

## PREFACE

This document is the Monitoring Program Annual Report required for submittal to the U.S. Environmental Protection Agency (EPA) by National Pollutant Discharge Elimination System (NPDES) Permit AK-002255-1 for 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). The NPDES permit incorporates provisions necessitated by the Clean Water Act (CWA) Section 301(h) variance from the requirements of secondary treatment.

The elements of the monitoring program 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
  - Intertidal Zone Bacteria
  
- Sediment and Bioaccumulation Monitoring
  - Sediment Analyses
  - Bioaccumulation Analyses

During 2011, the monitoring program consisted of sampling and analysis of the influent, effluent, and sludge twice for toxic pollutants and pesticides, one receiving water quality sampling and analysis effort, and quarterly whole effluent toxicity (WET) testing. In addition, AWWU conducted the required self-monitoring program for the influent, effluent, and sludge. The sediment and bioaccumulation components of the program were conducted during 2003 and 2004 and were required to be performed only once by the current NPDES 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. The report covers the period of 1 January through 31 December 2011.

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## **SUMMARY**

### **PURPOSE**

This report is submitted to meet the 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 that was signed on 30 June 2000 and became 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 is treated at this facility before discharge to the receiving waters of Knik Arm in Cook Inlet, Alaska. The NPDES permit incorporates the requirements necessitated by the Clean Water Act (CWA) 301(h) variance from secondary treatment and is in compliance with provisions of the Federal Water Pollution Control Act as amended by the CWA (33 U.S.C. §1251 et seq.) and the Water Quality Act of 1987.

### **HISTORY**

In September 1979, the AWWU submitted to the 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 the 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 et al., 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 the EPA. 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 NPDES permit.

The AWWU submitted an application to renew the CWA 301(h) variance from secondary treatment in 1990. A more recent application was submitted in 1998 with additional information provided to EPA in 1999. A draft NPDES permit that incorporated the 301(h) variance was issued in 1999 for public comment. The renewed permit was signed by EPA on 30 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 and is currently being reviewed by EPA.

## **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 [12 meters] with a mean range of 26.2 feet [7.98 meters] at Anchorage; NOAA/NOS, 2011). 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 over 2,500 milligrams/liter (mg/L) in Knik Arm (KLI 2007b). This sediment originates primarily from riverine and glacial melt waters flowing into Cook Inlet and Knik Arm from the Eagle, Knik, Matanuska, and Susitna Rivers.

Large temperature extremes occur between summer and winter. In the winter, ice can reach thicknesses of 1 - 2 m and consists of broken pieces due to the large tides and currents. An important consideration to this monitoring study is the large volume of saline water that enters Cook Inlet that is vertically mixed with the riverine and glacial inputs by tidal turbulence which allows this water body to be very effective in wastewater dilution and assimilation.

## **MONITORING OBJECTIVES**

The monitoring that was conducted during 2011 consisted of two main components: (1) in-plant monitoring of influent, effluent, and sludge, including whole effluent toxicity testing; 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 2011 program as outlined in the permit are:

### **2011 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

## **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 2011, once in June and once in August. Whole effluent toxicity testing was conducted quarterly, while receiving water quality monitoring was performed once in June. The following summarizes results of this year's monitoring based on the permit requirements:

## **2011 MONITORING RESULTS**

### **Influent, Effluent, and Sludge**

- The influent, effluent, and sludge chemical monitoring showed, that with no exceptions, the Asplund WPCF met the NPDES permit requirements and complied with all applicable AWQS. AWWU's self-monitoring of TRC, pH, fecal coliform bacteria, BOD<sub>5</sub>, and TSS showed compliance with all permit effluent limitations throughout 2011.
- AWWU's self-monitoring of TRC and pH showed that the permit limit for daily maximum TRC levels in the effluent was never exceeded and pH was within permit limits throughout 2011.
- The permit limit for the monthly maximum geometric mean of 850 fecal coliform colonies per 100 mL by most probable number (FC/100 mL) technique was not exceeded in 2011. The fecal coliform monthly criteria "that not more than 10% of the effluent samples shall exceed 2600 FC/100 mL" was also not exceeded in any month during 2011.
- AWWU's self-monitoring of TSS and BOD<sub>5</sub> showed compliance with both regulatory and permit effluent limitations. TSS and BOD<sub>5</sub> were well within the daily, weekly, and monthly criteria for the entire year. Average monthly removals for BOD<sub>5</sub> and TSS of greater than 30% are required by the amendment to the CWA (40 CFR Part 125; Final Rule). The removal rate for both TSS and BOD<sub>5</sub> met the 30% minimum removal requirement for all months during 2011. Annual removals were 78% for TSS and 46% for BOD<sub>5</sub> which indicate an exceptional level of primary treatment is being achieved.
- Total aromatic hydrocarbons (TAH), total aqueous hydrocarbons (TAqH), and total ammonia concentrations in the effluent were all found to be below their maximum allowable effluent concentrations (MAECs) as calculated from AWQS throughout 2011.
- Concentrations of metals and cyanide in the effluent never exceeded their MAECs at any time during any of the 2011 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 under 40 CFR Part 503 and most were either not-detected or within the established range or lower than values from a national study of secondary treatment plants. Most metals fell at or below the typical concentrations and all metals were below 95<sup>th</sup> percentile worst case values (EPA 1985c).
- Whole effluent toxicity testing conducted quarterly were below the permit trigger level for additional testing for all tested species and events in 2011 except for one high and apparently anomalous result in the 4<sup>th</sup> quarter of 2011. Two confirmatory tests were conducted in the 4<sup>th</sup> quarter that established that the effluent was below the trigger level.

