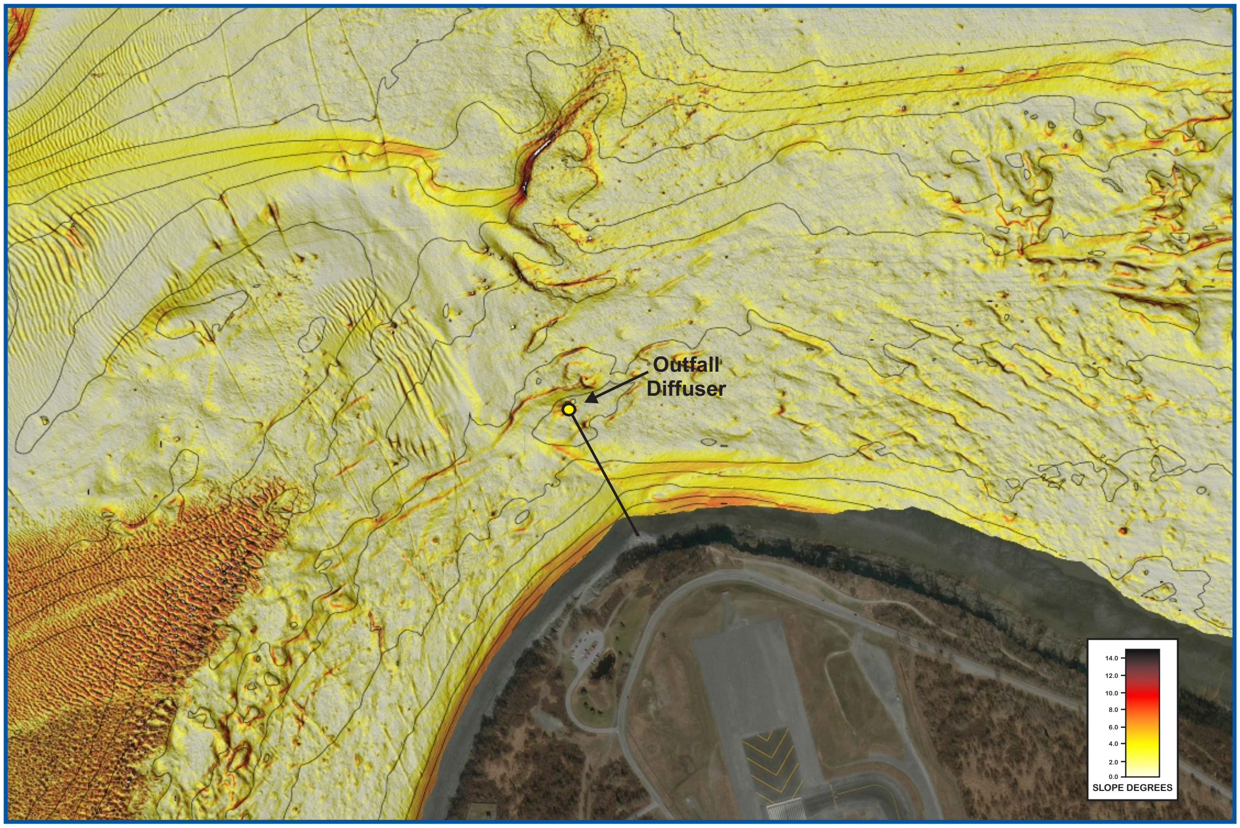
MONITORING PROGRAM ANNUAL REPORT
JANUARY - DECEMBER 2023

ANCHORAGE WATER AND WASTEWATER UTILITY
JOHN M. ASPLUND WATER POLLUTION CONTROL FACILITY AT POINT WORONZOF



Prepared for:

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Anchorage Water & Wastewater Utility
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February 2024

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NPDES Permit AK-002255-1

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PREFACE

This Monitoring Program Annual Report was prepared for the U.S. Environmental Protection Agency (EPA) to fulfill requirements of the National Pollutant Discharge Elimination System (NPDES) Permit AK-002255-1. This permit pertains to the effluent discharge from the John M. Asplund Water Pollution Control Facility (WPCF), operated by the Anchorage Water and Wastewater Utility (AWWU) at Point Woronzof under authority of the Municipality of Anchorage (MOA). This NPDES permit incorporates provisions necessitated by Section 301(h) of the Clean Water Act (CWA) for a variance from the requirements of secondary treatment.

Elements of the monitoring program as specified by the permit are:

- Influent, Effluent, and Sludge Monitoring
  - In-Plant Sampling
  - Toxic Pollutant and Pesticide Sampling
  - Pretreatment Monitoring
  - Whole Effluent Toxicity Monitoring
- Receiving Water Quality Monitoring
  - Plume Dispersion Sampling
  - Intertidal Zone Bacteria
- Sediment and Bioaccumulation Monitoring
  - Sediment Analyses
  - Bioaccumulation Analyses

During 2023, the monitoring program consisted of two influent, effluent, and sludge toxic pollutant and pesticide sampling and analysis efforts, a receiving water quality sampling and analysis effort, and quarterly whole effluent toxicity (WET) testing. These efforts were coordinated and conducted by Kinnetic Environmental, Inc. (KEI). In addition, AWWU conducted permit-required daily, weekly, and monthly self-monitoring for influent, effluent, and sludge. The sediment and bioaccumulation components of the monitoring program were originally conducted once each during 2003 and 2004 and have not been performed since, as the current NPDES permit only required those components be performed once during the life of the permit.

This annual report provides information and data pertaining to the monitoring program performed to meet the requirements as set forth in the NPDES permit that became effective on 2 August 2000. This report covers the period of 1 January through 31 December 2023.

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ACRONYMS

AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
ADT	Alaska Daylight Time
ANOVA	Analysis of Variance
ASTM	American Society for Testing and Materials
Avg or AVG	Average or Mean
AWQS	(State of) Alaska Water Quality Standard
AWWU	Anchorage Water and Wastewater Utility
B	Bottom Depth
BETX	Summation of Benzene, Ethylbenzene, Toluene, and Xylenes
BOD_5	Biochemical Oxygen Demand (5-Day)
CFR	Code of Federal Regulations
COC	Chain of Custody
CTD	Conductivity, Temperature, and Depth Profiler
CWA	Clean Water Act
DCS	Duplicate Control Sample
DGPS	Differential Global Positioning System
DI	Deionized
DMR	Discharge Monitoring Report
DMR-QA	Discharge Monitoring Report – Quality Assurance
DO	Dissolved Oxygen
Eff or EFF	Effluent
EIS	Environmental Impact Statement
EPA	U. S. Environmental Protection Agency
FB	Field Blank
FC	Fecal Coliform
FWPCA	Federal Water Pollution Control Act
GC	Gas Chromatography
H_2SO_4	Sulfuric Acid
HCl	Hydrochloric Acid
HEM	N-Hexane Extractable Material
Hg	Mercury
HNO_3	Nitric Acid
H_o1	Null Hypothesis 1
H_o2	Null Hypothesis 2
I&I	Infiltration and Inflow
Inf or INF	Influent
JBER	Joint Base Elmendorf-Richardson
KEI	Kinnetic Environmental, Inc. (formerly Kinnetic Laboratories, Inc.)
KLI	Kinnetic Laboratories, Inc.
KW	Kruskal-Wallis Statistical Test
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LOEC	Lowest Observed Effect Concentration
M	Mid-depth
MAEC	Maximum Allowable Effluent Concentration
Max	Maximum
MB	Method Blank

MDL	Method Detection Limit
Min	Minimum
MLLW	Mean Lower Low Water
MOA	Municipality of Anchorage
MPN	Most Probable Number
MRL	Method Reporting Limit
MRT	Multiple Range Test
MS	Matrix Spike
MSB	Matanuska-Susitna Borough
MSD	Matrix Spike Duplicate
MW	Mann-Whitney Statistical Test
NA	Not Applicable or Not Available
$Na_2S_2O_3$	Sodium Thiosulfate
NACWA	National Association of Clean Water Agencies
NaOH	Sodium Hydroxide
ND	Not Detected
NIST	National Institute of Standards and Technology
NOAA	National Oceanographic and Atmospheric Administration
NOEC	No Observed Effect Concentration
NOS	National Ocean Service
NPDES	National Pollutant Discharge Elimination System
NT	Not Tested
O&G	Oil and Grease
ORP	Oxidation Reduction Potential
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
pH	Hydrogen potential
POC	Organochlorine Pesticide
POP	Organophosphorus Pesticide
POTW	Publicly Owned Treatment Work
PQL	Practical Quantitation Limit
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QC	Quality Control
REM	Percent Removal
Rep	Replicate
RPD	Relative Percent Difference
S	Surface Depth
SOP	Standard Operating Procedure
SRM	Standard Reference Material
SSI	Sewage Sludge Incinerator
SSWQC	Site-Specific Water Quality Criteria
TAC	Test Acceptance Criteria
TAH	Total Aromatic Hydrocarbons
TAqH	Total Aqueous Hydrocarbons
TB	Trip Blank
TCDD	Dioxin 2,3,7,8-tetrachlorodibenzo-p-dioxin
TEM	Transmission Electron Microscopy
TIE	Toxicity Identification Evaluation
TPAH	Total Polycyclic Aromatic Hydrocarbons

TRC	Total Residual Chlorine
TRE	Toxicity Reduction Evaluation
TSS	Total Suspended Solids
TVS	Total Volatile Solids
WET	Whole Effluent Toxicity
WPCF	Water Pollution Control Facility
WWTF	Wastewater Treatment Facility
ZID	Zone of Initial Dilution

UNITS AND SYMBOLS

°	degree(s)
′	minutes of latitude or longitude
″	seconds of latitude or longitude
±	plus or minus
>	greater than
≥	greater than or equal to
<	less than
≤	less than or equal to
%	percent
‰	parts per thousand
°C	degrees Celsius
cm	centimeter(s)
cm/s	centimeters per second
EC_{50}	50 percent effective concentration
FC/100 mL	Fecal Coliform colonies per 100 milliliters
ft	foot or feet
g	gram(s)
hr	hour(s)
in	inch(es)
km	kilometer(s)
L	Liter(s)
lb	pound(s)
m	meter(s)
mgd or MGD	million gallons per day
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mi	mile(s)
mi^2	square miles
min	minute(s)
mL	milliliter(s)
MPN/100 mL	Most Probable Number per 100 milliliters
ng/L	nanograms per liter
nm	nautical mile
NTU	Nephelometric Turbidity Units
psu	practical salinity units
SU	Standard Units (pH)
TUc	Chronic Toxicity Units
µg/g	micrograms per gram
µg/L	micrograms per liter

SUMMARY

PURPOSE

This report was prepared to meet requirements of the U.S. Environmental Protection Agency (EPA) and the Alaska Department of Environmental Conservation (ADEC), as outlined in the National Pollutant Discharge Elimination System (NPDES) Permit AK-002255-1, signed on 30 June 2000 and effective on 2 August 2000. This permit authorizes discharge of effluent from the John M. Asplund Water Pollution Control Facility (Asplund WPCF). Wastewater from the Municipality of Anchorage (MOA) is treated and disinfected at this facility before discharge to the receiving waters of Knik Arm in Cook Inlet, Alaska. The NPDES permit incorporates requirements of the Clean Water Act (CWA) for a 301(h) variance from secondary treatment and is in compliance with provisions of the Federal Water Pollution Control Act (FWPCA) as amended by the CWA (33 U.S.C. §1251 et seq.) and the Water Quality Act of 1987.

HISTORY

In September 1979, Anchorage Water and Wastewater Utility (AWWU) submitted to EPA a 301(h) secondary treatment variance application proposing an improved discharge which eliminated chlorination and required the addition of both a 610-meter (m) extension and a 305-m diffuser to the Asplund WPCF outfall. The outfall extension was intended to move the point of discharge beyond the negative influence of a gyre that was reported to exist off Point Woronzof on a flood tide and was presumed to carry effluent toward shore, causing bacterial contamination of the shoreline.

Further studies were subsequently undertaken to derive design criteria for outfall improvements. The central issue was to evaluate outfall design alternatives and the chlorination/no chlorination option in relation to a system of eddies that occur on the flood tide. These studies were completed as an *Amendment to the Wastewater Facilities Plan for Anchorage, Alaska* (CH2M Hill in association with Ott Water Engineers, 1985). This amended plan recommended the use of the existing 245-m outfall with the addition of a three-nozzle diffuser. It was shown that chlorination would still be required to meet bacterial standards even with an extended outfall and diffuser. Because the same water quality standards could be met by chlorinating and installing an improved diffuser at the end of the existing outfall, there was no need to extend the outfall.

Concurrent with the studies to amend the facilities plan, a revised CWA 301(h) variance application was submitted to EPA in 1984. After extensive EPA review, public comment, and hearings, the Final Permit Decision was issued by EPA and the five-year NPDES permit became effective 16 October 1985 (EPA, 1985a). As required by this permit, a multi-port diffuser was installed in August 1987 prior to the second year of receiving water sampling. Fourteen years of monitoring were performed under the initial 1985 NPDES permit.

AWWU submitted an application to renew the CWA 301(h) variance from secondary treatment in 1990, but the application was never acted on by EPA. A more recent application was then prepared and submitted in 1998 at EPA's request with additional data and information provided in 1999. A renewed final NPDES permit that incorporated the 301(h) variance was signed by EPA in June 2000 to become effective on 2 August 2000 for five years. The permit was administratively extended in August 2005 pending a permit renewal decision from EPA. The most recent application for a reauthorization of the NPDES permit and CWA 301(h) variance was submitted in January 2005 for review by the EPA. In addition, AWWU has since conducted a number of special studies, including the evaluation of effects on endangered species in support of the permit renewal as a result of the Cook Inlet beluga whale (*Delphinapterus leucas*) being listed as an endangered species (CH2M Hill, 2011).

RECEIVING WATER ENVIRONMENT

The Asplund WPCF discharges into the Knik Arm of Cook Inlet, a unique body of estuarine water with extremely high tidal fluctuations (over 39 feet (ft) [12 m]) with a mean range of 26.2 ft [7.98 m] at Anchorage; NOAA/NOS, 2023). These fluctuations produce extensive tidal flats, swift tidal currents of 4 - 6 knots, and intense mixing within Cook Inlet. The continual input of sediments, combined with the re-suspension of bottom sediments due to high bottom shear stress with each tidal cycle, results in naturally high suspended sediment concentrations of up to 2,500 milligrams/liter (mg/L) in Knik Arm (KLI, 2007b). This sediment originates primarily from riverine and glacial melt waters flowing into Upper Cook Inlet and Knik Arm from Eagle, Knik, Matanuska, and Susitna Rivers that drain a combined area of over 23,300 square miles (mi^2).

Large temperature extremes occur between summer and winter. In the winter, ice can reach thicknesses of over 1 m and consists of broken pieces due to the large tides and strong currents. An important consideration to this ongoing monitoring is the large volume of saline ocean water entering Cook Inlet that is vertically mixed with the riverine and glacial inputs by tidal turbulence. These characteristics yield a water body that is very effective in wastewater dilution and assimilation.

MONITORING OBJECTIVES

The monitoring conducted during 2023 consisted of two main components: (1) in-plant monitoring of influent, effluent, and sludge, including whole effluent toxicity testing (WET); and (2) receiving water quality monitoring in the vicinity of the discharge and mixing zone, and at a control site across Knik Arm. Objectives of the 2023 program as outlined in the permit are:

2023 MONITORING OBJECTIVES

INFLUENT, EFFLUENT, AND SLUDGE MONITORING

- Determine compliance with the NPDES permit and State of Alaska water quality standard (AWQS) criteria
- Determine effectiveness of the industrial pretreatment program
- Aid in assessing the water quality at discharge point
- Characterize toxic substances
- Monitor plant performance
- Determine compliance with the regulatory criteria of Section 301(h) of the CWA
- Provide data for evaluating re-issuance of the NPDES permit

RECEIVING WATER QUALITY MONITORING

- Determine compliance with the NPDES permit and AWQS criteria
- Aid in assessing the water quality of the receiving water
- Determine compliance with the regulatory criteria of Section 301(h) of the CWA
- Determine the level of bacterial concentrations in nearshore waters
- Provide data for evaluating re-issuance of the NPDES permit

2023 MONITORING RESULTS

As part of its self-monitoring program, AWWU conducted daily, weekly, and monthly sampling of influent, effluent, and sludge, depending on the parameter measured. In addition, monitoring for toxic pollutants and pesticides was conducted twice during 2023, once in June and again in August. WET testing was conducted quarterly and receiving water quality monitoring was performed in June. The following summarizes results of this year's monitoring:

INFLUENT, EFFLUENT, AND SLUDGE

- Influent, effluent, and sludge monitoring showed that the Asplund WPCF met the NPDES permit requirements with no exceptions in 2023. AWWU's self-monitoring of total residual chlorine (TRC), pH, fecal coliform, 5-day biochemical oxygen demand (BOD_5) and total suspended solids (TSS) showed compliance with all permit limitations.

- AWWU's self-monitoring of effluent TRC and pH showed that the permit limit for daily maximum TRC was met, and pH was always within permit limitations.

- Fecal coliform concentrations in the effluent were low; neither the permitted limit of 850 fecal coliform colonies per 100 milliliters (FC/100 mL) as a monthly maximum geometric mean, nor the monthly criterion "that not more than 10 percent (%) of the effluent samples shall exceed 2600 FC/100 mL" were exceeded.

- AWWU's self-monitoring of TSS and BOD_5 showed compliance with all regulatory and permit effluent limitations including the required average monthly removal rate of ≥30% as stipulated by the amendment to the CWA (40 Code of Federal Regulations [CFR] Part 125; Final Rule) for these constituents. Effluent concentrations of TSS and BOD_5 were well below the daily, weekly, and monthly permit limits for the entire year. Average annual removals were 75% for TSS and 38% for BOD_5, indicating a high level of primary treatment was typically achieved.

- Effluent total aromatic hydrocarbons (TAH) and total aqueous hydrocarbons (TAqH) were below their maximum allowable effluent concentrations (MAECs) during 2023 as calculated from AWQS and the mixing zone dilution credit.

- Concentrations of metals, cyanide, and total ammonia in the effluent never exceeded their MAECs at any time during any of the 2023 monitoring events.

- Concentrations of toxic pollutants and pesticides, including metals and cyanide, in the influent and effluent were all within the established range or lower than values from a national study of secondary treatment plants (EPA, 1982a).

- Toxic pollutant sludge concentrations were found to be very low compared to the limits established by 40 CFR Part 503. Sludge metals were similar in range or lower than values from a national study of secondary treatment plants with all metals well below the 95th percentile worst-case values (EPA, 1985c).

- Results of quarterly WET testing met permit limits, and all were below the permitted trigger level for all species and events in 2023.

RECEIVING WATER QUALITY

- Little variation among stations was observed for most hydrographic parameters indicating that the receiving water environment is uniform and well mixed near the outfall.
- To test the hypothesis that water quality at the zone of initial dilution (ZID) boundary was not degraded with respect to water quality at near-field and control stations, statistical comparisons were made. Some differences were noted in water characteristics (e.g., dissolved oxygen, pH, salinity, and temperature); however, these were not ascribed to the outfall but were due to higher riverine influences at the control stations.
- Fecal coliform concentrations in receiving water and intertidal samples were found to be low at all locations and met the most restrictive AWQS criteria including stations located within the mixing zone boundary.
- Supplemental receiving water samples obtained as part of the plume monitoring indicated total metals were elevated compared to dissolved metals due to the naturally high suspended sediment load in Cook Inlet. No statistically significant differences between the outfall and control station groupings were seen for any dissolved or total recoverable metal. One anomalously high dissolved copper concentration that exceeded AWQS was seen at a far-field location outside of the ZID, but it appeared to be a laboratory filtration issue and not related to the outfall.
- Supplemental receiving water samples demonstrated that TAH and TAqH met the AWQS at all locations and were not statistically different between the control and outfall stations.
- Supplemental receiving water cyanide samples met AWQS at all locations. One sample was higher than AWQS criteria, however, this sample was taken within the ZID directly over the outfall where a dilution credit is allowed.
- TRC was detected at only one receiving water location in 2023, Station F1-1 directly over the outfall at low slack tide. All other measurements were <10 micrograms per liter (µg/L) compared to the marine AWQS of 7.5 µg/L for chronic, 13.0 µg/L for acute, and ADEC's Practical Quantitation Limit of 100 µg/L. Based on the highest daily effluent TRC concentration (808 µg/L) and a 180:1 dilution credit, the maximum TRC at the ZID boundary was estimated to be 4.5 µg/L, meeting all AWQS.
- Turbidity did not exceed natural conditions and color did not exceed 5 color units at any receiving water station other than at Station F1-1 within the ZID at low slack tide.

CONCLUSIONS

In summary, results of the 2023 monitoring confirm years of previous studies, data in the NPDES permit and 301(h) variance renewal application, and the decision by EPA to reissue the NPDES permit with a 301(h) variance. The Asplund WPCF operated within regulatory requirements during 2023 without exception and has shown no measurable impacts to the marine environment. In addition to the exceptional performance seen in 2023, the Asplund WPCF received the distinguished Platinum Award for exceptional plant performance and permit compliance from the National Association of Clean Water Agencies (NACWA) for 2018, after four consecutive years of Gold Awards. In addition, the Asplund WPCF received Silver Awards in 2019, 2020, and 2022, and another Gold Award in 2021 for exceptional performance.

1.0 INTRODUCTION

1.1 BACKGROUND AND FACILITY OVERVIEW

This monitoring program is designed to meet the requirements of the NPDES Permit AK-002255-1 that authorizes discharge from the John M. Asplund WPCF of municipal effluent into the Knik Arm of Cook Inlet receiving waters (Figure 1). The Asplund WPCF is operated by AWWU under authority of the MOA and subject to this NPDES permit that became effective 2 August 2000. The permit incorporates requirements necessitated by the CWA 301(h) secondary treatment variance and is in compliance with provisions of the FWPCA as amended by the Clean Water Act (CWA 33 U.S.C. §1251 et seq.) and Water Quality Act of 1987, P.L. 100-4.

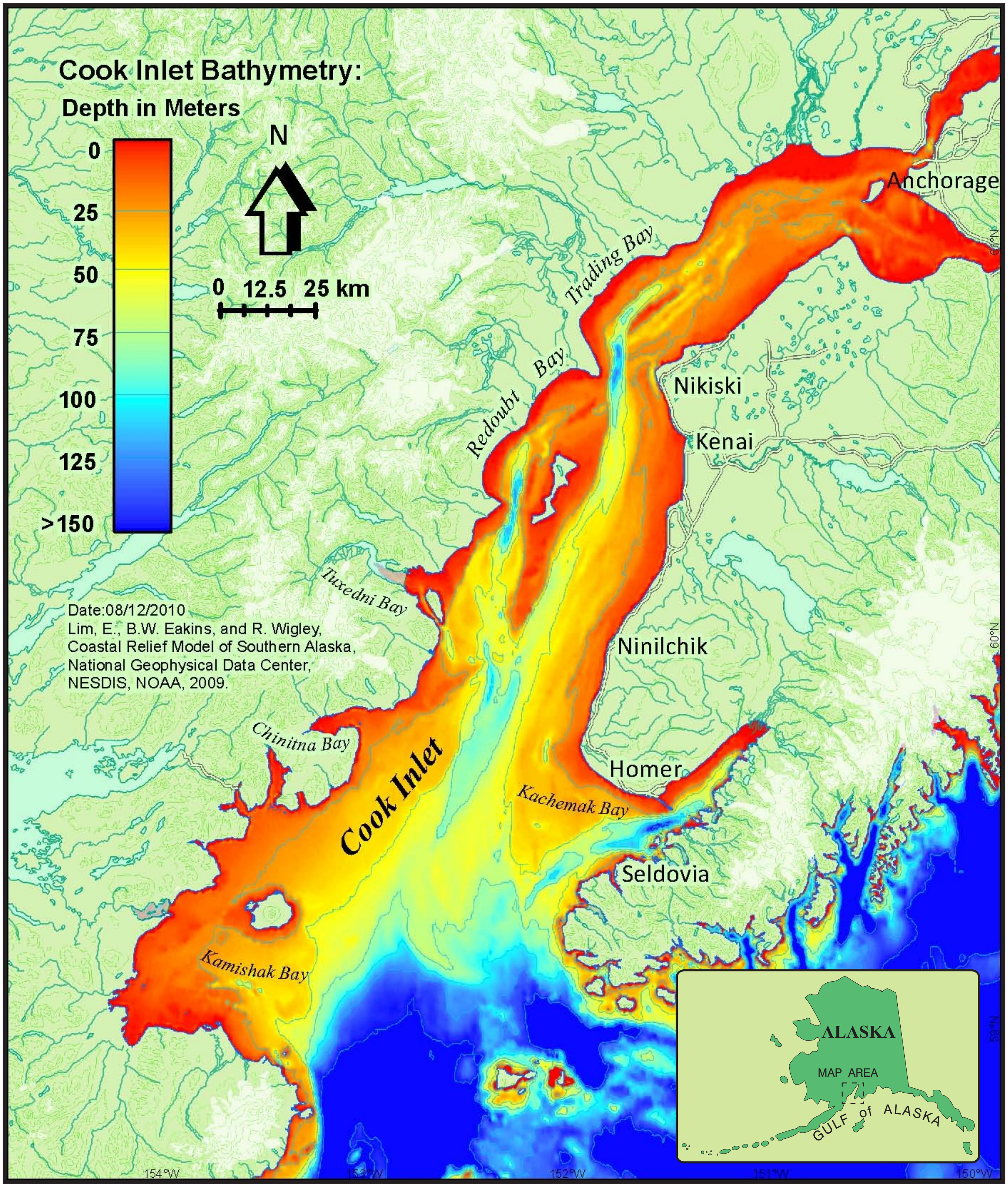
1.1.1 REGULATORY BACKGROUND

In 1972, while the Asplund WPCF and its outfall were being built, the FWPCA was amended to establish two phases of effluent limitations applicable to all Publicly Owned Treatment Works (POTWs). Under Section 301(b), POTWs were required to achieve secondary treatment of effluent by 1 July 1977 and "best practicable waste treatment technology" by July 1983.

Congress again amended the FWPCA in 1977. Section 301(h) was added, providing that the EPA Administrator, upon application from a POTW and with the concurrence of the State, might issue an NPDES permit modifying the requirements of Section 301(b). On 15 June 1979, EPA promulgated the regulations regarding issuance of a variance from secondary treatment to an applicant discharging into certain ocean and estuarine waters and demonstrating compliance with all nine of the rigorous 301(h) criteria.

In September 1979, AWWU submitted to EPA a 301(h)-variance application proposing an improved discharge which eliminated chlorination and required the addition of both an extension and diffuser to the Asplund WPCF outfall. Earlier studies had recommended construction of a 610-m outfall extension and a 305-m diffuser. The proposed extension/diffuser reportedly could meet fecal coliform receiving water standards without chlorination and prevent shore contact of the wastewater plume. As a parallel program, AWWU undertook preparation of a wastewater master plan for the Anchorage area. The resultant *Wastewater Facilities Plan for Anchorage, Alaska* (Ott Water Engineers, Inc. et al., 1982) and the Environmental Impact Statement (EIS) for the City of Anchorage, Alaska, Wastewater Facilities (EPA and Jones & Stokes, 1982) were accepted by EPA and ADEC.

Further studies were subsequently undertaken to derive design criteria for outfall improvements. Significant efforts were included to improve reconnaissance level receiving water data upon which the outfall length and diffuser design were to be based and to evaluate bacterial standards applicable to Knik Arm. The central issue was to evaluate outfall design alternatives and the chlorination/no-chlorination option in relation to the presence of a system of eddies that occur east of Point Woronzof on the flood tide and that might be capable of transporting the effluent plume shoreward. These studies were completed as an *Amendment to the Wastewater Facilities Plan for Anchorage, Alaska* (CH2M Hill with Ott, 1985). This plan recommended using the existing 245-m outfall with the addition of a three-nozzle diffuser. It was concluded that chlorination would still be required to meet bacterial standards even with an extended outfall and diffuser.



Date:08/12/2010
Lim, E., B.W. Eakins, and R. Wigley,
Coastal Relief Model of Southern Alaska,
National Geophysical Data Center,
NESDIS, NOAA, 2009.

Figure 1. General Study Area and Bathymetry.

Because the same standards could be met by use of chlorination and the existing outfall, there was no need to extend the outfall. With continued chlorination, all water quality standards were predicted to be met by the amended facilities plan.

Concurrent with studies to amend the facilities plan, a revised application entitled *Application for Modification of Secondary Treatment Requirements, Section 301(h), Clean Water Act* was submitted to EPA (CH2M Hill with Ott, 1984). The EPA Region 10 301(h) Review Team's Tentative Decision Document, entitled *Analysis of the Section 301(h), Secondary Treatment Variance Application for the John M. Asplund WPCF* (EPA, 1985b) and a draft NPDES permit were made available for public comment on 17 January 1985. After comments and appropriate hearings, the Final Permit Decision (EPA, 1985a) was issued 13 September 1985, and the start date of the five-year NPDES Permit AK-002255-1 was 16 October 1985. As required by this permit, a multi-port diffuser was installed at the Asplund WPCF outfall in the beginning of August 1987. This occurred prior to the 1987 summer water quality monitoring program. This original NPDES permit expired on 15 October 1990.

AWWU submitted a renewal application for the permit in April 1990 which addressed amendments made to the 301(h) provisions by the Water Quality Act. That renewal application was not acted upon by the EPA, and the facility continued to operate under an administrative extension of the 1985 permit until August 2000. In 1998 it was projected that the growth of Anchorage would result in the discharge limits contained in the 1985 permit being exceeded within a few years. Therefore, AWWU prepared and submitted another renewal application which replaced the 1990 application in October 1998 (CH2M Hill, 1998).

In tandem with the renewal application, AWWU conducted special studies and submitted a request for site-specific water quality criteria (SSWQC) to ADEC for the Point Woronzof area of Cook Inlet in December 1998 (AWWU, 1998). This request for SSWQC for turbidity and a suite of metals was necessary because the AWQS for marine waters could not be achieved due to the naturally high suspended sediment loads in Cook Inlet from glacial inputs. The SSWQC request was based on EPA's metals policy that had been recently promulgated which recommended the use of dissolved metals as bioavailable and appropriate for the protection of aquatic life and associated beneficial uses of the water body. Following both agency and public review and comments, the SSWQC were incorporated into the AWQS as amended on 27 May 1999. The SSWQC for the Point Woronzof area included turbidity and the dissolved fraction of arsenic, cadmium, hexavalent chromium, copper, lead, mercury, nickel, selenium, silver, and zinc.

Following the promulgation of these new AWQS, a tentative decision to grant AWWU its 301(h) variance was made by EPA in November 1999. The tentative decision, draft NPDES permit, and permit fact sheet were then made available for public review and comment. The State of Alaska's Division of Government Coordination issued its Final Consistency Determination for the action in February 2000. The current NPDES permit for the Asplund WPCF was signed by the EPA and went into effect 2 August 2000 for five years; it was then administratively extended in August 2005 pending permit renewal. The NPDES permit specifies the current ongoing monitoring program as documented in the Monitoring Program Work Plan (KLI, 2000a), submitted to EPA in October 2000, that identifies how AWWU intends to fulfill the requirements of the permit. The most recent application for a reauthorization of the permit with 301(h) variance was submitted in January 2005 with no action by EPA. Since that time, AWWU has performed a number of special studies including preparation of a biological evaluation in support of the permit renewal as a result of the Cook Inlet beluga whale being listed as an endangered species in October 2008 (CH2M Hill, 2011). These studies, which are some of the largest of their kind, included detailed analyses of influent, effluent, and biosolids for pollutants of emerging concern such as pharmaceuticals and personal care products. Currently, AWWU is preparing a new updated application for a reauthorization of the permit with a 301(h) variance that will include new studies that are being performed by AWWU in support of the application.

Since issuance of the current NPDES permit, EPA has approved ADEC's use of dissolved metals for the AWQS, approved SSWQC for Upper Cook Inlet in the vicinity of Point Woronzof, and removed Alaska from the National Toxic Rule list (EPA, 2006). In 2009, EPA approved the 2009 revisions to the AWQS and the December 2008 State of Alaska Toxics Manual which lists numerical limits. With the exception of cadmium and mercury, where the chronic cadmium standard changed from 9.3 µg/L in the SSWQC to 8.8 µg/L in the AWQS and the chronic mercury standard which changed from 0.025 µg/L in the SSWQC to 0.94 µg/L in the AWQS, all other dissolved metals criteria are the same in the two standards.

1.1.2 ASPLUND WPCF DESCRIPTION

AWWU provides both domestic wastewater and potable water utility service to customers located within the MOA. Wastewater processing and treatment is conducted at the Asplund WPCF located on approximately 45 acres in West Anchorage at Point Woronzof, adjacent to Cook Inlet. The wastewater treatment facility was constructed from 1971 through 1973 and is a conventional primary treatment plant rated for an average daily flow of 58 million gallons per day (mgd). The WPCF treats wastewater collected from the Anchorage Bowl region including the Joint Base Elmendorf-Richardson (JBER). Sludge from both the Eagle River and Girdwood wastewater treatment facilities (WWTFs) is also received at the Asplund WPCF for processing. The WPCF is operated under a CWA Section 301(h) modification as a primary treatment facility utilizing incineration as the solids handling process. The facility underwent a major expansion in the 1980s which roughly doubled its capacity. The facility currently operates at an average daily flow of approximately 30 mgd and is required to meet published BOD_5 and TSS removal rates of 30 percent (%) prior to discharging treated effluent to Cook Inlet at Point Woronzof. Figure 2 depicts the overall process flow for the WPCF in a simplified schematic form and Figure 3 provides a plan-view layout of the facility. The major processes of the Asplund WPCF include the following:

- Headworks
- Grit Removal
- Primary Clarification
- Disinfection
- Plant Effluent Discharge System
- Scum Concentration
- Solids Handling (Gravity Thickening, Dewatering, and Incineration)

Expected population growth within the service area combined with more stringent permitting regulations is expected to increase demand on the Asplund WPCF in the coming years. The future average daily dry weather flow in 2032 is projected to be 30.4 mgd whereas the 2032 peak wet weather flow for a 25-year event was determined to be 60.8 mgd (CDM Smith, 2014).

The WPCF receives and treats wastewater generated throughout the Anchorage Bowl geographic region that encompasses the area west of Chugach State Park, from Potter Marsh in the south to Eagle River in the north, including JBER. Influent flows and loads at the WPCF are conveyed to

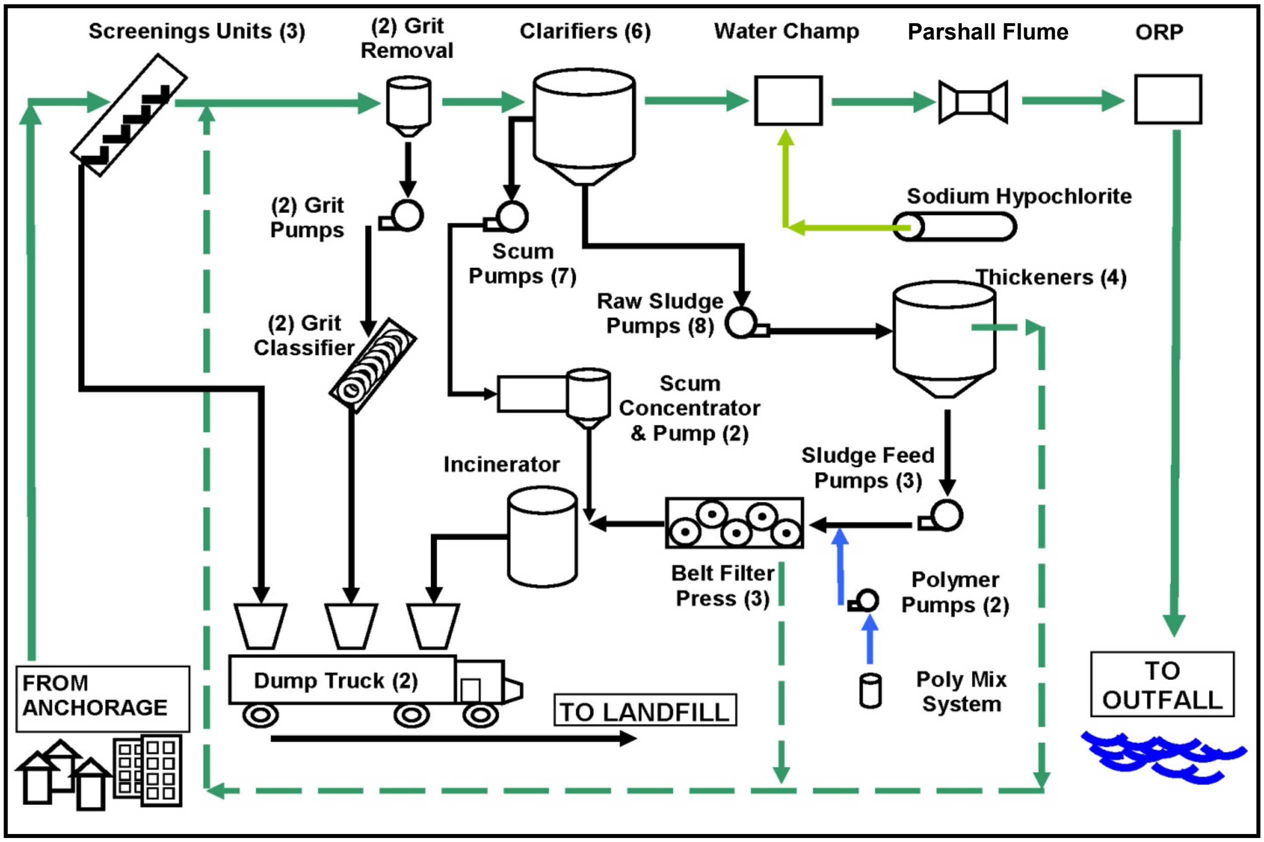


Figure 2. Asplund WPCF Process Flow Diagram.

