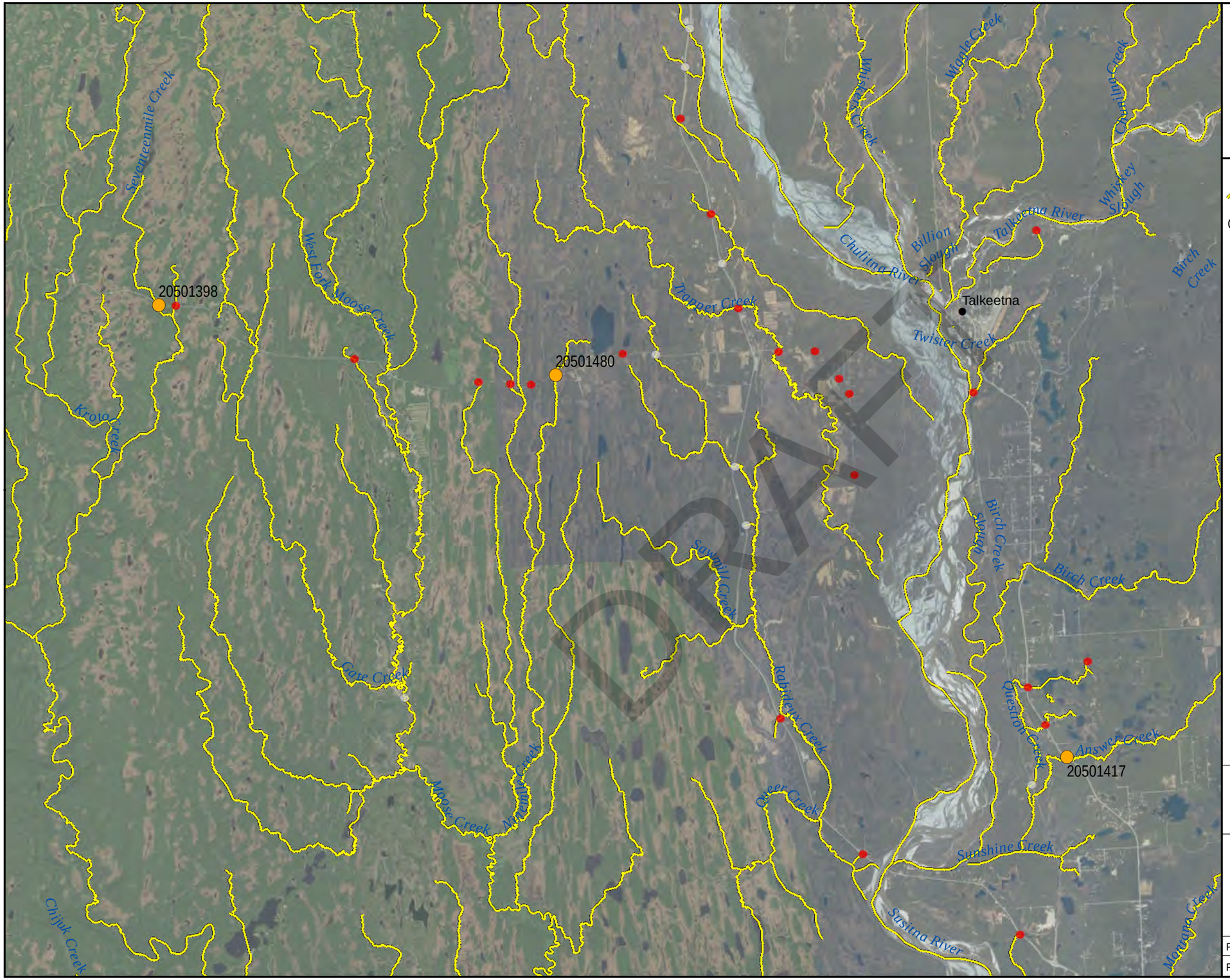
Figure:
6

PRM Culverts
King Salmon Area

Pebble Project

File: PLP164	Date: 1/23/2020
Revision: 04	Author: ORNRC

Document Path: G:\Pebble\ARC Proj\MXD\PLP164.mxd



THE pebble PARTNERSHIP

Culverts Reviewed by PLP

Anadromous Waters

Other Potential Culverts by Rating

Gray

Red

N

Miles

0 1 2 3 4

Scale 1:114,640

NAD 1983 StatePlane
Alaska 5 FIPS 5005
Seward Meridian

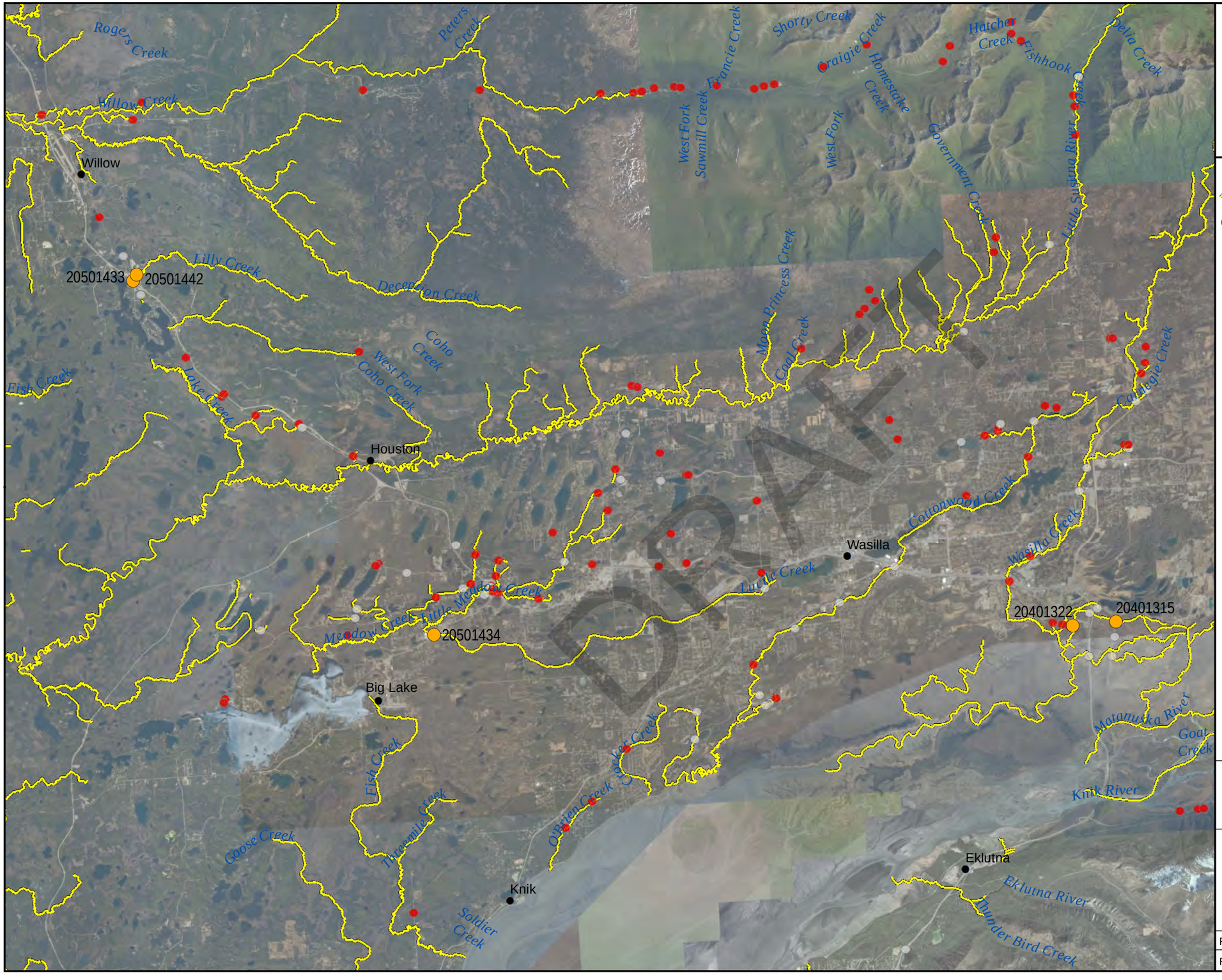
Figure:
7

PRM Culverts
Susitna River Area

Pebble Project

File: PLP164	Date: 1/23/2020
Revision: 04	Author: ORNRC

Document Path: G:\Pebble\ARC Proj\MXD\PLP164.mxd



THE pebble PARTNERSHIP

- Culverts Reviewed by PLP
- Anadromous Waters

Other Potential Culverts by Rating

- Gray
- Red

N

Miles

0 1.5 3 4.5 6

Scale 1:163,490

NAD 1983 StatePlane
Alaska 5 FIPS 5005
Seward Meridian

Figure:
8

PRM Culverts
Mat-Su Area

Pebble Project

File: PLP164	Date: 1/23/2020
Revision: 04	Author: ORNRC

Document Path: G:\Pebble\ARC Proj\MXD\PLP164.mxd

Attachment 5 – Permittee-Responsible Mitigation Plan for Marine Debris Removal at Kamishak Bay

DRAFT REPORT

Pebble Project

Permittee-Responsible Mitigation Plan for Marine Debris Removal at Kamishak Bay

December 2019

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ACRONYMS AND ABBREVIATIONS

ADF&G	Alaska Department of Fish and Game
MPPRCA	Marine Plastic Pollution Research and Control Act
MRSGR	McNeil River State Game Refuge
NPS	National Park Service
NOAA	National Oceanic and Atmospheric Administration
PLP	Pebble Limited Partnership
PRM	Permittee-responsible Mitigation
USACE	U.S. Army Corps of Engineers
WOUS	Waters of the U.S., including wetlands

1. Objectives

The Pebble Limited Partnership (PLP) is proposing this permittee-responsible mitigation (PRM) plan for the removal of marine debris at Kamishak Bay, as compensatory mitigation for the unavoidable losses to aquatics resources that would result from the Pebble Project's proposed discharges of dredge or fill material into waters of the U.S., including wetlands (WOUS). The primary purpose of this PRM project is habitat restoration, although it also provides protection to wildlife, including threatened and endangered species, by removing potential entanglement or ingestion hazards.

Marine debris is defined as persistent solid material that is manufactured or processed and directly or indirectly, intentionally or unintentionally, disposed of or abandoned into the marine environment (33 USC 1951 et seq. as amended by Title VI of the Public Law 112-213). Potential impacts of marine debris include wildlife entanglement, ingestion, and habitat damage.

- Wildlife entanglement. Derelict nets, ropes, line, or other fishing gear, packing bands, six-pack rings, and a variety of marine debris can wrap around marine life. Entanglement can lead to injury, illness, suffocation, starvation, and even death (NOAA 2019).