## 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 the water quality at the ZID boundary was not degraded with respect to the water quality at the nearfield and control stations, statistical comparisons were employed. Conventional parameters such as salinity, temperature, and turbidity did show significant differences between sites, however, these were not ascribed to the outfall but were due to river influences at the control stations. No statistically significant differences were seen for pH, TRC, TSS, color, or fecal coliform.
- 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.
- Supplemental receiving water quality samples obtained as part of the plume dispersion monitoring indicated that dissolved metals were all below the AWQS at all locations on the ZID boundary and outside of the ZID including the control stations. Statistically significant differences between the outfall and control station groupings were seen for the dissolved metals cadmium, nickel, and zinc due to higher concentrations within the ZID. Total metals were elevated at all locations compared to the dissolved as a result of the naturally high suspended sediment load. Statistically significant differences were seen for cadmium and silver due to variable ambient TSS levels.
- All cyanide concentrations in the receiving waters were found to be below the receiving water quality criterion limit of 1.0 µg/L and no statistically significant differences were detected between concentrations at the control and outfall stations.
- Supplemental receiving water samples also demonstrated that TAH and TAqH met the AWQS at all locations. The outfall stations were not found to be statistically significantly higher than the control locations for TAH or TAqH.
- Turbidity and color met the AWQS at all stations. TRC was at or below the detection limit of 10 µg/L at all locations except for one sample located within the ZID, as compared to the AWQS of 7.5 µg/L for chronic, 13.0 µg/L for acute marine water use, and 100 µg/L as ADEC's practical quantitation limit for regulatory purposes. Based on the highest maximum daily effluent TRC concentration of 930 µg/L seen during 2011 and a 180:1 dilution credit, it is estimated that maximum TRC in the receiving water would be 5 µg/L before reaching the ZID boundary and would meet all AWQS for TRC.

## CONCLUSIONS

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 the EPA to reissue the NPDES permit with 301(h) variance. The Asplund WPCF is operating within regulatory requirements and is showing no measurable impacts to the marine environment.

## 1.0 INTRODUCTION

### 1.1 REGULATORY/ENVIRONMENTAL BACKGROUND

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

#### 1.1.1 Regulatory Background

In 1972, while the Asplund WPCF and outfall were being built for the MOA, the Federal Water Pollution Control Act (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 the "best practicable waste treatment technology" by July 1983.

Congress again amended the FWPCA in 1977. Section 301(h) was added, providing that the Administrator of the EPA, 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 the issuance of this variance from secondary treatment to an applicant discharging into certain ocean and estuarine waters and demonstrating compliance with the 301(h) criteria.

In September 1979, the AWWU submitted to the 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 the 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, the AWWU undertook preparation of a wastewater master plan for the Anchorage area. The resultant Wastewater Facilities Plan for Anchorage, (Ott Water Engineers, Inc. et al., 1982) and the Environmental Impact Statement, City of Anchorage, Alaska, Wastewater Facilities (EPA and Jones & Stokes, 1982) were accepted by the EPA and ADEC.

Further studies were subsequently undertaken to derive design criteria for the outfall improvements. Significant efforts were included in this study to improve the reconnaissance level 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 or no-chlorination option in relation to the presence of a system of eddies that occur to the east of Point Woronzof on the flood tide which might be capable of transporting the effluent shoreward. These latter studies were completed as an Amendment to the Wastewater Facilities Plan for Anchorage, Alaska (CH2M Hill et al., 1985). This amended plan recommended use of the existing 245-m outfall with the addition of a three-nozzle diffuser. It was shown that chlorination would be required to meet bacterial standards even with an

Figure 1. General Study Area and Bathymetry.

extended outfall and diffuser. 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 the 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 the EPA (CH2M Hill et al., 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 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 listed as 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.

The 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, the AWWU prepared and submitted another renewal application which replaced the 1990 application in October 1998 (CH2M Hill, 1998).

In tandem with the renewal application, the AWWU conducted special studies and submitted a request for site-specific water quality criteria (SSWQC) to the ADEC for the Point Woronzof area of Cook Inlet in December 1998. This request for SSWQC was for turbidity and a suite of metals and was necessitated because the Alaska Water Quality Standards (AWQS) for marine waters could not be achieved for these waters as a result of the naturally high suspended sediment loads in Cook Inlet due to glacial inputs. The approach to the request was based on the EPA's Metals Policy that had been recently promulgated which recommends the use of only the dissolved fraction of 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 the AWWU its 301(h) variance was made by the EPA on 4 November 1999. The tentative decision, draft NPDES permit, and permit fact sheet were then made available for public review and comments. 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, and was then administratively extended in August 2005 pending permit renewal. The most recent application for a reauthorization of the NPDES permit with 301(h) variance was submitted in January 2005 and is still under review by the EPA.

The NPDES permit specifies the required monitoring program. The Monitoring Program Plan (Kinnetic Laboratories, Inc., 2000a), submitted to the EPA in October 2000, identified how the

AWWU plans to fulfill the requirements of this monitoring program. This annual report documents the progress and results of the monitoring program that was performed in 2011.