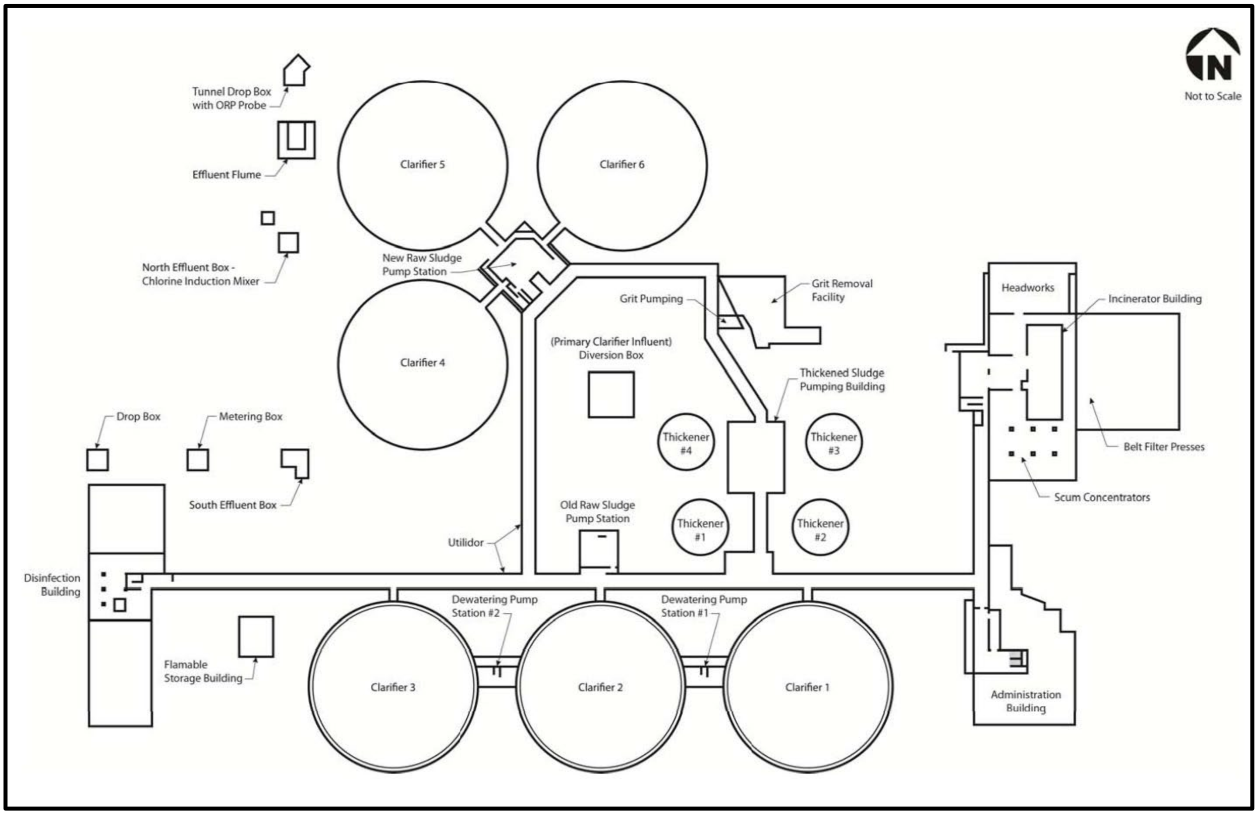


Figure 3. Asplund WPCF Facility Layout.

the plant via the Anchorage Bowl wastewater collection system. In addition to the domestic, commercial, and industrial inputs, piped flows to the plant include infiltration and inflow (I&I) and discharges of septage and landfill leachate that are collected and discharged into two collection system receiving stations. Since these loads are discharged into the collection system, all impacts of flows and loadings are captured in plant sampling and analyses. The one source of effluent flow that is not represented in the plant influent is makeup water. Approximately 1.1 mgd of makeup water is utilized in various plant processes such as the belt filter press and the incinerator scrubber washdown; this consists of a combination of city water and well water.

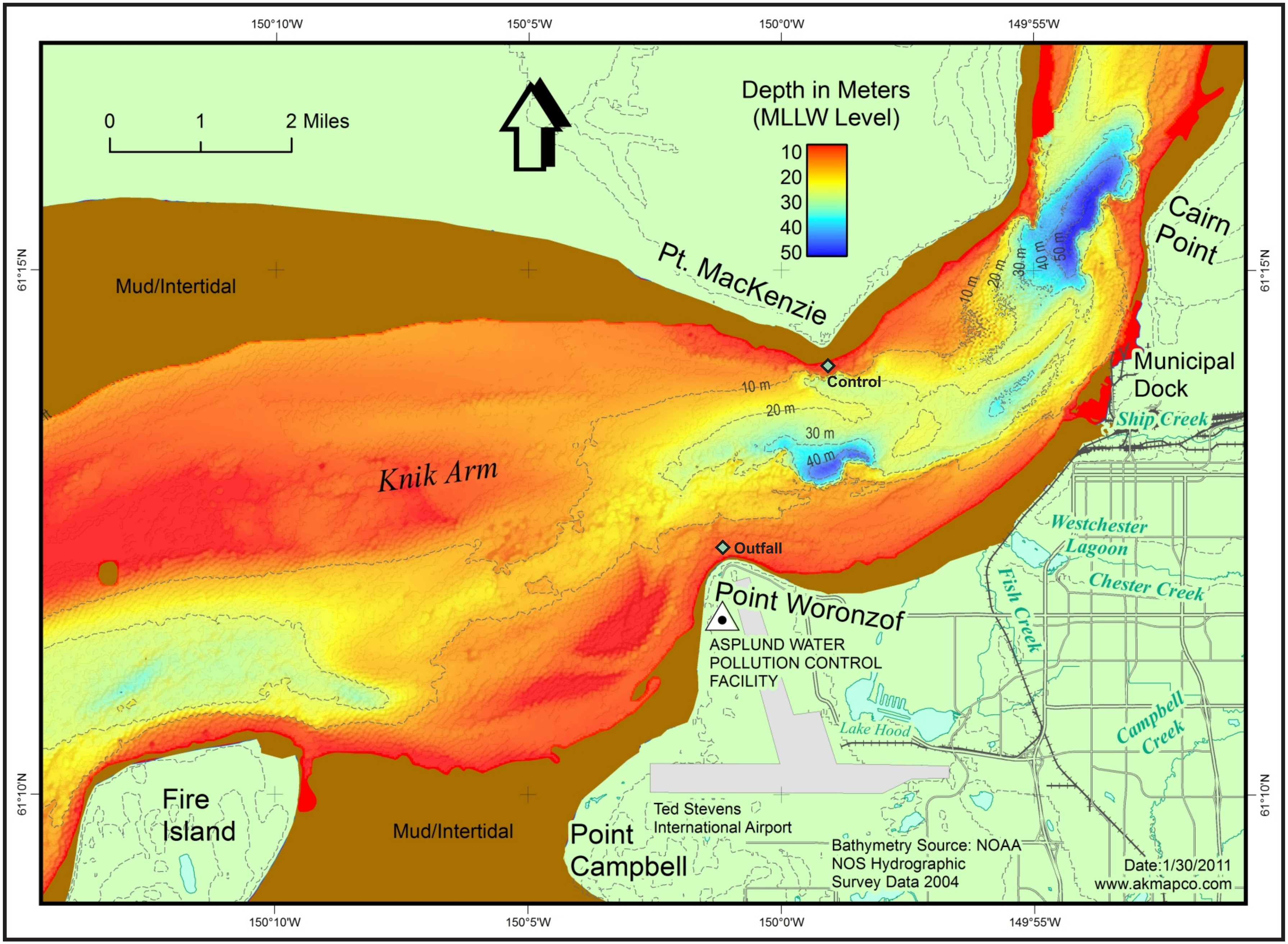
Combined septage from the King Street and Turpin Street receiving stations account for approximately 0.5% of the total influent flow, but due to their concentrated nature, they account for 11.9% of the total TSS loading and 6.0% of the total BOD_5 loading to the WPCF (CDM Smith, 2014). In addition to septage, landfill leachate from the Anchorage Regional Landfill and Matanuska-Susitna Borough (MSB) Central Landfill is collected at the Turpin receiving station. The Merrill Field Landfill discharges landfill leachate directly into the collection system. On a combined basis, leachate from these three landfills accounts for approximately 1.0% of the total influent flow, 3.0% of the TSS loading, and 7.8% of the total BOD_5 loading. The vast majority of the leachate loading was found to come from the Anchorage Regional Landfill even though flow from the Merrill Field Landfill was nearly four times greater (CDM Smith, 2014). Contributions from JBER to Asplund's influent are approximately 8.2% to the TSS loading and 12% to flow.

1.1.3 ENVIRONMENTAL BACKGROUND

The Asplund WPCF discharges offshore of Point Woronzof into the receiving waters of Knik Arm in Upper Cook Inlet, Alaska. Cook Inlet is a major tidal estuary that is approximately 333 kilometers (km; 180 nautical miles) long and 93 - 148 km (50 - 80 nautical miles) wide at its lower end with a large assimilative capacity and over 16,000 square km of surface area. Bathymetry indicates the Inlet is fairly deep, generally 36.6 m (120 ft) north of the Forelands and about 167 m (550 ft) at the entrance (refer to Figure 1). Numerous rivers, including the major Knik, Matanuska, and Susitna River drainages, discharge into the Upper Inlet. A detailed map of the Point Woronzof region indicates deep water (33 – 164 ft [10 - 50 m]) extending well past Anchorage up into Knik Arm (Figure 4).

Cook Inlet is a unique estuary, with perhaps the closest parallel being the Bay of Fundy between New Brunswick and Nova Scotia, Canada. The occurrence of tidal bores at the head, currents of 4 - 6 knots, suspended sediment loads of up to 2500 mg/L, large temperature extremes, and moving pancake ice of up to one meter thick make Cook Inlet unique. The high tidal ranges result from the geometry of the Inlet, which has a natural resonance period close to the semi-diurnal tidal period. The resulting large tidal fluctuations and fast currents cause complete vertical mixing of the Inlet waters including any discharges into those waters. Another important factor for the Point Woronzof discharge is the large volume of saline water that enters Cook Inlet that is completely vertically mixed with the riverine inputs by tidal turbulence. This allows the water body to be very effective in wastewater dilution and assimilation.

The particle size distributions of natural suspended sediments near Point Woronzof show that very large particles are suspended by the current-generated turbulence, with 50% of the load being in the size range of 65 - 250 microns. Particle settling is seen at slack tide, but due to high tidal currents, particles never completely settle. In the absence of currents, settling rate tests show that 93% of the solids in an ambient water sample settle within about 20 minutes (min).



Bathymetry Source: NOAA
NOS Hydrographic
Survey Data 2004

Date:1/30/2011
www.akmapco.com

Figure 4. Asplund WPCF Outfall and Control Station Locations.

Previous work has indicated that due to extremely swift currents, no seabed accumulation of suspended sediments, either natural or from the discharge, occurs in the vicinity of the outfall. The bottom is strictly coarse gravel and cobble because of these currents. Areas of deposition do exist in other areas, however, such as east of Point Woronzof, where mudflats and beaches are found, and southwest of the Point. Prior Asplund monitoring studies have also shown that essentially no benthic biota is found on the scoured cobble/gravel bottom or on the beaches in Knik Arm or at Point Woronzof. Similar sampling by these studies of the beaches and tidal flats showed very sparse abundances and very low diversities (KLI, 1979, 1987a, 1987b, and 1989). Benthic and intertidal marine fauna populations are limited by the naturally harsh physical environment of mud and glacial silt, high turbulence and bottom scouring, large tides and strong currents, and extreme ice conditions.

Current trajectories in the immediate vicinity of the outfall are of concern because of flow separation zones on either side of Point Woronzof. Previous work indicated that, on a flood tide, a clockwise eddy sometimes exists east of Point Woronzof resulting in shoreward transport at certain stages of the flood tide. A flow separation also exists to the west of Point Woronzof during ebb flow that entrains effluent closer to shore during the beginning of the tide cycle. The formation of eddies, however, has never been observed during these ebb tides.

1.2 STUDY DESIGN

1.2.1 MONITORING OBJECTIVES

The monitoring program as described by NPDES Permit No. AK-002255-1 includes influent, effluent, and sludge monitoring at the Asplund WPCF; receiving water and sediment quality monitoring; biological and toxicological monitoring; and a toxics control program. The objectives of the overall monitoring program as outlined in the NPDES permit are to:

- Determine compliance with the NPDES permit
- Determine compliance with AWQS criteria
- Determine effectiveness of the industrial pretreatment program
- Aid in assessing water quality at the discharge point
- Characterize toxic substances
- Monitor plant performance
- Determine compliance with the regulatory criteria of Section 301(h) of the CWA
- Determine the level of bacterial concentrations in nearshore waters
- Monitor for changes in sediment quality (organic enrichment, alteration of grain size distribution, and pollutant contamination) (note: not required or performed in 2023)
- Determine if pollutants from the discharge are accumulating in exposed biological organisms (note: not required or performed in 2023)
- Provide data for evaluating re-issuance of the NPDES permit

1.2.2 PROGRAM DESCRIPTION

The elements of the monitoring program for the Asplund WPCF are:

- Influent, Effluent, and Sludge Monitoring, including
  - In-plant sampling
  - Toxic pollutants and pesticides (including metals and cyanide)

    - Pretreatment monitoring
    - Whole effluent toxicity (WET) testing
- Receiving Water Quality Monitoring, including
    - Plume dispersion and water quality
    - Intertidal bacteria
- Biological and Sediment Monitoring, including
    - Sediment quality
    - Bioaccumulation

Table 1 provides an overview of the monitoring requirements as described by the permit. Detailed information regarding each program component is provided in Section 2.0, Methods.

1.2.3 HYPOTHESES

Hypotheses were formulated for the monitoring program as an unbiased approach in determining whether the Asplund WPCF was affecting the marine receiving water environment. The null (no effect) hypotheses (H_o) tested each year of monitoring are as follows:

H_o1: *Applicable State and Federal effluent and receiving water standards are met by the Asplund WPCF discharge.*

H_o2: *Water quality at the boundary of the ZID is not significantly changed with respect to nearfield or control stations.*

1.3 CONTRACTOR

AWWU's designated contractor for the 2023 Asplund WPCF Monitoring Program was Kinnetic Environmental, Inc. (KEI) of Anchorage, Alaska.

Influent, effluent, and sludge analyses of volatile and semi-volatile organic pollutants, pesticides, polychlorinated biphenyls (PCBs), cyanide, and trace metals (total and dissolved) for the toxic pollutant and pretreatment monitoring were performed by ALS Environmental of Kelso, WA, except dioxins which were analyzed by ALS Canada LTD of Burlington, ON Canada. Asbestos analyses were performed by International Asbestos Testing Laboratories of Mount Laurel, NJ. WET testing was performed by Pacific EcoRisk of Fairfield, CA. In addition, AWWU's Asplund Laboratory performed monthly in-plant analyses as part of its self-monitoring program and contracted the Part 503 sludge analyses to SGS North America Inc. of Anchorage, AK.

KEI performed the receiving water sampling and field analyses for turbidity, TRC, and color analysis. Analytical support for the receiving water sampling included: Brooks Applied Labs of Seattle, WA for trace metals; ALS Environmental, Kelso, WA for volatile and semi-volatile priority pollutants, pesticides, PCBs, and cyanide; ALS Canada LTD of Burlington, ON for dioxin; AWWU's Asplund WPCF Laboratory in Anchorage, AK for bacteriology and TSS; and TDI-Brooks International, Inc./B&B Laboratories, Inc., College Station, TX for polycyclic aromatic hydrocarbon (PAH) analyses.

1.4 PERIOD OF REPORT

This report documents results of the monitoring program from 1 January through 31 December 2023 under the current NPDES permit.

Table 1. Overall Monitoring Requirements.

Parameter	**Frequency**	**Sample Type**	**Remarks**
In-Plant Monitoring	See Table 2	See Table 2	See Table 2 - includes flow, TRC, dissolved oxygen (DO), BOD_5, TSS, temperature, pH, fecal coliform, total ammonia as nitrogen, enterococci bacteria, and oil and grease
Toxic Pollutants and Pesticides (including Metals and Cyanide)	2/year[a]	Influent, 24-hour (hr) flow composite Effluent, 24-hr flow composite Sludge, 24-hr composite	See Table 2
Pretreatment Program	2/year[a,b]	Influent, three 24-hr flow composite Effluent, three 24-hr flow composite Sludge, 24-hr composite	Includes metals and cyanide plus percent solids for sludge
Whole Effluent Toxicity (WET) Testing	4/year[c]	Effluent, 24-hr flow composite	See Table 2
Receiving Water Quality	1/year[d]	Receiving water, grab	See Table 5
Intertidal Bacteria	1/year[e]	Intertidal receiving water, grab	Fecal coliform sampling at 8 intertidal stations
Sediment	Once during the fourth year of the permit[e]	Grab samples of surficial (0-2 centimeters [cm]) sediment collected at intertidal and subtidal stations[f]	Includes total volatile solids (TVS), toxic pollutants and pesticides (including metals and cyanide), and sediment grain size distribution
Bioaccumulation	Once during the fourth year of the permit	Grab samples of intertidal macroalgae (*Vaucheria* spp.) Note: Macroalgae was not available during 2003 or 2004. Therefore, in consultation with EPA and AWWU, Pacific cod (*Gadus macrocephalus)* were collected and analyzed for this permit component in October 2004.	Includes toxic pollutants and pesticides (including metals and cyanide)

a Sampling will be conducted twice per year: once in summer-dry conditions and once in summer-wet conditions.

b One day of the three consecutive days of sampling will also serve as part of the Toxic Pollutant and Pesticides (metals and cyanide) sampling performed twice each year.

c WET testing will be performed on a quarterly basis.

d Sampling will be conducted once per year in summer-dry conditions.

e Sampling will be conducted in conjunction with the receiving water sampling.

f Sampling will be performed at Intertidal Stations 1, 2, and Control (IT-1, IT-2, and IT-C); a subtidal station located at the ZID boundary; and a subtidal control station near Point MacKenzie (in a similar water depth as the ZID boundary).

2.0 METHODS

2.1 INFLUENT, EFFLUENT, AND SLUDGE MONITORING

Influent, effluent, and sludge monitoring requirements as specified by the NPDES permit are outlined in Table 2. AWWU performed routine daily, weekly, and monthly sampling of conventional pollutant parameters, biannual sampling of enterococci bacteria, and daily measurements of flow rate. KEI performed the less-frequently monitored parameters of oil and grease, toxic pollutants and pesticides (including metals and cyanide), and WET testing.

- ✓ determine compliance with the NPDES permit and State of Alaska water quality criteria
- ✓ determine effectiveness of the industrial pre-treatment program
- ✓ aid in assessing the water quality at the discharge point
- ✓ characterize toxic substances
- ✓ help monitor plant performance
- ✓ determine compliance with the regulatory criteria of Section 301(h) of the CWA
- ✓ provide data for evaluating re-issuance of this permit

2.1.1 IN-PLANT MONITORING

In-plant influent, effluent, and sludge sampling was performed by AWWU personnel as described in Table 2 and in a separate monitoring program plan prepared by AWWU (AWWU, 2000). Samples were obtained following the schedule required by the permit. Influent was sampled at a representative location in the influent headworks, upstream from any recycle streams. Effluent was sampled at a well-mixed point downstream from the chlorination input point in the final effluent line with pumping of the sample back to the plant so that effluent samples were representative of actual chlorine contact time at the point of discharge. Composite sludge samples were obtained from the sludge feed screw auger downstream of the addition of primary scum and scum concentrate. Influent and effluent grab samples were obtained for pH and temperature, and effluent grab samples were obtained for TRC, dissolved oxygen (DO), and fecal coliform. Composite influent and effluent samples were obtained for the analysis of BOD_5, TSS, and total ammonia as nitrogen (effluent only).

2.1.2 TOXIC POLLUTANT AND PESTICIDE MONITORING

As outlined in the permit, toxic pollutant and pesticide sampling was conducted twice during 2023, once during June (summer-dry) and once during August (summer-wet). Samples were collected as required by the permit and either analyzed by AWWU laboratory personnel or provided to KEI for shipment to the appropriate analytical laboratory. Influent and effluent were sampled as discrete grabs or by 24-hour (hr) flow-proportional methodology (depending on the analysis method). Influent was sampled at a representative location in the influent headworks upstream from any recycle streams, and effluent was sampled at a well-mixed point downstream from the chlorination injection point in the final effluent line. Influent and effluent 24-hr flow-proportional sampling was performed with Teledyne ISCO Model 5800 Refrigerated Autosamplers. Influent and effluent samples were chilled as required during composite sampling. Sludge samples, consisting of eight discrete grabs collected every three hours over a 24-hr period, were obtained from the sludge feed screw auger, chilled, and composited prior to sample shipping and analysis.

Influent and effluent composite samples included pesticides, semi-volatile organics, metals, asbestos, and cyanide. Influent and effluent grab samples included volatile organic analyses and

Table 2. In-Plant Influent, Effluent, and Sludge Monitoring Requirements.

Parameter	Sample Point[a]	Sample Frequency	Sample Type
Flow[b]	Effluent	Continuous	Continuous
Total Residual Chlorine (TRC)[b]	Effluent	Continuous or every 2-4 hrs	Grab
Dissolved Oxygen (DO)[b]	Effluent	4/week	Grab
Biochemical Oxygen Demand (BOD_5)[b]	Influent and effluent	4/week	24-hr flow composite
Total Suspended Solids (TSS)[b]	Influent and effluent	4/week	24-hr flow composite
Temperature[b]	Influent and effluent	4/week	Grab
pH[b]	Influent and effluent	4/week	Grab
Fecal Coliform Bacteria[b]	Effluent	3/week	Grab
Total Ammonia as N[b]	Effluent	1/month	24-hr flow composite
Enterococci Bacteria[b]	Effluent	2/year[d]	Grab
Oil and Grease[c]	Effluent	2/year[d]	Grab
Toxic Pollutants and Pesticides (including Metals and Cyanide)[c,e]	Influent, effluent, and sludge	2/year[d]	24-hr flow composite (influent & effluent) 24-hr composite (sludge and influent /effluent volatile organics)
Whole Effluent Toxicity[c,f] (WET) Testing	Effluent	4/year	24-hr flow composite

a When both influent and effluent samples are required, samples will be collected during the same 24-hr period.

b AWWU performed this monitoring component.

c KEI performed this monitoring component.

d Twice per year sampling: during summer, once in dry conditions and once in wet conditions.

e As part of the pretreatment program sampling requirements, arsenic, cadmium, chromium, copper, cyanide, lead, mercury, nickel, silver, and zinc in influent, effluent, and sludge will be sampled, along with percent solids (in sludge only). These metals were analyzed for and reported as both total recoverable metals and dissolved metals for influent and effluent and as total metals in dry weight for sludge. Sampled as follows: Influent and effluent as three separate 24-hr flow composite samples taken on three consecutive days, one day of which coincides with the twice-yearly sampling (summer-dry and summer-wet conditions); and sludge as one composite of eight grabs/day when influent and effluent samples are being taken. In addition, the other five metals from the toxic pollutant list are analyzed in the summer-wet/summer-dry samples: beryllium, molybdenum, antimony, thallium, and selenium.

f WET requirements are summarized in the text (Section 2.1.4). Initial testing was a screening period performed during three quarters, during which three species were tested to determine the most sensitive species. Re-screening is performed each year during one quarter (different than the previous year) to determine the most sensitive species to use for continued testing. Accelerated testing requirements will be triggered if chronic toxicity is greater than 143 TUc (chronic toxicity units, TUc=100/NOEC).

total hydrocarbons as oil and grease. Volatile organics grab samples were collected every three hours during the 24-hr sampling period and composited at the contract laboratory prior to analysis.

At time of collection (or subsampling from composites), all samples were appropriately labeled using project-specific sample labels as described in Section 2.5. Sample collection and shipment was documented using project-specific chain of custody (COC) forms as described in Section 2.5.

Toxic pollutants as defined by the permit are those substances listed in 40 CFR 401.15 (Table 3). This list involves 65 categories of pollutants, including asbestos, aromatic hydrocarbons, pesticides, metals, and polychlorinated biphenyls (PCBs). Pesticides as defined in the permit are demeton, guthion, malathion, mirex, methoxychlor, and parathion as listed in 40 CFR 125.58. Other pesticides which were tested for are included on the toxic pollutants list (40 CFR 401.15). Methods used to analyze these constituents for the program and for which KEI was responsible, as well as those performed by AWWU, are provided in Table 3. Preservation and maximum holding time information for each method is provided in Table 4. All samples were collected in the appropriate sample containers and preserved, if necessary, as described by EPA or equivalent approved standard methodology. Filled sample containers were immediately chilled and shipped to various laboratories for analysis.

2.1.3 PRETREATMENT MONITORING

Pretreatment program monitoring (Table 1 and Table 2) was performed by AWWU’s Point Woronzof Laboratory. This monitoring was performed twice in 2023 in conjunction with summer-dry and summer-wet sampling. As part of the pretreatment program sampling requirements, arsenic, cadmium, chromium, copper, cyanide, lead, mercury, nickel, silver, and zinc in influent, effluent, and sludge were sampled, along with percent solids (in sludge only). Although not required by the permit, pretreatment sampling also included antimony, beryllium, molybdenum, selenium, and thallium. These samples were analyzed by ALS Environmental as total recoverable and dissolved metals for influent and effluent and as total recoverable metals in dry weight for sludge. Sampling was conducted as prescribed by the permit: influent and effluent as three separate 24-hr composite samples taken on three consecutive days, one day of which coincided with each of the twice-yearly toxic pollutant and pesticide sampling efforts (summer-dry and summer-wet). The sludge sampling consisted of a single composite of eight grabs/day when influent and effluent composite samples were being taken.

2.1.4 WHOLE EFFLUENT TOXICITY TESTING (WET)

As outlined in the permit, WET testing was performed on a quarterly basis using 24-hr flow-composited effluent samples. Final effluent was sampled by discrete flow-proportional samplers at a well-mixed point downstream from the chlorination injection point. Following sample collection, effluent samples were chilled, packaged, and shipped immediately to the toxicity laboratory for testing. Samples were appropriately labeled at the time of collection using project-specific labels as described in Section 2.5. Sample collection and shipment were documented using project-specific COC forms.

Table 3. Methods[a] for the Analysis of Toxic Pollutants and Pesticides for Influent, Effluent, and Sludge Monitoring.

Volatile Organic Compounds	Semi-Volatile Organic Compounds	Pesticides and PCBs	Inorganic Compounds
EPA 624.1 (Inf/Eff) **SW 8260C (Sludge)** Acrolein[b] Acrylonitrile[b] Benzene Bromoform Carbon tetrachloride Chloralkyl ethers Chloroform Chlorinated benzenes Chlorinated ethanes 1,2-dichloroethane Dibromochloromethane Dichloroethenes Dichloropropane Dichloropropene 1,1,1-trichloroethane Ethylbenzene Halomethanes Methylene chloride Toluene Tetrachloroethene Trichloroethene Vinyl chloride Xylenes[b]	**EPA 625.1 (Inf/Eff)** **SW 8270D (Sludge)** Acenaphthene Benzidine Chloralkyl ethers Chlorinated ethanes Chlorinated naphthalenes Chlorinated phenols 2-chlorophenol Dichlorobenzenes Dichlorobenzidine 2,4-dichlorophenol 2,4-dimethylphenol Dinitrotoluene Diphenylhydrazine Fluoranthene Haloethers Heptachlor & metabolites Hexachlorobutadiene Hexachlorocyclopentadiene Hexachloroethane Isophorone Naphthalene Nitrobenzene Nitrophenols Nitrosamines Polycyclic aromatic hydrocarbons (PAHs) Pentachlorophenol Phenol Phthalate esters	**ALS SOP (Inf/Eff/Sludge)** Demeton-o,s Malathion Ethyl Parathion Guthion (Azinphos-methyl) [b]	**EPA 100.1/100.2 TEM (Inf/Eff)** **EPA 600 PLM (Sludge)** Asbestos
		EPA 608.3 (Inf/Eff) **SW 8081B (Sludge)** Aldrin/Diedrin Chlordane (technical Mixture & metabolites) DDT & metabolites Endosulfan & metabolites Endrin & metabolites Heptachlor & metabolites Hexachlorocyclohexane Methoxychlor Mirex[b] Toxaphene	**EPA 200.8 (Inf/Eff)** **EPA 6020A (Sludge)** Antimony Arsenic Beryllium Cadmium Chromium Copper Lead Molybdenum Nickel Selenium Silver Thallium Zinc
	EPA 1613B (Inf/Eff) **SW 8290 (Sludge)** 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD)	**EPA 608.3 (Inf/Eff)** **SW 8082A (Sludge)** Polychlorinated biphenyls (PCBs)	**EPA 1631E (Inf/Eff/Sludge)** Mercury
	EPA 1664A (Inf/Eff) Oil and Grease		**SM 4500-CN, E (Inf/Eff)** **EPA 9012B (Sludge)** Cyanide

Inf Influent.

Eff Effluent.

[a] "EPA" refers to *Methods for Chemical Analysis of Water and Wastes*, EPA 1983, EPA-600/4-79-020 or 40 CFR 136; "SM" refers to *Standard Methods for the Examination of Water and Wastewater*, 22nd ed., APHA 2012; "SW" refers to SW 846, *Test Methods for Evaluating Solid Waste*. 3rd ed., EPA 1986a.

[b] Included with expanded method analyte list.

Table 4. Preservation and Analytical Procedures for Influent, Effluent, and Sludge.

Parameter	Sample Type	Preservation	Maximum Holding Time	Method[a]
Temperature	Inf/Eff	None required	Analyze immediately	SM 2550B
pH	Inf/Eff	None required	Analyze immediately	SM 4500-H^+ B
BOD_5	Inf/Eff	Cool, ≤6°C	48 hours	SM 5210B
Total Residual Chlorine	Eff	None required	Analyze immediately	Hach 8167 (EPA 4500-Cl, G)
DO Electrode	Eff	None required	Analyze immediately	SM 4500-O G
Suspended Solids	Inf/Eff	Cool, ≤6°C	7 days	SM 2540D
Total Solids	Sludge	Cool, ≤6°C	7 days	EPA 160.3 Modified SM 2540 G
Enterococci	Inf/Eff	Cool, ≤8°C, $Na_2S_2O_3$ in effluent	8 hours total, 6 hours receipt by laboratory	ASTM D6503-99
Asbestos	Inf/Eff	Cool, ≤6°C, dark	Filter within 48 hours of receipt at lab	EPA 100.2 EPA 100.1
	Sludge	Cool, ≤6°C	28 days	EPA 600
Fecal Coliform Bacteria	Eff	Cool, ≤8°C, dark 0.0008% $Na_2S_2O_3$	8 hours total, 6 hours receipt by laboratory	SM 9221B/E
Total Ammonia as Nitrogen	Eff	Cool, ≤6°C, H_2SO_4 to pH <2	28 days	Hach 8038 (EPA 4500-NH_3,C)
Total Hydrocarbons as Oil and Grease	Inf/Eff	Cool, ≤6°C, dark HCl to pH<2	28 days	EPA 1664A HEM[b]
Volatile Organics	Inf/Eff	Cool, ≤6°C, dark, HCl to pH <2 L-Ascorbic Acid in effluent	14 days	EPA 624.1
	Sludge	Cool, ≤6°C	14 days	SW 8260C
Dioxins	Inf/Eff	Cool, ≤6°C	1 year	EPA 1613B
	Sludge	Cool, ≤6°C	30 days until extraction/45 days after extraction 1 year	SW 8290
Semi-Volatile Organics	Inf/Eff	Cool, ≤6°C, dark L-Ascorbic Acid in effluent	7 days until extraction/40 days after extraction	EPA 625.1
	Sludge	Cool, ≤6°C	14 days until extraction/40 days after extraction	SW 8270D
Pesticides & PCBs	Inf/Eff	Cool, ≤6°C, L-Ascorbic Acid in effluent	7 days or 1 yr (PCBs) until extraction/40 days after extraction	EPA 608.3 ALS SOP
	Sludge	Cool, ≤6°C	14 days or 1 yr (PCBs) until extraction/40 days after extraction	ALS SOP SW 8081B SW 8082A

Table 4. Preservation and Analytical Procedures for Influent, Effluent, and Sludge. (continued)

Parameter	Sample Type	Preservation	Maximum Holding Time	Method[a]
Cyanide (total)	Inf/Eff	Cool, ≤6°C, NaOH to pH>12, 0.6 g L-Ascorbic Acid in effluent	14 days	SM 4500-CN, E
	Sludge	Cool, ≤6°C	14 days	EPA 9012 B
Antimony	Inf/Eff	Cool, ≤6°C, HNO_3 to pH<2	6 months	EPA 200.8
	Sludge	Cool, ≤6°C	6 months	EPA 6020A
Arsenic	Inf/Eff	Cool, ≤6°C, HNO_3 to pH<2	6 months	EPA 200.8
	Sludge	Cool, ≤6°C	6 months	EPA 6020A
Beryllium	Inf/Eff	Cool, ≤6°C, HNO_3 to pH<2	6 months	EPA 200.8
	Sludge	Cool, ≤6°C	6 months	EPA 6020A
Cadmium	Inf/Eff	Cool, ≤6°C, HNO_3 to pH<2	6 months	EPA 200.8
	Sludge	Cool, ≤6°C	6 months	EPA 6020A
Chromium	Inf/Eff	Cool, ≤6°C, HNO_3 to pH<2	6 months	EPA 200.8
	Sludge	Cool, ≤6°C	6 months	EPA 6020A
Copper	Inf/Eff	Cool, ≤6°C, HNO_3 to pH<2	6 months	EPA 200.8
	Sludge	Cool, ≤6°C	6 months	EPA 6020A
Lead	Inf/Eff	Cool, ≤6°C, HNO_3 to pH<2	6 months	EPA 200.8
	Sludge	Cool, ≤6°C	6 months	EPA 6020A
Mercury	Inf/Eff	Cool, ≤6°C, HCl to pH<2	90 days	EPA 1631 E
	Sludge	Cool, ≤6°C	28 days	EPA 1631 E
Molybdenum	Inf/Eff	Cool, ≤6°C, HNO_3 to pH<2	6 months	EPA 200.8
	Sludge	Cool, ≤6°C	6 months	EPA 6020A
Nickel	Inf/Eff	Cool, ≤6°C, HNO_3 to pH<2	6 months	EPA 200.8
	Sludge	Cool, ≤6°C	6 months	EPA 6020A
Selenium	Inf/Eff	Cool, ≤6°C, HNO_3 to pH<2	6 months	EPA 200.8
	Sludge	Cool, ≤6°C	6 months	EPA 6020A
Silver	Inf/Eff	Cool, ≤6°C, HNO_3 to pH<2	6 months	EPA 200.8
	Sludge	Cool, ≤6°C	6 months	EPA 6020A
Thallium	Inf/Eff	Cool, ≤6°C, HNO_3 to pH<2	6 months	EPA 200.8
	Sludge	Cool, ≤6°C	6 months	EPA 6020A
Zinc	Inf/Eff	Cool, ≤6°C, HNO_3 to pH<2	6 months	EPA 200.8
	Sludge	Cool, ≤6°C	6 months	EPA 6020A

[a] Unless noted, "EPA" refers to *Methods for Chemical Analysis of Water and Wastes*, EPA 1983, EPA-600/4-79-020 or 40 CFR 136; "SM" refers to *Standard Methods for the Examination of Water and Wastewater*, 22nd ed., APHA 2012. "SW" refers to SW 846, *Test Methods for Evaluating Solid Waste.* 3rd ed., EPA 1986a.

[b] EPA, 1999a. Method 1664, Rev. A; Document No. EPA-821-R-98-002.

Initial WET testing was performed as a screening period over the course of three quarters, during each of which three toxicity tests were performed: one vertebrate and two invertebrate species. These screening tests were performed during 2000 and 2001. Screening included the vertebrate *Atherinops affinis* (topsmelt) for survival and growth; an invertebrate bivalve species *Mytilus* spp. (mussel) for larval development; and an invertebrate echinoderm species *Strongylocentrotus purpuratus* (purple urchin) for fertilization. Once the initial screening period was completed, the single-most sensitive species (bivalve) was used for subsequent toxicity testing until the next three-species screening was performed. As required by the permit, three-species screening must be performed each year during one quarter (different than the previous year) to determine the most sensitive species to use for continued testing. Re-screening that was performed in 2002, 2003, and 2023 found bivalves to be the most sensitive species. Three-species re-screening performed from 2004 through 2022 found the purple sea urchin to be the most sensitive species.

Toxicity testing was performed as required by the permit and as described in *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms* (EPA, 1988) and *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to West Coast Marine and Estuarine Organisms*, First Edition (EPA, 1995). The presence of chronic toxicity was estimated as described by these references. Toxicity testing included testing a series of seven dilutions and a control, including the predicted concentration of the effluent at the edge of the ZID (0.70%) as well as four dilutions above and two dilutions below the ZID concentration. Reference toxicants were tested concurrent with the effluent testing using the same procedures. If effluent tests did not meet all test acceptance criteria (TAC) as specified in the referenced methods, then effluent was required to be re-sampled and re-tested as soon as possible. Control and dilution water was natural filtered seawater as called for by the referenced methods. If dilution water was different from culture water, a second control using culture water was also run.

If WET testing showed chronic toxicity to be greater than (>) 143 chronic toxicity units (TUc; TUc=100/No Observed Effect Concentration [NOEC]), then accelerated testing requirements were triggered. Accelerated testing would include implementation of the initial investigation Toxicity Reduction Evaluation (TRE) workplan along with at least one additional WET test. If the investigation indicated the source of toxicity (e.g., a plant upset) and no toxicity >143 TUc was observed in this additional test, the normal schedule of testing would be continued. If toxicity >143 TUc was observed in the additional test, then accelerated testing would continue with six more tests performed on a biweekly basis over a 12-week period. Testing must commence within two weeks of receipt of sample results indicating excess chronic toxicity. If no toxicity >143 TUc was observed in these additional tests, then the normal testing schedule was re-instated. If toxicity >143 TUc was observed in any of the six tests, then a TRE would be initiated within 15 days of receipt of the qualifying sample results. A Toxicity Identification Evaluation (TIE) must also be initiated as part of the overall TRE process; if this was initiated during the accelerated testing period, accelerated testing may be terminated or used as necessary in performing the TIE.

As part of permit requirements, an initial investigation TRE plan was prepared and submitted to EPA under separate cover (KLI, 2000b). This plan describes processes to be followed should chronic toxicity be detected. As required by the permit and described in *Toxicity Reduction Evaluation Guidance for Municipal Wastewater Treatment Plants* (EPA, 1999b), a preliminary toxicity evaluation must be initiated within 15 days of the receipt of sample results if chronic toxicity is detected above the toxicity trigger level. A more detailed TRE workplan may subsequently be developed to more fully investigate and identify the cause of the toxicity, identify and provide a schedule of the actions that AWWU will use to mitigate the impact of the discharge, and to prevent the recurrence of the toxicity. As noted above, the TIE may be initiated as part of the overall TRE process during the accelerated testing schedule.