- Ingestion. Animals including seabirds and marine mammals have been known to ingest marine debris. The debris item may be mistaken for food and ingested, and animal's natural food (e.g., fish eggs) may be attached to debris, or the debris item may have been ingested accidentally with other food. Debris ingestion may lead to loss of nutrition, internal injury, intestinal blockage, starvation, and even death (NOAA 2019).

- Habitat damage. Marine debris can scour, break, smother, and otherwise damage important marine habitat. Many of these habitats serve as the basis for marine ecosystems and are critical to the survival of many other species (NOAA 2019).

Marine debris has become one of the most recognized pollution problems in the world's oceans and waterways today and was officially recognized as a problem by the federal government with the passing of the Marine Plastic Pollution Research and Control Act (MPPRCA) in 1987 (Public Law 100-200, Title II). This act provides specific mandates for the National Oceanic and Atmospheric Administration (NOAA) including mapping, identification, impact assessments, removal and prevention activities, research and development of alternatives to gear posing threats to the marine environment, and outreach activities (NOAA 2013).

High tides and storm events deposit marine debris along beaches and other coastal habitats, where they can further degrade and break down into smaller pieces or microplastics. Debris accumulated on coastal habitats may remain onshore or be returned to the sea during storm events or high tides. Coastal cleanup projects can help reduce the thread of marine debris in coastal ecosystems. In the United States, federal agencies such as NOAA and the U.S. Army Corps of Engineers (USACE), and non-profit organizations have organized coastal cleanup events to restore coastal habitat degraded by marine debris. In 2015 the Ocean Alaska Science and Learning Center, supported by a grant from the National Park Foundation, removed approximately 22,000 pounds of marine debris from 50 miles (mi) of coastal habitats from Alaska national parks and preserves (NPS 2019). Coastal cleanup events in Cook Inlet have taken place near established communities such as Anchorage and Homer, but rarely take place in remote areas such as Kamishak Bay due to access limitations.

The goal of this PRM plan is to address the thread of marine debris to coastal ecosystems within Kamishak Bay.

Objectives of this PRM include:

- Remove and properly dispose of marine debris from 7.4 mi of coastal habitat in Kamishak Bay.

PLP is proposing to implement this PRM using company resources or contractors. In addition, PLP may consider public and community involvement during the cleanup effort, or participation in informational community events, to enhance public understanding of marine debris concerns.

2. Site Selection

This PRM plan targets mitigation opportunities of land contiguous to the proposed WOUS impacts in Kamishak Bay (i.e., on-site) that would result from construction of the proposed project, including Amakdedori Port, lightering mooring facilities, navigation buoys, airstrip, and segments of access road.