Since the issuance of the current NPDES permit, EPA has approved ADEC's proposed use of dissolved metals for the AWQS, approved all of the proposed SSWQC for Upper Cook Inlet in the vicinity of Pt. Woronzof, and removed Alaska from the National Toxic Rule (EPA, 2006). In September of 2009 EPA approved the 2009 revisions to the AWQS and the December 2008 State of Alaska Toxics Manual which lists numerical limits. Except for cadmium and mercury where the dissolved cadmium standard changed from 9.3 µg/L in the SSWQC to 8.8 µg/L in the AWQS and mercury 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 between the two standards.

### **1.1.2 Environmental Background**

The Asplund WPCF discharges to the receiving waters of Cook Inlet, Alaska. The discharge is located off Point Woronzof in Knik Arm of Upper Cook Inlet.

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. Bathymetry indicates the Inlet is deep, generally 36.6 m (20 fathoms) north of the Forelands and about 164.6 m (90 fathoms) at the mouth (refer to Figure 1). Numerous rivers, including the major Knik, Matanuska, and Susitna River drainages, discharge into the Inlet. A detailed map of the Point Woronzof region indicates deep water (9.1 - 51.8 m) extending well past Anchorage up the Knik Arm (Figure 2).

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 loads of up to 2500 mg/L, large temperature extremes, and moving pancake ice of up to one meter (m) 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 to this study 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 the natural suspended sediments near Point Woronzof show that very large particles are suspended by the current-generated turbulence, with 50 percent of the load being in the size range of 65 - 250 microns. The settling of large particles is seen at slack tide, but due to the shifting currents, never settle completely. Settling rate tests of the suspended material show that 93% of the solids in an ambient water sample settle in twenty minutes,

Previous work has indicated that due to the extremely swift currents, no seabed accumulation of suspended sediments, either natural or from the discharge, occur in the vicinity of the outfall. In this location, the bottom is strictly coarse gravel and cobble because of these currents. However, areas of deposition do exist, such as to the east of Point Woronzof, where mudflats and beaches are found, and to the southwest of the Point. The area between Fire Island and the mainland is hard-packed sand with no deposition of silt or finer materials as a result of the high current

**Figure 2. Asplund WPCF Outfall and Control Station Location.**

energy. Of course, any suspended solids in these materials of effluent origin would actually dilute the much larger natural load in the receiving water (400 - 2,500 mg/L versus approximately 60 mg/L effluent). Studies have also shown that essentially no benthic biota are found on the scoured cobble/gravel bottom or on the rock beaches in Knik Arm, at Point Woronzof, and at the control area. Similar sampling of soft bottom beaches and tidal flats showed very sparse abundances and very low diversities. Benthic and intertidal marine fauna populations are limited by the harsh physical environment of mud and silt, high turbulence and bottom scouring, large tide 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 has indicated that, on a flood tide, a clockwise eddy sometimes exists east of Point Woronzof resulting in shoreward transport at certain stages of the tide. A flow separation also exists to the west of Point Woronzof during ebb flow; however the effluent is not entrained shoreward in this area.

## **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 the 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 2011)
- Determine if pollutants from the discharge are accumulating in exposed biological organisms (note: not required or performed in 2011)
- 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 tested for this year of monitoring are as follows:

*H<sub>0</sub>1: Applicable State and Federal effluent and receiving water standards were met by the Asplund WPCF discharge.*

*H<sub>0</sub>2: Water quality at the boundary of the ZID was not significantly changed with respect to nearfield or control stations.*

## 1.3 CONTRACTOR

The AWWU's designated contractor for the 2011 Asplund WPCF Monitoring Program was Kinnetic Laboratories, Inc. (KLI) of Anchorage, Alaska.

Influent, effluent, and sludge analyses of aromatic hydrocarbons, pesticides, volatile and semi-volatile priority pollutants, cyanide, and trace metals (total and dissolved) for the toxic pollutant and pretreatment monitoring were performed by Columbia Analytical Services (CAS) of Kelso, WA. WET testing was performed by ToxScan, Inc. of Watsonville, CA, Nautilus Environmental of San Diego CA, and Pacific EcoRisk of Fairfield, CA. Asbestos analyses were performed by Solar Environmental Services, Inc. of Anchorage, AK, and International Asbestos Testing Laboratories (IATL) of Mount Laurel, NJ. In addition, AWWU's Asplund WPCF Laboratory performed the 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.

KLI also performed the receiving water sampling and analyses for turbidity and total residual chlorine (TRC). Analytical support for the receiving water sampling included: Calscience Environmental Labs., Inc. of Garden Grove, CA for trace metals; Soil Control Lab of Watsonville, CA for total suspended solids (TSS) and cyanide; CAS for aromatic hydrocarbons; Analytica Laboratories of Anchorage for color analysis; AWWU's Asplund WPCF Laboratory for bacteriology; and Texas A&M's Geochemical and Environmental Research Group (GERG) College Station, TX for polycyclic aromatic hydrocarbons (PAHs) analyses.

## 1.4 PERIOD OF REPORT

This report documents the progress and results of the monitoring program from 1 January through 31 December 2011 under the current NPDES permit.