2.1.5 PART 503 SLUDGE MONITORING

Operations at the Asplund WPCF include a sewage sludge incinerator (SSI) that is subject to regulation under 40 CFR Part 503 - *Standards for the Use or Disposal of Sewage Sludge*. The current NPDES permit requires sludge monitoring twice per year, once during summer-dry conditions and once during summer-wet conditions, as noted earlier. There are no Part 503 monitoring requirements included in the reissued NPDES permit because EPA Region 10's current policy is to remove these requirements in anticipation of writing "sludge only" permits in the future. However, the Part 503 regulations are "self-implementing" in that the facility is required to meet the SSI monitoring requirements in the regulation whether they are specifically included in a sludge-only permit or not. Therefore, monitoring at the Asplund WPCF includes Part 503 monitoring of sludge. Monitoring frequencies required by 40 CFR Part 503 are once per 60 days for arsenic, cadmium, chromium, lead, and nickel. Frequency required for mercury is at least once per year. Frequency for beryllium is not specified. AWWU has chosen to also test for mercury and beryllium once per 60 days, more frequently than required, so as to be consistent with the testing frequency for the other metals. Allowable limits are site-specific and were calculated in 2015 per Part 503 regulation by AWWU based on 2015 source testing data. While methods for this monitoring component have been described elsewhere (AWWU, 2000) and results of the monitoring have been provided under separate reporting requirements to EPA, the data are also included in this report.

2.2 RECEIVING WATER QUALITY MONITORING

2.2.1 WATER QUALITY SAMPLING

- ✓ determine compliance with the NPDES permit and State of Alaska water quality criteria
- ✓ aid in assessing the water quality at the discharge point
- ✓ determine compliance with the regulatory criteria of Section 301(h) of the CWA
- ✓ determine the level of bacterial concentrations in nearshore waters
- ✓ provide data for evaluation of permit re-issuance

As required by permit, water quality must be monitored annually during the summer in dry weather conditions (Table 1). In 2023, sampling was performed at non-fixed stations during consecutive ebb and flood tides at the outfall station and on the following day for a single flood tide at the control station. Station locations were determined by following the track of drogues released above the diffuser at the outfall station and at the control station located north across Knik Arm from Point Woronzof, directly off Point MacKenzie, in a similar water depth to the outfall. Three drogue tracks on each tide were performed at each location. Four stations were sampled on each drogue track, as follows:

- Directly above the diffuser
- As close to the ZID boundary as practicable
- At least one near-field station along the drogue’s path
- In the shallow subtidal area before the drogue grounded or along the drogue’s path at a far-field location.

As noted in the permit, the ZID is defined as "the water column above the area delineated by the sector of a circle with the center located 245 meters (m) offshore over the outfall diffuser, 30 m shoreward of the diffuser, 650 m in radius, and with a 220 degree (º) angle" (Figure 5).

The plume location was determined by following a holey-sock current drogue (Figure 6). The drogue consisted of a six-foot cylindrical nylon tube ballasted at the bottom with a weight and lead line and attached at the top with a bridle to a spherical float. This float was attached to the tracking spar via a connecting line. These cylindrical designs that enclose a parcel of water have been found to more accurately follow the ambient current patterns than other drogue designs such as the window shade design (Sombardier and Niiler, 1994).

Sampling was performed by positioning the vessel over the diffuser (or control site) for the first sampling station of the drogue track. The drogue was then released and the station sampled. The drogue was followed until navigation information indicated the ZID boundary had been reached, at approximately 650 m from the outfall, at which time the ZID-boundary station was immediately sampled. The third and fourth stations along each drogue track were sampled as the drogue traveled along shore, in the channel of Knik Arm, or as it slowed in shallow water prior to grounding. Navigation was accomplished using a differential global positioning system (DGPS) with an accuracy of ± 3-5 m.

Samples were collected as outlined in Table 5 and analyzed as outlined in Table 6. The surface waters of all stations were sampled for fecal coliform, color, turbidity, and TRC. Surface grab samples were collected directly into the appropriate sample bottles at sample depth (15 - 30 centimeters [cm]). Mid- and bottom-depth turbidity samples were collected at all stations using Niskin® bottles. Mid and bottom depths were determined at each station using the survey vessel's fathometer. Samples were collected at all three target depths simultaneously.

For color, an additional preparation step was added beginning in 2008 where color samples were allowed to settle and then decanted in the field prior to submittal to the laboratory. Upon reaching the laboratory, the samples were then processed by filtration to remove any remaining suspended sediment from the sample. The need for this additional field preparation step is the result of naturally high suspended sediment levels in samples from Knik Arm that in the past had sometimes not been completely removed prior to analysis, which resulted in anomalously high color values.

Hydrographic profiles of temperature, salinity, DO, and pH were collected at all stations using a Seabird SeaCAT® SBE-19plus V2 CTD (conductivity, temperature, and depth) profiler. This instrument was also equipped with DO, pH, and optical backscatter (turbidity) sensors to allow profiles of these parameters to also be recorded.

Samples for the analysis of total and dissolved metals, TSS, PAH (for TAqH), and TAH were collected from surface waters directly into appropriate sample containers at the first three stations (diffuser, ZID-boundary, and near-field) at low tide along the first flood drogue track, at both the outfall and control stations.

A single replicate sample for each parameter or a single hydrographic profile was collected at each station, except for quality control (QC) samples where field duplicates or triplicates were obtained.

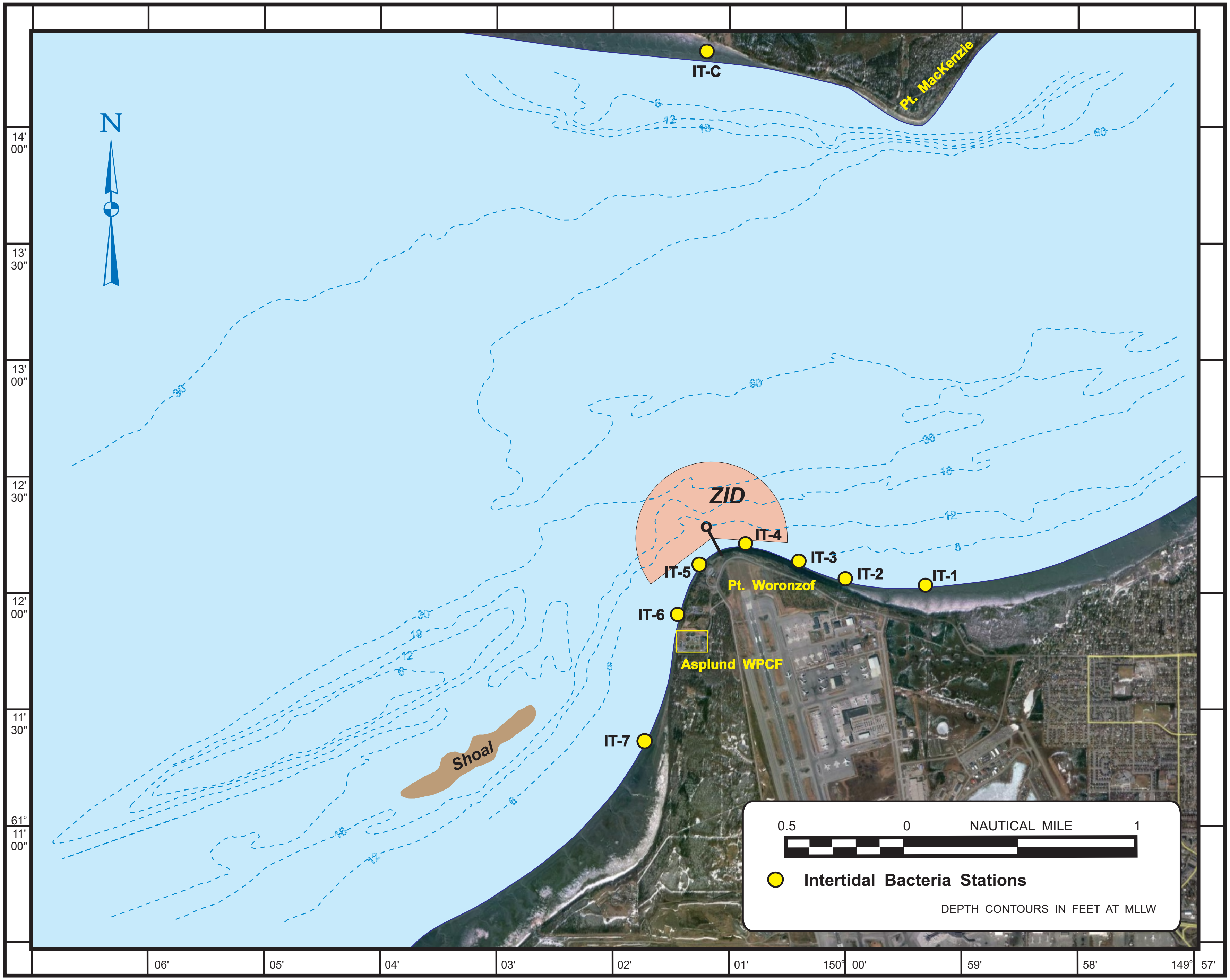


Figure 5. Asplund WPCF Outfall, ZID, and Locations of Intertidal Bacterial Sampling.

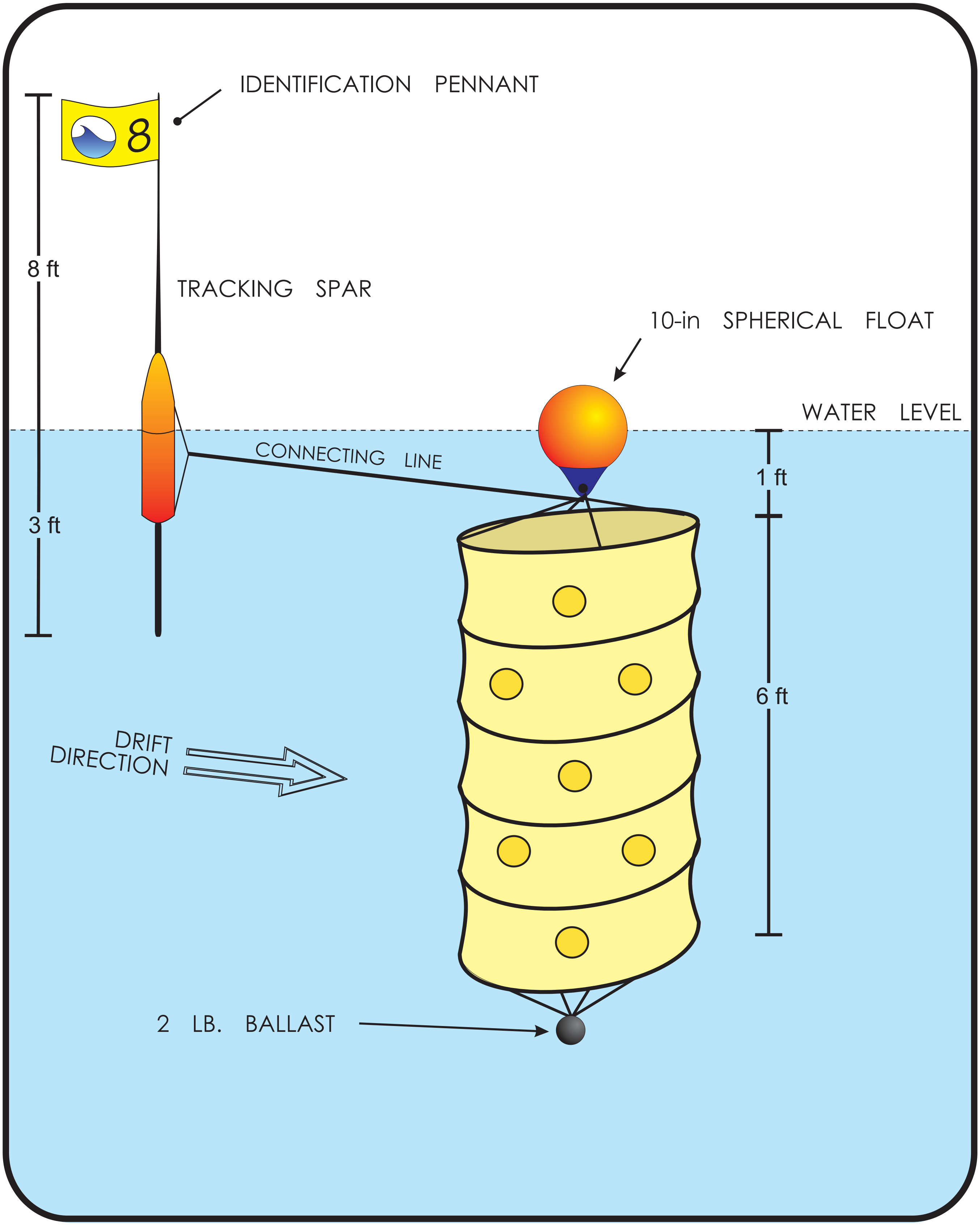


Figure 6. Holey-Sock Drogue, Flotation, and Marker Buoy.

Table 5. Receiving Water Quality Monitoring Requirements.

Parameter	Sampling Depth		
	Surface (above 0.5 m)	**Surface, Mid-, and Bottom**	**Profile (1- to 3-m intervals)**
Fecal Coliform	All stations[a], within the 15-30 cm layer		
Color			
Total Residual Chlorine (TRC)			
Field Observations: presence or absence of floating solids, visible foam (other than trace), oil wastes, and/or sheen	All stations where surface samples are collected		
Total Aqueous Hydrocarbons (TAqH)	First three stations along the first flood drogue track at both the outfall and control locations		
Total Aromatic Hydrocarbons (TAH)			
Metals and Cyanide[b]			
Total Suspended Solids (TSS)			
Turbidity		All stations	
pH			All stations
Temperature			
Dissolved Oxygen (DO)			
Salinity			

a Non-fixed stations were sampled following the track of drogues released at the diffuser (outfall station) or at a fixed station having the same depth due north across Knik Arm from Point Woronzof near Point MacKenzie (control station). Three drogue tracks were made during each of a consecutive flood and ebb tide at the outfall station. Stations included the following along each outfall drogue track: above the diffuser; as close to the ZID boundary as practicable; one near-field station along the drogue's path; and a far-field station along the drogue path or in the shallow subtidal area before the drogue grounds. Three drogue tracks were also made during a flood tide at the control station in conjunction with or as soon as practicable as the sampling at the outfall station.

b Metals include arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc; these were analyzed and reported as both total recoverable and dissolved metals.

Table 6. Methods, Preservation, and Maximum Holding Times for the Analysis of Receiving Water Quality Samples.

Parameter	Method[a]	Preservation	Maximum Holding Time
Fecal Coliform	SM 9221B/E	Cool, ≤8ºC, dark, (0.0008% $Na_2S_2O_3$ in presence of chlorine)	8 hours (6 hours max transport, 2 hours once received by lab)
Color	SM 2120B	Cool, ≤6ºC, dark	48 hours
Total Residual Chlorine	SM 4500-Cl I	None	Analyze immediately
Turbidity	SM 2130B	Cool, ≤ 6ºC, dark	48 hours
Total Aqueous Hydrocarbons (TAqH)	TAqH = TAH (BETX by EPA 624.1) plus TPAH	Cool, ≤6ºC, HCl to pH<2, L-Ascorbic Acid in presence of chlorine	14 days
	PAHs (EPA 625 SIM, TDI SOP1006)		7 days until extraction/ 40 days after extraction
Semivolatile Organics (added in 2022)	EPA 625.1	Cool, ≤6ºC, dark, L-Ascorbic Acid in presence of chlorine	7 days until extraction/ 40 days after extraction
Total Aromatic Hydrocarbons (TAH) Volatile Organic Compounds (full suite added 2022)	TAH = summation of BETX analytes EPA 624.1	Cool, ≤6ºC, HCl to pH<2, L-Ascorbic Acid in presence of chlorine	14 days
Pesticides & PCBs (added in 2022)	EPA 608.3 ALS SOP	Cool, ≤6ºC, HCl to pH<2, L-Ascorbic Acid in presence of chlorine	7 days or 1 year (PCBs)
Dioxins (added in 2022)	EPA 1613B	Cool, ≤6ºC	1 year
Metals (Total Recoverable and Dissolved[b])	EPA 1638 Mod. EPA 1640 Column EPA 1631E (Mercury)	Cool, ≤6ºC, HNO_3 to pH<2 (after filtration for dissolved). Mercury samples require no acidification.	6 months 90 days – Mercury
Cyanide	SM 4500-CN- E	Cool, ≤6ºC, NaOH to pH >12	14 days
Total Suspended Solids (TSS)	SM 2540D	Cool, ≤6ºC	7 days
Dissolved Oxygen (DO)	SM 4500-O G[c]	None	*in situ*
pH	SM 4500-H^+ B[c]	None	*in situ*
Temperature	SM 2550B[c]	None	*in situ*
Salinity	SM 2520B[c]	None	*in situ*

[a] "EPA" refers to the EPA document *Methods for Chemical Analysis of Water and Wastes*, revised March 1983, Document No. EPA-600/4-79-020 or 40 CFR 136, EPA 1983. "SM" refers to *Standard Methods for the Examination of Water and Wastewater*, 22nd ed., APHA 2012.

[b] Dissolved metals were filtered before acidification.

[c] Modified for *in situ* measurements collected with the CTD.

Field notes, including navigational and sampling information, were recorded on project-specific field logs. As required by the permit, field observations taken at each station included the presence or absence of floating solids, visible foam in other than trace amounts, oily wastes, or sheen. Weather observations were also recorded. All field documentation was reviewed by the field leader at the completion of the survey for accuracy and completeness. Sample collection and shipment was documented using project-specific COC forms as described in Section 2.5.

2.2.2 INTERTIDAL BACTERIAL SAMPLING

As part of the receiving water quality monitoring effort, intertidal sampling for fecal coliform bacteria was also performed at eight stations (Table 7 and Figure 5). The primary survey vessel, the *North Forty*, and a skiff were both utilized to collect two replicate water samples from each station near high slack water and as close to shore as safely practicable. Additional quality control samples were collected as described in Section 4.2. Surface samples were collected by grab sampling from 15 to 30 cm depths, directly into the appropriate container. Samples were analyzed using the same procedures described previously and in Table 6.

Table 7. Approximate Locations of Intertidal Bacteria Sampling Stations.

Station	Station Location Relative to Diffuser	Latitude (N)	Longitude (W)
IT-1	2000 m east	61° 12' 10"	149° 58' 55"
IT-2	1200 m east	61° 12' 11"	149° 59' 50"
IT-3	750 m east	61° 12' 15"	150° 00' 20"
IT-4	250 m east	61° 12' 19"	150° 00' 52"
IT-5	250 m southwest	61° 12' 15"	150° 01' 10"
IT-6	750 m southwest	61° 12' 02"	150° 01' 28"
IT-7	2000 m southwest	61° 11' 22"	150° 02' 02"
IT-C	Across Knik Arm, approximately 4 km due north	61° 14' 26"	150° 01' 09"

In addition to the required intertidal samples, two fecal coliform replicate samples were collected once during the water quality monitoring effort from three area streams that empty into Knik Arm: Ship, Chester, and Fish Creeks. Surface grab samples were collected from each stream and analyzed using the same procedures described previously and in Table 6.

At the time of collection, all fecal coliform samples were labeled using project-specific labels as described in Section 2.5. All samples were collected in appropriate clean and certified sample containers, and preserved according to the method. Samples were placed on gel ice immediately after sampling and remained chilled during transport to the laboratory.

2.2.3 VESSEL SUPPORT

The *NORTH FORTY*, a 26-ft KEI-owned survey vessel, was used for drogue tracking and water sampling in 2023. In addition, a 15-ft Zodiac® was used to retrieve grounded drogues and assist with intertidal bacteria sampling. The Zodiac was also used to transport samples with short holding times (i.e., bacterial and turbidity samples) ashore throughout the sampling effort.

2.3 SEDIMENT AND BIOACCUMULATION MONITORING

As stipulated in the NPDES permit, sediment and bioaccumulation monitoring was to be performed during the fourth year after the effective date of the permit. Accordingly, the intertidal and subtidal sediment sampling was performed and reported in conjunction with the 2003 receiving water monitoring program, and the bioaccumulation sampling was performed and reported in conjunction with the 2004 monitoring effort. No additional permit required sediment or bioaccumulation monitoring has been conducted since that time, as the ongoing monitoring has been continued at the year-five level of effort under the extension to the NPDES permit.

2.4 LABORATORY ANALYSIS

Laboratory analyses of all samples for this monitoring program followed preservation and analysis procedures described by EPA-accepted protocols as referenced in this document (Table 4 and Table 6). These procedures are fully described by the referenced documents and/or 40 CFR Part 136.

2.5 DOCUMENTATION PROCEDURES

All field and sampling data were recorded on appropriate pre-printed project-specific field data collection forms. Field data collection forms included drogue tracking forms, hydrographic field log forms, sample identification/COC forms, and sample labels. These forms were tailored to the monitoring program to facilitate accurate and complete documentation of field activities. The field task leader was responsible for review and approval of all field documentation. This was completed as soon as possible after sampling.

Hydrographic field logs included specific information such as station identification, unique sample identification numbers, navigational data, sampling or visual observations, sampling depths, and collection date and time. Drogue tracking logs included station identification information along with navigational data to allow the track of each drogue to be later determined and plotted. Pre-printed labels included such information as station designation, analysis type, date and time of sample collection, sampling personnel, and a pre-assigned sample identification number to uniquely identify each sample. Field duplicate and field blank QC samples were labeled as were regular environmental samples so as to be blind to the laboratory analysts performing the analyses.

In the field, in addition to unique sample numbers, samples were coded on their labels by location and depth to provide easy identification of the associated water quality measurements. The station designation was represented by: drogue drop location (C=control, E=ebb, and F=flood), the first number represents the drogue number, and the second number represents the sampling station along the drogue's path. The final character represents depth; surface (S), mid-depth (M), or bottom (B) sample (e.g., Station C2-3B).

Sample identification and integrity was ensured by a rigidly-enforced COC program. COC forms documented specific information concerning the sample identification, handling, preservation, shipment, and custody of the samples. Pertinent information from the sample label was transferred onto the COC, along with other information as required. COC forms were completed, signed by field personnel, and copied. The original of each COC form was packed with samples in coolers for shipment to the laboratory. The field task leader retained a copy of each form for field records and for tracking purposes should a shipment become lost or delayed. Upon receipt of samples at the analytical laboratory, the laboratory sample custodian signed the samples in by checking all sample labels against COC information and noting any discrepancies as well as sample condition (e.g., sample temperature, containers leaking or damaged during shipment). Internal sample tracking procedures at the laboratory were initiated upon receipt of samples as described by each laboratory's procedures.

2.6 QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES

2.6.1 OBJECTIVES

The monitoring program includes a comprehensive quality assurance/quality control (QA/QC) component that encompasses all aspects of the monitoring program, from initial sample collection and field observation recording through laboratory analysis and data analysis to reporting. The objectives of the QA/QC program were to fully document the field and laboratory data collected, to maintain and document data quality, and to ensure that the data collected are accurate, representative, and complete and are comparable with data collected through other EPA-regulated NPDES programs. The monitoring program was designed to allow the data to be assessed by the following parameters:

- Precision
- Accuracy
- Comparability
- Representativeness
- Completeness

Precision is a measure of agreement among repeated measurements of the same parameter, which was assessed through duplicate and triplicate sampling and analysis. Accuracy is a measure of the overall agreement of a measurement to a known value and includes a combination of random error (precision) and systematic error (bias) that are due to sampling and analytical operations. For this monitoring program, these were assessed in the field by comparing field instrumentation to known standards and in the laboratory by running standard reference material, performing blank spikes, matrix spikes, and comparing instrumentation performance to calibration standards. Comparability is a measure of the confidence with which one data set or method can be compared to another and was assured by utilizing standard EPA and other accepted sampling and laboratory protocols that could be traced back to known standards and using standard units of measure, such as navigational information that could be traced back to a known datum. Representativeness is the measure of the degree to which data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, or an environmental condition. This was assessed by determining sampling variability at a location by repeated sampling that could be compared to laboratory variability. Completeness is a measure of the amount of valid data obtained compared to the amount of anticipated data as outlined in the project workplan.

These parameters were controlled by: adhering to EPA-approved and documented methods and procedures; the analysis of QC samples on a routine basis; the use of contract laboratories with existing QA/QC plans; accepted and defined data review and verification procedures; and comprehensive sample documentation procedures. Throughout the monitoring program, KEI coordinated with the subcontracting laboratories to ensure that their in-house QA/QC programs were being implemented to meet the required standards.

Quality control activities in the field involved adherence to documented procedures, including those in the monitoring program workplan, and the comprehensive documentation of sample collection and sample identification information. Sample integrity and identification were ensured by rigidly-enforced COC procedures. The COC procedures document the handling of each sample from the time of collection to arrival at the laboratory.

Analytical methods in use throughout the monitoring program have been approved and documented by EPA. These methods were used as project-specific protocols to document and guide analytical procedures. Adherence to these documented procedures ensures that analytical results are properly obtained and reported.

2.6.2 FIELD QUALITY CONTROL

Quality control activities in the field consisted of the following:

- Adherence to approved and documented procedures in the monitoring program workplan
- Cross-checking of field identifications, measurements, and recording to ensure consistency, accuracy, and completeness of field sampling log forms
- Comprehensive documentation of field observations, sample collection and identification information, and navigation and drogue position information

Sampling procedures utilized for this project have been successfully used for a number of years on the Asplund WPCF monitoring program. Consistent use of documented and well-known procedures provides for greater likelihood of obtaining environmental samples uncontaminated by sampling procedures or apparatus. The use of project-specific field forms and data entry sheets also provided guidance to assure completeness and accuracy of field data. Adherence to these procedures and use of these project-specific documents helped ensure that data collected over the course of the project were complete, comparable, and accurate, and that study results were representative of conditions existing at the sampling sites.

Field Documentation

For observations made in the field, cross-checking between personnel was used as the primary method of quality control. As described in Section 2.5, sample documentation began in the field using pre-printed log forms, labels, COC forms, and pre-determined sample identification numbers designed specifically for use on this project. This extensive field documentation provided a paper trail that exists for each sample or field observation and ensures credibility of the data. All field records were reviewed by the field crew leader as soon as possible after sampling was completed. After review and verification, field logs were copied, electronically scanned, and filed at the KEI Anchorage office upon return from the survey. Electronic backup copies of all field forms and other data were also made and a complete copy of these records has been included in the appendices of this report.

Sample integrity and identification were ensured by the COC program. COC procedures documented the handling of a sample from the time the sample was collected to receipt of the sample at the analytical laboratory. At the time of shipment, field personnel kept a copy of the completed COC form, and the original accompanied the sample to the laboratory. Upon arrival and completion of the COC at the laboratory, a copy of the final signed COC was returned to KEI for documentation.

Sample Handling

Samples were frozen, chilled, and/or preserved as required by the appropriate methods in the field and until receipt at the laboratory. Samples were packed in coolers along with the completed COC forms for shipment to analytical facilities as previously described. Coolers were securely packed with ice packs as required and custody sealed with signed and dated tamper-evident tape for shipment. Upon receipt by the laboratory the condition of the samples was noted on the COC form including: cooler temperature, broken or missing samples, etc.

Navigation

As described previously, navigation was accomplished with a DGPS. The accuracy of DGPS coordinates was verified by positioning the vessel over the diffuser during a low slack tide when the outfall discharge was evident and comparing DGPS readings with the known outfall location. In addition, the DGPS provides on-going accuracy calculations based on the number of satellites and their positions in the sky. Historical intertidal stations were re-acquired using a hand-held DGPS to determine the distance to the outfall and by visual sightings to known landmarks. All station information was entered on appropriate field logs and reviewed by the field crew leader.

Field Instrumentation

Field equipment used for collection, measurement, and testing was subject to a strict program of control, calibration, adjustment, and maintenance. Care was taken to ensure that instruments used for field measurements of temperature, salinity, DO, and pH were calibrated and checked with a secondary probe system in the field and/or appropriate standards prior to and after each sampling event. The calibration standards used were in accordance with applicable criteria such as the U.S. Bureau of Standards, American Society for Testing and Materials (ASTM), or the National Institute of Standards and Technology (NIST) and followed the instrumentation manufacturer's recommended procedures.

For receiving water quality samples, analytical and instrument variability were checked with field and laboratory splits of larger-volume samples into triplicates and the subsamples analyzed for the various water quality parameters that included color, fecal coliform, TRC, and turbidity. Individual measurements and concentration ranges were reported for each parameter of each split. In addition, duplicate analyses of samples split in the laboratory were used as a means to assess laboratory precision.

For other water quality parameters that were analyzed in the field, the following summary of QA/QC procedures applied:

- Turbidity: The instrument was calibrated daily with a series of standards provided by the manufacturer. Due to the high turbidity in Cook Inlet, calibration samples included high range standards to ensure that the measured turbidities were within the range of the instrumentation calibration. In addition, select field samples were run in duplicate.

- Total Residual Chlorine: TRC was quantified with an ion selective electrode probe (SM 4500-Cl I) which requires a blank, blank spike, and a series of laboratory calibration standards. To account for seawater matrix interference issues, additional method blanks and calibration standards were prepared with Cook Inlet background seawater.

- Hydrographic CTD: Sensors are factory or field calibrated and then field checked with either a refractometer or secondary probe system for conductivity, research grade NIST traceable thermometer or secondary probe for temperature, and saturated water or secondary probe for DO. The pH probe was calibrated immediately prior to the field sampling effort using a 3-point procedure with commercial standards.

Sampling Variability

Sampling variability was documented by sampling three replicates at one station (C2-2S) for the water quality parameters. This included three replicate grabs at the surface for fecal coliform, color, TRC, and turbidity analyses. In addition, triplicate casts of the CTD for DO, pH, temperature, and salinity were performed at the same station in order to check field variability of the probe's electronic sensors. This field sampling variability check was performed to show the natural variability of receiving water which could then be compared to laboratory variability.

Field Check Samples

Field check samples included trip blanks for volatile organic analyses for EPA Method 624, field blanks and field-generated duplicates or triplicates. With the exception of the trip blanks which are initiated at the laboratory, field blanks were sent to the laboratory as blind samples to ensure unbiased reporting of results.

2.6.3 LABORATORY QUALITY CONTROL

Analytical quality control for this project included the following:

- Adherence to documented and approved procedures, including EPA, Standard Methods, etc., internal laboratory protocols, and respective laboratory QA/QC programs
- Calibration and verification of analytical instruments
- Ability of each analytical laboratory to meet analytical precision, accuracy, limits of detection, and limits of quantification that meet EPA requirements
- Use of quality control samples, internal standards, and surrogate solutions

The analytical laboratories used for this project operate under the quality assurance (QA) programs described in their QA management plans. These programs involve the participation of qualified and trained personnel; the use of standard operating procedures (SOPs) for analytical methodology and procedures; a rigorous system of documenting and validating measurements; maintenance and calibration of instruments; and the analysis of QC samples for precision and accuracy tracking. The pertinent methods' descriptions contained in SOPs that the laboratories are following are comprehensive and provide information concerning proper sample collection, receipt and login, processing, storage, and preservation; required apparatus and materials; analytical procedure; standardization and calibration techniques; quality control samples required; methods of calculating values and assessing data quality; and reporting and performance criteria.

Laboratory Documentation

Documentation in the laboratory included signing the original COC forms, documenting sample condition upon receipt, and generating the internal documents that track samples through the laboratory (e.g., sample control logs, refrigerator logs, etc.). Any deviations from the prescribed methods or internal laboratory SOPs were documented by the laboratory and included in a case narrative with the analysis report. Data affected by such deviations were appropriately qualified by the laboratory, as were any data that did not meet acceptable quality criteria. Typical data qualifiers included those denoting estimated concentrations (J) with a high (J+) or low (J-) bias, not detected (ND or U), method blank contamination (B), and matrix interference (P or i). For consistency, data qualifiers shown in report tables have been standardized where in some instances a laboratory report may show a different qualifier code. A full list of potential data qualifiers is included with the laboratory data reports in the appendices, and any data qualified by the laboratory have also been qualified where applicable in the data tables in this report.

Instrument Calibration

Calibration is an integral part of any instrumental analysis. Calibration requirements for each type of analysis to be used on this monitoring project are described in the appropriate methods. Typically, instrument calibration was performed daily or on a per batch basis as required by the laboratory method.

Laboratory Quality Control Procedures

Internal laboratory QC included the use of surrogate solutions and QC samples such as procedural (or method) blanks, matrix spike/matrix spike duplicates (MS/MSD), standard reference materials (SRMs), method-required QC check samples, and duplicates as specified in EPA approved analytical procedures. In addition, contract laboratories took part in EPA's annual *Discharge Monitoring Report - Quality Assurance (DMR-QA) Study* program where required for particular analyses to verify data accuracy. Surrogate compounds were spiked into samples as appropriate to assess individual sample matrix effects on sample analysis and reported as percent recovery. Surrogates were also included in other QC samples such as procedural blanks and matrix spike samples. Whenever possible, QC samples such as MS/MSD were run on samples from this program; however, in some cases where insufficient volume existed, laboratories performed standard batch QC (on foreign samples). Results from QC samples allowed the laboratory to assess QA parameters such as accuracy and precision of the data. Any data falling outside the acceptable criteria as defined in the methods were appropriately investigated by the laboratory, qualified, and described in the case narrative.

Method blanks (MBs) are pure, organic- and/or metal-free reagent water that are run through the analysis process and used to verify that analyte concentrations are accurate and do not reflect contamination. Method blanks were analyzed as called for by each method, typically one per sample batch.

Laboratory accuracy was assessed by routine spiking of environmental samples with a standard addition as called for by the appropriate method. These MS/MSD samples were run on the organic analyses collected as part of both the in-plant and receiving water monitoring components of the program. These matrix spike samples were fortified with components of interest as required by the method following the initial analysis to check the ability of the method to recover acceptable levels and to determine accuracy of the data. Quality control charts were prepared and maintained by the laboratories where applicable to show the range of individual measurements encountered by following standard EPA procedures such as those outlined in EPA method guidance documents or in, *Design of 301(h) Monitoring Programs for Municipal Wastewater Discharges to Marine Waters* (EPA, 1982b) and other data review guidance documents (e.g., EPA, 2020a and 2020b).

Trace metals analyses for the monitoring program were supported through the use of either certified SRMs or laboratory control samples (LCSs) and duplicates (LCSDs), which are QC reference materials with known metals values that are obtained from the National Bureau of Standards and other sources or prepared by the laboratory. These SRMs or LCSs were analyzed by the laboratory at the same time as the program samples in order to ensure laboratory accuracy. Results of these analyses should fall within acceptable limits and can be expressed as percent recovery and relative percent difference (RPD) for duplicates.

Method Detection Limits

Depending on each laboratory's adopted terminology, the method detection limits (MDLs), method reporting limits (MRLs), or practical quantitation limits (PQLs) for the various analytes were determined using the appropriate method as described in EPA methods for a particular analysis. These MDLs and MRLs/PQLs were reported with the data (see appendices) and are included in summary data tables as appropriate. Concentrations below the MDL or MRL were typically qualified with an "ND" code for not detected or "J" when reported as an estimated value that was above the MDL and below the MRL or PQL.

2.6.4 DATA REVIEW AND VALIDATION

Data were validated by comparing final data against original documentation, including the workplan, field logs and data sheets, and analytical reports. Any discrepancies were fully documented in the program files and described where necessary in this annual report. Data were validated according to accuracy, precision, and completeness for both the field sample collection and analytical laboratory components of the program. Qualitative evaluation and statistical procedures were used to check the quality of the field and laboratory data as appropriate. The primary goals of these review and validation procedures were to ensure that the data:

- Were representative of conditions in the study area
- Were accurate
- Demonstrated the required level of precision
- Were comparable with data from other NPDES programs
- Were acceptable for use as a tool to evaluate permit compliance
- Were useful in applying for reauthorization and renewal of 301(h) variance
- Allowed independent technical appraisal of the program's ability to meet the monitoring program objectives.

Analytical data were subjected to review upon receipt from the laboratory following guidelines such as those published in *U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Methods Data Review* (EPA, 2020a), or *U.S. EPA Contract*

Laboratory Program National Functional Guidelines for Organic Superfund Methods Data Review (EPA, 2020b). Items reviewed during data validation included sample holding times, results for laboratory MBs, MS/MSDs or LCS/LCSDs, check standards or SRMs, field and laboratory duplicates, field and laboratory triplicates, field and trip blanks, report completeness, and laboratory performance (i.e., ability to achieve MDLs and adherence to QA/QC criteria established for this program). Items failing to meet such validation and review procedures were noted and corrected, if possible. Items that could not be corrected and fell outside of acceptable limits (e.g., a sample analyzed outside holding time) have been noted in data tables and in the appendices of this annual report if they occurred. For example, if matrix interference was noted by the laboratory in their analysis of the influent and effluent samples, it is appropriately qualified in the data tables; it was also addressed by the laboratory in their case narrative on how or whether it impacted the data quality.

A full summary of the data review and validation performed for the program is provided in Appendix D in a QA/QC evaluation report. Data presented in the Results and Discussion sections of this report utilize the final data validation results that in some cases were the result of qualification of the data originally reported by the laboratory.

3.0 RESULTS

3.1 INFLUENT, EFFLUENT, AND SLUDGE MONITORING

3.1.1 MONTHLY DISCHARGE MONITORING DATA

Results of AWWU's daily, weekly, and monthly sampling of influent and effluent for non-metals are presented as monthly summaries in Table 8. Averages are based on the 12-month period from January through December 2023.

The percent removal of BOD_5 and TSS as determined by subtracting the effluent (Eff) concentration from the influent (Inf) concentration divided by the influent concentration ([Inf-Eff]/Inf x 100) averaged 38% for BOD_5 and 75% for TSS in 2023. On a monthly average basis, BOD_5 removal ranged from 35 to 43%. On a monthly average basis, removal of TSS ranged from 71 to 77%. Dischargers with 301(h) variances are required to remove 30% of BOD_5 and 30% of TSS on a monthly basis. With no exceptions in 2023, percent removals for TSS and BOD_5 met minimum values required by CWA amendments (40 CFR Part 125.60).

The highest monthly average effluent BOD_5 was 175 mg/L, substantially less than the permit limitation of 240 mg/L. The maximum daily BOD_5 concentration was 195 mg/L compared to the permit limit of 300 mg/L and the maximum weekly average was 185 mg/L compared to the permit limit of 250 mg/L.

Concentrations of TSS in the effluent were low and typical of those seen historically at the Asplund WPCF, with the highest monthly average effluent concentration of 72 mg/L compared to the permit limit of 170 mg/L, and a daily maximum concentration of 114 mg/L compared to the permit limit of 190 mg/L. Weekly average TSS concentrations also met permit requirements of $\leq$180 mg/L for all sampling events in 2023.

The highest geometric mean monthly fecal coliform value was seen in May 2023 at 7.8 FC/100 mL. All months in 2023 met the permit limitation of 850 FC/100 mL, based on a geometric mean of at least five samples. Monthly geometric means ranged from 2.8 to 7.8 FC/100 mL, well below the permit limitation and similar to that seen over the past few years. The criterion of not more than 10% of samples analyzed exceeding 2,600 FC/100 mL was met in 2023. In general, better plant performance trends in terms of more effective chlorine disinfection have resulted in lower fecal coliform bacteria concentrations in recent years.