The restoration sites were selected from within an approximately 13-mile long continuous stretch of coastline in Kamishak Bay where large amounts of marine debris have been documented by PLP personnel and contractors. Areas that are inaccessible to cleanup crews because of potentially hazardous terrain conditions (e.g., rocky bluffs) were excluded from potential consideration. The three selected sites include a total of 7.4 mi of coastal habitat (Figure 1):

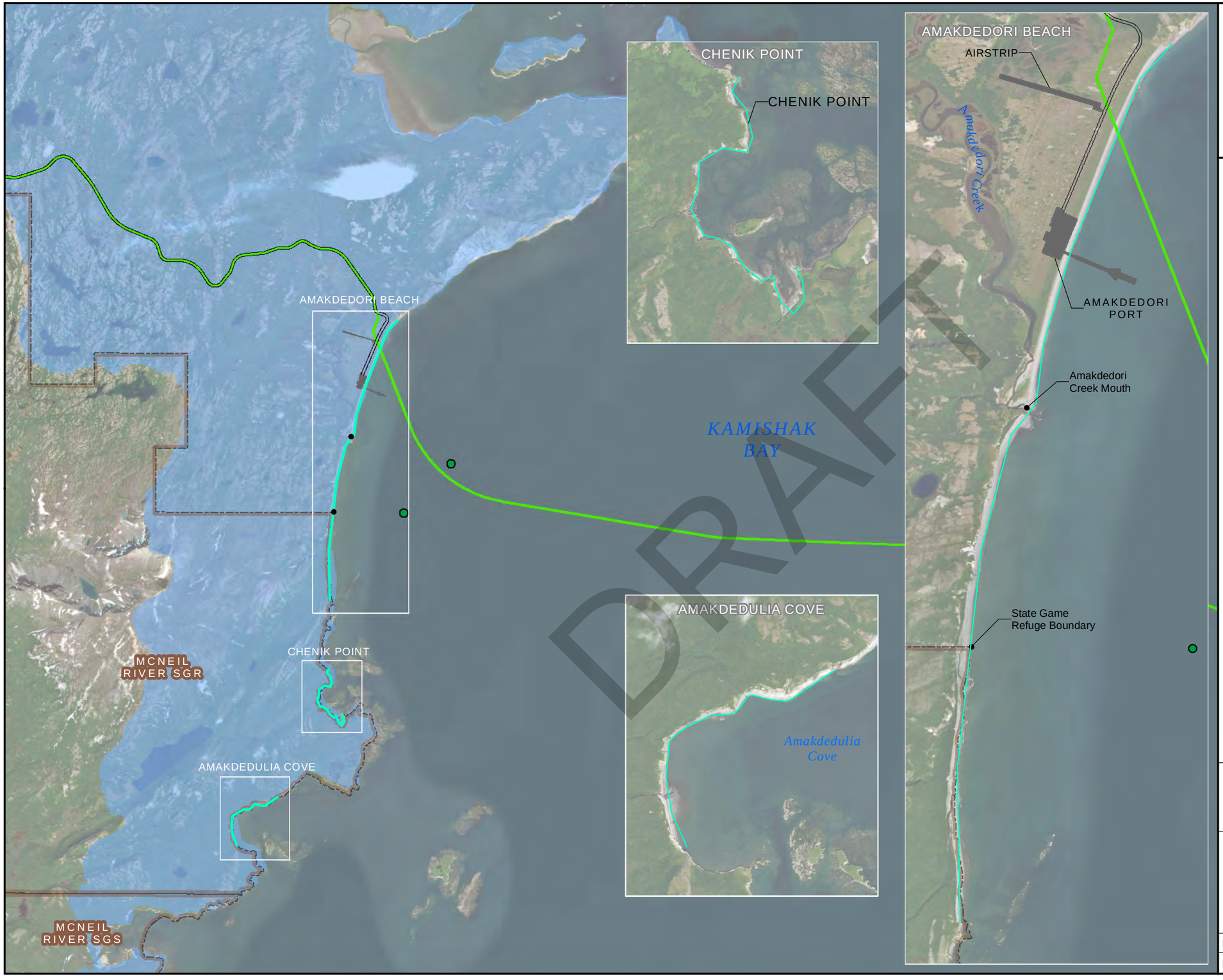
- Amakdedori Beach - 4.6 mi.
- Chenik Point - 1.5 mi.
- Amakdedulia Cove – 1.3 mi.

Marine debris would be removed from the supratidal (the area above spring high tide) and intertidal zones.

3. Site Protection Instrument

The 7.4 mi of coastal habitat that makes up the restoration area is composed of tidelands and submerged lands that are owned by the State of Alaska. Approximately 3.3 mi are on state-owned public lands and the remaining 4.1 mi are within the McNeil River State Game Refuge (MRSGR). The MRSGR is a special use area managed by the Alaska Department of Fish and Game (ADF&G). In 1996 the ADF&G adopted the McNeil River State Game Refuge and State Game Sanctuary Management Plan (ADF&G 2008), which provides some protection from development. Under this plan MRSGR lands cannot be sold, but leasing may be possible if the activity is compatible with the purpose for which the refuge was established.

Establishment of a site protection instrument is not feasible because PLP does not have a real estate interest but would obtain authorization to conduct this environmentally beneficial activity. Furthermore, the project site is a dynamic coastal environment and the long-term sustainability of the project cannot be assured because of the natural littoral processes that occur in the area.



THE pebble PARTNERSHIP

Kamishak Bay Cleanup Areas

Project Components

- Lighted Navigation Buoys
- Proposed Access Road
- Proposed Natural Gas Pipeline
- Proposed Port Site Footprint

Reference

- Mcneil River State Management
- Amakdedori Creek-Frontal Kamishak Bay Watershed (HUC 10)

N

Miles

0 1 2 3 4

Scale 1:96,672

NAD 1983 StatePlane
Alaska 5 FIPS 5005
Seward Meridian

Figure: **1**

Potential Beach Cleanup Project

Pebble Project

File: PLP197	Date: 1/2/2020
Revision: 01	Author: ORNRC

Document Path: G:\Pebble\ARC_Proj\MXD\PLP197.mxd

4. Baseline Information

Geoengineers (2018) conducted habitat mapping of nearshore habitats in Kamishak Bay. Amakdedori Beach consists of a long gravel/sand beach that receives strong wave action. The beach extends for several miles north and south of the mouth of Amakdedori Creek. North of the creek mouth the beach extends approximately 2 mi until it meets high cliff bluffs and mountains. Near the north end of this long beach, the low tide flats narrow in width and change from gavel and sand to a more stable hard clay substrate. Beyond the zones of finer material at Amakdedori Beach, the shallow subtidal flats become dominated by gravels and cobbles with increasing numbers of large boulders on the surface, likely derived from the high cliffs to the north. South of the mouth of Amakdedori Creek, the section of beach identified for cleanup at Chenik Point and Amakdedulia Cover, are more varied with bedrock outcrops and geologically active cliffs that often feed large angular rock to the upper beach (GeoEngineers 2018).

A wetlands delineation was completed for an approximately 1,700-foot-long reach of Amakdedori Beach (HDR 2019), and is representative of most of the site. Starting on the water's edge (Figure 2), the site includes bare marine intertidal unconsolidated shore composed of cobbles and gravel. The lower portion of this intertidal zone (closest to the water's edge) is flooded at least once daily, while the higher portion is flooded less often than daily. This is because of the variability in high tides. At the highest point of the beach (furthest from the water's edge) is a vegetated zone that may be affected by marine spray or surges during high marine storm events.