**Table 1. Overall Monitoring Requirements**

## 2.0 METHODS

### 2.1 INFLUENT, EFFLUENT, AND SLUDGE MONITORING

Influent, effluent, and sludge monitoring is outlined in Table 2. Routine daily, weekly, and monthly sampling of conventional pollutant parameters, enterococci bacteria, and flow rate were performed by AWWU. The less-frequently monitored parameters of oil and grease, toxic pollutants and pesticides (including metals and cyanide), and Whole Effluent Toxicity (WET) testing were handled by KLI.

- ✓ determine compliance with the NPDES permit and State of Alaska water quality criteria
- ✓ determine effectiveness of the industrial pretreatment 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 of frequency required by the permit. Influent was sampled at a representative location in the influent headworks, upstream from the recycle streams. Effluent was sampled at a well-mixed point downstream from the chlorination input point in the final effluent line that was 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. Influent and effluent grab samples were obtained for pH and temperature, and effluent grab samples were obtained for total residual chlorine (TRC), dissolved oxygen (DO), and fecal coliform. Composite influent and effluent samples were obtained for the analysis of biochemical oxygen demand (BOD<sub>5</sub>), total suspended solids (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 2011, 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 KLI for shipment to the appropriate analytical laboratory. Plant influent was sampled as discrete grabs or by 24-hour flow-proportional composite samplers (depending on the analysis method) at a representative location in the influent headworks upstream from the recycle streams. Effluent was sampled as discrete grabs or using flow-proportional samplers at a well-mixed point downstream from the chlorination injection point in the final effluent line. Influent and effluent samples were chilled as required during composite sampling. Sludge grab samples were obtained from the sludge feed screw auger and composited prior to analysis.

Samples were composited for the analysis of pesticides, semi-volatile organics, metals, asbestos, and cyanide. Samples consisted of composites of flow-proportioned samples collected over a 24-hour (hr) period using two Teledyne ISCO Model 4700 Refrigerated Autosamplers. Grab samples for volatile organics analysis were collected every three hours during the 24-hr sampling period and composited by the laboratory prior to analysis. Grab samples were collected for analysis of total hydrocarbons as oil and grease and purgeable aromatic compounds.

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

Sludge samples were collected from the sludge feed screw auger every three hours over a 24-hr period and the eight samples representatively composited prior to analysis.

At time of collection, all samples were appropriately labeled using pre-prepared, project-specific sample labels as described in Section 2.5. Sample collection and shipment was documented using project-specific chain of custody forms as described in Section 2.5.

Toxic pollutants as defined by the permit are those substances listed in 40 Code of Federal Regulations (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). The methods that were used to analyze these constituents for the program and for which KLI was responsible, as well as those performed by AWWU, are also provided in Table 3. Preservation and maximum holding time information for each of these methods is provided in Table 4. All samples were collected in the appropriate sample containers and preserved, if necessary, as described by the EPA or equivalent method. All sample containers were immediately placed on gel ice after sampling. Samples remained chilled as required during shipment to the analytical laboratory.

### **2.1.3 Pretreatment Monitoring**

The pretreatment monitoring program as outlined in Table 1 and Table 2 was performed by the AWWU. This monitoring was performed twice in 2011 in conjunction with the summer dry and 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, the pretreatment sampling also included the metals: antimony, beryllium, molybdenum, selenium, and thallium. These samples were analyzed by CAS as total recoverable metals and dissolved metals for influent and effluent and as total recoverable metals in dry weight for sludge. Sampling was conducted as follows: Influent and effluent as three separate 24-hr composite samples taken on 3 consecutive days (Monday - Thursday), the first day of which coincided with the twice-yearly toxic pollutant and pesticide sampling (summer dry and summer wet, respectively). The sludge sampling consisted of a single composite of eight grabs/day when influent and effluent samples were being taken. A detailed study plan describing this monitoring was provided previously (AWWU, 2000).

### **2.1.4 Whole Effluent Toxicity Testing**

As outlined in the permit, the WET testing must be performed on a quarterly basis on 24-hr flow-composited effluent samples. Effluent was sampled by discrete flow-proportional samplers at a well-mixed point downstream from the chlorination injection point in the final effluent line. Effluent samples were collected in the appropriate precleaned sample containers as described in the bioassay method, chilled, and shipped immediately to the toxicity laboratory for testing. Samples were appropriately labeled at the time of collection using pre-prepared, project-specific sample labels as described in Section 2.5. Sample collection and shipment were documented using project-specific chain of custody forms. Sample containers were immediately placed on gel ice after sampling and remained chilled during shipment to the toxicity laboratory.

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

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





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 the third and fourth quarters of 2000 and the first quarter of 2001. Screening included the vertebrate *Atherinops affinis* (topsmelt) for survival and growth; an invertebrate bivalve species (either *Mytilus* spp. [mussel; survival and growth] or *Crassostrea gigas* [oyster; larval development]); and an invertebrate echinoderm species fertilization test (*Strongylocentrotus purpuratus* [purple urchin] or *Dendraster excentricus* [sand dollar]). Once the initial screening period was completed, the single most sensitive species (bivalve) was used for subsequent toxicity testing until re-screening was performed again. As required by the permit, re-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 was performed in the second quarter of 2002 and the third quarter of 2003, with bivalves again found to be the most sensitive species. Re-screening that was performed from 2004 through 2011 found the purple sea urchin to be the most sensitive species.