The TRC daily maximum concentration did not exceed the permit-required limitation of 1.2 mg/L for the entire year, with a maximum daily value of 0.808 mg/L and a monthly maximum daily range of 0.453 to 0.808 mg/L. The monthly average TRC concentration ranged from 0.26 in February to 0.33 mg/L in July, with an overall annual average of 0.29 mg/L. The permit requirement that effluent pH remain between 6.5 and 8.5 standard units was always met, exhibiting a daily minimum and maximum range of 6.8 to 7.6 pH standard units (SU) for the year. This indicates a very consistent level of treatment and close adherence to operational goals and procedures.

Although other parameters such as DO, temperature, and ammonia do not have permit limitations, ranges were typical of those seen historically. DO in the effluent exhibited monthly averages ranging from 1.9 to 3.7 mg/L, with a yearly average of 2.7 mg/L. Temperature showed

Table 8. Discharge Monitoring Data for Influent and Effluent Non-Metals.

Month	Average EFF Flow Rate (MGD)	Temperature Average (°C)		pH Minimum/ Maximum (pH)[a]		TRC Average (mg/L)		DO Average (mg/L)		BOD_5 Average (mg/L)			TSS Average (mg/L)			Fecal Coliform Geometric Mean (FC/100 mL)		Total Ammonia[c] (mg/L)	
		INF	**EFF**	**INF**	**EFF**	**INF**	**EFF**	**INF**	**EFF**	**INF**	**EFF**	**REM (%)[b]**	**INF**	**EFF**	**REM (%)[b]**	**INF**	**EFF**	**INF**	**EFF**
01/23	27.36	12.0	10.9	7.2/7.7	6.8/7.6	NT	0.27	NT	2.3	268	161	40	251	67	74	NT	4.2	NT	23.3
02/23	26.61	11.5	10.8	7.1/7.8	7.1/7.6	NT	0.26	NT	1.9	283	163	43	260	59	77	NT	3.7	NT	26.0
03/23	27.12	11.4	10.7	7.2/7.5	6.8/7.3	NT	0.31	NT	3.7	274	165	40	269	67	75	NT	7.0	NT	31.0
04/23	32.24	11.3	10.4	7.3/7.8	6.9/7.5	NT	0.28	NT	3.1	253	157	38	250	66	74	NT	7.1	NT	27.8
05/23	35.44	11.8	10.7	7.2/7.5	7.0/7.5	NT	0.27	NT	3.7	251	163	35	239	65	73	NT	7.8	NT	19.7
06/23	30.07	13.9	12.9	7.2/7.5	7.0/7.2	NT	0.30	NT	3.0	275	175	36	300	70	77	NT	6.6	NT	33.0
07/23	32.39	15.1	14.0	7.1/7.4	7.0/7.3	NT	0.33	NT	3.1	255	149	42	271	64	76	NT	3.4	NT	29.2
08/23	32.85	15.8	15.0	7.2/9.4	7.0/7.3	NT	0.32	NT	2.7	254	153	40	286	67	77	NT	3.6	NT	20.3
09/23	33.68	14.9	14.8	7.2/7.9	6.9/7.3	NT	0.26	NT	2.1	253	164	35	248	72	71	NT	2.9	NT	22.3
10/23	32.82	14.2	13.6	7.2/7.5	7.0/7.4	NT	0.29	NT	2.2	241	146	39	249	62	75	NT	2.8	NT	25.5
11/23	29.61	13.5	12.3	7.2/7.5	7.0/7.4	NT	0.30	NT	2.9	233	149	36	233	61	74	NT	3.4	NT	21.7
12/23	28.12	13.0	11.1	7.1/7.6	6.9/7.4	NT	0.30	NT	2.2	238	153	36	234	62	74	NT	2.8	NT	29.7
Average	30.69	13.2	12.3	7.1/9.4	6.8/7.6	NT	0.29	NT	2.7	256	158	38	258	65	75	NT	4.6	NT	25.8

a	Monthly or yearly (minimum/maximum).
b	Monthly removal percentages are based on monthly influent and effluent averages. Value is rounded to nearest whole number.
c	One sample per month for ammonia.
INF	Influent.
EFF	Effluent.
MGD	Million gallons per day.
NT	Not tested (tested in effluent only).
REM	Percent removal.

yearly averages of 13.2 degrees Celsius (ºC) and 12.3 ºC in the influent and effluent, respectively. Monthly values for total ammonia in the effluent ranged from 19.7 to 33.0 mg/L, with a yearly average of 25.8 mg/L, similar to that seen historically. Average effluent flow for the year was 30.69 mgd, similar in range to 2022; which was about 10% higher than average flow over the preceding five years.

3.1.2 TOXIC POLLUTANTS AND PESTICIDES ANALYSES

Toxic pollutant and pesticide monitoring for influent, effluent, and sludge was conducted from 20-21 June 2023 for summer-dry weather and 14-15 August 2023 for the summer-wet weather sampling. Sampling was performed over 24-hr periods by AWWU personnel.

Results of the toxic pollutant and pesticide analyses are provided in Table 9 (June 2023) and Table 10 (August 2023). For semi-volatile organic compounds, volatile organic compounds, PCBs, and pesticides, only those pollutants that were detected in the influent, effluent, or sludge are listed. All other compounds were not detected above their respective MDLs. Refer to Appendices A and B for laboratory reports and a complete listing of pollutants analyzed. Also, refer to Appendix D for the QA/QC evaluation report that summarizes the analytical data validation results that in some cases resulted in further qualification of the data reported by the laboratory. Pollutants found in the influent were usually detected in the effluent and vice versa and were also often present in the sludge. In general, pollutant concentrations were very low and many of the concentrations for the two sampling events were estimates (denoted with a "J" qualifier) that fell below MRLs but above MDLs.

Percent removal values shown in these tables were computed from influent and effluent concentrations. Percent removal was only calculated for compounds where a concentration in the influent and effluent was reported at a level above the MRL. Compounds with estimated concentrations denoted with a "J" qualifier or those reported as ND were not used for percent removal calculations. For summed values, such as benzene, ethylbenzene, toluene, and xylenes (BETX), non-detects or “U” qualified values were replaced by the MDL or MRL, as appropriate.

Percent removal calculations for some contaminants may not truly represent treatment plant efficiency due to several factors that influence removal rates. Most notable is the fact that influent and effluent autosamplers do not produce parallel samples over the same required 24-hr time interval due to the approximate 6-hr hydraulic residence time of wastewater flow through the treatment process prior to being discharged as final effluent. The percent removal calculation is also affected by the addition of more than 1 million gallons of fresh water from the city’s drinking water supply and/or on-site well water to the treatment process (makeup water). Thickened sludge from both the Girdwood and Eagle River WWTFs is also processed at the Asplund WPCF, resulting in additional wastewater from the belt filter press. Finally, incinerator scrubber and in-plant wash-down waters are added back into the treatment process, which only impact the effluent composite sample. Also, the percent removal calculation is often performed on pollutant concentrations that are near the MRL. As a result of these factors, calculation of negative pollutant removals is possible, in spite of all evidence supporting an efficient and effective treatment process indicated by very high removal efficiencies seen for TSS and BOD_5.

Types and concentrations of measured volatile and semi-volatile organic compounds were fairly consistent between the two sampling periods. Volatile compounds detected in both the influent

Table 9. Toxic Pollutants and Pesticides in the Influent, Effluent, and Sludge, Sampled 20 and 21 June 2023.

Pollutant	Influent (µg/L)	Effluent (µg/L)	Sludge (mg/kg)	Percent Removal
DISSOLVED METALS				
Antimony	0.630	0.806	NA	-27.9
Arsenic	1.51	2.08	NA	-37.7
Beryllium	<0.005	<0.005	NA	---
Cadmium	0.053	0.124	NA	-134.0
Chromium	0.92	1.07	NA	-16.3
Copper	16.1	25.6	NA	-59.0
Lead	0.490	0.711	NA	-45.1
Mercury	0.0134	0.0106	NA	20.9
Molybdenum	6.74	5.03	NA	25.4
Nickel	3.21	3.46	NA	-7.8
Selenium	0.3 J	0.5 J	NA	---
Silver	0.039	0.078	NA	-100.0
Thallium	<0.009	<0.009	NA	---
Zinc	33.7	84.7	NA	-151.3
TOTAL METALS				
Antimony	0.806	0.690	1.61	14.4
Arsenic	2.64	2.33	3.6	11.7
Beryllium	0.013 J	<0.005	0.121	---
Cadmium	0.209	0.151	0.956	27.8
Chromium	2.51	1.55	12.5	38.2
Copper	52.9	34.5	176	34.8
Lead	1.76	1.26	8.67	28.4
Mercury	0.0304	0.0200	0.223	34.2
Molybdenum	7.47	5.25	3.90	29.7
Nickel	4.71	3.93	10.4	16.6
Selenium	0.6 J	0.7 J	2.2 J	---
Silver	0.191	0.163	1.44	14.7
Thallium	0.029	0.015 J	0.064 J	---
Zinc	151	109	493	27.8

Table 9. Toxic Pollutants and Pesticides in the Influent, Effluent, and Sludge, Sampled 20 and 21 June 2023. (continued)

Pollutant	Influent (µg/L)	Effluent (µg/L)	Sludge (mg/kg)	Percent Removal
VOLATILE ORGANICS - detected substances only				
Acetone	150	160	18 J	-6.7
Benzene	0.060 J	0.070 J	<0.00018	---
2-Butanone (MEK)	17 J	19 J	1.200	---
Carbon Disulfide	<0.20	<0.20	0.076	---
Chloroform	1.5	2.0	0.0052 J	-33.3
Chloromethane	<0.060	0.75	<0.00059	---
1,4-Dichlorobenzene	0.46 J	0.34 J	0.013 J	---
Ethylbenzene	0.29 J	0.32 J	0.011 J	---
2-Hexanone	1.9 J	3.3 J	<0.0031	---
Methylene Chloride	2.1	1.9 J	<0.00052	---
Tetrachloroethene (PCE)	0.35 J	0.20 J	0.015 J	---
Toluene	5.8	5.6	0.450	3.4
m,p-Xylenes	1.2	1.4	0.040	-16.7
o-Xylene	0.45 J	0.54	0.015 J	---
SEMI-VOLATILE ORGANICS - detected substances only				
Bis(2-ethylhexyl) Phthalate	<15	<15	12 J	---
Diethyl Phthalate	<1.7	2.6 J	<0.62	---
Di-n-octyl Phthalate	<3.3	<3.3	14 J	---
Nitrobenzene	<3.5	<3.5	3.0 J	---
Phenol	28	15 J	<1.5	---

Table 9. Toxic Pollutants and Pesticides in the Influent, Effluent, and Sludge, Sampled 20 and 21 June 2023. (continued)

Pollutant	Influent (µg/L)	Effluent (µg/L)	Sludge (mg/kg)	Percent Removal
HYDROCARBONS				
Oil & Grease (EPA 1664A-HEM)	40,000	27,900	NT	30.2
Total Aromatic Hydrocarbons as BETX from EPA Method 624[a]	7.80	7.93	0.516	-1.3
TPAH	NT	4.884	NT	---
TAqH[b]	NT	12.81	NT	---
PESTICIDES, PCBS, & DIOXINS – detected substances only				
4,4’-DDD	0.027 P	0.021 P	<0.0014	22.2
Endosulfan Sulfate	<0.014 i	0.022	<0.0023	---
Demeton-O,S	<0.027	<0.027	0.360	---
Malathion	<0.0050	0.010 J	<0.064	---
ENTEROCOCCI BACTERIA				
Enterococci[c]	NT	<10/<10	NT	---
OTHER COMPONENTS				
Asbestos[d]	<3.1	<0.93	ND	---
Cyanide	<0.5	0.6 J	0.53 J	---

a	Summation of BETX values using MDL for non-detected compounds.
b	Summation of BETX/TAH plus TPAH
c	Enterococci reported in MPN/100 mL; two replicates (sample and duplicate). Sample date 6/20/23.
d	Asbestos reported in million fibers/L (influent and effluent) or percent (sludge).
i	The MRL/MDL is elevated due to a chromatographic interference.
J	Estimated value (below MRL but above MDL).
P	GC or HPLC confirmation criteria exceeded. The relative percent difference between results is greater than 40%.
NA	Not applicable.
ND	Not detected.
NT	Not tested.
---	Not applicable (not calculated).
<	Not detected, followed by MDL.

Table 10. Toxic Pollutants and Pesticides in the Influent, Effluent, and Sludge, Sampled 14 and 15 August 2023.

Pollutant	Influent (µg/L)	Effluent (µg/L)	Sludge (mg/kg)	Percent Removal
DISSOLVED METALS				
Antimony	0.522	0.628	NA	-20.3
Arsenic	1.55	1.93	NA	-24.5
Beryllium	<0.005	<0.005	NA	---
Cadmium	0.035	0.065	NA	-85.7
Chromium	0.70	0.71	NA	-1.4
Copper	13.1	20.9	NA	-59.5
Lead	0.221	0.443	NA	-100.5
Mercury	0.0241	0.00845	NA	64.9
Molybdenum	1.08	1.34	NA	-24.1
Nickel	3.53	3.83	NA	-8.5
Selenium	0.5 J	0.4 J	NA	---
Silver	0.023	0.044	NA	-91.3
Thallium	<0.009	<0.009	NA	---
Zinc	17.1	72.3	NA	-322.8
TOTAL METALS				
Antimony	0.976	0.652	1.39	33.2
Arsenic	3.16	2.31	4.6	26.9
Beryllium	0.015 J	<0.005	0.066	---
Cadmium	0.238	0.164	0.855	31.1
Chromium	3.12	1.55	20.6	50.3
Copper	65.6	39.3	221	40.1
Lead	3.11	1.20	9.60	61.4
Mercury	0.0778	0.0223	0.243	71.3
Molybdenum	2.38	1.51	4.44	36.6
Nickel	5.93	4.41	15.2	25.6
Selenium	0.9 J	0.5 J	2.2 J	---
Silver	0.489	0.165	1.48	66.3
Thallium	<0.009	<0.009	0.039 J	---
Zinc	186	118	540	36.6

Table 10. Toxic Pollutants and Pesticides in the Influent, Effluent, and Sludge, Sampled 14 and 15 August 2023. (continued)

Pollutant	Influent (µg/L)	Effluent (µg/L)	Sludge (mg/kg)	Percent Removal
VOLATILE ORGANICS - detected substances only				
Acetone	170	220	14*	-29.4
Benzene	0.20 J	0.27 J	<0.000054	---
2-Butanone (MEK)	8.2 J	14 J	<5.3 B	---
Carbon Disulfide	<0.20	<0.20	0.0069	---
Chloroform	1.7 J	2.1 J	<0.00011	---
Chloromethane	<0.060	0.96 J	<0.00018	---
1,4-Dichlorobenzene	0.50 J	0.42 J	0.0038 J*	---
Ethylbenzene	0.63 J	0.76 J	0.0038 J	---
2-Hexanone	<0.80	<0.80	0.019	---
Methylene chloride	2.3 J	1.4 J	<0.00016	---
Tetrachloroethene (PCE)	0.31 J	0.18 J	0.0034 J	---
Toluene	7.5	7.7	0.220	-2.7
m,p-Xylenes	2.4 J	3.1 J	0.015	---
o-Xylene	1.1 J	1.5 J	0.0054	---
SEMI-VOLATILE ORGANICS - detected substances only				
Bis(2-ethylhexyl) Phthalate	<15	8.7	10 J	---
Diethyl Phthalate	2.8 J	3.0 J	<1.1	---
Phenol	46	13	<2.5	71.7

Table 10. Toxic Pollutants and Pesticides in the Influent, Effluent, and Sludge, Sampled 14 and 15 August 2023. (continued)

Pollutant	Influent (µg/L)	Effluent (µg/L)	Sludge (mg/kg)	Percent Removal
HYDROCARBONS				
Oil & Grease (EPA 1664-HEM)	52,400	26,400	NT	49.6
Total Aromatic Hydrocarbons as BETX from EPA Method 624[a]	11.83	13.33	0.244	-12.7
PESTICIDES, PCBS, & DIOXINS – detected substances only				
Demeton-O,S	0.067 J	<0.027	0.210 *	---
Malathion	<0.0050	0.020 J	<0.020	---
ENTEROCOCCI BACTERIA				
Enterococci[b]	NT	<10 /10	NT	---
OTHER COMPONENTS				
Asbestos[c]	15	<2.5	ND	---
Cyanide	1.8 J	2.0 J	0.84	---

a	Summation of BETX values using MDL for not-detected compounds.
b	Enterococci reported in MPN/100 mL: two replicates (sample and duplicate).
c	Asbestos reported in million fibers/L (influent and effluent) or percent (sludge).
B	Requalified due to estimated concentration seen in the method blank.
J	Estimated value (below MRL but above MDL).
NA	Not applicable
ND	Not detected.
NT	Not tested.
---	Not applicable (not calculated).
<	Not detected, followed by MDL.
*	The result is an outlier, see case narrative.

and effluent during both sampling events included: acetone, benzene, 2-butanone (MEK), chloroform, 1,4-dichlorobenzene, ethylbenzene, methylene chloride, tetrachloroethene (PCE), toluene, and xylenes. Most of these compounds were estimated values as they were detected in concentrations below their MRLs and were therefore qualified with a ”J.”

Of the semi-volatile compounds, only phenol was detected in both the influent and effluent during both the June and August sampling events. Semi-volatile influent and effluent concentrations were mostly ND as they fell below their respective MDLs when analyzed due to their complex matrices.

Fewer volatile compounds were detected in the sludge as compared to those seen in the influent or effluent for either the June or August sampling efforts, whereas in June more semi-volatile compounds were seen in the sludge as compared to either the influent or effluent. Carbon disulfide while detected in the sludge during both June and August, was not detected in influent or effluent during either sampling event. As with the influent and effluent samples, many sludge concentrations were estimated and qualified with a “J” as they fell below MRLs. Several volatile compounds that were detected in the influent and effluent were ND in the sludge (Table 9 and Table 10). Semi-volatile compounds seen in sludge during either the June or August sampling effort included bis(2-ethylhexyl) phthalate, nitrobenzene, and di-n-octyl phthalate.

The oil and grease concentration measured in the effluent in June 2023 was found to have dropped back down to the lower middle of the range seen over the previous five years with an effluent concentration of 27.9 mg/L, compared to a 5-year range of 24.2 to 42.7 mg/L. The effluent concentration of oil and grease in August was also low at 26.4 mg/L. Effluent BETX values were 7.9 and 13.3 µg/L in June and August samplings, respectively. Refer to Sections 4.1 and 4.2 for further discussion of the significance of hydrocarbon concentrations.

The AWQS include site-specific criteria for the Knik Arm of Cook Inlet and the Point Woronzof area along with state-wide criteria that are based on dissolved metals. These AWQS were utilized to determine the MAEC, defined as the receiving water AWQS criteria multiplied by the initial dilution of 142:1 for conservative substances (e.g., metals) and 180:1 for non-conservative substances (TRC, ammonia, cyanide, TAH, and TAqH) after taking into account any natural background concentration. Both total and dissolved concentrations of metals in the effluent were then compared to the MAECs. With the exception of BOD_5, TSS, fecal coliform, and TRC that have permit limits, MAECs are <u>not</u> permit-specified limits but are used in this report as indicators to determine whether the effluent approached AWQS criteria after taking into account the permit-allowable dilution within the ZID/mixing zone.

Dissolved metals concentrations were found to be low in influent and effluent during both sampling events. Dissolved beryllium and thallium were not seen in either the influent or effluent during any of the six sampling efforts (Table 11). The other metals (antimony, arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, silver, and zinc) were typically measured at low levels above their MDLs and, for the most part, above their MRLs.

Total recoverable metals concentrations in both influent and effluent were found to be low. Antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, silver, and zinc were seen in the influent or effluent during both sampling events, all at very low levels when compared to their respective MAECs. Thallium was not found in influent

Table 11. Pretreatment Monitoring Data for Influent and Effluent Metals and Cyanide.

Parameter	June 2023						August 2023					
	Influent			Effluent			Influent			Effluent		
Sample Date	**21**	**22**	**23**	**21**	**22**	**23**	**15**	**16**	**17**	**15**	**16**	**17**
Dissolved Metals (µg/L)												
Antimony*	0.630	0.679	0.646	0.806	0.612	0.783	0.522	0.559	0.557	0.628	0.541	0.675
Arsenic	1.51	1.63	1.73	2.08	2.07	2.08	1.55	1.77	2.29	1.93	2.30	2.73
Beryllium*	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	0.053	0.044	0.054	0.124	0.076	0.114	0.035	0.034	0.032	0.065	0.064	0.055
Chromium	0.92	1.06	0.90	1.07	0.85	0.91	0.70	0.82	0.80	0.71	0.66	0.55
Copper	16.1	17.2	14.9	25.6	24.2	24.4	13.1	12.5	11.8	20.9	18.2	11.8
Lead	0.490	0.398	0.358	0.711	0.415	0.539	0.221	0.382	0.343	0.443	0.444	0.398
Mercury	0.0134	0.0100	0.0132	0.0106	0.00916	0.00824	0.0241	0.0123	0.00862	0.00845	0.00668	0.00607
Molybdenum*	6.74	2.17	1.20	5.03	3.24	1.73	1.08	1.23	1.55	1.34	1.52	2.15
Nickel	3.21	3.57	3.33	3.46	4.12	4.72	3.53	2.73	3.58	3.83	3.53	3.85
Selenium*	0.3 J	0.5 J	0.5 J	0.5 J	0.6 J	0.5 J	0.5 J	0.3 J	0.4 J	0.4 J	0.6 J	06. J
Silver	0.039	0.036	0.027	0.078	0.039	0.041	0.023	0.036	0.042	0.044	0.032	0.033
Thallium*	<0.009	<0.009	<0.009	<0009	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009
Zinc	33.7	30.0	26.5	84.7	75.4	96.4	17.1	21.5	24.4	72.3	73.0	57.0
Total Metals and Cyanide (µg/L)												
Antimony*	0.806	0.895	0.917	0.690	0.735	0.904	0.976	0.996	1.19	0.652	0.745	0.904
Arsenic	2.64	2.61	2.68	2.33	2.28	2.23	3.16	3.80	3.64	2.31	2.73	3.42
Beryllium*	0.013 J	0.010 J	0.007 J	<0.005	<0.005	<0.005	0.015 J	0.021	0.015 J	<0.005	0.009 J	0.010 J
Cadmium	0.209	0.288	0.289	0.151	0.170	0.176	0.238	0.286	0.299	0.164	0.193	0.178
Chromium	2.51	3.12	2.64	1.55	1.52	1.51	3.12	4.32	3.21	1.55	1.82	1.75
Copper	52.9	62.7	49.1	34.5	40.9	40.3	65.6	60.8	43.7	39.3	37.7	30.1
Cyanide	<0.5	<0.5	<0.5	0.6 J	0.6 J	0.7 J	1.8 J	<0.5	<0.5	2.0 J	<0.5	<0.5
Lead	1.76	2.28	2.11	1.26	1.10	1.29	3.11	4.22	8.08	1.20	1.71	1.80
Mercury	0.0304	0.0582	0.0259	0.0200	0.0169	0.0153	0.0778	0.226	0.0584	0.0223	0.0269	0.0344
Molybdenum*	7.47	2.58	1.70	5.25	3.11	1.84	2.38	2.41	2.38	1.51	2.01	2.48
Nickel	4.71	5.30	5.00	3.93	4.74	5.18	5.93	6.39	6.38	4.41	4.20	4.59
Selenium*	0.6 J	0.7 J	0.6 J	0.7 J	0.7 J	0.9 J	0.9 J	0.6 J	0.7 J	0.5 J	0.7 J	0.5 J
Silver	0.191	0.199	0.158	0.163	0.114	0.121	0.489	0.333	0.267	0.165	0.200	0.180
Thallium*	0.029	0.031	0.012 J	0.015 J	0.015 J	0.011 J	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009
Zinc	151	148	145	109	128	145	186	184	138	118	123	110

<	Not detected, followed by MDL or MRL.
*	Not required by permit for "Pretreatment" monitoring. Note, beryllium is required by Municipal Code for industrial users.
J	Estimated value (below MRL but above MDL).

or effluent samples during August sampling. The concentration for total copper in effluent was found to be the highest of any metal with respect to its MAEC, with the highest measured level of 40.9 µg/L nearly an order of magnitude lower than the MAEC of 317 µg/L.

No dioxin compounds were detected in either the June or August 2023 sampling. The pesticides endosulfan sulfate and malathion were detected in effluent samples but not influent or sludge during June testing. The DDT metabolite 4,4'-DDD was seen in both influent and effluent samples during June though not in sludge or August samples. The pesticide demeton-O,S was detected in sludge during the June and August sampling events at 0.360 and 0.210 milligrams per kilogram (mg/kg), respectively and in the influent in June at 0.067 J µg/L. In June and August, malathion was detected in the effluent at trace levels but was not detected in either the influent or sludge. Other than those discussed above, no other pesticide compounds were detected in either influent, effluent, or sludge during either the June or August sampling events. For a complete list of organochlorine and organophosphate pesticides analytes, refer to Appendices A and B.

The permit calls for analysis of enterococci bacteria in treated final effluent twice per year in conjunction with the summer-dry and summer-wet sampling. Two samples each were analyzed in both June and August of this year. All samples returned values of ≤10 most probable number per 100 mL (MPN/100 mL).

During the June sampling event, cyanide concentrations were <0.5 µg/L in the influent, 0.6 J µg/L in the effluent, and 0.53 J mg/kg in the sludge. During the August sampling, cyanide concentrations were 1.8 J µg/L in influent, 2.0 J µg/L in effluent, and 0.84 mg/kg in sludge. All effluent cyanide concentrations were well below the MAEC of 181 µg/L.

3.1.3 PRETREATMENT MONITORING DATA

As part of the NPDES permit, AWWU is required to conduct pretreatment monitoring twice per year in conjunction with toxic pollutant and pesticide analyses. This monitoring includes three consecutive days of 24-hr composite sampling of influent and effluent and one day of sludge sampling. Pretreatment analyses include total cyanide and a suite of metals that are analyzed as both total and dissolved. Results of the pretreatment monitoring are presented in Table 11.

Collection of samples for trace metals analysis performed as part of the toxic pollutant and pesticide sampling events in 2023 coincided with the first day of the pretreatment monitoring for the Asplund WPCF in June and August. Individual metals concentrations for the 3-day pretreatment sampling event were generally found to be very similar, with little variation between sampling days, particularly for the effluent.

Of all the metals in the effluent, copper, mercury, nickel, and zinc concentrations were the highest relative to AWQS criteria. However, concentrations of these metals were still well below their respective MAECs. For example, dissolved copper concentrations in the effluent ranged from 24.2 to 25.6 µg/L during the three days of pretreatment sampling in June and from 11.8 to 20.9 µg/L during the August sampling effort, as compared to the MAEC of 317 µg/L. Total copper in the effluent was found to range from 30.1 to 40.9 µg/L for the six pretreatment samples compared to the MAEC of 317 µg/L. Dissolved mercury results in the effluent ranged from 0.00607 to 0.0106 µg/L in the six pretreatment samples, as compared to the MAEC of 2.73 µg/L. Total mercury samples ranged from 0.0153 to 0.0344 µg/L, well below the MAEC. Dissolved nickel in the effluent ranged from 3.46 to 4.72 µg/L during pretreatment samplings, while total nickel ranged from 3.93 to 5.18 µg/L as compared to the MAEC of 978 µg/L. Dissolved zinc in the effluent ranged from 57.0 to 96.4 µg/L during both pretreatment samplings, while total zinc ranged from 109 to 145 µg/L during these samplings as compared to the MAEC of 11,249 µg/L. All other metals were also found to be substantially less than their respective MAECs. Influent total recoverable metals values were generally higher and more variable than those seen in the effluent, as would be expected. Cyanide concentrations in the effluent ranged from <0.5 to 2.0 J µg/L as compared to the MAEC of 181 µg/L.

3.1.4 WHOLE EFFLUENT TOXICITY TESTING RESULTS

Quarterly WET testing for 2023 was initiated during March, May, August, and October and consisted of 24-hr flow based composite effluent samples as required by the permit. Results included the determination of lowest observed effect concentration (LOEC), no observed effect concentration (NOEC), and the calculation of chronic toxicity units (TUc) for each test.

First quarter WET tests were performed successfully using the purple urchin fertilization test method. Annual re-screening for the most sensitive species in 2023 was performed during the second quarter, with detailed laboratory results supporting the recommendation that the bivalve (*Mytilus galloprovincialis*) larval development test be used in subsequent WET testing until the annual three-species comparison is again performed in 2024. Third and fourth quarter WET tests were performed using the bivalve larval development test method (refer to Section 2.1.4).

WET test results for 2023 are summarized below in Table 12 as the LOEC, NOEC, and TUc, where TUc = 100/NOEC. Detailed results in the form of descriptive laboratory reports that present all data in tabular form along with statistical analyses, QA/QC information, and reference toxicant test results have previously been submitted to ADEC and EPA with Asplund WPCF's monthly discharge monitoring reports (DMRs) and are not duplicated in this report. All TAC were met for all WET tests performed in 2023 including reference toxicant bioassays.

Table 12. Summary of WET Test Data from 2023.

Toxicity Test	LOEC (%)	NOEC (%)	TUc
1st Quarter 2023			
Echinoderm (fertilization)	5.6	2.8	35.7
2nd Quarter 2023			
Bivalve (development)	2.8	1.4	71.4
Topsmelt (survival)	>11.2	11.2	8.9
Topsmelt (growth)	>11.2	11.2	8.9
Echinoderm (fertilization)	5.6	2.8	35.7
3rd Quarter 2023			
Bivalve (development)	11.2	5.6	17.9
4th Quarter 2023			
Bivalve (development)	5.6	2.8	35.7

Note: Toxic trigger in Permit for additional testing is a TUc of >143.

First quarter testing was performed on a single 24-hr composite sample collected on 7 March 2023. This was a gamete fertilization test performed with the previous year's most sensitive species, the echinoderm *Strongylocentrotus purpuratus.* The LOEC concentration was 5.6% effluent with a NOEC concentration of 2.8% effluent. Chronic toxicity was 35.7 TUc.

Second quarter WET testing included the annual rescreening for the most sensitive species and was conducted on samples collected between 15-19 May 2023. The WET tests included: the bivalve (*Mytilus galloprovincialis*) larval development; topsmelt (*Atherinops affinis*) survival and growth; and echinoderm (*Strongylocentrotus purpuratus*) fertilization. Results of the topsmelt bioassay showed no toxicity at any effluent test concentration for either the survival or growth endpoints. The LOEC for survival and growth was >11.2% effluent, the NOEC was 11.2%, and the TUc was 8.9. For the echinoderm fertilization test, some toxicity was observed at the second highest effluent concentration tested resulting in an LOEC of 5.6%, a NOEC of 2.8%, and a TUc of 35.7. Results for the bivalve larval development test showed the LOEC concentration was 2.8% effluent with a NOEC concentration of 1.4% effluent. Chronic toxicity was 71.4 TUc. The concurrent reference toxicant test results for these three species were within laboratory control chart limits and indicated typical sensitivity of the test populations. Based on the results of the three-species testing it was determined to use the bivalve larval development test as the most sensitive species for toxicity testing until the three-species comparison is repeated in 2024.

The third quarter WET bivalve larval development test was performed on a single 24-hr composite sample collected on 16 August 2023. The LOEC concentration was 11.2% effluent with a NOEC concentration of 5.6% effluent. Chronic toxicity was 17.9 TUc.

Fourth quarter WET testing was performed on a single 24-hr composite sample collected on 10 October 2023. The LOEC concentration was 5.6% effluent with a NOEC concentration of 2.8% effluent. Chronic toxicity was 35.7 TUc.

In summary, all WET tests that were performed for the 2023 monitoring program were within the permit specified trigger of ≤ 143 TUc.

3.1.5 PART 503 SLUDGE MONITORING DATA

AWWU operates a sludge incinerator at the Asplund WPCF for which the NPDES permit requires sludge monitoring twice per year as part of the Toxic Pollutants and Pesticides/Pretreatment monitoring. In addition, 40 CFR Part 503 regulations require the testing of sludge every 60 days. During 2023, the Part 503 sludge monitoring was performed a total of eight times. This data will be submitted along with other incinerator operational information to EPA by 19 February 2024 as a separate report; however, for completeness and comparison purposes, this information is included here as well. Results of the 2023 sludge metals monitoring are presented in Table 13.

All sludge metals concentrations were extremely low compared to allowable limits. Maximum results for all metals tested (arsenic, beryllium, cadmium, chromium, lead, mercury, and nickel) were within their historic ranges. As mentioned previously, no actual sludge limits exist in the current NPDES permit. Allowable limits are site specific and were recalculated in 2015 by AWWU per Part 503 regulations. EPA may issue "sludge only" permits in the future; in the interim, 40 CFR Part 503 regulations are "self-implementing."

Table 13. Part 503 Discharge Monitoring Data for Metals Concentrations in Sludge in mg/kg.

Parameter	Arsenic	Beryllium[b,d]	Cadmium	Chromium	Lead	Mercury[c,d]	Nickel
Site Specific Limit [a,e]	2168	2014	1267	28452	741	129	355647
01/15/23	3.55	<0.166	0.714	11.5	8.28	<0.497	9.12
03/13/23	2.86 J	<0.158	0.651	12.4	7.29	0.261 J	10.5
05/07/23	3.32 J	<0.177	0.689 J	13.0	9.38	0.414 J	11.2
06/21/23	3.6	0.121	0.956	12.5	8.67	0.223	10.4
07/16/23	4.14	<0.152	0.909	14.7	11.8	0.390 J	12.1
08/15/23	4.6	0.066	0.855	20.6	9.6	0.243	15.2
09/10/23	4.25	<0.162	1.13	12.4	12.5	0.296 J	56.1
11/26/23	2.85 J	<0.160	0.614 J	9.68	6.29	0.283 J	7.84
AVERAGE[f]	3.6	0.145	0.81	13.3	9.2	0.326	16.6
MINIMUM	2.85 J	0.066	0.614 J	9.68	6.29	0.223	7.84
MAXIMUM	4.6	<0.177	1.13	20.6	12.5	<0.497	56.1

a Site-specific sludge limits calculated by AWWU. Based on evaluation provided by Montrose Environmental Group, Inc., July 2015, Asplund Incinerator Source Test.

b Beryllium emissions shall not exceed 10 grams per day. With a control efficiency of 0.9998 at the maximum sludge feed rate, a sludge concentration of 2014 milligrams per dry kilogram of sludge will not result in a violation of the limit.

c Mercury emissions shall not exceed 3,200 grams per day. With a control efficiency of 0.0 at the maximum sludge feed rate, a sludge concentration of 129 milligrams per dry kilogram of sludge will not result in a violation of the limit.

d Monitoring frequencies required by 40 CFR Part 503 for incineration are once per 60 days for arsenic, cadmium, chromium, lead, and nickel. Mercury is at least once per year. Frequency for beryllium is not specified. AWWU has chosen to test mercury and beryllium more frequently than required to be consistent with the other metals.

e Concentrations are in mg/kg dry weight and reported as total metals.

f Calculation of averages utilize the MDL value where concentrations were found to be ND.

J Estimated value (below MRL but above MDL).

< Not detected, followed by MDL.

3.2 RECEIVING WATER QUALITY MONITORING RESULTS

Water quality sampling of the receiving water was conducted on 20-21 June 2023, concurrent with the summer-dry influent, effluent, and sludge toxic pollutant and pesticide sampling.

3.2.1 PLUME DISPERSION SAMPLING

Drogue Tracking Results

Drogues were released on 20 June 2023 at the within-ZID station for both the ebb and flood tidal cycles. For the control locations, drogues were released on 21 June 2023 at the control station for the flood tidal cycle. Three drogues were deployed during each tidal cycle, and four stations were sampled along each drogue track.

Outfall Site

The three Point Woronzof ebb drogue tracking cycles were performed during the morning and early afternoon of 20 June 2023. The predicted tidal range during ebb stage was 29.2 ft (Figure 7 and Table 14; NOAA/NOS, 2023). Table 14 also lists the individual drogue travel times as well as average drogue speed.

A composite of ebb drogue deployments is depicted in Figure 8, with drogue tracks very similar to those seen in previous years. Ebb drogues traveled from approximately 1.9 to 3.7 nautical miles (nm), with all three drogues traveling in a west-southwesterly direction. No eddies were observed during these drogue tracks, nor did any of the drogues become grounded. The first ebb (E1) drogue was released at 09:08 Alaska Daylight Time (ADT), 8 minutes after the tide turned from flood to ebb, and the drogue initially traveled in a northwesterly direction before turning toward the west-southwest paralleling the shoreline at an average speed of 69 centimeters per second (cm/s) over its entire track of approximately 1.9 nm. The second ebb drogue (E2) was released at 10:51 ADT and moved west-southwest following a similar (though initially more westerly) path to the first drogue with an average speed of 132 cm/s, traveling approximately 2.8 nm. The third drogue (E3) was released at 12:40 ADT, about 3:40 hours (hrs) after high slack. The third drogue traveled mostly parallel to but north of the two prior drogues at an average speed of 120 cm/s over its track of 3.7 nm. Relationships of the ebb drogue tracks, and water quality stations sampled along each drogue track with respect to the tide are shown in Figure 7.

The three Point Woronzof flood drogue tracking cycles were performed beginning in the late afternoon of 20 June 2023. The tidal range during flood stage was 28.3 ft (Figure 7 and Table 14). Flood drogue tracks are depicted in Figure 9. The first flood drogue (F1) was deployed at 16:16 ADT, near low slack water over the outfall. This drogue initially traveled east-northeast before veering to the east and then encountered a clockwise eddy in this area that caused it to loop back towards shore and reverse its course. Drogue F1 traveled approximately 1.5 nm at an average speed of 42 cm/s.