Figure 2. Amakdedori Beach (view south)

Amakdedori Beach, Chenik Point, and Amakdedulia Cove border habitats that are used by marine wildlife including Steller's sea lion, harbor seals, northern sea otters, beluga whales, humpback whales, Steller's eiders and other sea ducks (ADF&G 2008). The Steller's sea lion, northern sea otter, beluga and humpback whale, and Steller's eider are protected species under the Endangered Species Act, and the beach borders designated critical habitat for the northern sea otter, and beluga and humpback whales.

Marine debris observed at the restoration sites include buoys of a variety of materials (e.g., plastic, metal, polystyrene foam), insulation materials (e.g., polystyrene foam sheets and fragments), barrels, buckets, plastic bottles, propane canisters, fish nets and seines, rope, pallets, lumber, coolers, fish totes, pressurized cannisters for paint and lubricant, tarps and fabric (Figure 3, Figure 4).

Figure 3. Marine debris at Amakdedori Beach (view north)

Figure 4. Polystyrene foam buoy and ropes at Amakdedori Beach

5. Determination of Credits

Marine debris has several documented impacts to habitats and natural resources. It can cause physical damage to shoreline, marshes, and the benthos. Marine debris can also cause injury to wildlife from entanglement, ingestion and ghost fishing (where derelict fishing gear continues to catch and kill marine life for many years after it has been lost or discarded). The removal of marine debris will result in ecosystem service benefits to 7.4 mi of Kamishak Bay beach habitats, adjacent marine habitat, and the wildlife species that use these habitats. This restoration would not result in a gain of aquatic resources area for purposes of tracking "no net loss" of wetlands; however, the benefit to the habitat can still be used to compensate for a loss in resource area.

6. Mitigation Work Plan

The mitigation work plan includes the following items:

- Geographic boundaries. The restoration site encompasses approximately 7.4 mi of coastline in Kamishak Bay (Figure 1).

- Marine debris baseline density study. PLP will conduct a standing-stock study to identify and quantify the types and amount of debris along the shoreline prior to cleanup. Debris within discrete 100 meter transects at the shoreline site will be tallied. The results will provide an assessment, and the baseline, of the total load of debris and will be used to determine the density (# of items per unit area) of debris present. Debris density reflects the long-term balance between debris inputs and removal and is important to understanding the overall impact of debris. The standing-stock study would use and follow the procedures and forms described in the NOAA Marine Debris Shoreline Survey Field Guide (NOAA 2012, or current version) included in Exhibit A. The standing-stock study will be shared with the NOAA Marine Debris Program.

- Marine debris cleanup plan.

    - Cleanup team. Marine debris cleanup from sites will be completed by a 12-person field crew consisting of eight cleanup technicians, two bear guards, one hazardous material (hazmat) trained technician, and one project field team coordinator. All crew members will be trained in applicable site-specific safety and environmental procedures. At least one member of the field crew will be a qualified EMT. The field crew will be based in Kokhanok and transported to the cleanup site each day by helicopter.
    - Debris size criteria and volume estimates. Small debris items measuring over 1 inch (~bottle cap size) will be picked by hand and placed in light trash bags which will then be consolidated in super sacks. Heavy and larger items will be placed directly in super sacks. For planning, PLP estimates a total of 12,500 pounds (lbs) of marine debris would be removed from Kamishak Bay coastal habitats, based on a debris density of 1,650 lbs/mi that was calculated from the National Park Service (NPS) cleanup of beaches in Katmai and the Gulf of Alaska (NPS 2019).
    - Collection. Collected debris will be segregated as necessary for final disposal at regulated facilities. Any items that are known or suspected to contain hazardous materials (e.g., oil, paint or unknown substances) will be segregated from other wastes and managed in

accordance with applicable state and federal regulations. Supersacks that have been filled will be closed or covered and slung by helicopter to a designated temporary upland staging area just above the tidal zone. Any debris items that cannot be moved by hand will be lifted by helicopter and placed in the storage area or in a super-sack.

- Removal. Once cleanup is completed at each of the three beach project sites, a barge will be mobilized to a safe offshore location near each beach staging areas. As soon as the barge is in-place the super sack will be slung by helicopter to the barge and secured on the deck.
- Disposal. The loaded barge will transit to Nikiski or other Cook Inlet dock where the supersacks would be offloaded and transferred to trucks for transport to a Kenai Peninsula Borough (KPB) landfill for proper disposal. Alternative disposal, other than the KPB landfill, would be considered on a case-by-case basis for waste types that may not be accepted at the landfill (i.e., hazardous materials).

- Schedule. Marine debris removal work at Kamishak Bay is estimated to last approximately 20 days, followed by a 36-hour period to transfer the consolidated marine debris from land to the barges. The work would be completed during ice the free season between May and October when favorable weather is forecasted. Clean-up work can be scheduled to avoid sensitive wildlife or land use periods. PLP will consult with the relevant landowner or land management agency prior to the start of the cleanup work.

- Reporting. On completion of the cleanup, a report will be prepared that includes:

  - Results of the pre-clean-up standing-stock survey.
  - Summary narrative of the debris removal effort.
  - Breakdown of the debris types and weights removed.
  - Before and after photographs of cleanup sites.

7. Maintenance Plan

Kamishak Bay is exposed to substantial wave energy generated by wind waves and swells coming from the Gulf of Alaska (GeoEngineers 2018) that can transport marine debris. It is expected that after the initial cleanup, marine debris will continue to accumulate along cleaned beaches, however the rate at which marine debris will accumulate is unknown. To ensure the continued viability of the restored habitat, additional cleanup event(s) may be necessary to suppress the build-up of marine debris.

Five years after the initial marine debris removal action, PLP will initiate monitoring (Section 9) by conducting a standing-stock survey (NOAA 2012). The calculated marine debris density will be used to determine what additional actions are needed:

- If the marine debris density is less than 10 percent of the baseline, monitoring will be continued.

- If the marine debris density is greater than 10 percent of the baseline, additional beach cleanup efforts will be conducted to remove accumulated marine debris.

After the initial five-year monitoring event post cleanup, additional monitoring events would be scheduled using adaptive management.

8. Performance Standards

The following performance standard will be used to determine whether the compensatory mitigation project is achieving its objectives:

- All visible marine debris is removed from the 7.4 mi of beach during the initial cleanup event.

9. Monitoring Requirements

Standing-stock surveys (NOAA 2012) will be completed at the start of the project prior to debris removal, and 5 years post clean-up to record marine debris densities as indicated in the following Table 1:

Table 1 Restoration Site Monitoring Schedule

Timing	Purpose
Pre debris removal	Determine baseline conditions prior to start of cleanup
5-year post debris removal	Ensure recovered resource is stable
Schedule as determined by adaptive management	Ensure continued viability of the resource

10. Long-term Management Plan

After the initial clean up event, PLP will continue to manage and be financially responsible for maintenance and monitoring activities. PLP will assume long-term management until conclusion of mine operation activities, currently estimated to 20 years after construction. PLP is not proposing long-term management beyond this point.