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

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

As part of the WET testing, an initial investigation TRE plan was prepared and submitted to EPA under separate cover (Kinnetic Laboratories, Inc., 2000b). This plan describes the events that will occur should chronic toxicity be detected. As required by the permit and the manual Toxicity Reduction Evaluation Guidance for Municipal Wastewater Treatment Plants (EPA, 1999b), a preliminary TRE will 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 will

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 sludge incinerator 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 from NPDES permits with the intention 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 monitoring requirements in the regulation whether they are specifically included in a permit or not. Therefore, monitoring at the Asplund WPCF includes Part 503 monitoring of sludge. Monitoring frequencies required by 40 CFR Part 503 for incineration 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 re-calculated per Part 503 regulation in May 2008 by CH2M Hill based on 2007 data (CH2M Hill, 2008). 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

As required by the permit, water quality must be monitored annually during the summer in dry weather conditions (Table 1). Sampling was performed at non-fixed stations during consecutive ebb and flood tides at the outfall station and 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 as the outfall. Three drogue tracks on each tide were performed at each location. Four stations were sampled on each drogue track released at the outfall as follows:

- |  |
|--|
| <ul style="list-style-type: none"><li>✓ determine compliance with the NPDES permit and State of Alaska water quality criteria</li><li>✓ aid in assessing the water quality at the discharge point</li><li>✓ determine compliance with the regulatory criteria of Section 301(h) for the CWA</li><li>✓ determine the level of bacterial contamination in nearshore waters</li><li>✓ provide data for evaluation of permit re-issuance</li></ul> |
|--|

- directly above the diffuser
- as close to the ZID boundary as practicable
- at least one nearfield station along the drogues path
- in the shallow subtidal area before the drogue grounds or along the drogues path at a farfield 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 over the outfall, 30 meters (m) shoreward of the diffuser, 650 m in radius, and with a 220° angle (Figure 3).

The plume location was determined by following a holey-sock current drogue (Figure 4). The drogue consisted of a six-foot cylindrical nylon tube ballasted at the bottom with a two-pound 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 or spherical 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 station) for the first sampling station of the drogue track. The drogue was released at the same time and followed until navigation information indicated that the ZID 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 through the channel in 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  $\pm 5$  m.

Samples were collected for the parameters outlined in Table 5. The surface waters of all stations were sampled for fecal coliform, color, turbidity, and TRC. Surface samples were collected by grabbing 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<sup>®</sup> bottles. Mid- and bottom depths were determined at each station using the survey vessel's fathometer. Samples were collected as simultaneously as possible at all three target depths. Hydrographic profiles of temperature, salinity, DO, and pH were collected at all stations using a Seabird SEACAT<sup>®</sup> SBE-19 CTD (conductivity, temperature, and depth) recorder. This instrument was also equipped with a DO, pH, and optical backscatter (turbidity) sensors to allow profiles of these parameters to be recorded. Samples for the analysis of total and dissolved metals, TSS, polycyclic aromatic hydrocarbons (PAH), and total aromatic hydrocarbons (TAH) were collected from surface waters at the first three stations (diffuser, ZID boundary, and channel) at low tide along the first flood drogue track at both the outfall and control stations. These samples were collected as grab samples directly into the appropriate sample containers. A single replicate sample for each parameter or a single hydrographic profile was collected at each station except for quality control samples, which are described in Section 4.2.

Samples were analyzed following the methods provided in Table 6. Samples were appropriately labeled at time of collection using pre-prepared, project-specific sample labels as described in Section 2.5 and prepared for shipment to the laboratory. Preservation and maximum holding time information for each of these methods is also provided in Table 6. All sample containers were immediately placed on gel ice after sampling. Samples remained chilled as required during shipment to the analytical laboratory.

### **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 listed in Table 7 and depicted in Figure 3. Two

**Figure 3. Asplund WPCF Outfall, ZID, and Locations of Intertidal Bacteriological Sampling**

**Figure 4. Holey-Sock Drogue, Flotation, and Marker Buoy**

**Table 5. Receiving Water Quality Monitoring Requirements**

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

**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 from the diffuser	61° 14' 26"	150° 01' 09"

replicate water samples were collected from each station near high slack water when the water depths were between 1 to 3 feet (ft). Additional quality control samples were collected as described in Section 4.2. Surface samples were collected by grabbing from 15 - 30 cm depths directly into the appropriate container. Samples were analyzed using the same procedures described previously and in Table 6.

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

At time of collection, all fecal coliform samples were appropriately labeled using pre-prepared, project-specific sample labels as described in Section 2.5. All samples were collected in the appropriate pre-cleaned sample containers, dechlorinated when necessary, and preserved as described by the method. Samples were placed on gel ice immediately after sampling and remained chilled during transport to the laboratory. 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 chain of custody forms as described in Section 2.5.

### 2.2.3 Vessel Support

The *NORTH FORTY*, a 26-ft KLI-owned survey vessel, was used for drogue tracking and water sampling in 2011. In addition, a 15-ft Zodiac<sup>®</sup> was used to retrieve grounded drogues and conduct intertidal bacteria sampling. The Zodiac<sup>®</sup> was also used to transport samples with short holding times (i.e., bacterial and turbidity samples) ashore during 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 and the bioaccumulation sampling was performed and reported in conjunction with the 2004 monitoring effort.

## **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 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, water sampling log forms, sample identification/chain of custody 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.