The second flood drogue (F2) was deployed at 18:33 ADT, 2 hours and 17 minutes after low slack. This drogue was transported to the northeast, then moved easterly, about one nautical mile offshore. The drogue was tracked for about 2.1 nm at an average speed of 147 cm/s before it was

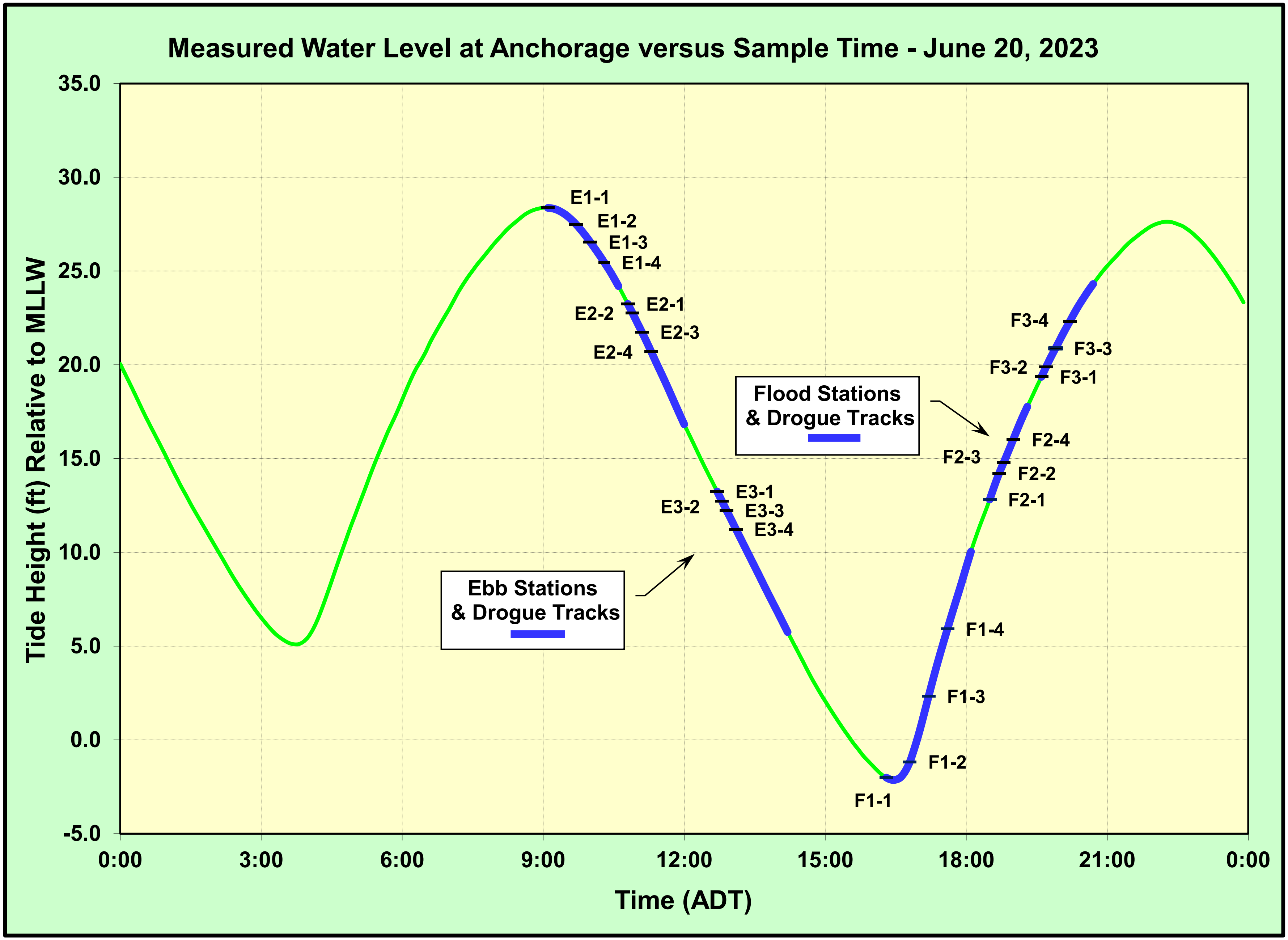


Figure 7. Tidal Information for Receiving Water Sampling, Ebb and Flood Tide.

Table 14. 2023 Drogue Tracking Information.

Date	Station	Tidal Information				Drogue No.	Release Time After Slack (Hr:Min)	Drogue Track Time (Hr:Min)	Drogue Track Distance (nautical miles)	Average Drogue Speed (cm/s)
		Slack Water (Alaska Daylight Time[a]; Stage)		Direction	Range (Feet)					
20 June 2023	Outfall	09:00	HIGH	EBB	29.2	E1	00:08	1:26	1.9	69
20 June 2023	Outfall	09:00	HIGH	EBB	29.2	E2	01:51	1:06	2.8	132
20 June 2023	Outfall	09:00	HIGH	EBB	29.2	E3	03:40	1:34	3.7	120
20 June 2023	Outfall	16:16	LOW	FLOOD	28.3	F1	00:00	1:52	1.5	42
20 June 2023	Outfall	16:16	LOW	FLOOD	28.3	F2	02:17	0:43	2.1	147
20 June 2023	Outfall	16:16	LOW	FLOOD	28.3	F3	03:20	1:07	3.4	157
21 June 2023	Control	16:46	LOW	FLOOD	27.9	C1	00:00	1:31	2.6	90
21 June 2023	Control	16:46	LOW	FLOOD	27.9	C2	01:54	1:07	2.5	115
21 June 2023	Control	16:46	LOW	FLOOD	27.9	C3	03:17	1:00	4.7	241

[a] NOAA/NOS Tides and Currents 2023 (Port of Anchorage, Alaska).

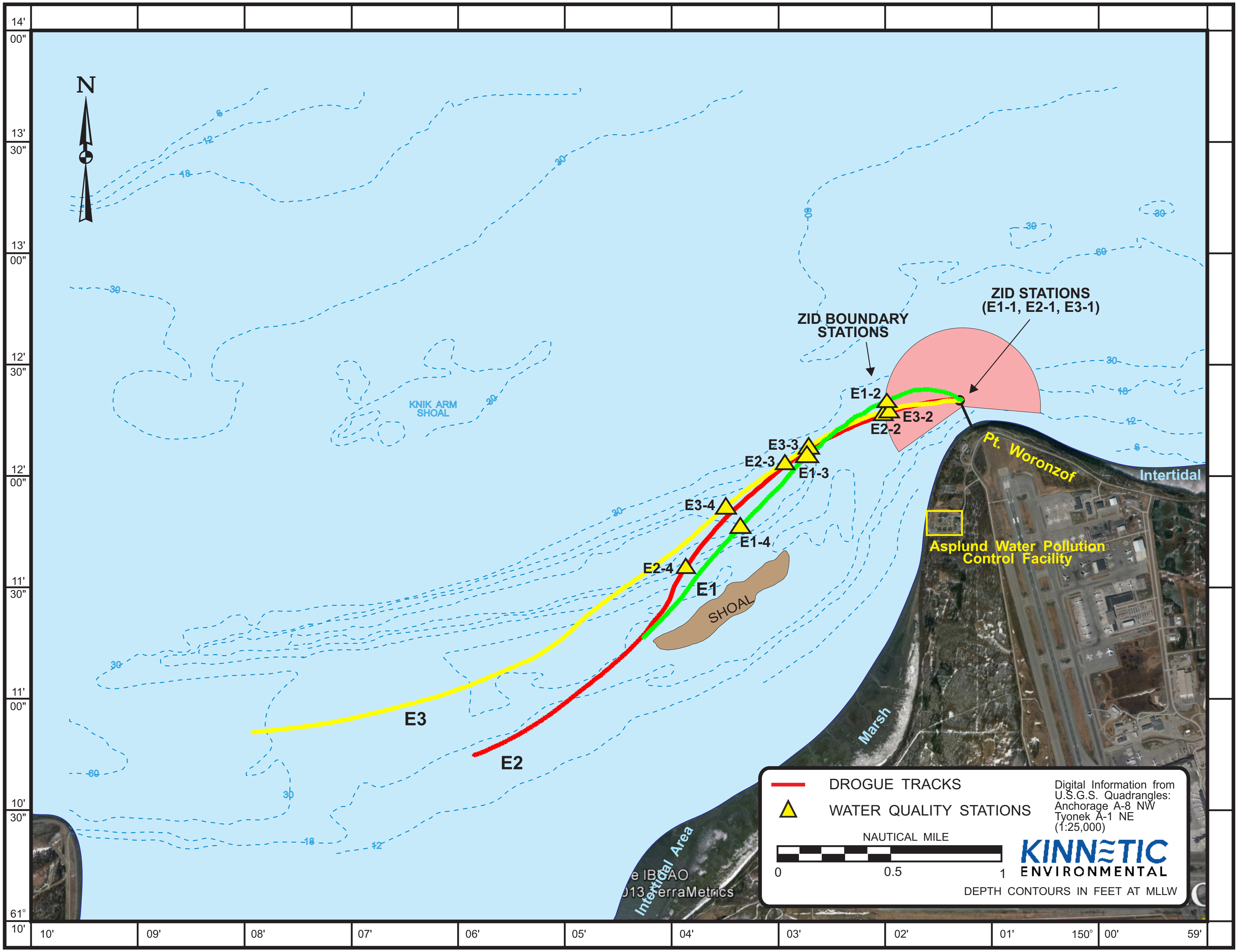


Figure 8. Summary of Ebb Drogue Tracks and Receiving Water Sampling Locations at Point Woronzof, 20 June 2023.

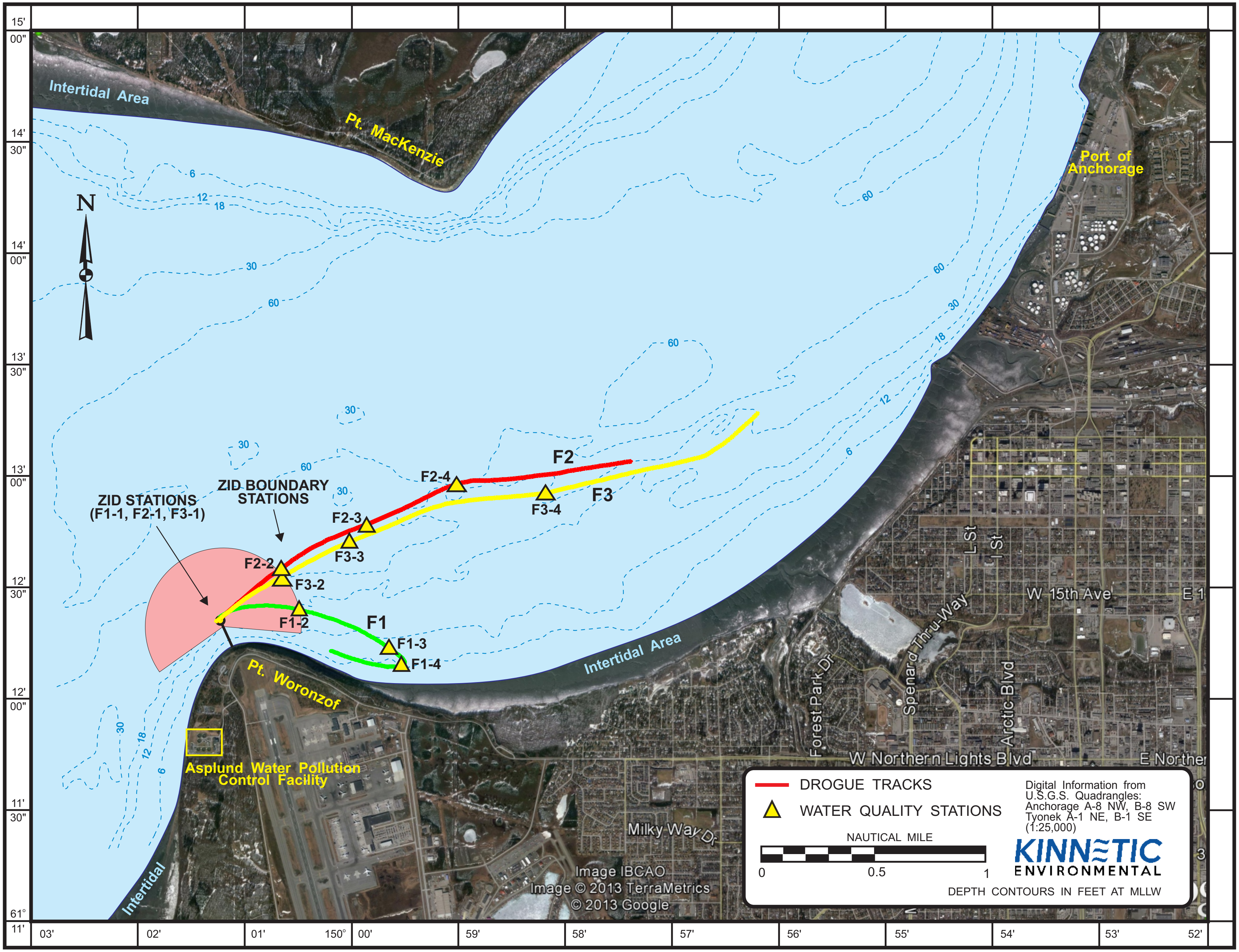


Figure 9. Summary of Flood Drogue Tracks and Receiving Water Sampling Locations at Point Woronzof, 20 June 2023.

retrieved. The third flood drogue (F3) was deployed at 19:36 ADT, 3 hours and 20 minutes after low slack water and tracked for 1 hour and 7 minutes. This drogue traveled northeast in the Knik Arm Channel mimicking the path of the F2 drogue. The third drogue traveled at a speed of 157 cm/s and was tracked for 3.4 nautical miles before being recovered approximately one nautical mile offshore.

Control Site

The Point MacKenzie control drogues were deployed and tracked on 21 June 2023. The predicted tidal range during the flood tide was 27.9 ft. Tidal information is provided in Figure 10 and Table 14 (NOAA/NOS, 2023). A composite of the three drogue trajectories at the control site is presented in Figure 11. The relationship of drogue tracks with respect to the tide and when sampling took place are shown in Figure 10.

The first drogue (C1) was released at 16:46 ADT at low tide; it traveled to the east before swinging northeast and then to the north toward Port MacKenzie paralleling the shoreline along its entire track, approximately 0.5 nautical miles from shore. This drogue was tracked for 1 hr and 31 min traveling 2.6 nm at an average speed of 90 cm/s before being retrieved. The second drogue (C2) was released at 18:40 ADT, 1 hr and 54 min into the flood tidal cycle and tracked for 67 minutes. This drogue had an average speed of 115 cm/s over the entire track and moved towards the northeast. This second drogue was eventually retrieved after traveling 2.5 nm and spending some time entrained in a series of eddies south of the large underwater promontory south of Port MacKenzie. The third control drogue (C3) was released at 20:03 ADT, approximately 3 hours 17 minutes after low slack water. The drogue moved northeast on a tract more central to the main channel of Knik Arm than that seen for the first two control drogues (C1 and C2). Drogue C3 traveled at an average speed of 241 cm/s and traveled 4.7 nm before it was retrieved offshore and well north of Port MacKenzie.

Summary of Receiving Water Quality Data

The receiving water quality sampling for all analysis types was conducted concurrently with the drogue tracking studies on 20-21 June 2023. As discussed previously, three drogues were released at the ZID for both the ebb and flood tide cycles and three were released at the control site for the flood tide. Water samples and CTD measurements were obtained at four stations along each drogue's track prior to its being retrieved. As specified in the permit, the ZID boundary is located at a distance of 650 m from the outfall diffuser. To successfully sample at the ZID stations, the vessel was positioned directly up current from the diffuser and allowed to drift down across it. Upon reaching the outfall diffuser, the drogue was deployed and the within-ZID station was immediately sampled. The distance from the outfall diffuser to the drogue was monitored with the DGPS, and upon reaching a 650-m distance from the diffuser, the ZID-boundary station was sampled adjacent to the drogue. The third and fourth stations were then sampled along the drogue's path. Due to high current speeds, anchoring the vessel and sampling at each station was not practical or desirable, since anchoring would result in large wire angles for sampling gear, would reduce safety, and would not allow subsequent sampling along the drogues path.

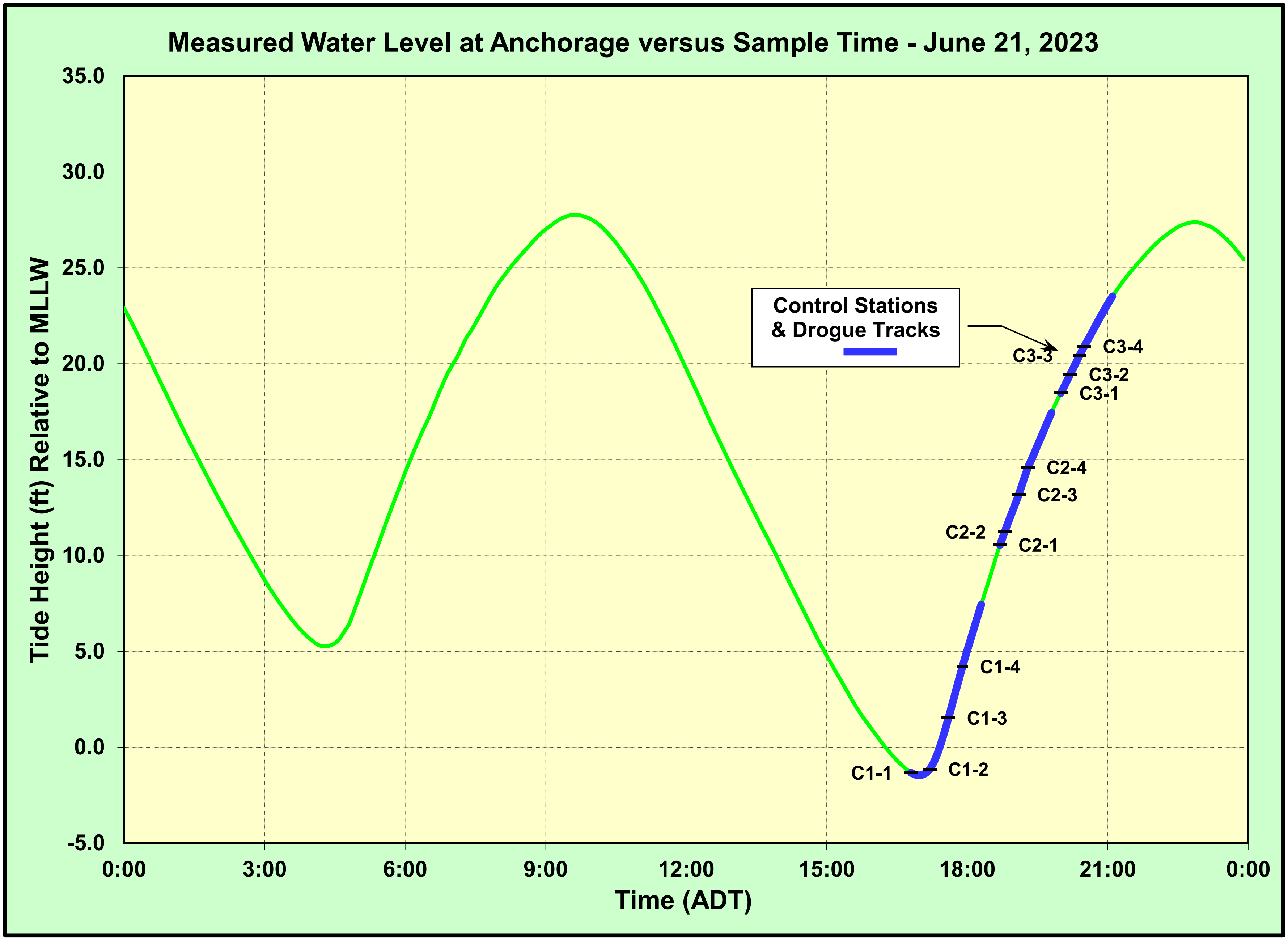


Figure 10. Tidal Information for Receiving Water Sampling, Control Tide.

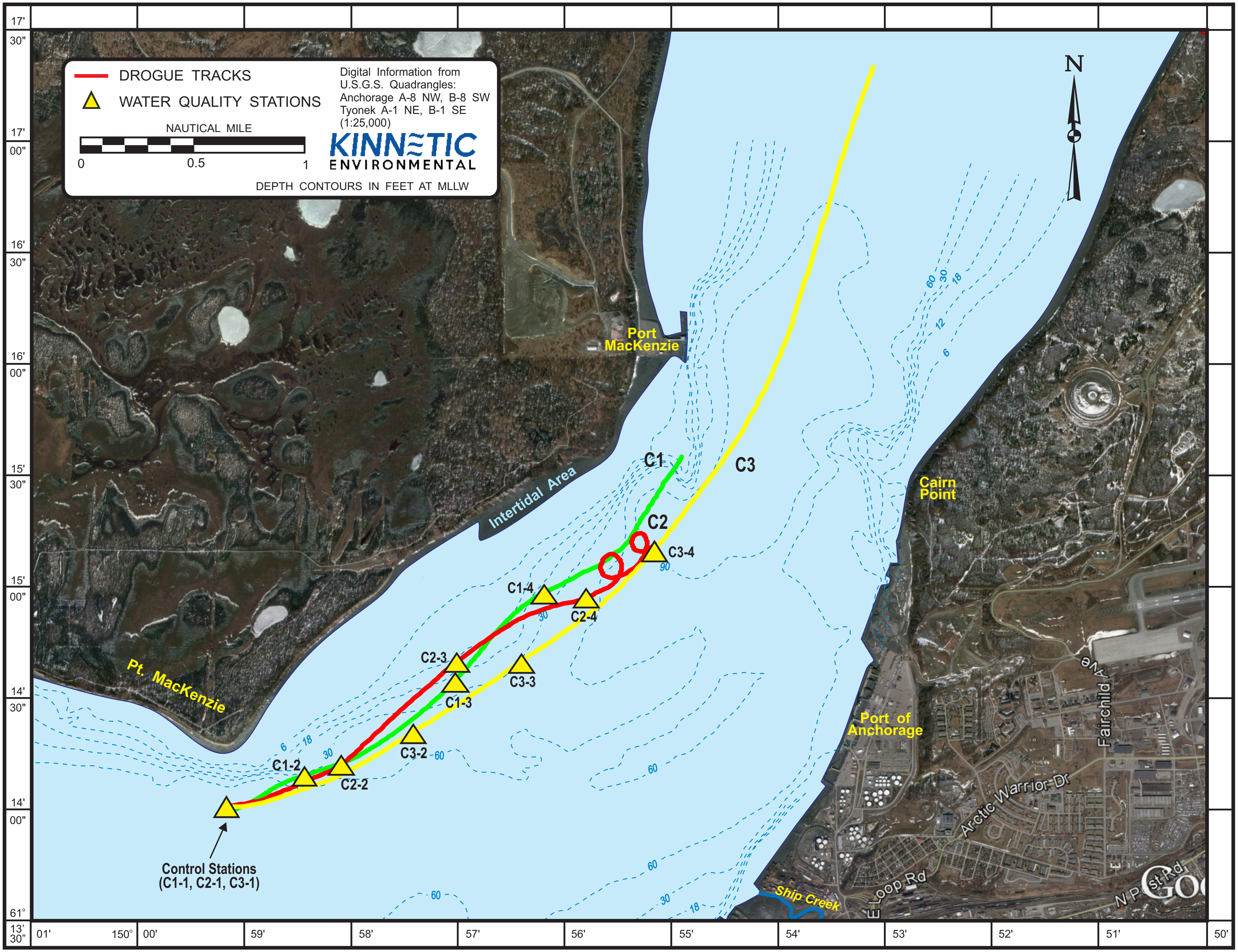


Figure 11. Summary of Control Drogue Tracks and Receiving Water Sampling Locations at Point MacKenzie, 21 June 2023.

The waters of the Inlet are extremely well-mixed both vertically and horizontally, as indicated by CTD data. During the survey, water temperatures seen in the surface, middle, and bottom samples were in a narrow range with a minimum of 10.38 °C and a maximum of 12.17 ºC, with warmer temperatures generally seen at the control station locations and closer to the surface (Table 15). Salinities were found to vary from a minimum of 12.72 parts per thousand (‰) practical salinity units (psu) to a maximum of 16.45 psu. Salinities were generally found to increase slightly during the flood and decrease on the ebb, as is typical for estuaries. As has been often seen in the past, the control stations were found to be slightly warmer and less saline due to a greater influence from river runoff on the north side of Knik Arm. Also, some sites exhibited a lower salinity water lens at the surface that was evident in the CTD data. Values for pH were in a very tight range with a low of 7.79 SU seen at Station E1-1 to a high of 7.88 SU with little to no vertical stratification at most locations and slightly higher levels at the control stations, which is also probably due to greater riverine influences. The DO concentrations measured in situ with the CTD ranged from 8.20 to 9.78 mg/L with most concentrations being at or near 100% saturation (UNESCO and National Institute of Great Britain, 1973).

Representative hydrographic profiles of water quality are presented for a ZID-boundary station during ebb tide, Station E2-2, and a typical control station, Station C2-4 (Figure 12). The water column was found to be fairly well mixed from the surface to the bottom at all stations, although some stations did exhibit some stratification, particularly in the temperature and salinity structure. This stratification was not attributed to the outfall but was primarily due to freshwater influences from local river inputs and was most evident at the outfall ebb and control locations. Refer to Appendix C8 for CTD profile plots and detailed data from each water quality station.

Discrete water samples were obtained at the surface of each station and analyzed for color, TRC, fecal coliform bacteria, and turbidity. Color values registered 2.5 color units on the platinum-cobalt scale at all locations other than Stations F1-1 and E1-1 over the outfall at slack tide which tested at 10 and 5 color units, respectively. Turbidity values for water samples collected during the monitoring ranged from a low of 42.6 Nephelometric Turbidity Units (NTU) to a high of 856 NTU. Lower values were seen at the surface and near slack tide; as in the past, generally higher levels overall were seen at control locations.

During 2023, all measured receiving water TRC concentrations were below the MDL of 0.01 mg/L except Station F1-1 located directly over the outfall at low tide which tested at 0.018 mg/L. The effluent TRC concentration measured by AWWU staff during the outfall receiving water sampling was 0.136 mg/L on 20 June as documented in their monthly monitoring report, which is substantially lower than maximum daily permit limit of 1.2 mg/L. It should be noted that the lowest achievable MDL due to seawater matrix interferences for TRC analysis was between the AWQS 1-hr average acute limit of 0.013 mg/L and the 4-day chronic limit of 0.0075 mg/L. Also, the MDL that was achieved is an order of magnitude less than the 0.10 mg/L practicable limit that ADEC considers achievable in seawater for regulatory purposes. The ion selective electrode method (SM 4500-Cl I) was used for the receiving water sampling to reduce interferences from common oxidizing agents, temperature, turbidity, and color; however, all TRC methods are subject to positive interferences in estuarine or marine waters.

Fecal coliform values in 2023 were again found to be low, ranging from <1.8 to a high of 7.8 FC/100 mL at Station E1-4. The overall median for fecal coliform at all of the outfall stations (both ebb and flood) was <1.8 FC/100 mL, and the median for the control stations was <1.8 FC/100 mL.

Table 15. Hydrographic and Water Quality Data, 20 and 21 June 2023.

Station Number	Time (ADT)	Latitude (North)	Longitude (West)	Depth (M)	Temp[a] (°C)	Salinity[a] (psu)	pH[a] (SU)	DO[a] (mg/L)	Turbidity (NTU)	Color (units)	TRC (mg/L)	Fecal Coliform[b]
20 June 2023												
E1-1S	09:08	61° 12.341’	150° 01.269’	0.5	10.97	15.25	7.79	8.20	195	5	<0.01	<1.8
-1M				6.0	10.61	16.29	7.82	9.71	394			
-1B				11.5	10.55	16.41	7.82	9.75	396			
E1-2S	09:40	61° 12.336’	150° 01.979’	0.5	11.13	15.07	7.82	9.37	42.6	2.5	<0.01	<1.8
-2M				8.0	10.87	15.39	7.84	9.66	263			
-2B				15.5	10.44	16.44	7.83	9.73	309			
E1-3S	10:00	61° 12.092’	150° 02.732’	0.5	10.63	16.25	7.86	9.62	117	2.5	<0.01	2.0
-3M				7.5	10.40	16.33	7.87	9.78	148			
-3B				15.0	10.41	16.45	7.87	9.78	366			
E1-4S	10:15	61° 11.779’	150° 03.352’	0.5	11.18	15.10	7.87	9.38	113	2.5	<0.01	7.8
-4M				4.0	10.40	16.29	7.88	9.63	277			
-4B				8.0	10.38	16.37	7.87	9.72	352			
E2-1S	10:51	61° 12.343’	150° 01.281’	0.5	10.92	15.42	7.84	9.22	415	2.5	<0.01	<1.8
-1M				5.5	10.90	15.49	7.84	9.48	419			
-1B				10.5	10.89	15.51	7.84	9.56	475			
E2-2S	10:56	61° 12.289’	150° 01.977’	0.5	10.89	15.53	7.84	9.41	472	2.5	<0.01	<1.8
-2M				7.5	10.88	15.55	7.85	9.65	507			
-2B				14.5	10.85	15.64	7.86	9.68	546			
E2-3S	11:04	61° 12.058’	150° 02.924’	0.5	10.89	15.59	7.84	8.79	472	2.5	<0.01	<1.8
-3M				7.0	10.87	15.62	7.84	9.28	488			
-3B				14.0	10.87	15.64	7.84	9.64	491			
E2-4S	11:16	61° 11.591’	150° 03.885’	0.5	10.89	15.59	7.84	9.20	467	2.5	<0.01	<1.8
-4M				2.5	10.89	15.64	7.85	9.63	475			
-4B				4.5	10.88	15.64	7.85	9.59	477			

Table 15. Hydrographic and Water Quality Data, 20 and 21 June 2023. (continued)

Station Number	Time (ADT)	Latitude (North)	Longitude (West)	Depth (M)	Temp[a] (°C)	Salinity[a] (psu)	pH[a] (SU)	DO[a] (mg/L)	Turbidity (NTU)	Color (units)	TRC (mg/L)	Fecal Coliform[b]
E3-1S	12:40	61° 12.341’	150° 01.290’	0.5	11.14	14.72	7.83	9.33	546	2.5	<0.01	<1.8
-1M				3.5	11.13	14.77	7.84	9.53	599			
-1B				7.0	11.13	14.77	7.83	9.52	566			
E3-2S	12:47	61° 12.294’	150° 01.974’	0.5	11.14	14.74	7.83	9.51	517	2.5	<0.01	<1.8
-2M				6.0	11.14	14.75	7.84	9.70	595			
-2B				11.5	11.13	14.76	7.84	9.64	607			
E3-3S	12:56	61° 12.134’	150° 02.726’	0.5	11.14	14.71	7.83	9.31	571	2.5	<0.01	<1.8
-3M				6.0	11.12	14.80	7.84	9.54	592			
-3B				11.5	11.09	14.88	7.84	9.53	598			
E3-4S	13:08	61° 11.861’	150° 03.498’	0.5	11.14	14.78	7.83	9.28	427	2.5	<0.01	<1.8
-4M				6.0	11.12	14.81	7.84	9.56	602			
-4B				11.5	11.12	14.81	7.84	9.57	615			
F1-1S	16:16	61° 12.343’	150° 01.280’	0.5	11.52	14.10	7.86	9.44	357	10	0.018	2.0
-1M				1.0	11.51	14.11	7.86	9.59	380			
-1B				1.5	11.51	14.11	7.86	9.54	326			
F1-2S	16:50	61° 12.397’	150° 00.537’	0.5	11.54	14.07	7.84	9.48	340	2.5	<0.01	2.0
-2M				1.5	11.54	14.08	7.84	9.59	364			
-2B				2.5	11.54	14.07	7.84	9.58	396			
F1-3S	17:13	61° 12.231’	149° 59.682’	0.5	11.59	14.04	7.85	9.57	260	2.5	<0.01	1.8
-3M				1.0	11.58	14.04	7.85	9.65	383			
-3B				2.0	11.58	14.04	7.85	9.65	389			
F1-4S	17:37	61° 12.150’	149° 59.548’	0.5	11.59	13.92	7.86	9.44	53.9	2.5	<0.01	<1.8
-4M				1.5	11.59	13.99	7.87	9.59	293			
-4B				2.5	11.60	14.00	7.87	9.58	383			

Table 15. Hydrographic and Water Quality Data, 20 and 21 June 2023. (continued)

Station Number	Time (ADT)	Latitude (North)	Longitude (West)	Depth (M)	Temp[a] (°C)	Salinity[a] (psu)	pH[a] (SU)	DO[a] (mg/L)	Turbidity (NTU)	Color (units)	TRC (mg/L)	Fecal Coliform[b]
F2-1S	18:33	61° 12.345’	150° 01.281’	0.5	11.38	14.70	7.81	9.29	515	2.5	<0.01	<1.8
-1M				3.5	11.38	14.71	7.82	9.51	504			
-1B				7.0	11.38	14.72	7.82	9.49	504			
F2-2S	18:40	61° 12.585’	150° 00.685’	0.5	11.36	14.76	7.83	9.28	542	2.5	<0.01	4.5
-2M				6.0	11.36	14.77	7.84	9.52	571			
-2B				12.0	11.34	14.77	7.85	9.54	552			
F2-3S	18:49	61° 12.782’	149° 59.877’	0.5	11.42	14.66	7.83	9.34	495	2.5	<0.01	<1.8
-3M				7.0	11.41	14.60	7.86	9.53	615			
-3B				14.0	11.41	14.58	7.85	9.57	706			
F2-4S	18:58	61° 12.947’	149° 59.029’	0.5	11.40	14.51	7.85	9.10	444	2.5	<0.01	<1.8
-4M				7.0	11.40	14.59	7.85	9.55	625			
-4B				14.0	11.42	14.54	7.85	9.53	720			
F3-1S	19:36	61° 12.344’	150° 01.274’	0.5	11.10	15.29	7.83	9.27	466	2.5	<0.01	<1.8
-1M				4.5	11.10	15.26	7.83	9.55	489			
-1B				8.5	11.11	15.24	7.83	9.62	509			
F3-2S	19:42	61° 12.543’	150° 00.679’	0.5	11.10	15.27	7.84	9.41	486	2.5	<0.01	<1.8
-2M				6.5	11.10	15.28	7.85	9.60	513			
-2B				13.0	11.10	15.27	7.85	9.55	503			
F3-3S	19:50	61° 12.704’	150° 00.053’	0.5	11.12	15.16	7.85	9.46	522	2.5	<0.01	2.0
-3M				9.0	11.11	15.07	7.85	9.60	625			
-3B				17.5	11.12	14.97	7.85	9.57	670			
F3-4S	20:10	61° 12.926’	149° 58.196’	0.5	11.25	14.90	7.84	9.38	350	2.5	<0.01	<1.8
-4M				8.0	11.18	14.83	7.85	9.58	693			
-4B				16.0	11.17	14.84	7.85	9.58	700			

Table 15. Hydrographic and Water Quality Data, 20 and 21 June 2023. (continued)

Station Number	Time (ADT)	Latitude (North)	Longitude (West)	Depth (M)	Temp[a] (°C)	Salinity[a] (psu)	pH[a] (SU)	DO[a] (mg/L)	Turbidity (NTU)	Color (units)	TRC (mg/L)	Fecal Coliform[b]
21 June 2023												
C1-1S	16:46	61° 13.999’	149° 59.154’	0.5	12.17	12.72	7.86	9.37	73.0	2.5	<0.01	<1.8
-1M				3.5	11.82	13.64	7.87	9.46	672			
-1B				7.0	11.81	13.75	7.87	9.46	603			
C1-2S	17:10	61° 14.150’	149° 58.430’	0.5	11.94	13.12	7.87	9.32	390	2.5	<0.01	<1.8
-2M				2.5	11.90	13.20	7.87	9.49	499			
-2B				4.5	11.88	13.23	7.88	9.55	563			
C1-3S	17:35	61° 14.575’	149° 57.020’	0.5	11.95	13.12	7.87	9.45	633	2.5	<0.01	<1.8
-3M				1.0	11.96	13.08	7.87	9.57	629			
-3B				1.5	11.96	13.07	7.87	9.57	735			
C1-4S	17:55	61° 14.970’	149° 56.202’	0.5	12.09	12.78	7.87	9.10	556	2.5	<0.01	<1.8
-4M				2.5	12.00	12.95	7.88	9.57	617			
-4B				5.0	12.03	12.84	7.88	9.57	833			
C2-1S	18:40	61° 14.014’	149° 59.142’	0.5	11.96	12.90	7.87	9.31	54.2	2.5	<0.01	2.0
-1M				5.5	11.93	12.99	7.87	9.49	337			
-1B				10.5	11.92	13.05	7.88	9.55	483			
C2-2S (A)	18:49	61° 14.199’	149° 58.087’	0.5	11.98	12.80	7.87	9.04	311	2.5	<0.01	<1.8
-2S (B)				0.5	11.98	12.80	7.87	9.27	276	2.5	<0.01	<1.8
-2S (C)				0.5	11.97	12.78	7.87	8.95	290	2.5	<0.01	2.0
-2M				3.0	11.97	12.80	7.87	9.55	310			
-2B				6.0	11.97	12.79	7.87	9.56	322			
C2-3S	19:04	61° 14.661’	149° 57.015’	0.5	11.99	12.79	7.87	9.51	272	2.5	<0.01	<1.8
-3M				2.5	11.98	12.79	7.87	9.54	309			
-3B				4.5	11.98	12.80	7.88	9.58	298			

Table 15. Hydrographic and Water Quality Data, 20 and 21 June 2023. (continued)

Station Number	Time (ADT)	Latitude (North)	Longitude (West)	Depth (M)	Temp[a] (°C)	Salinity[a] (psu)	pH[a] (SU)	DO[a] (mg/L)	Turbidity (NTU)	Color (units)	TRC (mg/L)	Fecal Coliform[b]
C2-4S	19:17	61° 14.951’	149° 55.792’	0.5	12.06	12.84	7.87	9.51	306	2.5	<0.01	<1.8
-4M				9.5	12.00	12.83	7.87	9.53	366			
-4B				18.5	11.82	13.26	7.87	9.53	368			
C3-1S (A)	20:03	61° 14.009’	149° 59.132’	0.5	11.70	13.91	7.84	9.17	364	2.5	<0.01	<1.8
-1S (B)				---	---	---	---	---	372	2.5	<0.01	<1.8
-1S (C)				---	---	---	---	---	353	2.5	<0.01	<1.8
-1M				5.0	11.65	13.97	7.86	9.55	554			
-1B				9.5	11.65	14.01	7.86	9.54	605			
C3-2S	20:14	61° 14.343’	149° 57.408’	0.5	11.64	14.13	7.86	9.41	407	2.5	<0.01	1.8
-2M				4.5	11.58	14.47	7.86	9.51	653			
-2B				9.0	11.57	14.31	7.87	9.53	820			
C3-3S	20:21	61° 14.659’	149° 56.406’	0.5	11.70	14.00	7.85	9.42	479	2.5	<0.01	<1.8
-3M				6.0	11.59	14.37	7.86	9.52	806			
-3B				12.0	11.57	14.23	7.86	9.54	856			
C3-4S	20:31	61° 15.162’	149° 55.157’	0.5	11.70	14.07	7.86	9.44	408	2.5	<0.01	<1.8
-4M				16.5	11.63	14.05	7.86	9.61	646			
-4B				33.0	11.59	14.19	7.86	9.64	664			

a Values from CTD for 0.5 m depth taken as close to surface as possible.

b Fecal coliform reported as FC/100 mL.

< Not detected, followed by the Method Detection Limit.

--- Samples not collected.