11. Adaptive Management Plan

PLP will use adaptive management as an overall approach to ensure the plan goals and objectives are met:

- PLP will prepare a report of the initial cleanup event and submit to USACE for review. USACE will review the report and determine whether performance standards have been met, or if additional work is needed to meet the performance standard.

- Monitoring results will be used to determine marine debris accumulation rates. This information will be used to schedule the timing of future monitoring or to determine if and when an additional cleanup is required. PLP will provide the USACE with schedule updates of monitoring and cleanup events.

- In the unlikely event that the proposed cleanup sites, or a portion of them, cannot be completed because of land management restrictions, wildlife, or safety reasons, PLP will substitute those areas with others of equal length within Kamishak Bay, or elsewhere in Cook Inlet. Should this become necessary, PLP will notify the USACE for verification and approval.

- Any required revisions to this PRM will be provided to the USACE for review and approval.

12. Financial Assurances

PLP will establish a performance bond to ensure the PRM projects are satisfactorily constructed and all performance criteria are met. PLP will be responsible for:

- All permit acquisition and compliance.
- Project design, set-up, management, planning, support, and execution of the PRM plan.
- Site inventory, data collection, and monitoring.
- Reporting to USACE.

The bond will be closed once the PRM objective and performance standard has been met, and a final sign-off on the PRM plan has been provided by the USACE.

13. Other Information

No other information is provided.

14. References

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Exhibit A

NOAA Marine Debris Shoreline Survey Field Guide

Sarah Opfer, Courtney Arthur, and Sherry Lippiatt

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Ocean Service
Office of Response and Restoration
Marine Debris Program

January 2012

This shoreline protocol was developed and tested by the NOAA Marine Debris Program. This document is a revised version of the August 2011 field guide, and should be treated as a draft protocol that may be altered in the future. Further testing is currently underway to develop a statistically robust survey design that will recommend the frequency of sampling, number of transects, and sampling unit size at site, location, and regional spatial scales.

Mention of trade names or commercial products does not constitute endorsement or recommendation for their use by the National Oceanic and Atmospheric Administration.

NOAA Marine Debris Shoreline Survey Field Guide

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January 2012

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Introduction

Marine debris has become one of the most widespread pollution problems in the world's oceans and waterways today. The NOAA Marine Debris Program (MDP) serves as a centralized marine debris resource within NOAA, coordinating and supporting activities within NOAA and with other federal agencies. The MDP uses partnerships to support projects carried out by state and local agencies, tribes, non-governmental organizations, academia, and industry.

Marine debris monitoring programs are necessary to compare debris sources, amounts, locations, movement, and impacts across the US and internationally. Monitoring data can be used to evaluate the effectiveness of policies to mitigate debris and provide insight into priority targets for prevention. Thus, the NOAA MDP has developed standardized marine debris shoreline survey protocols to facilitate regional and site-specific comparisons. This document provides a standard data sheet and two different methods for shoreline monitoring and assessment.

Types of Shoreline Surveys

The objectives of your study will determine how you monitor for marine debris. There are two main types of shoreline surveys: accumulation and standing-stock surveys.

- Accumulation studies provide information on the rate of deposition (flux) of debris onto the shoreline. These studies are more suited to areas that have beach cleanups, as debris is removed from the entire length of shoreline during each site visit. This type of survey is more labor-intensive and is used to determine the rate of debris deposition (# of items per unit area, per unit time). Accumulation studies can also provide information about debris type and weight. These surveys cannot be used to measure the density of debris on the shoreline because removal of debris biases the amount of debris present during subsequent surveys.
- Standing-stock studies provide information on the amount and types of debris on the shoreline. Debris within discrete transects at the shoreline site is tallied during standing-stock surveys. This is a quick assessment of the total load of debris and is used to determine the density (# of items per unit area) of debris present. Debris density reflects the long-term balance between debris inputs and removal and is important to understanding the overall impact of debris.

Table 1. Salient characteristics of standing-stock and accumulation surveys.

CHARACTERISTIC	STANDING-STOCK	ACCUMULATION
Debris removed during surveys?	No	Yes
Time required per survey	Less	More
Length of shoreline site	100 m	100 m or longer
Is a set survey interval required (e.g., once per week or per month)?	Yes	Yes
Types of data that can be collected	• Debris density (# of items / unit area) • Debris material types	• Debris deposition rate (# of items / unit area / unit time) • Debris material types • Debris weight

We suggest that users give careful consideration to which type of survey best suits their goals and objectives. Table 1 provides important information to take into account when deciding how to monitor. Once a survey type is chosen, meaningful data can be collected through regular monitoring. The following sections describe how to choose survey sites and conduct surveys.

How to Pick Your Site

To select your sampling site(s), follow these steps:

1. The first step is to choose an appropriate shoreline location based on the objectives of your study. For example, if you wish to examine the impact of land use, you should select locations in watersheds with various land use types. Next, categorize the various areas within your location (it may help to use an aerial photo or map, as shown below). For example, your location may cover a span of shoreline 1 km long. Within that 1 km, there may be an area with heavy recreational use and another area where an urban stream mouth is located. Identify any barriers to shoreline access or offshore structures that may affect nearshore circulation (e.g. jetties).

2. Select shoreline sites (where you will sample) according to the characteristics below. If your location includes different use areas (for example, an area with heavy recreational use and a more remote area), it is preferable to select a site within each use category.

Shoreline sites should have the following characteristics:

- Sandy beach or pebble shoreline
- Clear, direct, year-round access
- No breakwaters or jetties
- At least 100 m in length parallel to the water (note that standing-stock surveys require a 100-m shoreline site)
- No regular cleanup activities

These characteristics should be met where possible, but can be modified.

Before You Begin Your Surveys

Before any data collection begins, the Shoreline Characterization Sheet should be completed for each shoreline site. On this data sheet you will note:

- GPS coordinates in decimal degrees at the beginning and end of your shoreline site, or at the site's four corners if the width of the beach is > 6 m;
- Shoreline characteristics (e.g. tidal range and substrate); and
- Surrounding land-use characteristics that may influence the delivery of land-based debris to the site (e.g., farmland 5 km from a small town or urban parkland 50 m from a river mouth).

The Shoreline Characterization Sheet needs to be completed only once per site per year unless major changes occur to the shoreline.

Shore IDs (on the Shoreline Characterization Sheet) should be created based on the initials of the shoreline name (e.g., Fort Smallwood = FS). This will make it easier to keep track of multiple sampling sites.

The Shoreline Characterization Sheet and Debris Density Data Sheet were adapted from Cheshire et al. (2009)[1].