Sampling logs included specific information such as station identification, sample identification numbers, navigational data, sampling or photographic 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 quality control (QC) samples were labeled as were regular environmental samples so as to be blind to the laboratory analysts that were preparing and conducting the analyses.

Sample identification and integrity was ensured by a rigidly-enforced chain of custody program. Sample identification/chain of custody (COC) forms provided specific information concerning the 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 if needed. In some cases, where photocopying was not convenient or possible, two-part carbonless forms were used. The original of each COC form was packed with the samples in coolers for shipment to the laboratory. The field task leader retained a copy of each form for the field records and for tracking purposes should a shipment become lost or delayed. Upon receipt of the samples at the analytical laboratory, the laboratory sample custodian signed the samples in by checking all sample labels against the 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 immediately upon receipt of samples as described by each laboratory's standard operating procedures.



## 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 2011.

The removal of BOD<sub>5</sub> and TSS as determined by subtracting the effluent from the influent divided by the influent [(Inf-Eff)/Inf x 100] averaged 46% for BOD<sub>5</sub> and 78% for TSS in 2011. On a monthly average basis, the removal of BOD<sub>5</sub> ranged from 43 to 50%. These averages exceed the minimum values required by the amendments to the CWA (40 CFR Part 125.60), whereby dischargers with 301(h) variances are required to remove 30% of BOD<sub>5</sub> and 30% of the suspended solids on a monthly basis. The highest monthly average effluent BOD<sub>5</sub> was 166 mg/L, substantially less than the permit limitation of 240 mg/L. All of the BOD<sub>5</sub> values (daily, weekly, and monthly averages) reported for the calendar year 2011 met the permit limitations. 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 71 mg/L compared to the permit limit of 170 mg/L. Weekly average and daily maximum TSS also met permit requirements for all sampling events in 2011. On a monthly average basis, the removal of TSS ranged from 75 to 80% with all values within the CWA requirements of 30% removal.

The highest geometric mean monthly fecal coliform bacteria count was 22 FC/100 mL seen in February 2011. All of the months in 2011 met the permit limitation of 850 FC/100 mL based on a geometric mean of at least five samples, which ranged from 2 to 22 FC/100 mL, well below the permit limitation. The criterion of not more than 10% of the samples analyzed should exceed 2,600 FC/100 mL was also met for every month in 2011. Better plant performance trends in terms of more effective chlorine disinfection resulted in lower fecal coliform bacteria concentrations than seen in some prior 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 0.93 mg/L and a monthly maximum daily range of 0.53 to 0.93 mg/L. The monthly averages of TRC concentrations ranged from 0.29 to 0.37 mg/L, with an overall annual average of 0.33 mg/L. The permit requirement that effluent pH remain between 6.5 and 8.5 standard units was always met, exhibiting a minimum and maximum range of 6.8 to 7.7 pH units 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 1.6 to 3.3 mg/L, with a yearly average of 2.4 mg/L which was similar to that seen in 2009 and 2010 where the yearly averages were 2.8 and 3.0 mg/L, respectively. Temperature showed yearly averages of 12.7 and 12.9 °C in the influent and effluent, respectively. Monthly values for total ammonia in the effluent ranged from 19.9 to 40.2 mg/L, with a yearly average of 25.5 mg/L, similar to that seen historically. Average Plant flow for the year was 25.0 million gallons per day (mgd) which is very similar to the average flow rate seen over the past five years.

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

### 3.1.2 Toxic Pollutants and Pesticides Analyses

Toxic pollutant and pesticide monitoring for influent, effluent, and sludge was conducted on 14 - 15 June 2011 for summer-dry weather and 31 July – 1 August 2011 for the summer-wet sampling. Sampling was performed over a 24-hr period by AWWU personnel.

Results of the toxic pollutant and pesticide analyses are provided in Table 9 (June 2011) and Table 10 (August 2011). For semi-volatile organic compounds (EPA Methods 625/8270C), volatile organic compounds (EPA Methods 624/8260B), and pesticides (EPA Methods 608/8081A/8082 and 614/8141A), only those pollutants that were detected in the influent, effluent, or sludge are listed. Refer to Appendices A and B for the laboratory reports and a complete listing of pollutants analyzed. Pollutants found in the influent were usually detected in the effluent and were also often present in the sludge, and vice versa. In general, pollutant concentrations were very low and many of the concentrations reported for the two samplings were estimated since they were below the method reporting limits (MRLs).

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 where compounds were reported as non-detected (ND) were not used for percent removal calculations. Where laboratory duplicate analyses were performed for a parameter, a percent removal is provided for each duplicate. For summed values, such as BETX, the MRL was used for values reported as ND.

Calculation of percent removal for some contaminants may not truly be representative of treatment plant efficiency due to several factors that influence the removal values. Most notable is the fact that influent and effluent autosamplers do not produce parallel samples over the same required 24-hour time period due to the approximately 6-hour hydraulic residence time of the wastewater flowing through the treatment process prior to being discharged as final effluent. Also affecting the calculation of percent removal is 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 after the influent autosampler. Additionally, incinerator scrubber water, filtrate from the belt filter presses, scum concentrator return water, and in-plant wash down water are added back into the treatment process which only impacts the effluent composite sample. Often the percent removal calculation is performed on data that is near the MRL. As such, calculation of negative removals for pollutants is possible in spite of all evidence to support an efficient and effective treatment process as indicated by the very high removal efficiencies seen for TSS and BOD<sub>5</sub>.