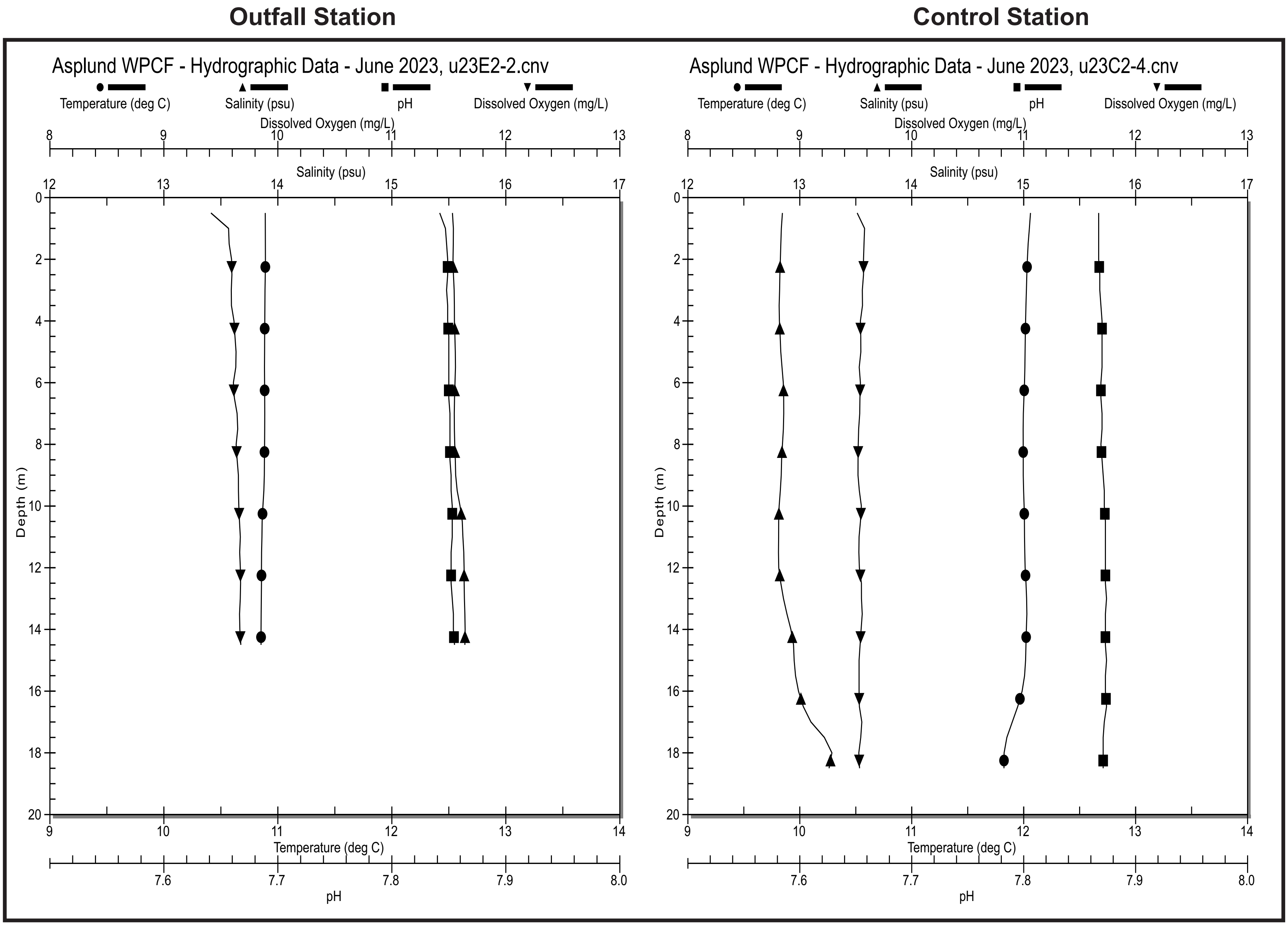


Figure 12. Sample Hydrographic Profiles from Outfall and Control Stations, June 2023.

In addition to routine water quality monitoring, supplemental surface samples were collected at the first three stations along the first flood drogue trajectory at both the outfall (diffuser, ZID-boundary, and near-field) and control sites that represented worst-case low water and low-flow conditions. These supplemental samples were analyzed for BETX, PAHs, dissolved and total recoverable metals, cyanide, and TSS. The supplemental analyses in 2023 also included a full suite of volatile and semi-volatile organics, organochlorine pesticides (POCs), organophosphorus pesticides (POPs), polychlorinated biphenyls (PCBs), and dioxins.

Dissolved metals concentrations were uniformly found to be lower than total recoverable concentrations in 2023 with the exception of cadmium at Station F1-2. The value for dissolved copper at station F1-1, 3.75 µg/L (directly above the outfall at low tide) tested above the AWQS site specific limit of 3.1 µg/L. The effluent concentration of dissolved copper on this date was 25.6 µg/L (Table 11) in the 24-hr composite sample and 16.2 µg/L (Table 16) in a grab sample that was taken at the same time as the receiving water sampling effort. An anomalously high dissolved copper concentration was seen at Station F1-3 approximately 1400 meters from the outfall with a concentrations of 20.8 µg/L. This high value is within the range of the total recoverable copper values seen at this and other receiving water stations and may indicate a filtration failure as the other five dissolved copper values collected in the receiving water were 2.07 µg/L or less. Two other dissolved metals returned their highest values at this station; nickel at 1.69 µg/L and lead at 0.203 µg/L. Based on the location of this sample and the very high copper concentration, these elevated values were <u>not</u> attributed to the outfall but were believed to be a laboratory issue with either the filtration step or the actual analysis. Other than the two copper values discussed above all other dissolved metal values at all stations were decidedly lower than AWQS criteria.

Total recoverable metals concentrations were quite variable with the highest total metals concentrations corresponding closely to high ambient TSS levels. The highest levels of all metals tested including arsenic, cadmium, chromium, copper, mercury, nickel, lead, silver, and zinc occurred at Station C1-3, which had the highest TSS concentration at 818 mg/L. TSS concentrations ranged from 332 to 462 mg/L at the outfall stations and from 100 to 818 mg/L at the control stations. As seen in prior years, the total recoverable metals sample results for 2023 clearly indicate that TSS is the primary source for total metals.

Cyanide testing is prone to interference issues when testing at very low concentrations, especially in seawater. Station F1-1 returned a value of 7.9 J µg/L while effluent cyanide sample tested as part of the supplemental receiving water sampling program was determined to be 6.2 µg/L. The 24-hr composite pre-treatment effluent cyanide concentration on the same day was 0.6 J µg/L. All other receiving water cyanide samples tested less than the MDL of 0.5 µg/L.

Hydrocarbon analyses results are presented in Table 17. TAH defined by the AWQS as BETX (EPA Method 624.1) was determined by summing benzene, ethylbenzene, toluene, and total xylenes. Benzene and ethylbenzene were not detected at any of the receiving water stations. Toluene and m,p-xylenes were detected at Station F1-1 within the ZID at concentrations of 0.78 and 0.30 J µg/L, respectively. The TAH summation concentrations ranged from a low of <0.31 µg/L to a high of <1.22 µg/L at Station F1-1, where individual BETX MDLs were used in calculating the TAH summations when concentrations were ND. All TAH concentrations were below the AWQS of 10 µg/L. The effluent sample collected on the same day had a TAH concentration of 7.93 µg/L (Table 9), slightly below the AWQS of 10 µg/L and significantly less than the MAEC of 1,810 µg/L.

Table 16. Concentrations of Dissolved Metals, Total Recoverable Metals, Cyanide, and Total Suspended Solids in Receiving Water and Effluent Samples.

Station	Arsenic	Cadmium	Chromium	Copper	Cyanide	Mercury	Nickel	Lead	Silver	Zinc	TSS
	µg/L										mg/L
Dissolved Metals											
F1-1S (WITHIN ZID)	1.88	0.0810	<1.70	3.75	NA	0.00101	1.29	0.0400	0.107 J	3.97	NA
F1-2S (ZID BOUND) *a*	1.77	0.0750	<1.70	2.07	NA	0.00043	1.51	0.102	<0.050	1.70	NA
F1-2S (ZID BOUND) *b*	1.79	0.208	<1.70	2.00	NA	0.00453	1.50	0.0599	<0.050	2.00	NA
F1-3S (NEAR FIELD)	1.77	0.0788	<1.70	20.8	NA	0.00040 J	1.69	0.203	<0.050	2.40	NA
C1-1S (CONTROL)	1.67	0.0693	<1.70	1.34	NA	0.00038 J	1.33	0.0271	<0.050	1.09	NA
C1-2S (CONTROL)	1.72	0.0697	<1.70	1.48	NA	0.00027 J	1.40	0.0470	<0.050	1.43	NA
C1-3S (CONTROL)	1.88	0.0715	<1.70	1.59	NA	0.00039 J	1.33	0.0458	<0.050	1.17	NA
EFFLUENT	1.70	0.0785	<1.70	16.2	NA	0.00670	2.06	0.369	<0.050	37.5	NA
Total Metals											
F1-1S (WITHIN ZID)	9.15	0.133	17.4	25.9	7.9	0.0200	13.2	3.46	0.070 J	47.7	332
F1-2S (ZID BOUND) *a*	9.51	0.139	16.4	18.9	<0.5	0.0271	11.3	3.44	0.060 J	31.8	462
F1-2S (ZID BOUND) *b*	8.73	0.135	13.9	21.4	<0.5	0.0248	13.0	4.04	0.059 J	37.2	440
F1-3S (NEAR FIELD)	10.5	0.126	19.9	21.2	<0.5	0.0122	12.7	3.92	0.069 J	35.6	422
C1-1S (CONTROL)	5.23	0.0946	7.66	10.7	<0.5	0.0117	7.53	1.83	<0.050	18.8	100
C1-2S (CONTROL)	10.8	0.136	19.6	25.2	<0.5	0.0375	15.6	4.61	0.070 J	46.7	516
C1-3S (CONTROL)	18.2	0.175	35.9	41.7	<0.5	0.0583	30.0	7.80	0.130 J	77.6	818
EFFLUENT	2.11	0.151	<1.70	26.0	6.2	0.0176	2.56	1.12	0.096 J	66.5	76

a	Field sample value	J	Result is an estimated value between MDL and MRL.
b	Field duplicate value.	NA	Not applicable / not available.
<	Not detected followed by MDL.		

Table 17. Supplemental Receiving Water Analyses.

Parameter	Control Flood Samples			ZID Flood Samples		
	C1-1S	**C1-2S**	**C1-3S**	**F1-1S**	**F1-2S**[c]	**F1-3S**
Volatile Organics in µg/L (BETX plus other detected substances)						
Acetone	<2.0	<2.0	<2.0	19 BJ+	<2.0/ <2.0	<2.0
Benzene	<0.06	<0.06	<0.06	<0.06	<0.06 / <0.06	<0.06
Chloroform	<0.07	<0.07	<0.07	0.31 J	<0.07 / <0.07	<0.07
Chloromethane	<0.06	<0.06	<0.06	0.12 J	<0.06 / <0.06	<0.06
Ethylbenzene	<0.03	<0.03	<0.03	<0.5 B	<0.03 / <0.03	<0.03
Toluene	<0.07	<0.07	<0.5 B	0.78	<0.5 B / <0.5 B	<0.5 B
m,p-Xylenes	<0.10	<0.10	<0.10	0.30 J	<0.10 / <0.10	<0.10
o-Xylene	<0.05	<0.05	<0.05	<0.5 B	<0.05 / <0.05	<0.05
Xylenes (Total)	<0.15	<0.15	<0.15	<0.8	<0.15 / <0.15	<0.15
TAH (as BETX)[a]	<0.31	<0.31	<0.31	<1.22	<0.31 / <0.31	<0.31
Polycyclic Aromatic Hydrocarbons (PAH) by GC/MS in µg/L						
TPAH	0.007	0.042	0.091	0.771	0.046 / 0.043	0.034
Total Aqueous Hydrocarbons (TAqH) in µg/L						
TAqH[b]	<0.32	<0.35	<0.40	<1.99	<0.36/< 0.35	<0.34
Semi-Volatile Organics - detected substances only						
Bis(2-ethylhexyl) Phthalate	<0.8 B	<0.8 B	<0.58	<0.8 B	<0.58 / <0.8 B	1.2 BJ+
2-Chloronaphthalene	0.11 J	<0.038	<0.038	<0.038	<0.038/<0.038	<0.038
Diethyl Phthalate	0.11 J	<0.065	<0.065	<0.065	<0.065 / <0.065	0.40 J
Naphthalene	0.090 J	<0.039	0.044 J	<0.039	<0.039 / 0.10 J	<0.039
Phenanthrene	<0.034	<0.034	0.043 J	<0.034	<0.034/<0.034	<0.034
Phenol	<0.022	0.19 J	<0.022	<0.022	<0.022/ <0.022	2.3
1,2,4-Trichlorobenzene	0.17 J	<0.033	<0.033	<0.033	<0.033/<0.033	<0.033
Cyanide, Pesticides, PCBs, & Dioxins in µg/L						
Cyanide	<0.5	<0.5	<0.5	7.9	<0.5/<0.5	<0.5
Organochlorine Pesticides	ND	ND	ND	ND	ND / ND	ND
Organophosphorus Pesticides	ND	ND	ND *	ND	ND / ND	ND
OP Pesticide Malathion	<0.0050	<0.0050	<0.0050 *	0.0075 J	<0.0050 / <0.0052	<0.0052
Polychlorinated Biphenyls	ND	ND	ND	ND	ND / ND	ND
Dioxins	ND	ND	ND	ND	ND / ND	ND

a Defined by the State of Alaska as the summation of BETX analytes where the MDL was used for ND values.

b TAqH defined as the summation of TAH plus PAH analytes from EPA Method 625 SIM analysis; these calculated values include the full suite of PAH analyte values measured by TDI Brooks.

c Duplicate sample analyses performed at F1-2S to assess field variability.

J Estimated value (below MRL but above MDL).

BJ+ Requalified, biased high due to estimated concentration seen in the method and/or field blank

ND Not detected. B Requalified due to estimated concentration seen in the method or field blank

* Reanalysis performed past recommended holding time, see case narrative.

< Below MDL or MRL for individual analytes or for summations where one or more analytes was ND.

All concentrations of individual PAHs were summed and reported as total PAHs (TPAH) in Table 17. TPAH concentrations were low at both control and outfall stations. TPAH values ranged from 0.007 to 0.091 µg/L at the control stations and from 0.034 to 0.771 µg/L at the outfall stations. The TPAH concentration measured in the effluent sample was 4.884 µg/L. TAqH as determined by the summation of PAHs plus BETX for the six stations and effluent (Table 9 and Table 17). All receiving water concentrations of TAqH were below the AWQS of 15 µg/L. Overall, TAqH concentrations ranged from <0.32 to <1.99 µg/L. The concentration of TAqH in the effluent was 12.81 µg/L, compared to the MAEC of 2,715 µg/L and the AWQS of 15 µg/L.

In addition to the BETX compounds that were already discussed, volatile organic analyses also detected low levels of acetone, chloroform, and chloromethane at Station F1-1 directly over the outfall at low slack tide. No other volatile organic compounds were seen at any of the other receiving water sample locations.

Semivolatile analyses detected low levels of bis(2-ethylhexyl) phthalate at Station F1-3, however this sample was requalified since estimated concentrations were also seen in the associated method blank which are flagged accordingly. Other semivolatile compounds that were detected at estimated levels below the MRL included: 2-chloronaphthalene, diethyl phthalate, naphthalene, phenanthrene, phenol, and 1,2,4-Trichlorobenzene that were seen as scattered hits amongst both the outfall and control stations. The source of these compounds (mostly found at the control site) is unknown, however, overall, the concentrations were quite low and not a concern with respect to aquatic toxicity.

The organophosphate pesticide malathion was discerned at station F1-1 returning an estimated value of 0.0075 J µg/L. Other analyses included POCs, PCBs, and dioxin which were all found to be below their respective detection limits for all samples and analytes. Refer to Appendix C3 for complete results and a list of analytes for which analyses were conducted.

3.2.2 INTERTIDAL ZONE AND STREAM BACTERIAL SAMPLING

Intertidal zone bacterial sampling was performed on 20 June 2023. Sampling began at 21:00 ADT approximately one hour prior to high tide and was completed at 21:30 ADT (Table 18). Effluent grabs and area streams were sampled near low tide on 20 June 2023. Refer to Figure 5 and Figure 13 for maps of the intertidal station and stream sampling locations. Two replicates were taken at all intertidal and stream locations. All stream samples were collected above any tidal influence to represent stream only inputs.

As seen over the last five years, fecal coliform concentrations at the intertidal stations were very low at all locations in 2023 and ranged from <1.8 to 2.0 FC/100 mL. The intertidal fecal coliform median was <1.8 FC/100 mL and the geometric mean was 1.8 FC/100 mL, where the detection limit was utilized for the geometric mean calculation. Fecal coliform concentrations of 4.5 and 6.8 FC/100 mL were found in the replicate effluent samples taken on the same day. Fecal coliform concentrations found in Fish, Chester, and Ship Creeks ranged from a low of 31 FC/100 mL in one sample collected at Chester Creek to highs of 490 and 790 FC/100 mL in the two replicate samples collected from Ship Creek. Elevated levels were also seen in the two replicate samples from Fish Creek with counts of 49 and 79 FC/100 mL.

Table 18. Summary of Bacterial Analyses, 20 June 2023.

Station and Replicate	Sample Date	Sample Time (ADT)	Fecal Coliform FC/100 mL
IT-1 Replicate 1	20 June	21:30	<1.8
IT-1 Replicate 2	20 June	21:30	<1.8
IT-2 Replicate 1	20 June	21:27	<1.8
IT-2 Replicate 2	20 June	21:27	<1.8
IT-3 Replicate 1	20 June	21:25	2.0
IT-3 Replicate 2	20 June	21:25	<1.8
IT-4 Replicate 1	20 June	21:22	<1.8
IT-4 Replicate 2	20 June	21:22	<1.8
IT-5 Replicate 1	20 June	21:20	<1.8
IT-5 Replicate 2	20 June	21:20	<1.8
IT-6 Replicate 1	20 June	21:18	2.0
IT-6 Replicate 2	20 June	21:18	<1.8
IT-7 Replicate 1	20 June	21:14	<1.8
IT-7 Replicate 2	20 June	21:14	2.0
IT-C Replicate 1	20 June	21:00	2.0
IT-C Replicate 2	20 June	21:00	<1.8
Asplund Effluent Replicate 1	20 June	16:15	4.5
Asplund Effluent Replicate 2	20 June	16:15	6.8
Fish Creek Replicate 1	20 June	14:35	49
Fish Creek Replicate 2	20 June	14:35	79
Chester Creek Replicate 1	20 June	14:18	49
Chester Creek Replicate 2	20 June	14:18	31
Ship Creek Replicate 1	20 June	13:52	490
Ship Creek Replicate 2	20 June	13:52	790

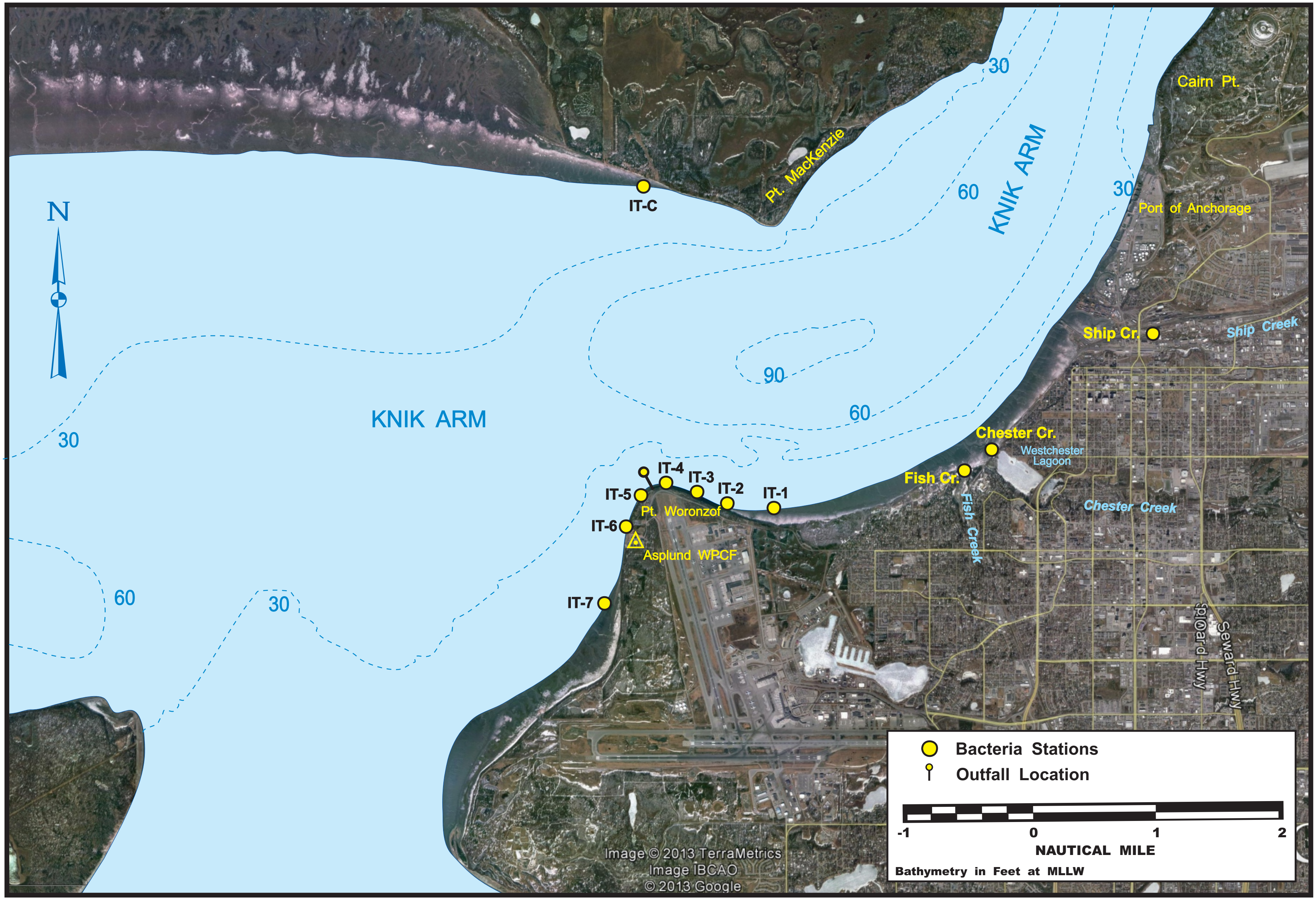


Figure 13. Stream and Intertidal Fecal Coliform Bacterial Sampling Locations.

4.0 DISCUSSION

4.1 INFLUENT, EFFLUENT, AND SLUDGE MONITORING

The NPDES permit for the Asplund WPCF requires compliance with applicable Alaska State water quality standards as promulgated in Chapter 70 of the Alaska Administrative Code (AAC) entitled *Water Quality Standards* (18 AAC 70; ADEC, 1999). This chapter requires that criteria outlined in "EPA Quality Criteria for Water" (also known as "The Red Book"; EPA, 1976), the revised quality criteria for water (EPA, 1986b), and other applicable criteria as referenced in the AWQS be met in applicable receiving waters at every point outside of the ZID boundary. Also, as noted in Section 1.1.1, the State of Alaska water quality regulations include site-specific criteria for the Point Woronzof area for turbidity and the dissolved fractions of arsenic, cadmium, hexavalent chromium, copper, lead, mercury, nickel, selenium, silver, and zinc.

Since issuance of the current permit, EPA has approved the use of dissolved metals for all of the State's marine water quality criteria, approved all of ADEC's proposed SSWQC for Upper Cook Inlet, and removed Alaska from the National Toxics Rule list (EPA, 2006). Except for dissolved cadmium and mercury, where the chronic cadmium standard changed from 9.3 µg/L in the SSWQC to 8.8 µg/L in the AWQS and the marine chronic mercury standard changed from 0.025 µg/L in the SSWQC to 0.94 µg/L in the AWQS, all other dissolved chronic metals criteria are the same in the two standards. Even though EPA has approved the use of dissolved metals criteria for the AWQS, the current SSWQC will most likely remain in effect for the Point Woronzof area for permit renewal as those are also listed in the current AWQS. To be conservative, we have used the more restrictive criteria for dissolved cadmium and mercury to evaluate the data in this report. For other parameters such as TRC, we have utilized the current AWQS (ADEC, 2022a and 2022b), since those criteria will be utilized for the permit renewal process. Finally, the permit itself includes some effluent limitations that must be met. The following sections discuss parameters "of concern" in regard to requirements of the permit or AWQS, as well as historical data from the Asplund WPCF, other POTWs, and other EPA data.

4.1.1 INFLUENT AND EFFLUENT MONITORING

Table 19 lists permit effluent limitations and the most restrictive marine water quality criteria applicable to the current NPDES permit; it includes each required monitoring parameter. Since chronic toxicity criteria concentrations are lower than acute toxicity criteria concentrations, the more stringent of the two values was used here for comparison. For a majority of pollutants, the most restrictive AWQS are based on the chronic toxicity criteria for saltwater aquatic life, although a few are based on current human-health criteria.

The MAEC for each parameter was calculated from the outfall design dilution factor of 142:1 (conservative substances: metals, organic pollutants, WET, etc.) or 180:1 (non-conservative: ammonia, fecal coliform, and TRC), the water quality criteria, and where available, the natural background concentrations as determined historically at the control site near Point MacKenzie. Inclusion of natural background levels into this calculation is necessary since it lowers the MAEC as a result of natural concentrations in the receiving water as required by EPA and ADEC reasonable potential analysis calculation procedures. It was assumed that the final effluent would be diluted by a minimum factor of 143 by the time it reached the boundary of the ZID. For most metals, the MAECs were calculated from the SSWQC for dissolved metals contained in the AWQS for the Point Woronzof area.

Table 19. NPDES Requirements, State of Alaska Water Quality Standards, and AWWU 2023 Maximum Concentrations for Effluent Comparisons.

Parameter	Receiving Water Quality Standard[a]		Maximum Allowable Effluent Concentration[b] (MAEC)	AWWU 2023 Maximum Effluent Concentration[c]
	Limit	Criterion		
Antimony (µg/L)	14	Human health, not listed for saltwater aquatic life	2,002	0.904[,e]
Arsenic (µg/L)	36	Chronic toxicity, measured as dissolved	4,882	3.42[e]
Beryllium (µg/L)[f]	5.3	For the protection of aquatic life in soft fresh water	758	0.010 J[e]
Cadmium (µg/L)	9.3 (8.8)[g]	Chronic toxicity, measured as dissolved	1,322 (1,250)	0.193[e]
Chromium (VI)[h] (µg/L)	50	Chronic toxicity, measured as dissolved	7,038	1.82[e]
Copper (µg/L)	3.1	Chronic toxicity, measured as dissolved	317	40.9[e]
Lead (µg/L)	8.1	Chronic toxicity, measured as dissolved	1,140	1.80[e]
Mercury (µg/L)	0.025 (0.05)[i]	Chronic toxicity, measured as dissolved	2.73	0.0344[e]
Nickel (µg/L)	8.2	Chronic toxicity, measured as dissolved	978	5.18[e]
Selenium (µg/L)	71	Chronic toxicity, measured as dissolved	10,136	0.9 J[e]
Silver (µg/L)	1.9	Acute toxicity, measured as dissolved	257	0.200[e]
Thallium (µg/L)	1.7	Human health, not listed for saltwater aquatic life	243	0.015[d,e]
Zinc (µg/L)	81	Chronic toxicity, measured as dissolved	11,249	145[e]

Table 19. NPDES Requirements, State of Alaska Water Quality Standards, and AWWU 2023 Maximum Concentrations for Effluent Comparisons. (continued)

Parameter	Receiving Water Quality Standard[a]		Maximum Allowable Effluent Concentration[b] (MAEC)	AWWU 2023 Maximum Effluent Concentration[c]
	Limit	Criterion		
Cyanide (µg/L)	1	For marine aquatic life	181	6.2[n]
Total Aqueous Hydrocarbons (TAqH) (µg/L)	15	Growth and propagation of fish, shellfish, aquatic life, and wildlife including seabirds, waterfowl, and furbearers	2,715	12.8[j]
Total Aromatic Hydrocarbons as BETX (µg/L)	10	Same as above	1,810	13.3[d]
pH (pH units)		*k*	6.5 - 8.5	6.8 -7.6[l]
Total Residual Chlorine (TRC) (mg/L)	0.013 0.0075	*k*	Daily Max. 1.2	Daily Max. 0.808[l]
BOD_5 (mg/L)		*k*	Monthly Avg. 240 Weekly Avg. 250 Daily Max. 300 Monthly Removal Rate ≥30%	Monthly Avg. 175[l] Weekly Avg. 185[l] Daily Max. 195[l] Monthly Avg. Removal ≥35% [l] Annual Avg. Removal 38% [l]
Total Suspended Solids (TSS) (mg/L)		*k*	Monthly Avg. 170 Weekly Avg. 180 Daily Max. 190 Monthly Removal Rate ≥30%	Monthly Avg. 72[l] Weekly Avg. 81[l] Daily Max. 114[l] Monthly Avg. Removal ≥71% [l] Annual Avg. Removal 75% [l]
Total Ammonia (mg/L)[m]	8.1 1.2	Acute Chronic	1,466 217	Monthly Max. 33.0[l]
Fecal Coliform (FC/100 mL)		*k*	Monthly geometric mean of at least five samples shall not exceed 850. Not more than 10% of samples shall exceed 2600.	Monthly geometric mean maximum was 7.8[l] The criterion of not more than 10% of samples exceeding 2600 was met in 2023.[l]

Table 19. NPDES Requirements, State of Alaska Water Quality Standards, and AWWU 2023 Maximum Concentrations for Effluent Comparisons. (continued)

Parameter	Receiving Water Quality Standard[a]		Maximum Allowable Effluent Concentration[b] (MAEC)	AWWU 2023 Maximum Effluent Concentration[c]
	Limit	Criterion		
Other Detected Effluent Constituents with Specific Alaska Water Quality Criteria (µg/L)				
1,4-Dichlorobenzene	2,600	Human Health[i]	371,800	0.42 J[d]
Diethyl Phthalate	120,000	Human Health[i]	17,160,000	3.0 J[d]
Endosulfan Sulfate	240	Human Health[i]	34,200	0.022
Ethylbenzene	29,000	Human Health[i]	4,147,000	0.76 J[d]
Malathion	0.1	Chronic Marine	14.3	0.02 J
Phenol	4,600,000	Human Health[i]	657,800,000	15 J[d]
Toluene	200,000	Human Health[i]	28,600,000	7.7[d]

a Alaska Administrative Code, 2022. Water Quality Standards, Chapter 70, 18 AAC 70.020(b)

b For conservative substances, effluent water quality criteria were determined by assuming a dilution of 142:1 at the ZID boundary, where: MAEC = 142 * (Criteria - Natural Background Concentration) + Criteria; pollutant concentrations in the effluent should not exceed these values. For non-conservative substances, a dilution of 180:1 was utilized in the MAEC calculation.

c For metals, the maximum effluent concentration was determined from both total and dissolved concentrations.

d Values from June or August 2023 toxic pollutant and pesticide samplings.

e Values from AWWU's industrial pretreatment monitoring program.

f Suggested criteria from EPA *Quality Criteria for Water,* 1986b (Gold Book). No Alaska Water Quality Standard for Aquatic Life or Human Health.

g Standard based on revised EPA level that was approved for State of Alaska (2001).

h All samples tested as total chromium.

i Alaska water quality Human Health criteria for consumption of water & aquatic organisms (ADEC, 2022a).

j TAqH value is sum of effluent PAHs sample run by TDI Brooks as part of the receiving water sampling effort and effluent BETX summation from June priority pollutants sampling.

k MAECs are not based on water quality criteria but instead are specified in MOA's 2000 NPDES permit.

l Values from AWWU's in-plant monitoring.

m Ammonia receiving water criteria based on pH of 8.0, temperature of 15.0˚C, and salinity of 20 psu.

n Effluent sample run by ALS Environmental as part of the receiving water sampling effort.

J Estimated value (below MRL but above MDL).

To determine compliance with AWQS, effluent limits were compared with effluent values found in Table 8 through Table 11 as well as those in Table 16. The 2023 maximum effluent concentrations shown in Table 19 were the maximum encountered during the calendar year, either during AWWU's in-plant monitoring, the toxic pollutant and pesticide monitoring events, pretreatment monitoring, or the supplemental effluent monitoring that was performed as part of the receiving water monitoring program. For metals, both total and dissolved concentrations in the effluent were compared against their MAEC, since to be conservative it is assumed that all of the metals contained in the effluent are potentially bioavailable upon entering the receiving water. All effluent concentrations were found to be much lower than the MAECs specified in the permit or computed from the AWQS criteria. In addition, permit limitations for all chemical parameters were met for the 2023 program year.

All effluent metals concentrations, both dissolved and total, were substantially less than their respective MAECs. The metal that most closely approached its MAEC was copper, where the maximum concentration of total copper detected in effluent in 2023 was 40.9 µg/L compared to the MAEC of 317 µg/L. The highest dissolved effluent copper concentration was 25.6 µg/L. Of the metals analyzed, beryllium does not have either an SSWQS or an AWQS for either human health or marine aquatic life criteria, although a suggested EPA criterion is provided in Table 19 for comparison (EPA, 1986b).

Total recoverable metals detected in the influent and final effluent were also compared with data from an EPA study of 40 POTWs in Table 20 (EPA, 1982a). Without exception, all metals and cyanide values were lower than or within the range of those detected in other POTWs from across the nation, even though the Asplund WPCF provides only primary treatment as compared to secondary treatment provided at the other plants that were examined in this study.

Historic influent and effluent total recoverable metals and cyanide concentrations collected as part of AWWU's monitoring program are presented in Table 21 and Table 22. Concentrations are very low and fairly consistent over time. Concentrations of all total recoverable and dissolved metals fell within the range of concentrations seen over the prior five years during the summer-dry and summer-wet toxic pollutant sampling (Table 21). Overall, the long-term results for metals have always been well within their MAECs and have always met AWQS and permit criteria.

Historic trends for three total recoverable metals (copper, mercury, and zinc) concentrations that most closely approached their MAECs and for total cyanide are presented in graphical form in Figure 14 and Figure 15. Presented data are annual averages with high and low ranges along with a polynomial regression trend from the time of permit reissuance in 2000 through the current year. In general, copper, mercury, and cyanide concentrations had been showing a slight downward trend but have since leveled off over the past five years indicating that the effluent has not increased in pollutant concentrations, and in all cases, it can clearly be seen that all concentrations are well within their respective MAECs. Total zinc concentrations in final effluent have increased over the last five years compared to the prior five years with greater variability seen between individual measurements (Figure 15). The effluent maximum total zinc concentration seen during 2023 was 145 µg/L, compared to the AWQS of 81 µg/L and an MAEC of 11,249 µg/L (Table 19).

Table 20. Comparison Between Influent/Effluent Results for Anchorage and 40 POTWs[a].

Parameter	Anchorage Values				40 POTW Study Values				
	2023 Concentration (µg/L)				Frequency of Detection (%)		Range Detected (µg/L)		Influent Median
	Summer-Dry		Summer-Wet		Influent	Secondary Effluent	Influent	Secondary Effluent	(µg/L)
	INF	EFF	INF	EFF					
VOLATILES[b]									
Benzene	0.060 J	0.070 J	0.20 J	0.27 J	61	23	1-1560	1-72	2
Chloroform	1.5	2.0	1.7 J	2.1 J	91	82	1-430	1-87	7
1,4- Dichlorobenzene	0.46 J	0.34 J	0.50 J	0.42 J	17	3	2-200	3-9	NA
Ethylbenzene	0.29 J	0.32 J	0.63 J	0.76 J	80	24	1-730	1-49	8
Methylene Chloride	2.1	1.9 J	2.3 J	1.4 J	92	86	1-49000	1-62000	38
Tetrachloroethene	0.35 J	0.20 J	0.31 J	0.18 J	95	79	1-5700	1-1200	23
Toluene	5.8	5.6	7.5	7.7	96	53	1-13000	1-1100	27
SEMI-VOLATILES[b]									
Bis (2-ethylhexyl) Phthalate	<15	<15	<15	8.7	92	84	2-670	1-370	27
Diethyl Phthalate	<1.7	2.6 J	2.8 J	3.0 J	53	13	1-42	1-7	3
Phenol	28	15 J	46	13	79	29	1-1400	1-89	7
TOTAL METALS & CYANIDE									
Antimony	0.806	0.690	0.976	0.652	14	13	1-192	1-69	NA
Arsenic	2.64	2.33	3.16	2.31	15	12	2-80	1-72	NA
Beryllium	0.13 J	<0.005	0.015 J	<0.005	3	1	1-4	1-12	NA
Cadmium	0.209	0.151	0.238	0.164	56	28	1-1800	2-82	3
Chromium	2.51	1.55	3.12	1.55	95	85	8-2380	2-759	105
Copper	52.9	34.5	65.6	39.3	100	91	7-2300	3-255	132
Lead	1.76	1.26	3.11	1.20	62	21	16-2540	20-217	53
Mercury	0.0304	0.0200	0.0778	0.0223	70	31	0.2-4	0.2-1.2	0.517
Molybdenum	7.47	5.25	2.38	1.51	NA	NA	NA	NA	NA
Nickel	4.71	3.93	5.93	4.41	79	75	5-5970	7-679	54
Selenium	0.6 J	0.7 J	0.9 J	0.5 J	9	10	1-10	1-150	NA
Silver	0.191	0.163	0.489	0.165	71	25	2-320	1-30	8
Thallium	0.029	0.015 J	<0.009	<0.009	3	2	1-19	1-2	NA
Zinc	151	109	186	118	100	94	22-9250	18-3150	273
Cyanide	<0.5	0.6 J	1.8 J	2.0 J	100	97	3-7580	2-2140	249

a Source: EPA, 1982a. *Fate of Priority Pollutants in POTWs.* Final Report, Volume I, EPA 440/1-82/303.
b Only analytes detected in either the influent or effluent and in the 40 POTW study are included.
< Not detected, followed by MDL or MRL.
J Estimated value (below MRL but above MDL).
NA Not available

Table 21. Comparison of Toxic Pollutants and Pesticides in Anchorage's Final Effluent to the Previous Five Years.