You will need the following supplies in order to complete your surveys:

- Digital camera
- Hand-held GPS unit
- Extra batteries for GPS and camera (we recommend rechargeable batteries)
- Surveyor's measuring wheel - *for standing-stock surveys only*
- Flag markers or stakes
- ~100′ fiberglass measuring tape
- First aid kit (including sunscreen, bug spray, drinking water)
- Work gloves
- Sturdy 12″ ruler
- Clipboards for data sheets
- Data sheets (on waterproof paper)
- Pencils
- Trash bag or bucket - *for accumulation surveys only*

Safety is a priority. Do not touch or lift potentially hazardous or large, heavy items. Notify your local officials if such items are encountered.

All of the data collection forms you will need are included in Appendix A at the end of this document. The same data collection forms are used for accumulation and standing-stock surveys.

- Shoreline Characterization Sheet (pp. 8–9)
- Debris Density Data Sheet (pp. 10–12)

[1] Cheshire, A. C., E. Adler, et al. (2009). UNEP/IOC Guidelines on Survey and Monitoring of Marine Litter, UNEP Regional Seas Intergovernmental Oceanographic Commission: 132 pp.

Accumulation Surveys

If you decide to conduct accumulation surveys, follow this protocol:

1. BEFORE arriving at the site, check local tide tables and plan to arrive at your site during low tide.

2. ONCE ARRIVED, begin filling out the Debris Density Data Sheet's Additional Information section. Mark the beginning and end of your shoreline site, perhaps with flags or stakes. (Remember to pick up these markers at the end of your survey to make sure they do not become marine debris!) The back of the shoreline is where the primary substrate (e.g., sand) changes (e.g., sand becomes gravel) or at the first barrier (e.g., vegetation line).

3. In order to cover the entire site from water's edge to the back of the shoreline, decide whether you will traverse the survey area parallel or perpendicular to the water. See Appendix B for walking pattern schematics. If more than one surveyor is available, the survey area should be divided evenly with clearly specified areas assigned to each individual. Surveyors should traverse the survey area in a pre-determined walking pattern until the entire site is cleared of marine debris.

4. Record on your Debris Density Data Sheet counts of debris items that measure over 2.5 cm, or 1 inch (~bottle cap size), in the **longest** dimension (see Figure 1). If any part of the item is within the survey area, count the item. Record large debris items, anything bigger than 1 foot (~ 0.3 m, typical forearm length from palm to elbow) in the large debris section of the Debris Density Data Sheet.

5. Take photos of your shoreline site and some of the debris items!

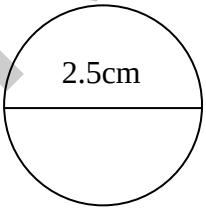


Figure 1. Minimum debris size to be counted. **This size is required to keep surveyors counting the same size items and to help keep the survey results uniform.*

Standing-stock Surveys

If you decide to conduct standing-stock surveys, follow this protocol:

1. Sketch your 100-m shoreline site and divide the 100 m into 5-m segments. There should be 20 of them. Number each section (left to right) from 1 to 20. Each 5-m segment should run from the water's edge to the back of the shoreline (Figure 2). The back of the shoreline is where the primary substrate (e.g., sand) changes (e.g., sand becomes gravel) or at the first barrier (e.g., vegetation line).

2. BEFORE arriving at the site, select four numbers from the Random Number Table (Appendix C) by first choosing a number between 1 and 5, and then a number between 1

and 4. The corresponding number in the table (1–20) is one of the four transects you will survey. Complete this exercise four times to choose four random transects (each transect can be used only once per survey). These numbers correspond to the 5-m segments you drew on your sketch and are called transect ID numbers (see Debris Density Data Sheet). You should fill out one Debris Density Data Sheet per transect. On any sampling day, 20 m of your 100-m shoreline site is analyzed (i.e., 20% coverage of the area). In addition, check local tide tables and plan to arrive at your site during low tide.

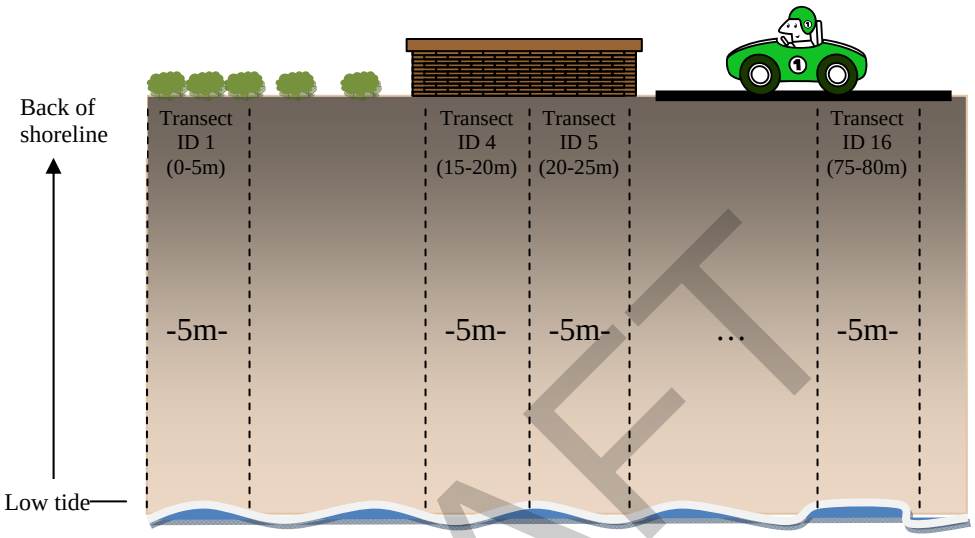


Figure 2. Shoreline section (100 m) displaying perpendicular transects from water's edge at low tide to the first barrier at the back of the shoreline section.

3. ONCE ARRIVED, begin filling out the Debris Density Data Sheet Additional Information section. Using your measuring wheel, begin at the start of your shoreline section and mark the four selected transect boundaries with flags according to the distances provided in the Transect ID table (for example, transect 12 covers 55 to 60 m from the start of your shoreline section).

4. Measure the width of each transect from water's edge to the back of the shoreline. Record GPS coordinates for each transect in decimal degree format. For shoreline segments that are less than 6 m wide from the water's edge to the back of the shoreline, GPS coordinates should be taken at the center (Figure 3). For shoreline segments that are over 6 m wide, take GPS coordinates at two spots—one nearer the back of the shoreline and one nearer the water.

5. Walking each transect from water's edge to the back of the shoreline, record on your Debris Density Data Sheet counts of debris items that measure over 2.5 cm, or 1 inch (~bottle cap size), in the **longest** dimension (see Figure 1). If any part of the item is within the sample transect, count the item. *Remember that for standing-stock surveys, debris is not removed from the shoreline.* Record large debris items, anything bigger than 1 foot (~ 0.3 m, typical forearm length from palm to elbow) in the large debris section of the Debris Density Data Sheet.