The types and concentrations of measured volatile and semi-volatile organic compounds were fairly consistent between the two sampling periods. Volatile compounds that were detected in both the influent or effluent during both sampling events included: 1,4-Dichlorobenzene, 2-Butanone (MEK), acetone, benzene, bromodichloromethane, carbon disulfide, chloroform, cis-1,2-dichloroethene, ethylbenzene, m,p-xylenes, methylene chloride, o-xylene, styrene, tetrachloroethene (PCE), toluene, and trichloroethene (TCE). Many of these compounds were estimated values as they were detected below their MRLs and therefore were qualified with a J.

**Table 9. Toxic Pollutants and Pesticides in the Influent, Effluent, and Sludge, Sampled 14 and 15 June 2011**

Table 9PG 2

Table 9PG 3



**Table 10. Toxic Pollutants and Pesticides in the Influent, Effluent, and Sludge, Sampled 31 July and 1 August 2011**

Table 10 PG 2

Table 10 PG 3

Semi-volatile compounds that were detected in both the influent and effluent during both sampling events included: 4-methylphenol, bis(2-ethylhexyl) phthalate, butyl benzyl phthalate, diethyl phthalate, di-n-butyl phthalate, and phenol. As with the volatile analyses, many of the semi-volatile concentrations were estimated and qualified with a J as they fell below MRLs.

Although not as numerous, volatile and semi-volatile compounds in the sludge were similar to those seen in the influent and effluent for both the June and the July/August sampling efforts. As with the influent and effluent samples, many of the sludge concentrations were estimated and qualified with a J as they fell below MRLs.

Oil and grease concentrations measured in the influent and effluent in 2011 using EPA 1664A HEM were lower than those seen in 2010 although within the range of those seen over the prior five years that ranged from 14.9 to 49.1 mg/L with effluent concentrations of 28.5 and 26.2 mg/L during the June and August sampling, respectively. Effluent BETX values as measured by EPA 624 were 10.2 and 10.9 µg/L in the June and August 2011 samplings, respectively. Refer to Sections 5.1 and 5.2 for further discussion of the significance of the total hydrocarbon values.

The AWQS have site-specific criteria for Knik Arm of Cook Inlet and the Point Woronzof area and also include State wide criteria that are based on dissolved metals. These AWQS were utilized to determine the maximum allowable effluent concentration (MAEC; defined as the value specified as the receiving water AWQS criteria multiplied by the initial dilution of 142:1 for conservative substances and 180:1 for non-conservative substances (TRC, ammonia, cyanide, TAH, and TAqH) after taking into account the natural background concentration). Both total and dissolved concentrations of metals in the effluent were then compared to the MAECs. The With the exception of BOD<sub>5</sub>, TSS, fecal coliform, and TRC, MAECs are not permit specified limits, but were used as indicators in this report to determine whether the effluent approached AWQS criteria after taking into account the allowable dilution within the mixing zone.

Total recoverable metals concentrations in both the influent and effluent were found to be low. Antimony, arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, silver, and zinc were seen in the influent or effluent during both sampling events and beryllium and thallium during the August sampling event, but at very low levels when compared to their respective MAECs. The concentration for total copper in effluent was found to be the highest of any of the metals with respect to its MAEC of 317 µg/L, with a level of 35.4 µg/L during the June sampling. While copper was found to be the highest metal detected in the effluent with respect to its MAEC, it was still nearly an order of magnitude less than the MAEC.

Dissolved metals concentrations were also found to be low. Dissolved beryllium, mercury, and thallium were all below MRLs for both influent and effluent for both sampling periods. Dissolved antimony, arsenic, cadmium, chromium, copper, lead, molybdenum, nickel, selenium, silver, and zinc were above detection limits in influent and effluent during both of the sampling events.

Almost no pesticides were detected in the influent, effluent, or sludge during the June or August 2011 sampling events. A single “estimated result” for Endrin ketone at 0.0031J µg/L was obtained in the August sludge sample. This sludge sample also returned a result of 0.788 picograms/gram for 2,3,7,8-(TCDD). No PCBs were detected in either the June or August sampling events. For a complete list of the various chlorinated organic and pesticide analytes, refer to Appendices A1 and B1.

The permit calls for the analysis of enterococci bacteria in effluent twice per year in conjunction with the summer dry and summer wet sampling. The enterococci in the effluent was reported as 52.5 and 42 most probable number (MPN)/100 mL in the two samples analyzed for the June 2011 sampling and 20 and 85 MPN/100 mL for two replicate samples taken during the August 2011 sampling event.

Asbestos was not detected in the influent, effluent, or sludge during the either sampling event. The concentration of cyanide in the effluent was 4J and sludge was 0.57J/0.60J  $\mu\text{g/L}$  during June 2011 sampling event. Cyanide in the effluent and sludge during the August sampling event was detected at estimated concentrations of 8J  $\mu\text{g/L}$  and 0.34J  $\mu\text{g/g}$  respectively. The effluent cyanide concentration was still well below the MAEC of 181  $\mu\text{g/L}$ .