Pollutant	2018		2019		2020	
	Dry	Wet	Dry	Wet	Dry	Wet
	6/26-27	8/20-21	6/18-19	9/9-10	6/23-24	8/10-11
ORGANICS (µg/L)						
Acetone	NT	NT	NT	NT	270	130
Acrolein	<140	<28.0	<140	<140	1.3 J	1.0 J
Benzene	<1.05	<0.210	<1.05	<1.05	0.17 J	0.040 J
Bis-(2-ethylhexyl) phthalate	<7.74	77.1	95.0 J	<150	4.3 J	5.6
Bromodichloromethane	<1.10	<0.220	<1.10	<1.10	0.050 J	<0.010
Bromomethane	<1.15	<0.230	<1.15	<1.15	<0.010	0.090 J
2-Butanone (MEK)	NT	NT	NT	NT	24	21
Butyl benzyl phthalate	5.62 J	NT	NT	NT	2.3	1.2
Carbon disulfide	NT	NT	NT	NT	0.62 J+	0.61 J+
Chlorobenzene	<0.800	<0.160	<0.800	<0.800	<0.010	0.030 J
Chloroethane	<2.60	<0.520	<2.60	<2.60	0.44 J	0.36 J
Chloroform	3.95 J	2.68	3.25 J	2.80 J	2.7	1.9
Chloromethane	<1.80	<0.360	<1.80	<1.80	1.9 J+	1.6 J+
*1,4-Dichlorobenzene	<4.70/<0.800	<0.160	<0.800	<0.800	0.38 J	0.27 J
cis 1,2-Dichloroethene	<1.80	<0.360	<1.80	<1.80	<0.010	<0.010
Diethyl phthalate	<8.77	<17.0	<34.0	<170	1.9 J	1.9
Dimethyl phthalate	<6.71	NT	NT	NT	<0.21	0.12 J
Di-n-butyl Phthalate	<11.4	<22.0	<44.0	<220	0.80 J	0.36 J
Di-n-octyl Phthalate	18.9 J	NT	NT	NT	<0.33	<0.17
Ethylbenzene	1.20 J	0.290 J	<1.05	<1.05	0.22 J	0.080 J
Fluoranthene	<7.22	<14.0	<28.0	<140	0.26 J	0.15 J
2-Hexanone	NT	NT	NT	NT	<0.010	<0.010
Isophorone	<9.28	<18.0	<36.0	<180	0.38 J	<0.080
Methylene Chloride	1.05 J	<0.210	6.85 J	3.25 J	2.8	<2.0
Phenanthrene	<7.22	<14.0	<28.0	<140	0.44 J	0.22 J
Phenol	13.7 J	<5.90	54.5 J	<59.0	30	6.9
Pyrene	<3.82	<7.40	<14.8	<74.0	0.26 J	0.10 J
Styrene	NT	NT	NT	NT	0.070 J	<0.010
Tetrachloroethene	<1.10	0.250 J	<1.10	<1.10	0.31 J	0.050 J
2,4,6-Trichlorophenol	<4.59	NT	NT	NT	0.59 J	1.2 J
Toluene	14.7	6.68	6.65	5.20	7.9	4.4
Vinyl chloride	<1.80	<0.360	<1.80	<1.80	<0.010	0.020 J
* Total Xylenes	<2.80 J	<2.31 J	<2.35 J	<2.25	1.13 J	0.31 J
Total Hydrocarbons as O&G	29100	35800	24200	29000	30000	25700
TAH as BETX	22.2	9.49	11.1	9.55	9.4	4.8

Table 21. Comparison of Toxic Pollutants and Pesticides in Anchorage's Final Effluent to the Previous Five Years. (continued)

Pollutant	2021		2022		2023	
	Dry	Wet	Dry	Wet	Dry	Wet
	6/8-9	7/27-28	6/15-16	8/9-10	6/20-21	8/14-15
ORGANICS (µg/L)						
Acetone	160	200	270	210	160	220
Acrolein	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Benzene	0.060 J	0.080 J	0.31 J	<0.060	0.070 J	0.27 J
Bis-(2-ethylhexyl) phthalate	7.2	<12	<15	<12	<15	8.7
Bromodichloromethane	<0.20	<0.20	<0.20	< 0.20	<0.20	<0.20
Bromomethane	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090
2-Butanone (MEK)	20	20 J	18 J	19 J	19 J	14 J
Butyl benzyl phthalate	<7.8	<16	<20	<16	<20	<7.8
Carbon disulfide	0.42 J	0.69 J	0.70	0.29 J	<0.20	<0.20
Chlorobenzene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloroethane	<0.10	0.69 J	<0.10	<0.10	<0.10	<1.10
Chloroform	2.3	2.9 J	3.3	2.0	2.0	2.1 J
Chloromethane	0.91 J+	1.9 J	1.4	0.53	0.75	0.96 J
* 1,4-Dichlorobenzene	0.38 J	0.75 J	0.41 J	0.39 J	0.34 J	0.42 J
cis-1,2-Dichloroethene	0.050 J	0.070 J	<0.050	<0.050	<0.050	<0.050
Diethyl phthalate	2.1 J	1.5 J	2.1 J	<1.3	2.6 J	3.0 J
Dimethyl phthalate	<0.68	<1.4	<1.7	<1.4	<1.7	<0.68
Di-n-butyl phthalate	<7.3	<15	<19	<15	<19	<7.3
Di-n-octyl phthalate	1.5 J	<2.7	<3.3	<2.7	<3.3	<1.4
Ethylbenzene	0.19 J	0.16 J	0.55	0.17 J	0.32 J	0.76 J
Fluoranthene	<0.69	<1.4	<1.8	<1.4	<1.8	<0.69
2-Hexanone	<0.80	<0.80	5.7 J	<0.80	3.3 J	<0.80
Isophorone	<1.7	<3.3	<4.1	<3.3	<4.1	<1.7
Methylene chloride	5.2	3.0 J	0.99 J	0.39 J	1.9 J	1.4 J
Phenanthrene	0.45 J	<0.67	<0.84	<0.67	<0.84	<0.34
Phenol	8.4	15	9.7	6.0	15 J	13
Pyrene	<0.90	<1.8	<2.3	<1.8	<2.3	<0.90
Styrene	0.060 J	0.090 J	0.37 J	0.38 J	<0.050	<0.050
Tetrachloroethene	0.23 J	0.17 J	0.57	0.080 J	0.20 J	0.18 J
2,4,6-Trichlorophenol	<3.0	<6.0	<7.5	<6.0	<7.5	<3.0
Toluene	6.0	6.5	8.5	5.7	5.6	7.7
Vinyl chloride	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090
* Total Xylenes	1.03 J	0.91 J	3.29	0.85 J	1.94	4.6 J
Total Hydrocarbons as O&G	42700 J-	40700	42,400	29,000	27,900	26,400
TAH as BETX	7.3	7.6	12.6	6.8	7.9	13.3

Table 21. Comparison of Toxic Pollutants and Pesticides in Anchorage's Final Effluent to the Previous Five Years. (continued)

Pollutant	2018		2019		2020	
	Dry	Wet	Dry	Wet	Dry	Wet
	6/26-27	8/20-21	6/18-19	9/9-10	6/23-24	8/10-11
TOTAL METALS (µg/L)						
Antimony	0.700	0.678	0.612	0.657	0.655	0.644
Arsenic	2.72	2.62	2.47	3.32	2.54	2.52
Beryllium	<0.005	0.004 J	<0.005	0.017 J	<0.005	0.006 J
Cadmium	0.210	0.248	0.170	0.207	0.205	0.187
Chromium	1.57	1.53	2.27	3.28	1.42	1.59
Copper	36.2	33.6	42.0	60.8	36.2	33.8
Lead	2.21	1.81	1.51	2.10	2.75	1.56
Mercury	0.0310	0.0255	0.0236	0.0347	0.0245	0.0219
Molybdenum	3.99	2.47	3.57	1.98	6.95	1.69
Nickel	4.72	4.39	6.11	5.83	4.96	5.02
Selenium	0.8 J	1.0 J	0.8 J	0.7 J	0.7 J	0.8 J
Silver	0.490	0.327	0.237	0.201	0.330	0.231
Thallium	0.009 J	0.018 J	0.015 J	0.020 J	0.011 J	<0.009
Zinc	105	95.0	116	98.2	105	99.5
DISSOLVED METALS (µg/L)						
Antimony	0.642	0.590	0.601	0.581	0.685	0.538
Arsenic	2.22	2.38	2.39	2.74	2.25	2.31
Beryllium	<0.005	<0.002	<0.005	<0.005	<0.005	<0.005
Cadmium	0.128	0.157	0.140	0.126	0.103	0.091
Chromium	1.02	0.95	1.92	1.66	0.81	0.89
Copper	23.7	22.8	36.3	20.8	15.6	17.9
Lead	1.10	0.848	1.19	0.782	0.927	0.548
Mercury	0.0185	0.0199	0.0192	0.0147	0.0112	0.00938
Molybdenum	4.59	2.22	2.72	1.75	6.76	1.50
Nickel	4.39	4.08	6.29	4.72	4.74	4.86
Selenium	0.7 J	0.8 J	0.7 J	0.6 J	0.6 J	0.6 J
Silver	0.368	0.145	0.213	0.061	0.193	0.065
Thallium	<0.008	<0.008	<0.009	0.032	0.016 J	<0.009
Zinc	69.2	61.4	104	73.5	68.0	62.5
PESTICIDES (µg/L)						
4,4' DDD	<0.027	<0.028	<0.020	<0.007	<0.0055	<0.056
Aldrin	<0.027	<0.028	<0.020	<0.025	0.0068	<0.056
Demeton-O,S	<0.0029	<0.0028	<0.15	<0.027	<0.062	<0.027
Endosulfane sulfate	<0.029	<0.030	<0.020	<0.021	<0.0055	<0.056
Endrin ketone	<0.025	<0.025	<0.020	0.0096 J	<0.0055	<0.056
Heptachlor	<0.027	<0.027	<0.0020	<7.0	<6.8	<0.056
Malathion	<0.0028	<0.0027	<0.050	<0.050	0.013 J	0.012 J
OTHER						
Cyanide (µg/L)	<2.7 Δ	1.0 J	<0.5	0.8 J	<0.5	<0.5
Asbestos (million fibers/L)	<2.6	<2.5	9.3	8.2	<9.3	<3.7

Table 21. Comparison of Toxic Pollutants and Pesticides in Anchorage's Final Effluent to the Previous Five Years. (continued)

Pollutant	2021		2022		2023	
	Dry	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**
	6/8-9	**7/27-28**	**6/15-16**	**8/9-10**	**6/21-22**	**8/15-16**
TOTAL METALS (µg/L)						
Antimony	0.641	0.702	0.651	0.785	0.690	0.652
Arsenic	2.44	2.74	2.51	3.22	2.33	2.31
Beryllium	<0.005	<0.005	0.006 J	0.011 J	<0.005	<0.005
Cadmium	0.192	0.188	0.189	0.193	0.151	0.164
Chromium	1.66	1.86	1.57	2.24	1.55	1.55
Copper	52.8	52.5	37.1	32.1	34.5	39.3
Lead	4.80	2.11	1.62	1.90	1.26	1.20
Mercury	0.0651	0.0239	0.0191	0.0215	0.0200	0.0223
Molybdenum	1.72	3.92	1.91	1.90	5.25	1.51
Nickel	5.37	5.03	4.50	4.76	3.93	4.41
Selenium	0.6 J	0.8 J	0.7 J	0.6 J	0.7 J	0.5 J
Silver	0.144	0.185	0.148	0.191	0.163	0.165
Thallium	<0.009	<0.009	0.052	<0.009	0.015 J	<0.009
Zinc	119	165	115	97.7	109	118
DISSOLVED METALS (µg/L)						
Antimony	0.535	0.567	0.554	0.654	0.806	0.628
Arsenic	2.02	2.38	2.26	2.58	2.08	1.93
Beryllium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	0.102	0.123	0.100	0.093	0.124	0.065
Chromium	0.83	0.93	1.03	1.00	1.07	0.71
Copper	17.0	21.1	24.1	15.6	25.6	20.9
Lead	0.693	0.667	0.812	0.573	0.711	0.443
Mercury	0.0348	0.0223	0.00095	0.00872	0.0106	0.00845
Molybdenum	1.59	3.75	1.85	1.75	5.03	1.34
Nickel	9.49	4.71	4.24	3.88	3.46	3.83
Selenium	0.5 J	0.6 J	0.6 J	0.5 J	0.5 J	0.4 J
Silver	0.024	0.065	0.056	0.046	0.078	0.044
Thallium	<0.009	<0.009	0.013 J	<0.009	<0.009	<0.009
Zinc	66.0	71.9	81.0	52.4	84.7	72.3
PESTICIDES (µg/L)						
4,4' DDD	<0.048$^{\Delta}$	<0.0057	<0.0050	<0.0075	0.021 P	<0.0050
Aldrin	<0.048$^{\Delta}$	<0.0077	<0.0050	<0.092 i	<0.0050	<0.0050
Demeton-O,S	<0.14	0.038 J,H	<0.027	<0.027	<0.027	<0.027
Endosulfane sulfate	<0.048$^{\Delta}$	<0.0047	<0.0050	<0.0050	0.022	<0.0079
Endrin ketone	<0.048$^{\Delta}$	<0.0070	<0.0050	<0.0050	<0.0050	<0.0050
Heptachlor	<0.048	<0.016	<0.016 i	0.014	<0.0050	<0.0050
Malathion	<0.025	<0.0050	<0.0050	<0.0050	0.010 J	0.020 J
OTHER						
Cyanide (µg/L)	<0.9	<0.5	1.1 J	0.9 J	0.6 J	2.0 J
Asbestos (million fibers/L)	<9.3	<7.4	<7.4	<7.4	<0.93	<2.5

*	Non-priority pollutant	<	Not detected, followed by MDL or MRL.
J	Estimated value (below MRL but above MDL).	i	Matrix interference resulted in elevated MRL/MDL.
J+	Estimated value high bias.	NT	Not tested.
J-	Matrix interference may have resulted in low bias.	**Δ**	Reported at MRL
H	Exceeded extraction holding time.		

Table 22. Historical Pretreatment Discharge Monitoring Data (1986 - Present) for Influent and Effluent Total Metals and Cyanide Concentrations in µg/L.

Year	Average Monthly EFF Flow (MGD)	Arsenic		Beryllium		Cadmium		Chromium		Copper		Lead		Mercury		Nickel		Silver		Zinc		Cyanide	
		INF	EFF	INF	EFF	INF	EFF	INF	EFF	INF	EFF	INF	EFF	INF	EFF	INF	EFF	INF	EFF	INF	EFF	INF	EFF
1986-2017 Min	23	<1	<1	<0.006	<0.003	0.197	0.14	<1	<1	30	10	<1	<1	0.05	0.02	<1	<1	<0.002	0.13	54	38	<0.4	<0.9
1986-2017 Max	34	26	16	0.6	0.3	20	30	112	120	280	150	149	50	3.0	1.5	77	60	30.4	98	1520	407	85	59
2018 Avg	26.3	3.1	2.7	0.009	0.006	0.447	0.206	2.89	1.63	62.9	32.6	3.01	1.68	0.130	0.032	6.08	4.48	0.56	0.37	179	98	1.9	1.9
2018 Min	24.5	2.8	2.6	<0.005	0.004 J	0.236	0.126	2.57	1.00	52.8	24.4	2.30	0.78	0.057	0.026	5.44	4.20	0.31	0.29	148	68	1.0 J	<0.9
2018 Max	28.5	3.5	2.8	0.015 J	0.008 J	1.26	0.252	3.45	2.18	74.6	36.5	3.77	2.21	0.303	0.053	6.76	4.72	0.94	0.49	221	110	<2.7	<2.7
2019 Avg	27.1	4.11	2.87	0.030	0.010	0.314	0.190	5.19	2.62	61.8	42.6	4.93	1.81	0.127	0.029	8.82	5.52	0.454	0.215	210	118	<0.5	0.6
2019 Min	24.9	3.22	2.47	<0.005	<0.005	0.273	0.170	3.44	1.99	16.9	33.2	2.26	1.51	0.0121	0.0234	5.09	3.76	0.298	0.174	178	98.2	<0.5	<0.5
2019 Max	29.6	5.36	3.32	0.066	0.018 J	0.448	0.207	7.89	3.46	81.3	60.8	12.5	2.10	0.270	0.0347	13.8	6.70	0.541	0.255	247	142	<0.5	0.8 J
2020 Avg	26.8	3.30	2.56	0.016	0.007	0.329	0.196	3.45	1.64	78.2	42.0	4.47	1.86	0.108	0.024	7.01	5.35	0.514	0.226	202	118	<0.5	<0.5
2020 Min	25.4	2.79	2.33	0.010 J	<0.005	0.243	0.165	2.62	1.39	65.8	33.8	2.28	1.48	0.009	0.022	6.09	4.92	0.278	0.136 J+	170	99.5	<0.5	<0.5
2020 Max	30.8	3.99	2.89	0.023	0.011 J	0.425	0.229	4.68	1.95	93.9	50.2	8.40	2.75	0.323	0.027	8.00	6.19	0.802	0.330	259	143	<0.5	<0.5
2021 Avg	27.4	2.63	2.48	0.010	<0.005	0.243	0.199	2.56	1.51	50.8	43.2	3.76	2.45	0.061	0.030	5.51	4.22	0.198	0.174	170	119	0.7	1.0
2021 Min	24.9	2.23	2.33	0.006 J	<0.005	0.190	0.188	2.10	1.26	24.9	35.4	1.65	1.71	0.028	0.018	3.54	3.23	0.014 J	0.137	120	102	<0.5	<0.5
2021 Max	32.2	3.12	2.74	0.013 J	<0.005	0.305	0.212	3.05	1.86	69.4	52.8	8.71	4.80	0.100	0.065	6.47	5.37	0.307	0.217	196	165	1 J	2 J
2022 Avg	30.2	3.30	2.73	0.013	0.008	0.263	0.177	2.96	1.73	59.2	33.4	2.43	1.64	0.0487	0.0205	6.06	4.58	0.288	0.156	164	101	0.5	0.8
2022 Min	27.0	2.58	2.27	0.006 J	<0.005	0.201	0.151	2.44	1.57	46.9	26.9	1.92	1.47	0.0309	0.0187	5.34	4.30	0.219	0.121	145	75.4	<0.5	<0.5
2022 Max	35.7	4.23	3.22	0.022	0.011 J	0.329	0.193	3.90	2.24	67.3	37.1	2.76	1.90	0.0893	0.0230	7.19	4.76	0.396	0.191	185	124	0.6 J	1.1 J
2023 Avg	30.7	3.09	2.55	0.014 J	0.006 J	0.268	0.172	3.15	1.61	55.8	37.1	3.59	1.39	0.079	0.0226	5.62	4.51	0.273	0.157	159	122	0.7 J	0.8 J
2023 Min	26.6	2.61	2.23	0.007 J	<0.005	0.209	0.151	2.51	1.51	43.7	30.1	1.76	1.10	0.0259	0.0153	4.71	3.93	0.158	0.114	138	109	<0.5	<0.5
2023 Max	35.4	3.80	3.42	0.021	0.010 J	0.299	0.193	4.32	1.82	65.6	40.9	8.08	1.80	0.226	0.0344	6.39	5.18	0.489	0.200	186	145	1.8 J	2.0 J

INF	Influent.
EFF	Effluent.
Avg	Mean, calculated using MDL for ND compounds, or MRL for U qualified compounds.
Min	Minimum.
Max	Maximum.
<	Not detected, followed by MDL or MRL when qualified with a U.
J	Estimated value (below MRL but above MDL).
J+	Estimated value, potentially biased high.

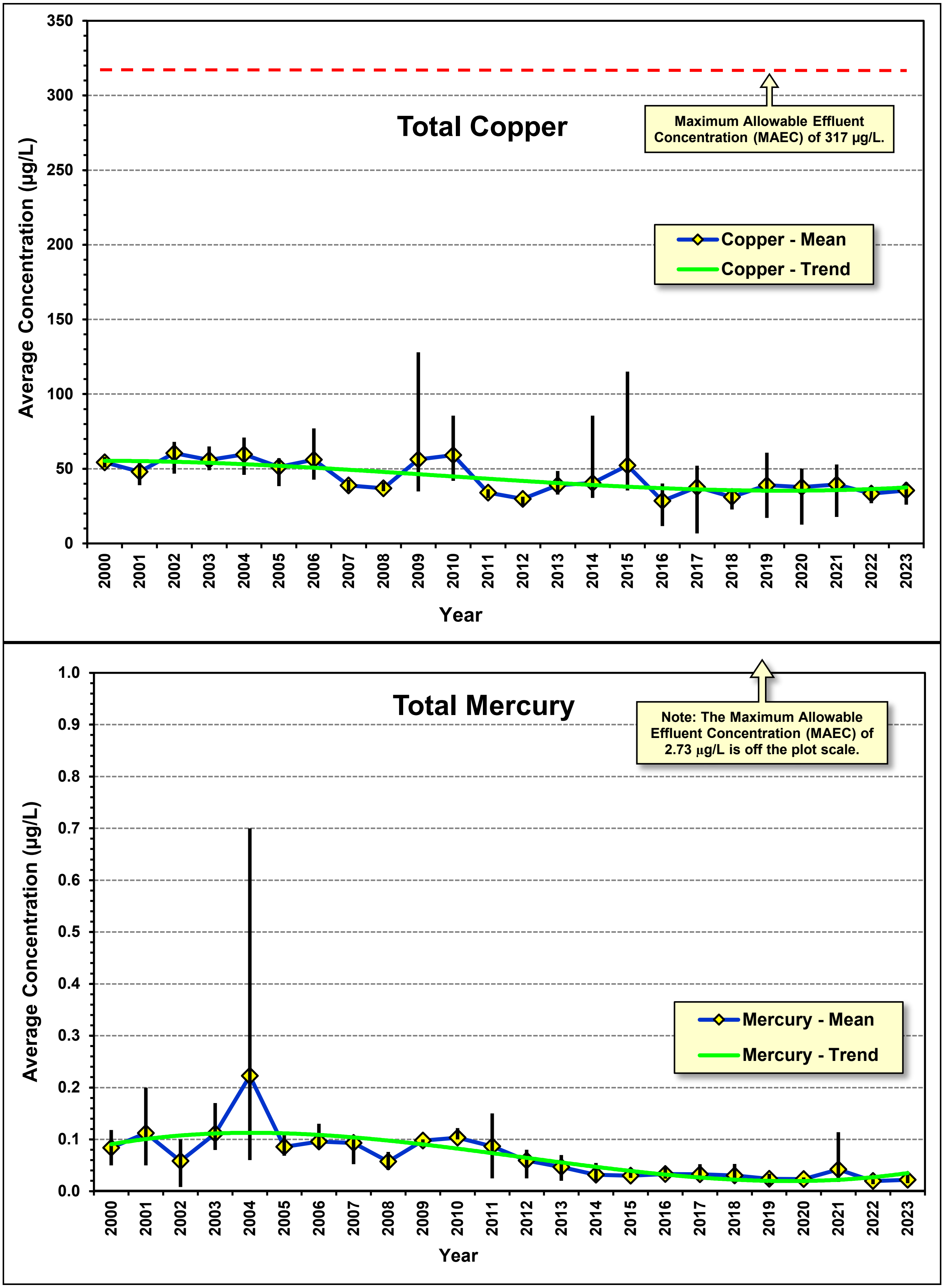


Figure 14. Historic Effluent Mean, Range, and Trend for Total Copper and Mercury.

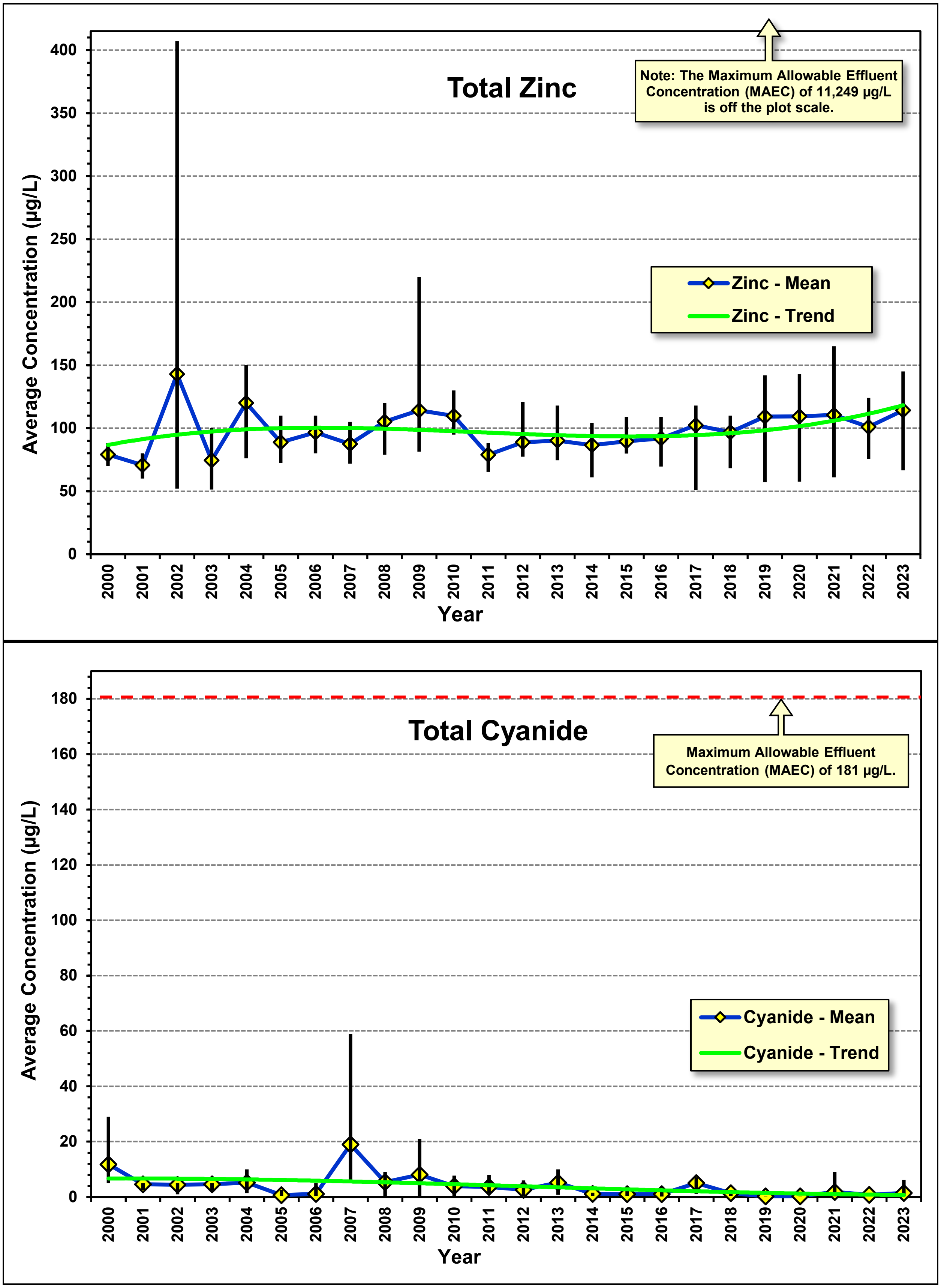


Figure 15. Historic Effluent Mean, Range, and Trend for Total Zinc and Cyanide.

During 2023, cyanide concentrations in the effluent ranged from <0.5 to 2.0 J µg/L during the pre-treatment sampling and at 6.2 µg/L during the receiving water sampling effort, all samples were well below the MAEC of 181 µg/L. In general, total cyanide concentrations have remained relatively low since 2000 with a few elevated numbers that were seen in 2007, 2009, 2013 and 2017 (Figure 15). In all cases, concentrations have been well below the MAEC since reissuance of the permit in 2000.

The most restrictive criteria for the growth and propagation of fish, shellfish, other aquatic life, and wildlife was used for the hydrocarbon limits presented in Table 19. As seen in all prior years, concentrations of TAqH and TAH as BETX were all found to be substantially below their MAECs. TAqH was analyzed in effluent only during the receiving water quality sampling with a concentration of 12.81 µg/L as compared to the AWQS of 15 µg/L and a MAEC of 2,715 µg/L. The maximum TAH value of 13.33 µg/L occurred during the August 2023 toxic pollutant sampling which is slightly higher than the AWQS of 10 µg/L and well below the MAEC of 1,810 µg/L.

Consistent with prior results, the MAEC for total ammonia was met in 2023, with effluent concentrations exhibiting a monthly maximum of 33.0 mg/L as compared to the MAEC of 217 mg/L for the chronic limit and an MAEC of 1,466 mg/L for the acute limit. These MAECs are based on saltwater acute ammonia criteria of 8.1 mg/L and saltwater chronic criteria of 1.2 mg/L, which are a function of temperature, salinity, and pH in AWQS. For comparison in this report, ammonia criteria were based on a salinity of 20 psu, temperature of 15 ºC, and a pH of 8.0 units.

In addition to MAECs based on AWQS criteria, a number of other effluent limitations are specified in the permit. These daily, weekly, and monthly limitations for effluent concentrations and loading include pH, TRC, BOD_5, TSS, and fecal coliform (Table 19). All concentrations for these parameters met permit limitations for 2023. A historical perspective of effluent flow rate, fecal coliform counts, and TRC concentrations is presented in Figure 16. The effluent flow rate has remained fairly consistent since 2000 with a slight downward trend attributable to improvements in I&I, since the general population in Anchorage that is serviced by the Asplund WPCF has increased over that time period. The flow, however, did trend upward in 2022 and 2023 which may have been the result of a substantial increase in precipitation that was seen these last two years. A vast improvement in fecal coliform levels can also be seen as a result of the improved disinfection system installed in 2002, resulting in both lower TRC levels and lower fecal coliform counts. Although there was an upward trend in TRC annual average levels between 2010 and 2015, TRC has since decreased over the past eight years with a large decline in 2020 from approximately 0.5 mg/L over the prior five years to a range of 0.25 to 0.29 mg/L over the most recent four years (Figure 16).

Permit limitations for monthly and weekly averages and daily maximums were met for BOD_5 and TSS for the year. Monthly removal rates for both BOD_5 and TSS were also met for the entire year (Figure 17). Amendments to the CWA require at least 30% average monthly removal for both BOD_5 and TSS. TSS met this requirement on both an average monthly and annual basis with the lowest monthly removal of 71% which occurred in September. Removal of BOD_5 averaged 38% for the calendar year with a minimum monthly removal rate of 35%. The average removal for 2023 is within that seen during the previous five years where average annual removals ranged from 36 to 40%.

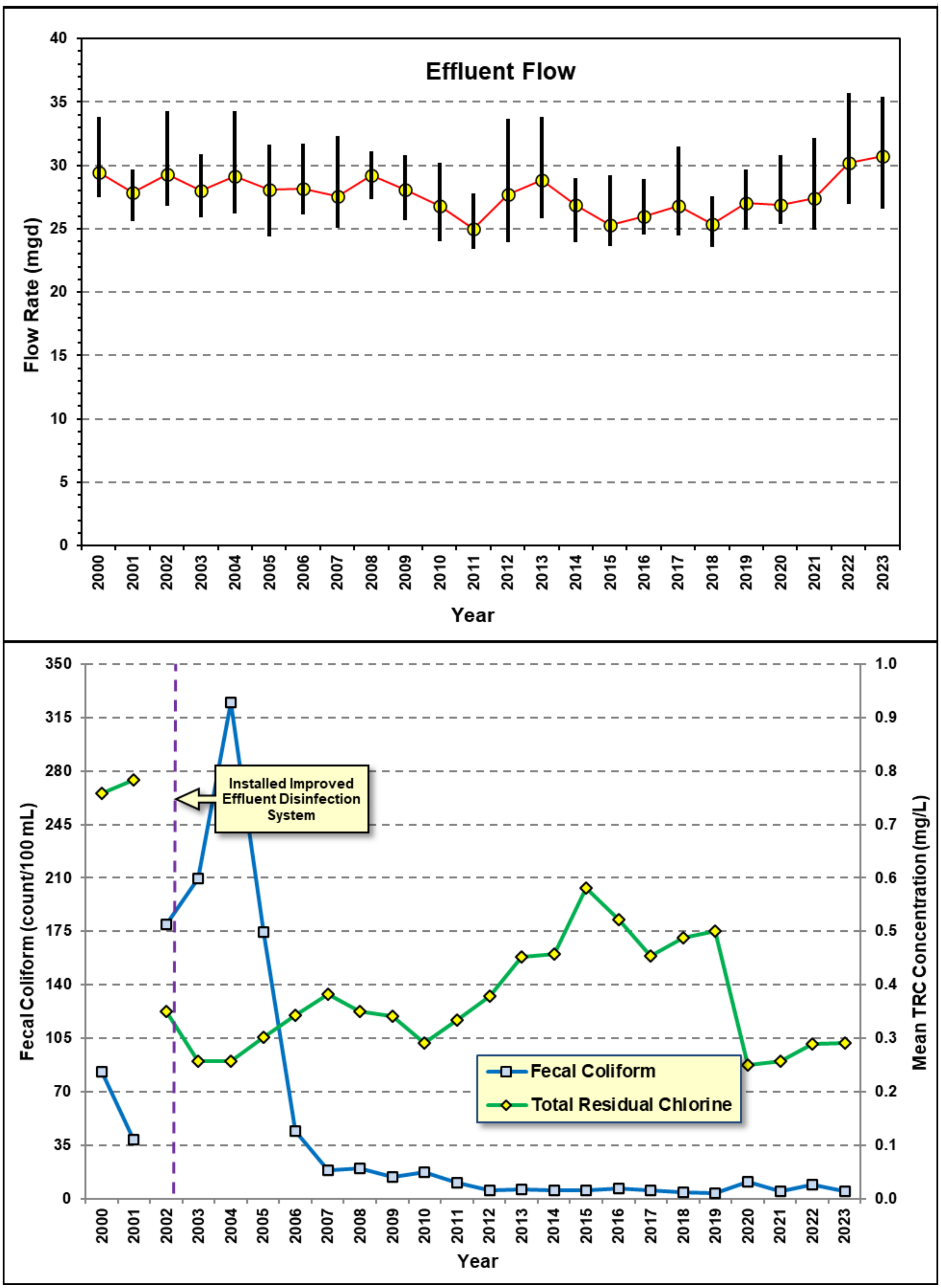


Figure 16. Historic Effluent Flow Rate, Fecal Coliform, and TRC Concentration.

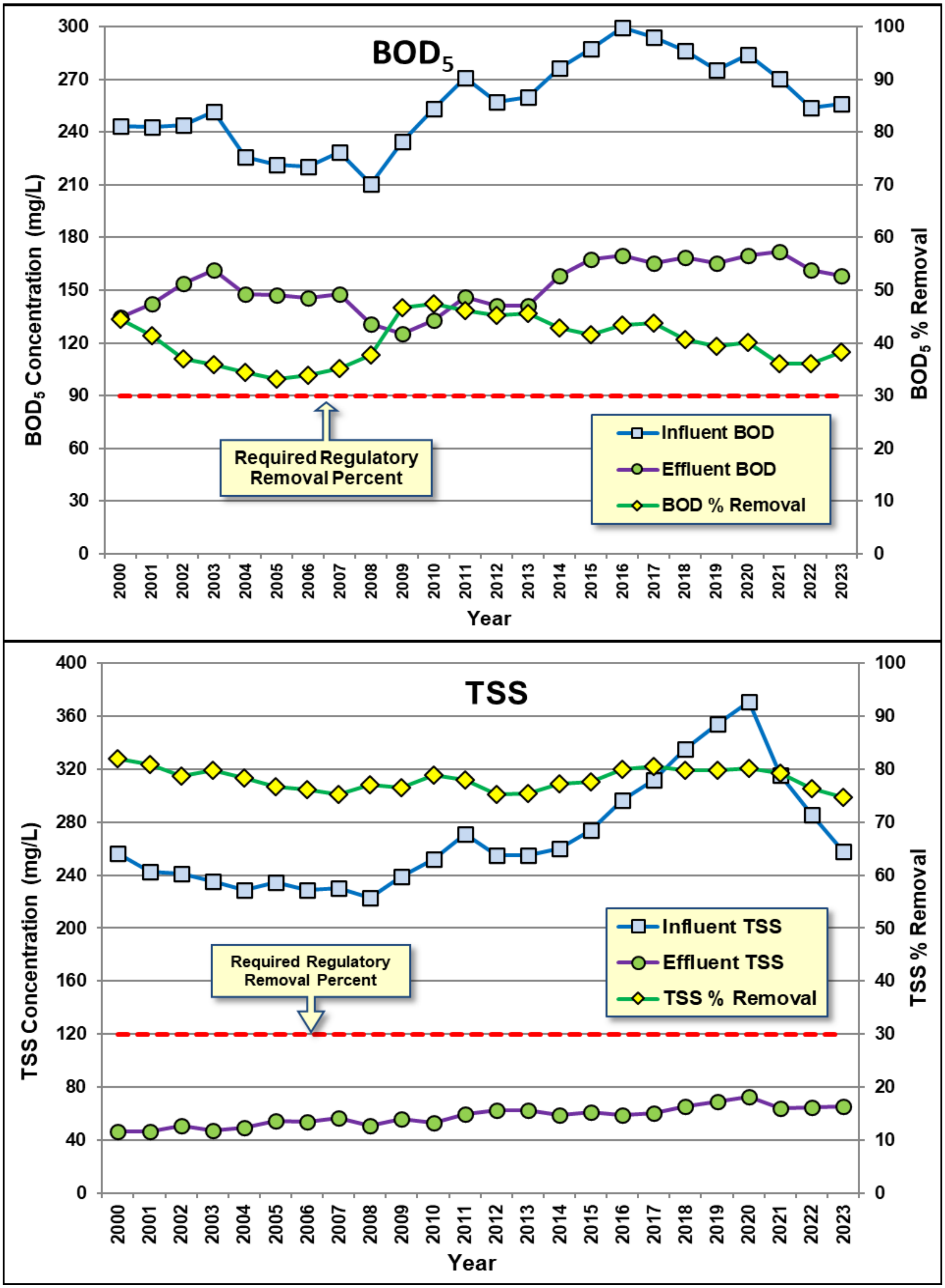


Figure 17. Historic Influent, Effluent, and Percent Removals for BOD_5 and TSS.

Monthly removal for TSS ranged from 71 to 77% with an annual average of 75%, which is slightly less than that seen over the last 8-10 years, but still well above the required average monthly criteria of 30%. TSS had been showing a consistent increase in influent concentrations between 2014 and 2020 and then showed a substantial drop beginning in 2021 (Figure 17). Due to effective removal during treatment, a similar increase in effluent TSS has not been seen. Although influent and effluent BOD_5 had crept upwards during 2013-2016 (Figure 17), this appears to have leveled off with an annual average BOD_5 effluent concentration of 158 mg/L in 2023 compared to the annual average range of 162 to 172 mg/L seen during the prior five years (Table 23).

All fecal coliform criteria were met each month in 2023. The permit limitation of a monthly geometric mean (of at least five samples) of $\leq$850 FC/100 mL was met; maximum monthly geometric mean in 2023 was 7.8 FC/100 mL (Table 8 and Table 23). Fecal coliform also met the monthly criteria "that not more than 10% of the effluent samples shall exceed 2600 FC/100 mL during any month" for all months in 2023. The yearly average effluent fecal coliform bacteria concentration, reported at 4.6 FC/100 mL for 2023, was within the previous five-year average range of 3.2 to 10.8 FC/100 mL. The fecal coliform monthly average rose from 39 FC/100 mL in 2001 to a high of 325 FC/100 mL in 2004; since then, it has steadily fallen. The 2004 fecal levels were the highest yearly average seen to date and were attributed to a program to optimize chlorine usage as described below. Since that time, fecal coliform values, including the most recent ten-year time period, have stabilized more in line with prior data, indicating that disinfection efficacy at the WPCF has been optimized (Figure 16).