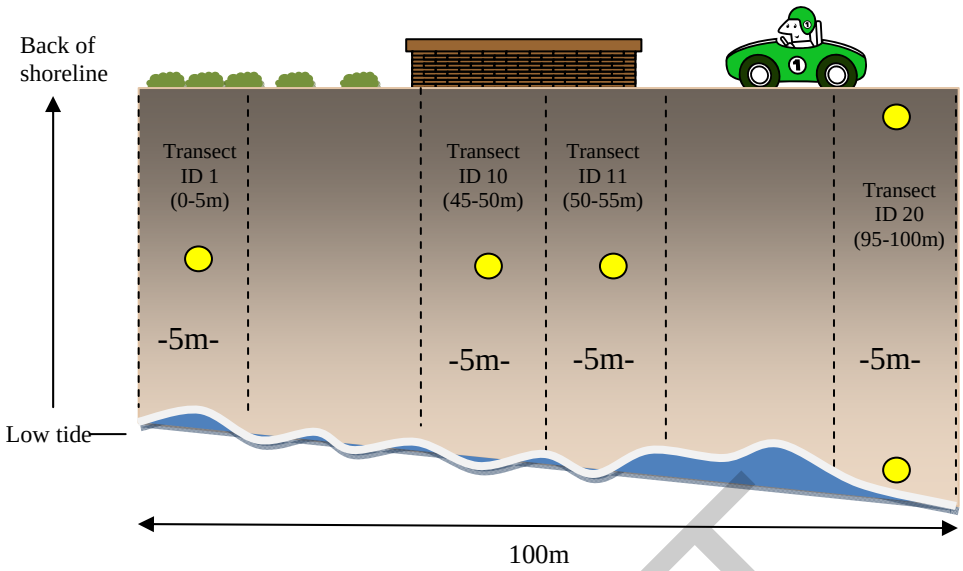


Figure 3. Example of a shoreline section (100m) with yellow circles indicating marked GPS coordinates. Width determines location of GPS coordinates.

6. Take photos of each transect and some of the debris items!

Submitting Your Shoreline Debris Data to NOAA

Marine debris monitoring groups should plan to compile and analyze their own survey results. The NOAA MDP will have periodic calls for data from monitoring groups. If you would like more information on data analysis or to be included in data calls, please send an email to MD.monitoring@noaa.gov.

Appendix A: Data Forms

SHORELINE DEBRIS Shoreline Characterization Sheet	Organization		Name of organization responsible for collecting the data
	Surveyor name		Name of person responsible for filling in this sheet
	Phone number		Phone contact for surveyor
Complete this form **ONCE** for each site location	Date		Date of this survey

SAMPLING AREA

Shore ID			Unique code for the shoreline
Shoreline name			Name by which the section of shoreline is known (e.g., beach name, park)
State/County			State and county where your site is located
Coordinates at start of shoreline section	Latitude	Longitude	Recorded as XXX.XXXX (decimal degrees) at start of shoreline section (in both corners if width > 6 meters)
Coordinates at end of shoreline section	Latitude	Longitude	Recorded as XXX.XXXX (decimal degrees) at end of shoreline section (in both corners if width > 6 meters)
Photo number/ID			The digital identification number(s) of photos taken of shoreline section

SHORELINE CHARACTERISTICS – from beginning of shoreline site

Length of sample area (should be 100 m if standing-stock survey)		Length measured along the midpoint of the shoreline (in meters)
Substratum type		For example, a sandy or gravel beach
Substrate uniformity		Percent coverage of the main substrate type (%)
Tidal range		Maximum & minimum vertical tidal range. Use tide chart (usually in feet).
Tidal distance		Horizontal distance (in meters) from low- to high-tide line. Measure on beach at low and high tides or estimate based on wrack lines.
Back of shoreline		Describe landward limit (e.g., vegetation, rock wall, cliff, dunes, parking lot)
Aspect		Direction you are facing when you look out at the water (e.g., northeast)

LAND-USE CHARACTERISTICS – within shoreline location

Location & major usage	Urban		Select one and indicate major usage (e.g., recreation, boat access, remote)
	Suburban		
	Rural		
Access			Vehicular (you can drive to your site), pedestrian (must walk), isolated (need a boat or plane)
Nearest town			Name of nearest town
Nearest town distance			Distance to nearest town (miles)
Nearest town direction			Direction to nearest town (cardinal direction)
Nearest river name			If applicable, name of nearest river or stream. If blank, assumed to mean no inputs nearby
Nearest river distance			Distance to nearest river/stream (km)
Nearest river direction			Direction to nearest river/stream (cardinal direction from site)
River/creek input to beach	YES	NO	Whether nearest river/stream has an outlet within this shoreline section
Pipe or drain input	YES	NO	If there is a storm drain or channelized outlet within shoreline section
Notes (including description, landmarks, fishing activity, etc.):			

SHORELINE DEBRIS **Debris Density Data Sheet**	Organization		Name of organization responsible for data collection
	Surveyor name		Name of person responsible for filling in this sheet
	Phone number		Phone contact for surveyor
Complete this form during **EACH** survey or transect (if standing-stock) per site visit	Email address		Email contact for surveyor
	Date		Date of this survey

ADDITIONAL INFORMATION

Shoreline name			Name for section of shoreline (e.g., beach name, park)
Survey Type	Accumulation ☐	Standing-stock ☐	Type of shoreline survey conducted (check box)
Transect ID # (N/A if accumulation survey)			Transect ID (include shoreline ID, date, and transect #)
Coordinates of start of shoreline site	Latitude	Longitude	Recorded as XXX.XXXX (decimal degrees). Record in both corners if width > 6 m. If transect, record at water's edge.
Coordinates of end of shoreline site	Latitude	Longitude	Recorded as XXX.XXXX (decimal degrees). Record in both corners if width > 6 m. If transect, record at back of shoreline.
Width of beach			Width of beach at time of survey from water's edge to back of shoreline (meters)
Time start/end	Start	End	Time at the beginning and end of the survey
Season			Spring, summer, fall, winter, tropical wet, etc.
Date of last survey			Date on which the last survey was conducted
Storm activity			Describe significant storm activity within the previous week (date(s), high winds, etc.)
Current weather			Describe weather on sampling day, including wind speed and % cloud coverage
Number of persons			Number of persons conducting the survey
Large items	YES	NO	Did you note large items in the large debris section?
Photo ID #s			The digital identification number(s) of debris photos taken during this survey.

Notes: Evidence of cleanup, sampling issues, etc.

DEBRIS DATA: (continued on back)

ITEM	TALLY (e.g., ~~IIII~~)			TOTAL
PLASTIC				
Plastic fragments	Hard	Foamed	Film	
Food wrappers				
Beverage bottles				
Other jugs or containers				
Bottle or container caps				
Cigar tips				
Cigarettes				
Disposable cigarette lighters				
6-pack rings				
Bags				
Plastic rope/small net pieces				
Buoys & floats				
Fishing lures & line				
Cups (including polystyrene/foamed plastic)				
Plastic utensils				
Straws				
Balloons				
Personal care products				
Other:				
METAL				
Aluminum/tin cans				
Aerosol cans				
Metal fragments				
Other:				
GLASS				
Beverage bottles				
Jars				
Glass fragments				
Other:				

ITEM	TALLY (e.g., ~~IIII~~)	TOTAL
RUBBER		
Flip-flops		
Gloves		
Tires		
Rubber fragments		
Other:		
PROCESSED LUMBER		
Cardboard cartons		
Paper and cardboard		
Paper bags		
Lumber/building material		
Other:		
CLOTH/FABRIC		
Clothing & shoes		
Gloves (non-rubber)		
Towels/rags		
Rope/net pieces (non-nylon)		
Fabric pieces		
Other:		
OTHER/UNCLASSIFIABLE		

***LARGE DEBRIS ITEMS* (> 1 foot or ~ 0.3 m)**

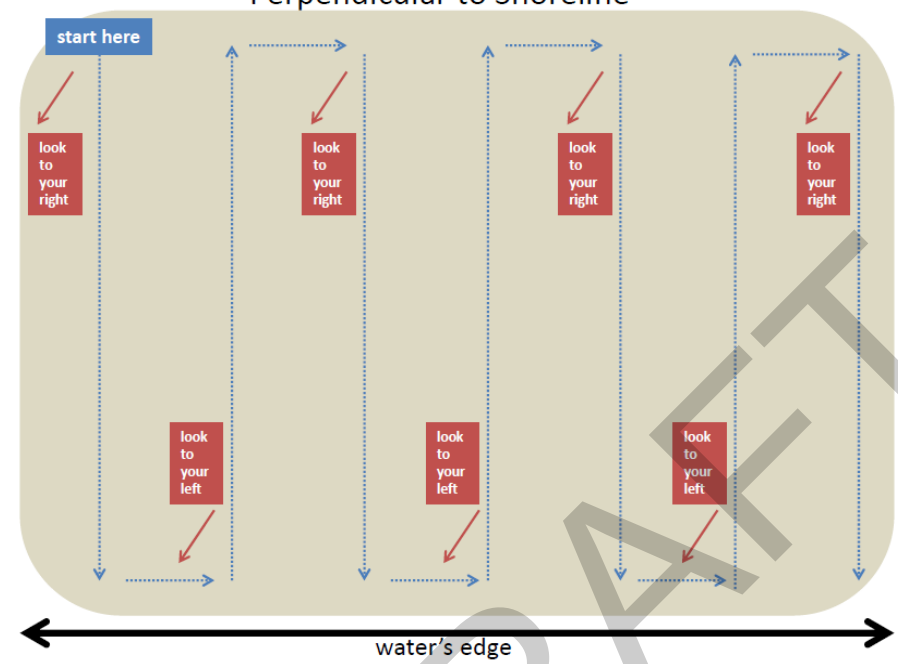
Item type (vessel, net, etc.)	Status (sunken, stranded, buried)	Approximate width (m)	Approximate length (m)	Description / photo ID #

Notes on debris items, description of "Other/unclassifiable" items, etc:

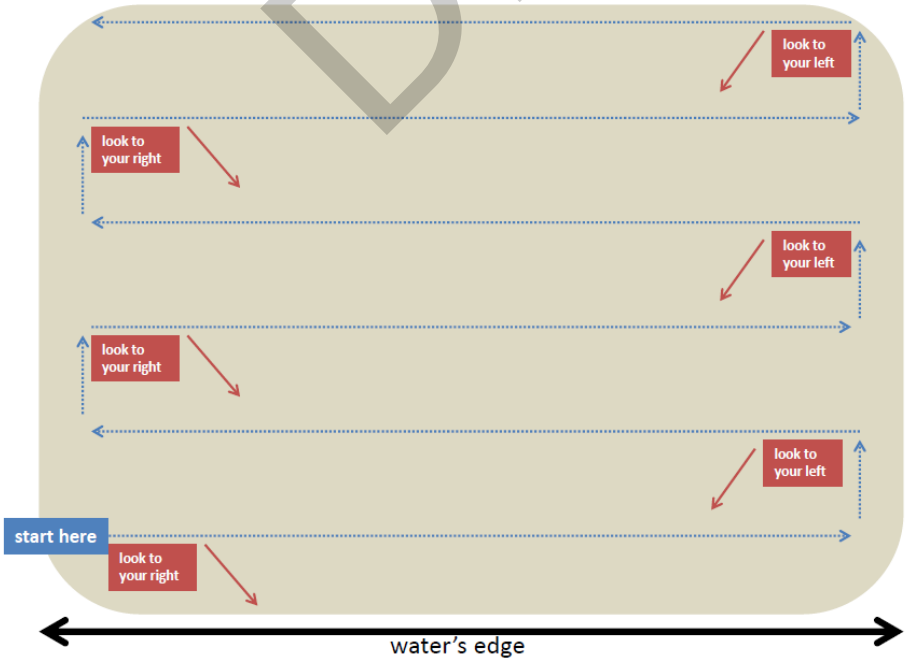
Appendix B: Shoreline Walking Patterns

The schematics below are potential survey walking patterns to ensure that the entire shoreline site or transect is covered. Suggested distance between walking lines is approximately one meter.

Walking Pattern #1:
Perpendicular to Shoreline



Walking Pattern #2
Parallel to Shoreline



APPENDIX C: RANDOM TRANSECT SELECTION

If you are conducting a standing-stock survey, use these tables to select transects. BEFORE arriving at the site, select four numbers from the Random Number Table, by first choosing a number between 1 and 5, and then a number between 1 and 4. The corresponding number in the table (1–20) is one of the four transects you will survey. Complete this exercise four times to choose four random transects (each transect can be used only once per survey).

Random Number Table					
	1	2	3	4	5
1	4	8	17	9	1
2	7	19	2	12	20
3	18	14	6	16	11
4	3	5	15	10	13

Transect ID and distance along shore from start of 100-m shoreline section (see Figure 2 above)

Transect ID	Meters	Feet and inches
1	0–5 m	0–16' 4"
2	5–10 m	16'4"–32'9"
3	10–15 m	32'9"–49'2"
4	15–20 m	49'2"–65'7"
5	20–25 m	65'7"–82'
6	25–30 m	82'–98'5"
7	30–35 m	98'5"–114'9"
8	35–40 m	114'9"–131'2"
9	40–45 m	131'2"–147'7"
10	45–50 m	147'7"–164'
11	50–55 m	164'–180'5"
12	55–60 m	180'5"–196'10"
13	60–65 m	196'10"–213'3"
14	65–70 m	213'3"–229'7"
15	70–75 m	229'7"–246'
16	75–80 m	246'–262'5"
17	80–85 m	262'5"–278'10"
18	85–90 m	278'5"–295'3"
19	90–95 m	295'3"–311'8"
20	95–100 m	311'8" - 328'1"

United States Department of Commerce

John Bryson
Secretary

National Oceanic and Atmospheric Administration

Jane Lubchenco, Ph.D.
Undersecretary of Commerce for Oceans and Atmosphere
Administrator, National Oceanic and Atmospheric Administration

National Ocean Service

David Kennedy
Assistant Administrator for Ocean Services and
Coastal Zone Management