As described in earlier reports, a project to improve the efficiency of the Asplund WPCF effluent disinfection system was implemented during 2001-2002. The chlorine injection process was improved by installation of rapid mixing equipment (the “Water Champ” installed in November 2001) to mix chlorine gas directly with the effluent. Oxidation Reduction Potential (ORP) technology using a *Strantrol 890 Controller* was installed in December 2001 to adjust the chlorine dosage rate in response to both flow and oxidation reduction potential of the wastewater. Prior to this improvement, it was never possible to determine an exact correlation between TRC and coliform kill. Dosage control by the ORP resulted in adequate coliform kills with far lower chlorine residuals and substantially reduced annual chlorine usage, but optimization of the disinfection process continues to be an on-going process.

In 2016, the Asplund WPCF discontinued use of gaseous chlorine for disinfection, replacing it with 12.5% sodium hypochlorite. The new on-site sodium hypochlorite generation equipment was manufactured by Electrolytic Technologies LLC and incorporates the Klorigen^{TM} chlor-alkali process to primarily produce 12.5% sodium hypochlorite using ultra-pure salt. The Klorigen^{TM} process employs ion-selective membrane cells that produce chlorine gas and sodium hydroxide when electrical current is passed through the cells. The chlorine gas and sodium hydroxide are combined to form sodium hypochlorite that is stored on-site and dosed into the plant effluent for disinfection. A small amount of excess chlorine gas produced in the process is fed directly to plant effluent. Sodium hypochlorite disinfectant is added to the plant effluent at the same location previously used for the gaseous chlorine injection. In 2023, TRC averaged 0.29 mg/L, which is within the yearly average range of 0.25 to 0.50 mg/L seen during the prior five years and well within historic ranges; although TRC concentrations trended upwards

Table 23. Historical Mean Monthly Discharge Monitoring Data (1986 - Present) for Influent and Effluent Non-Metals.

Year	Temperature (°C)		pH^{a} (pH units)		TRC (mg/L)		DO (mg/L)		BOD$_5$ (mg/L)		TSS (mg/L)		Fecal Coliform (FC/100 mL)		Ammonia (mg/L)	
	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent
1986-2017 Min	8.9	9.0	6.4	6.4	NT	0.07	NT	1.2	98	69	117	37	NT	2	NT	13.8
1986-2017 Max	17.0	18.0	9.07	8.5	NT	1.00	NT	8.6	327	201	364	86	NT	1213	NT	40.2
2018 Avg	13.4	13.3	NA	NA	NT	0.49	NT	2.8	287	169	335	65	NT	4.0	NT	27.5
2018 Min	11.7	10.6	7.01	7.09	NT	0.43	NT	2.1	249	157	258	60	NT	2.5	NT	24.0
2018 Max	15.4	16.1	7.88	7.87	NT	0.53	NT	3.5	352	182	470	71	NT	8.1	NT	30.8
2019 Avg	13.9	13.5	NA	NA	NT	0.50	NT	2.5	275	166	354	69	NT	3.2	NT	25.4
2019 Min	11.8	10.5	6.7	7.0	NT	0.44	NT	1.3	240	147	269	60	NT	2.0	NT	22.1
2019 Max	16.5	17.0	7.9	7.8	NT	0.56	NT	3.8	334	183	497	76	NT	6.4	NT	28.6
2020 Avg	13.6	13.0	NA	NA	NT	0.25	NT	2.2	284	170	371	73	NT	10.8	NT	26.1
2020 Min	10.6	10.2	6.5	6.6	NT	0.03	NT	1.4	244	147	303	60	NT	2.5	NT	21.7
2020 Max	15.6	16.4	7.7	7.6	NT	0.59	NT	3.7	324	189	441	79	NT	49.0	NT	31.4
2021 Avg	14.3	12.8	NA	NA	NT	0.26	NT	2.2	270	172	315	64	NT	4.8	NT	26.6
2021 Min	12.7	10.3	2.4	6.8	NT	0.21	NT	1.1	210	147	234	58	NT	2.0	NT	24.5
2021 Max	16.4	15.6	8.3	8.5	NT	0.33	NT	3.2	295	187	378	74	NT	8.9	NT	30.1
2022 Avg	13.6	12.6	NA	NA	NT	0.29	NT	3.0	254	162	286	65	NT	9.3	NT	25.2
2022 Min	12.0	10.2	6.9	6.9	NT	0.26	NT	1.8	201	130	198	60	NT	2.6	NT	19.8
2022 Max	15.5	15.3	7.7	7.7	NT	0.34	NT	4.0	289	183	360	72	NT	28.0	NT	30.4
2023 Avg	13.2	12.3	NA	NA	NT	0.29	NT	2.7	256	158	258	65	NT	4.6	NT	25.8
2023 Min	11.3	10.4	7.1	6.8	NT	0.26	NT	1.9	233	146	233	59	NT	2.8	NT	19.7
2023 Max	15.8	15.0	9.4	7.6	NT	0.33	NT	3.7	283	175	300	72	NT	7.8	NT	33.0

a	Values represent monthly pH minimum and maximum.
Avg	Mean.
Min	Minimum.
Max	Maximum.
NA	Not applicable.
NT	Not tested.

between 2010 and 2015 and have since seen a major decline starting in 2019 (Figure 16). Note that average annual fecal coliform levels did increase slightly in 2020 but levels have since declined over the past three years.

Historic discharge monitoring data (1986 - 2023) for other parameters of concern measured in influent and effluent are presented in Table 23. Most parameters have remained fairly steady over time. Dissolved oxygen levels increased from 1986 with a peak of 8.6 mg/L in 1992, and then generally decreased over the next ten years. Monthly mean levels of DO over the past five years have remained fairly consistent, ranging from 2.2 to 3.0 mg/L with an average of 2.7 mg/L in 2023.

Concentrations of other toxic pollutants and pesticides detected in influent and final effluent were generally lower than or within the range of those detected in other POTWs from across the nation, even though Asplund WPCF provides only primary treatment as opposed to secondary treatment at these other facilities (Table 20). Toxic pollutants and pesticides also generally fell within the historical range of values seen in past years; levels of toxic pollutants and pesticides detected in Anchorage effluent this year and over the previous five years are shown in Table 21. Data indicates some variability over time, but a generally similar pattern overall: levels are low, often below minimum reporting levels. Also, types and concentrations of measured organic compounds varied between sampling periods. Furthermore, in some instances, differences in pollutant concentrations occurred between influent and effluent. Inconsistencies can be explained by looking at sampling methodology and plant operation in the case of point-source contaminants. If contaminant spikes occur in the influent, these might or might not be captured during the sampling. On the other hand, an effluent sample could contain the contaminant as a result of clarifier mixing. Contaminant concentration differences between influent and effluent samples can also be caused by lower TSS in the effluent and residence time within the facility. This can be seen in Table 9 and Table 10, where greater variability usually occurs in influent concentrations. Also, only the effluent includes contributions from both the Eagle River and Girdwood WWTFs, a result of belt filtrate inputs because sludge from those facilities is processed at the Asplund WPCF.

Quarterly WET testing results from 2023 were below the permit-specified trigger level of 143 TUc for all species and events. WET tests in 2023 included the annual three-species screening performed in the second quarter, the sea urchin fertilization test during the first quarter, and the bivalve development test during the third and fourth quarters.

In summary, effluent chemistry monitoring showed that with no exceptions, concentrations of toxic pollutants and pesticides, metals, cyanide, and conventional parameters were much lower than their applicable permit limits and their MAECs. The percent removals of BOD_5 and TSS were higher than the 30% minimum required by the CWA with no permit exceedances. All toxic pollutant and pesticide concentrations, including metals and cyanide, were lower than or within the range of those detected at secondary treatment plants from across the nation. WET testing indicated final effluent was within the permitted WET acceptance range for 2023.

4.1.2 SLUDGE MONITORING

While the current permit does not contain sludge limits for levels of toxic pollutants and pesticides, comparisons can be made to other treatment facilities' monitoring results and to the site-specific allowable limits for metals determined for Asplund WPCF (Table 24). In all cases, sludge metals were found to be substantially lower than site-specific limits (Table 13). Again, data indicate that average concentrations of toxic pollutants and pesticides in Anchorage's sludge are generally lower than "typical" concentrations seen at other treatment facilities (Table 24; EPA, 1985c).

Part 503B sludge metals sampling in 2023 included seven metals, six of which were always seen at less than the typical concentrations from other municipal sludge, while all were less than 95th percentile values. Concentrations of beryllium, cadmium, chromium, lead, mercury, and nickel were always less than the typical concentration seen at other POTW facilities from across the nation. The one metal that was at the typical range was arsenic, which ranged from 2.85 J to 4.6 mg/kg with an average of 3.6 mg/kg compared to a typical value of 4.6 mg/kg and a 95th percentile value of 20.77 mg/kg seen at other facilities across the nation (Table 13 and Table 24).

Other metals analyzed, although not a requirement of the Part 503 regulations, were copper, molybdenum, selenium, and zinc. Copper, molybdenum and zinc concentrations were below typical concentrations during both the June and August samplings. Selenium values reported for the June and August 2023 sampling events were 2.2 J and 2.2 J mg/kg, respectively, which exceeded the typical concentration of 1.11 mg/kg but were less than the 95th percentile concentration of 4.848 mg/kg at other treatment plants (Table 24).

Table 25 provides an overview of historical sludge data for total metals. In general, 2023 data, though variable, indicated similar concentrations of arsenic, beryllium, cadmium, chromium, lead, and mercury compared to historical data over the last few years. The average mercury was below the typical concentrations of 1.49 mg/kg at other treatment plants and was within the average range seen in the prior five years. Yearly averages for chromium and lead had been driven up by single high results in June 2016 and have now dropped back to historical norms. As discussed in previous reports, similar spikes in both chromium and nickel were found during June 2009, but these had dropped down to concentrations that were similar to the historic range for the remainder of that year and for all subsequent sampling since 2010. As with the anomalously high values seen in 2009, the cause of the high concentrations of chromium and lead seen in June 2016 are unknown and no elevated results have been seen in any of the subsequent sampling efforts since 2016, although nickel was found to be slightly elevated in 2023 compared to the prior five years.

4.2 WATER QUALITY MONITORING

4.2.1 PLUME DISPERSION SAMPLING

To test the hypothesis that conventional water quality parameters at the ZID boundary were not degraded with respect to water quality at near-field and control stations, the non-parametric Kruskal-Wallis (KW) test (one-way analysis of variance [ANOVA] by ranks) and Dunn's multiple pairwise comparison test was used to determine whether significant differences occurred among the four site groups (alpha = 0.05; Zar, 1999). The results of these tests for the

Table 24. Comparison Between Sludge Results for Anchorage and Typical and Worse Case Concentrations Used by EPA in Developing Median or Mean Environmental Profiles[a].

Pollutant (mg/kg)	**2023 Anchorage Values**			**Typical Concentration**	**95th Percentile "Worse Case"**
	June[b]	**August[b]**	**2023 AVG[c]**		
Aldrin/Dieldrin	<0.0014/<0.00050	<0.00059/<0.00022	---	0.07	0.81
Arsenic	3.6	4.6	3.6	4.6	20.77
Benzene	<0.00018	<0.000054	---	0.326	6.58
Benz(a)anthracene	<0.72	<1.2	---	0.68	4.8
Benzo(a)pyrene	<1.3	<2.1	---	0.14	1.94
Beryllium	0.121	0.066	0.14	0.313	1.168
Bis(2-ethylhexyl)phthalate	12 J	10 J	---	94.28	459.25
Cadmium	0.956	0.855	0.81	8.15	88.13
Carbon Tetrachloride	<0.00031	<0.000094	---	0.048	8.006
Chlordane	<0.011	<0.0048	---	3.2	12
Chloroform	0.0052 J	<0.00011	---	0.049	1.177
Chromium	12.5	20.6	13.3	230.1	1499.7
Copper	176	221	---	409.6	1427
Cyanide	0.53 J	0.84	---	476.2	2686.6
DDT/DDE/DDD	<0.0014/<0.00091/<0.0014	<0.00061/<0.00040/<0.00060	---	0.28	0.93
3,3-Dichlorobenzidine	<2.2	<3.5	---	1.64	2.29
Endrin	<0.00073	<0.00032	---	0.14	0.17
Heptachlor	<0.00089	<0.00039		0.07	0.09
Hexachlorobenzene	<1.3	<2.1	---	0.38	2.18
Hexachlorobutadiene	<0.86	<1.4	---	0.3	8
Lead	8.67	9.60	9.2	248.2	1070.8
alpha/gamma-BHC	<0.110 i	<0.00031	----	0.11	0.22
Malathion	<0.064	<0.020	---	0.045	0.63
Methylene chloride	<0.00052	<0.00016	---	1.6	19
Mercury	0.223	0.243	0.326	1.49	5.84
Molybdenum	3.90	4.44	---	9.8	40
Nickel	10.4	15.2	16.6	44.7	662.7
PCBs (Arochlor 1254/1260)	<0.0016/<0.0016	<0.021 i /<0.025 i	---	0.99	2.9
Pentachlorophenol	<5.0	<8.0	---	0.0865	30.434
Phenanthrene	<0.86	<1.4	---	3.71	20.69
Phenol	<1.5	<2.5	---	4.848	82.06
Selenium	2.2 J	2.2 J	---	1.11	4.848
Tetrachloroethene	0.015 J	0.0034 J	---	0.181	13.707
Trichloroethene	<0.00049	<0.00015	---	0.46	17.85
2,4,6-Trichlorophenol	<1.1	<1.8	---	2.3	4.6
Vinyl Chloride	<0.00059	<0.00018	---	0.43	311.942
Zinc	493	540	---	677.6	4580

a Source: EPA 1985c. *Summary of Environmental Profiles and Hazard Indices for Constituents of Municipal Sludge: Methods and Results*. Office of Water Regulations and Standards, Appendix F.

b Data from NPDES 2023 toxic pollutant and pesticide monitoring.

c Average from 2023 Part 503 monitoring events.

i MRL/MDL is elevated due to chromatographic interference.

J Estimated value (between MDL and MRL).

--- Not monitored in-plant for Part 503.

< Not detected, followed by MDL or MRL.

Table 25. Historical Discharge Monitoring Data (1986 - Present) for Metals in Sludge in mg/kg Dry Weight.

Year	Arsenic	Beryllium	Cadmium	Chromium	Lead	Mercury	Nickel
1986-2017 Min	0.78	0.017 J	0.21	2.7	2.5	<0.02	2.6
1986-2017 Max	151	1.75	10.0	122	468	7.3	400
2018 Avg	4.2	0.14	1.32	18.0	14.5	0.349	13.9
2018 Min	0.98	0.070	0.301	3.58	4.77	0.0385	2.70
2018 Max	10.3	0.266	2.94	57.1	37.9	0.836	42.1
2019 Avg	2.8	0.09	0.80	10	8	0.23	9
2019 Min	0.816	<0.0228	0.235	3.04	2.52	0.0918	3.07
2019 Max	4.91	0.154	1.83	18.5	16.5	0.505	17.2
2020 Avg	2.9	0.064	0.72	8.8	8.4	0.23	7.2
2020 Min	0.990	0.0253	0.293	2.81	4.18	0.0389	2.47
2020 Max	5.3	0.0995	1.28	14.4	14.4	0.363	11.4
2021 Avg	2.9	0.13	0.6	10.3	9.9	0.38	8.1
2021 Min	0.841	0.047	0.199	4.03	3.57	0.0498	2.52
2021 Max	5.0	0.200	1.1	15.1	16.6	0.851	13.3
2022 Avg	4.1	0.13	0.94	13.7	10.6	0.53	11.5
2022 Min	2.59 J	0.052 J	0.67	9.57	6.69	0.18	7.87
2022 Max	6.4	0.089	1.23	21.7	14.0	1.370	17.4
2023 Avg	3.6	0.145	0.81	13.3	9.2	0.326	16.6
2023 Min	2.85 J	0.066	0.614 J	9.68	6.29	0.223	7.84
2023 Max	4.6	<0.177	1.13	20.6	12.5	<0.497	56.1

<	Not detected, followed by Method Detection Limit.
Avg	Mean.
Min	Minimum.
Max	Maximum.
Note:	Results for years 1986-1999 represent the range of historical results for monthly Min and Max as available. Results for 2000-2023 represent Part 503 sludge monitoring values.

conventional water quality parameters are presented in Table 26. The non-parametric Mann-Whitney (MW) test (Zar, 1999) was used to evaluate differences between medians for cyanide, hydrocarbons, metals, and TSS at the outfall (F1) versus control (C1) drogue stations. The results for these tests are also presented in Table 26. When ND values were present, software designed specifically for handling left-censored ND data was used in the statistical analyses (Helsel, 2012 and 2016). This software contains versions of the KW and MW tests tailored specifically for handling censored data.

Receiving water survey data showed statistically significant differences in temperature, salinity and pH at the surface, middle, and bottom depths between the control stations and the outfall stations (within-ZID, ZID-boundary, and near-field stations) that all grouped together. For temperature, the control stations were found to be significantly higher than the Point Woronzof within-ZID, ZID-boundary, and near-field sites that grouped together for all depths. A similar pattern was seen in salinity with significantly lower salinities seen at the control stations compared to the three outfall site groupings for all depths. Water pH was also found to be

Table 26. **2023 Water Quality Station Group Differences at the 5% Significance Level as Determined by Nonparametric ANOVA and Two-Sample Tests.**

Water Quality Parameter	Water Column Depth		
	Surface	**Middle**	**Bottom**
Conventional Analyses*			
Temperature	$\mathbf{\underline{1\ 2\ 3}\ 4}$	$\mathbf{\underline{1\ 2\ 3}\ 4}$	$\mathbf{\underline{2\ 1\ 3}\ 4}$
Salinity	$\mathbf{4\ \underline{3\ 1\ 2}}$	$\mathbf{4\ \underline{2\ 3\ 1}}$	$\mathbf{4\ \underline{3\ 1\ 2}}$
Dissolved Oxygen	NS	$\mathbf{\rlap{\underline{4\ 1\ 3}}\underline{\ 2}}$	NS
pH	$\mathbf{\underline{1\ 2\ 3}\ 4}$	$\mathbf{\rlap{\underline{1\ 2}}\underline{\ 3}\ 4}$	$\mathbf{\rlap{\underline{1\ 2}}\underline{\ 3}\ 4}$
Turbidity	NS	NS	NS
Color Units	NS	---	---
Fecal Coliform	NA	---	---
Total Residual Chlorine (TRC)	NA	---	---
Metal, Cyanide, Hydrocarbon, and TSS Analyses**			
Arsenic	NS^{D}, NS^{TR}	---	---
Cadmium	NS^{D}, NS^{TR}	---	---
Chromium	NA^{D}, NS^{TR}	---	---
Copper	NS^{D}, NS^{TR}	---	---
Mercury	NS^{D}, NS^{TR}	---	---
Nickel	NS^{D}, NS^{TR}	---	---
Lead	NS^{D}, NS^{TR}	---	---
Silver	NA^{D}, NS^{TR}	---	---
Zinc	NS^{D}, NS^{TR}	---	---
Cyanide	NA^{TR}	---	---
Total Aromatic Hydrocarbons (as BETX)	NS^{TR}	---	---
Total Aqueous Hydrocarbons (TAqH)	NS^{TR}	---	---
Total Polycyclic Aromatic Hydrocarbons (TPAH)	NS^{TR}	---	---
Total Suspended Solids (TSS)	NS^{TR}	---	---

*	Kruskal-Wallis tests were performed on four station groups (Group 1: Within-ZID Sites; Group 2: ZID Boundary Sites; Group 3: Nearfield Sites; and Group 4: Control Sites). Results from the Conover-Inman Test procedure (Two-tailed test) have been **bolded** where significant pairwise differences were found among groups. Underlined groups (arranged left to right, from lowest to highest rank) are NOT significantly different from each other at $p > 0.05$; see: Zar, 1999, Ed. 4.
**	Mann-Whitney U Tests were performed on two station groups: Drogue F1 stations at the outfall site and Drogue C1 stations at the control site.
---	Not Applicable (surface samples only)
NS	Not Significant Kruskal-Wallis or Mann-Whitney Test Result ($p > 0.05$)
NA	Statistical analyses were not conducted because the number of non-detected values were >50% for one or more groups.
D	Dissolved Fraction.
TR	Total Recoverable Fraction

significantly different at the control stations compared to the outfall sites with higher levels seen at the control site at all depths. For DO, some differences were seen at the middle depth with the control stations found to be significantly different than the ZID-boundary stations. For turbidity and color, no significant differences were seen for any station groupings or depths. No statistical analyses were computed for fecal coliform bacteria or TRC concentrations since more than half of the results were non-detected values.

Statistical differences for temperature and salinity were the result of the control stations being slightly warmer and less saline than those near the outfall. Though significant differences were found for some parameters, variations between station groupings were small and were attributed to greater riverine influences at the control stations and not to any influence from the Pt. Woronzof discharge. This is similar to that seen in prior years, where the control stations were often found to be warmer and less saline as a result of greater riverine influence on the north side of Knik Arm as a result of freshwater inputs from the Matanuska and Knik Rivers that also affect DO and pH levels since the water is from a different source. Control sites have also been typically more turbid, probably due to higher currents in the area.

All pH values at both the outfall and control stations fell well within AWQS of 6.5 - 8.5 and did not vary more than 0.2 pH units outside the naturally occurring range as required by AWQS (Table 27). For color, all receiving water values were 2.5 color units, well below the AWQS of 15 color units, except for Stations E1-1 and F1-1 which returned a value of 5 and 10 color units respectively, both of which were taken within the ZID directly over the diffuser at slack water.

In addition to standard water quality sampling, concentrations of TAH as BETX and TPAH were measured at the surface at six stations (three at the control site and three at the flood tide outfall site, along the first drogue track at each location). For TPAH, TAqH, and BETX, the outfall stations were not found to be statistically significantly different from the control locations. All BETX summations were below the AWQS of 10 µg/L with the highest value of <1.3 µg/L seen at Station F1-1 within the ZID. All TPAH levels were relatively low with a maximum of 0.771 µg/L at Station F1-1. TAqH concentrations were calculated for all six stations using the MDL for all ND values, yielding a maximum of <2.07 µg/L at Station F1-1, far below the AWQS of 15 µg/L.

The State's receiving water quality standard for the "growth and propagation of fish, shellfish, aquatic life, and wildlife including seabirds, waterfowl, and furbearers" is 15 µg/L for TAqH and 10 µg/L for TAH as seen in Table 27. These standards were met during receiving water sampling at all outfall locations. In addition, for contact recreation, AWQS for hydrocarbons is as follows: "May not cause a film, sheen, or discoloration on the surface or floor of the waterbody or adjoining shorelines. Surface waters must be virtually free from floating oils." No film, sheen, or discoloration was observed at any station during the 2023 receiving water-sampling program, and none was observed on adjoining shorelines.

A comparison of water quality data listed in Table 15 with marine receiving water quality criteria for the State of Alaska (Table 19 and Table 27) indicates that all of the parameters listed in Table 15 met AWQS outside of the ZID. Only one TRC concentration was above the PQL of 10 µg/L; (F1-1 tested at 18 µg/L). Based on the maximum daily effluent TRC concentration of 0.808 mg/L (808 µg/L) for the entire year and a dilution credit of 180:1 in the NPDES permit, the highest potential estimate of TRC concentration at the ZID boundary would be 4.5 µg/L, which

Table 27. State of Alaska Water Quality Standards for Receiving Water.

<table>
<tr><th>Parameter</th><th>Most Restrictive Marine Water Quality Standards</th></tr>
<tr><td>Fecal Coliform</td><td>Based on a 5-tube decimal dilution test the fecal coliform median most probable number (MPN) may not exceed 14 FC/100 mL (harvesting for consumption of raw mollusks or other raw aquatic life); a geometric mean of 20 FC/100 mL (for aquaculture of products not normally cooked and seafood processing); and not more than ten percent (10%) of the samples may exceed 40 FC/100 mL (aquaculture of products not normally cooked and seafood processing).</td></tr>
<tr><td>Dissolved Oxygen</td><td>Dissolved oxygen concentrations in estuaries and tidal tributaries may not be less than 5.0 mg/L except where natural conditions cause this value to be depressed.</td></tr>
<tr><td>pH</td><td>pH may not be less than 6.5 or greater than 8.5, and may not vary more than 0.2 pH unit outside of the naturally occurring range.</td></tr>
<tr><td>Turbidity</td><td>Turbidity may not exceed the natural conditions.</td></tr>
<tr><td>Temperature</td><td>May not cause the weekly average temperature to increase more than 1°C. The maximum rate of change may not exceed 0.5°C per hour. Normal daily temperature cycles may not be altered in amplitude or frequency.</td></tr>
<tr><td>Salinity</td><td>Maximum allowable variation above natural salinity:
<table>
<tr><th>Natural Salinity (‰)</th><th>Human-induced Salinity (‰)</th></tr>
<tr><td>0 to 3.5</td><td>1</td></tr>
<tr><td>>3.5 to 13.5</td><td>2</td></tr>
<tr><td>>13.5 to 35.0</td><td>4</td></tr>
</table></td></tr>
<tr><td>Sediment</td><td>No measurable increase in concentrations above natural conditions.</td></tr>
<tr><td>Color</td><td>Color may not exceed 15 color units or the natural conditions, whichever is greater.</td></tr>
<tr><td>Petroleum Hydrocarbons, Oils and Grease</td><td>Total aqueous hydrocarbons (TAqH) in the water column may not exceed 15 µg/L. Total aromatic hydrocarbons (TAH) in the water column may not exceed 10 µg/L. May not cause a film, sheen, or discoloration on the surface or floor of the water-body or adjoining shorelines. Surface waters must be virtually free from floating oils.</td></tr>
<tr><td>Total Residual Chlorine</td><td>May not exceed 13 µg/L (one-hr average) acute and 7.5 µg/L (four-day average) chronic; for marine aquatic life.</td></tr>
<tr><td>Toxic and Other Deleterious Substances</td><td>See Table 19.</td></tr>
</table>

meets AWQS at all receiving water locations outside of the ZID. Also, although TRC analyses were only able to achieve a PQL of 10 µg/L that is slightly higher than the 7.5 µg/L chronic limit, ADEC considers a PQL of 100 µg/L, which is 10 times higher, to be the reasonable and achievable limit for regulatory purposes. TSS and total recoverable and dissolved metals samples collected at the outfall and control sites were also subject to statistical testing. No statistically significant differences were noted for any of these parameters.

Dissolved copper tested in receiving water during the 2023 monitoring program, was found to have exceeded AWQS criteria at two locations (Table 16). The copper concentration at Station F1-1 which is located within the ZID directly over the outfall at low slack tide was found to be 3.75 µg/L, slightly above the chronic AWQS criteria of 3.1 µg/L. The other sample was from Station F1-3 located 1.4 km from the outfall which had a concentration of 20.8 µg/L. Based on the location of this sample and the very high copper concentration, this elevated value was not attributed to the outfall but was believed to be a laboratory issue with either the filtration step or the actual analysis and was also associated with two of the other seven highest values seen for dissolved metals in 2023. Since the adoption of more appropriate SSWQC for dissolved metals in May 1999 and the adoption of dissolved metals in the AWQS, the receiving waters of Cook Inlet near the Asplund WPCF discharge have always been in compliance with the AWQS with the exceptions noted above.

Cyanide results in receiving water samples tested as ND (<0.5 µg/L) except for one sample taken at Station F1-1 directly over the outfall that had a concentration of 7.9 µg/L. The AWQS for cyanide (tested as free cyanide) is 1.0 µg/L although the permit requires testing of total cyanide. The cyanide concentration in the effluent sample collected in conjunction with the receiving water sampling was 6.2 µg/L, well below the MAEC of 181 µg/L. Since the elevated concentration seen at Station F1-1 is located within the ZID, it is not considered as an exceedance of AWQS criteria. Also, it should be noted that cyanide detection in seawater is prone to interference which might help explain why this sample was higher than that seen in the effluent.

In summation, statistical analyses of 2023 receiving water quality data indicated that water quality outside the ZID was not degraded in comparison to control stations for any parameter as a result of the Asplund WPCF discharge. Differences noted in some parameters such as temperature, salinity, and pH were attributed to riverine influences and were not caused by Asplund's discharge. All AWQS were met in 2023 for the receiving water quality monitoring at all locations in the vicinity of the outfall with the exception of one dissolved copper value that was believed to be elevated due to a laboratory filtration problem. No statistically significant differences between the outfall and control sites were seen for any dissolved or total recoverable metal, color, turbidity, TSS, or hydrocarbons.

4.2.2 FECAL COLIFORM BACTERIA

In the past, ADEC has indicated that one of their primary concerns is bacterial contamination of the shoreline by the Asplund WPCF discharge, as indicated by fecal coliform bacteria concentrations. Because Knik Arm's water uses have not been classified, regulations provide that the most restrictive standard must apply.

State marine water quality standards for contact recreation require that the geometric mean fecal coliform concentration taken within a 30-day period not exceed 100 FC/100 mL and that not more than one sample, or more than 10% of the samples if there are more than 10, exceed 200 FC/100 mL. Criteria for secondary recreation and for industrial water supply require that mean fecal coliform concentration not exceed 200 FC/100 mL and that not more than 10% of samples exceed 400 FC/100 mL. State marine water quality criteria for harvesting for consumption of raw mollusks or other raw aquatic life require that, based on a 5-tube decimal dilution test, the median shall not exceed 14 FC/100 mL and that not more than 10% of the samples shall exceed 43 FC/100 mL. For seafood processing and aquaculture water supply for products not normally cooked, criteria are that the geometric mean may not exceed 20 FC/100 mL and not more than 10% of the samples shall exceed 40 FC/100 mL. For aquaculture processing water supply for products normally cooked, criteria are that the geometric mean may not exceed 200 FC/100 mL and not more than 10% of the samples shall exceed 400 FC/100 mL.

Since harvesting of shellfish and other raw aquatic life is not performed in these waters and there is no aquaculture or seafood processing, it seems that criteria for secondary recreation is most applicable; however, secondary recreation criteria are not the most restrictive. Taking into account all potential water uses, the most restrictive criteria are the following: median shall not exceed 14 FC/100 mL (consumption of raw shellfish and other aquatic life); the geometric mean shall not exceed 20 FC/100 mL (seafood processing and aquaculture for raw consumption); and not more than 10% of samples shall exceed 40 FC/100 mL (seafood processing and aquaculture for raw consumption; Table 27).

Statistical analyses that are typically performed for fecal coliform on station groupings for the ZID, ZID-boundary, or near-field stations as compared to the control locations could not be performed in 2023 since >50% of the samples were ND (<1.8 FC/100 ml). Fecal coliform concentrations ranged from <1.8 to 7.8 FC/100 mL at outfall stations (including the within-ZID stations) and <1.8 to 2.0 FC/100 mL at control stations. The median of all outfall stations was <1.8 FC/100 mL (including stations both within and outside the ZID for both ebb and flood tides), well within the 14 FC/100 mL criterion; the median at control stations was also <1.8 FC/100 mL. Outfall stations (inside and outside the ZID) had a geometric mean 2.0 FC/100 mL, while the control site had a geometric mean of 1.8 FC/100 mL, both well below the criterion of 20 FC/100 mL. All samples taken at either outfall or control station locations met the criteria of not more than 10% of the measurements may exceed 40 FC/100 mL.

The range of fecal coliform concentrations for all intertidal samples collected during 2023 was low and similar to that seen in prior years, ranging from a low of <1.8 to a high of 2.0 FC/100 mL, with a median of <1.8 FC/100 mL and a geometric mean of 1.8 FC/100 mL. These values met the most restrictive water quality criterion of a median of 14 FC/100 mL and a geometric mean of 20 FC/100 mL. Intertidal samples also met the criterion of not more than 10% of the samples may exceed 40 FC 100/mL. While high concentrations were not seen in 2023 or during the last few years, in the past, elevated fecal concentrations sometimes occurred in the intertidal area that were attributed to heavy waterfowl use and were not believed to be the result of the effluent discharge. The area is also heavily used in summer by hikers accessing the beach at Point Woronzof to walk their dogs.

Elevated fecal coliform bacteria concentrations were seen in all three area creeks sampled in 2023, where sampling was performed in fresh water prior to its entering marine waters in Knik Arm. Historical data indicated that these three streams have had much higher levels of fecal coliform than marine waters that were tested in the vicinity of Point Woronzof. Two replicate fecal coliform concentrations measured in Fish Creek were 49 and 79 FC/100 mL (refer to Table

18). Replicate concentrations in Ship Creek were measured at 490 and 790 FC/100 mL, while those at Chester Creek were 49 and 31 FC/100 mL. Fecal coliform concentrations from Chester, Fish, and Ship Creeks that discharge into Knik Arm were all much greater than those measured in receiving water at the intertidal, outfall, or control locations, and more importantly, exceeded concentrations seen in Asplund WPCF's effluent discharge.

Fecal coliform concentrations in effluent samples collected in conjunction with receiving water, intertidal, and stream sampling were 4.5 and 6.8 FC/100 mL. These values were similar to geometric mean monthly effluent values reported in 2023 for the Asplund WPCF, which ranged from 2.8 to 7.8 FC/100 mL with an overall annual mean of 4.6 FC/100 mL.

In summary, fecal coliform concentrations in 2023 were found be very low in the receiving waters. Statistically analyses could not be performed for fecal coliform in 2023 due to the very large number of none detected concentrations. Fecal coliform samples collected during the receiving water sampling program met all AWQS criteria, including all outfall stations both within and outside the ZID. Fecal concentrations in area creeks in 2023 were again found to be elevated but within the historical range for fecal coliform concentrations seen in prior years. It is clear that area streams are an important source of fecal coliform loading to the receiving waters of Knik Arm and that waterfowl use of the intertidal areas has historically caused elevated fecal coliform levels that are higher than those being discharged by the Asplund WPCF.

5.0 CONCLUSIONS

The following conclusions were based on results from the 2023 monitoring effort as compared to the current NPDES permit and State of Alaska water quality standards:

- Influent, effluent, and sludge monitoring showed that the Asplund WPCF met the NPDES permit requirements and complied with all applicable CWA and AWQS limits with no exceptions in 2023. AWWU's self-monitoring of TRC, BOD_5, pH, fecal coliform, and TSS showed compliance with all permit effluent limitations.

- AWWU's self-monitoring of effluent TRC and pH showed that the permit limit for daily maximum TRC was met, and pH was always within permit limitations.

- Fecal coliform concentrations in the effluent were low; neither the permitted limit of 850 FC/100 mL as a monthly maximum geometric mean, nor the monthly criterion "that not more than 10% of the effluent samples shall exceed 2600 FC/100 mL" were exceeded.

- AWWU's self-monitoring of TSS and BOD_5 showed compliance with all regulatory and permit effluent limitations including the required monthly removal rate of $\geq 30\%$ as stipulated by the amendment to the CWA. Effluent concentrations of TSS and BOD_5 were well below the daily, weekly, and monthly permit limits for the entire year. Average annual removals were 75% for TSS and 38% for BOD_5, indicating a high level of primary treatment was typically achieved.

- Effluent TAH and TAqH were below their MAECs during 2023 as calculated from AWQS and the mixing zone dilution credit.

- Concentrations of metals, cyanide, and total ammonia in the effluent never exceeded their MAECs at any time during any of the 2023 monitoring events.

- Concentrations of toxic pollutants and pesticides, including metals and cyanide, in the influent and effluent were all within the established range or lower than values from a national study of secondary treatment plants (EPA, 1982a).

- Toxic pollutant sludge concentrations were found to be very low compared to the limits established by 40 CFR Part 503. Sludge metals were similar in range or lower than values from a national study of secondary treatment plants with all metals well below the 95th percentile worst-case values (EPA, 1985c).

- Results of quarterly WET testing met permit limits, and all results were below the permitted trigger level for all species and events in 2023.

- Little variation among stations was observed for most hydrographic parameters indicating that the receiving water environment is uniform and well mixed near the outfall.

- To test the hypothesis that water quality at the ZID boundary was not degraded with respect to water quality at near-field and control stations, statistical comparisons were made. Some statistical differences were noted in water characteristics (e.g., dissolved oxygen, pH, salinity, and temperature); however, these were not ascribed to the outfall but were due to higher riverine influences at the control stations.

- Fecal coliform concentrations in receiving water and intertidal samples were found to be low at all locations. AWQS criteria of a median of not more than 14 FC/100 mL, a geometric mean of not more than 20 FC/100 mL, and of not more than 10% of the samples exceeding 40 FC/100 mL were met at all receiving water and intertidal locations including stations located within the mixing zone boundary.

- Supplemental receiving water samples obtained as part of the plume monitoring indicated total metals were elevated compared to dissolved metals due to the naturally high suspended sediment load in Cook Inlet. No statistically significant differences between the outfall and control station groupings were seen for any dissolved or total recoverable metal. One anomalously high dissolved copper concentration that exceeded AWQS was seen at a far-field location outside of the ZID, but it appeared to be a laboratory filtration issue and not related to the outfall.

- Supplemental receiving water samples demonstrated that TAH and TAqH met the AWQS at all locations and were not statistically different between the control and outfall stations.

- Supplemental receiving water cyanide samples met AWQS at all locations. One sample was higher than AWQS criteria, however, this sample was taken within the ZID directly over the outfall where a dilution credit is allowed.

- TRC was only detected at a single receiving water location in 2023, Station F1-1 directly over the outfall at low slack tide. All other measurements were <10 µg/L compared to the marine AWQS of 7.5 µg/L for chronic, 13.0 µg/L for acute, and ADEC's PQL of 100 µg/L. Based on the highest daily effluent TRC concentration (808 µg/L) and a 180:1 dilution credit, the maximum TRC at the ZID boundary was estimated to be 4.5 µg/L, meeting all AWQS.

- Turbidity did not exceed natural conditions and color met AWQS and did not exceed 5 color units at any receiving water station other than at Station F1-1 within the ZID directly over the outfall at low slack tide.

SUMMARY

In summary, results from the past year of the monitoring program confirm years of previous studies, data in the NPDES permit and 301(h) variance renewal application, and the decision by EPA to reissue the NPDES permit with a 301(h) variance. The Asplund WPCF operated within regulatory requirements during 2023 without exceptions and has shown no measurable impacts to the marine environment. In addition to the exceptional performance seen in 2023, the Asplund WPCF received the distinguished Platinum Award for exceptional plant performance and permit compliance from the National Association of Clean Water Agencies (NACWA) for 2018, after four consecutive years of Gold Awards given from 2014 through 2017. In addition, the Asplund WPCF received Silver Awards in 2019, 2020, and 2022 and another Gold Award in 2021 for exceptional performance and permit compliance.

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