### **3.1.3 Pretreatment Monitoring Data**

As part of the NPDES permit, AWWU is to conduct pretreatment monitoring twice per year in conjunction with the toxic pollutant and pesticide analyses. This monitoring includes three consecutive days of 24-hr composite sampling of the influent and effluent and one day of sludge sampling. Pretreatment analyses include 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, as part of the toxic pollutant and pesticide sampling events in June and August 2011, coincided with the first day of the pretreatment monitoring for the Asplund WPCF during 2011, as discussed in Section 3.1.2. 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, total copper and zinc concentrations were the highest. However, concentrations of these metals were still well below their respective MAECs. For example, dissolved copper in the effluent was reported at concentrations of 20.3 - 23.9  $\mu\text{g/L}$  during the three days of pretreatment sampling in June 2011 and a range of 16.6 - 20.1  $\mu\text{g/L}$  during the August sampling effort as compared to the MAEC of 317  $\mu\text{g/L}$ . Total copper in the effluent was found to range from 30.5 to 36.3  $\mu\text{g/L}$  for the six pretreatment samples compared to the MAEC of 317  $\mu\text{g/L}$ . Influent values were generally more variable than those seen in effluent, as would be expected. Dissolved zinc in the effluent ranged from 33.4 - 44.4  $\mu\text{g/L}$  during both pretreatment samplings, while total zinc ranged from 65.4 - 88.2  $\mu\text{g/L}$  during these samplings as compared to an MAEC of 11,249  $\mu\text{g/L}$ . Dissolved and total mercury were below reporting limits of 0.2  $\mu\text{g/L}$  in all six effluent pretreatment samples, as compared to the MAEC of 2.73  $\mu\text{g/L}$ , although there were some estimated (J) values seen between the MDL and MRL. Other metals were also found to be substantially less than their respective MAECs. Cyanide concentrations in the effluent ranged from ND(< 3) - 8J  $\mu\text{g/L}$  as compared to a MAEC of 181  $\mu\text{g/L}$ .

### **3.1.4 Whole Effluent Toxicity Testing Results**

Quarterly WET testing was conducted on 24-hr flow composite effluent samples as required under the permit during all four quarters of calendar year 2011. Echinoderm fertilization tests were performed using the purple sea urchin, *Strongylocentrotus purpuratus*, during the first, third, and fourth quarters of 2011. Use of this test during the first, third, and fourth quarters was based on the screening test results from the first quarter of 2010 and second quarter of 2011 which had determined the sea urchin to be the most sensitive species tested (see Section 2.1.4).

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

Annual re-screening for the most sensitive species in 2011 was performed during the second quarter. Based on the interpretation of these detailed laboratory results, the laboratory recommended continuing with the sea urchin as the most sensitive species for 2011 until the annual 3-species rescreening is performed again during 2012.

Results of all the tests performed in 2011 are summarized below and presented in Table 12 as the lowest observed effect concentration (LOEC), no observed effect concentration (NOEC), and in chronic toxicity units (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 here in this report.

**Table 12. Summary of WET Test Data from 2011.**

Toxicity Test	LOEC (%)	NOEC (%)	TUc
<b>1<sup>st</sup> Quarter 2011</b>			
Echinoderm (fertilization)	2.8	1.4	71.4
<b>2<sup>nd</sup> Quarter 2011</b>			
Echinoderm (fertilization)	1.4	0.7	142.8
Bivalve (survival)	> 2.8	2.8	≤ 35.7
Bivalve (development)	> 2.8	2.8	≤ 35.7
Topsmelt (survival)	> 2.8	2.8	≤ 35.7
Topsmelt (growth)	> 2.8	2.8	≤ 35.7
<b>3<sup>rd</sup> Quarter 2011</b>			
Echinoderm (fertilization)	1.4	0.7	142.8
<b>4<sup>th</sup> Quarter 2011</b>			
Echinoderm (fertilization)	0.35	0.175	571.4
<b>Confirmatory Tests for 4<sup>th</sup> Quarter 2011</b>			
Echinoderm (fertilization)	2.8	1.4	71.4
Echinoderm (fertilization)	1.4	0.7	142.8

First quarter 2011 echinoderm fertilization testing was performed on a single 24-hr composite sample collected on 24-25 January 2011. Results from this sample showed significant decrease in egg fertilization at the highest effluent sample concentration with an LOEC of 2.8% and a NOEC of 1.4% effluent. The TUc was 71.4, which was within the allowable permit trigger level of 143 TUc that would require additional testing. All test acceptance criteria (TAC) were met in both the effluent bioassay and the reference toxicant bioassay.

The three-species WET testing was performed during the second quarter of 2011. The test included: the bivalve larvae, *Mytilus galloprovincialis*, survival and development; topsmelt, *Atherinops affinis*, survival and growth; and echinoderm, *Strongylocentrotus purpuratus* fertilization. The second quarter sampling event was conducted between 8 and 13 May 2011.

Results of the bivalve test showed that no concentration of effluent that was tested produced any toxicity to the test organisms. The NOECs for both survival and development were 2.8% effluent and both LOECs were > 2.8% effluent. Chronic toxicity units were  $\leq 35.7$  TUC for both survival and development in the bivalves. Both reference toxicant tests were within laboratory control chart limits and indicated typical sensitivity of the test population.

The topsmelt bioassay showed no significant decrease in survival or growth at any concentration compared with seawater-only controls. The LOECs for survival and growth were > 2.8%, and the NOECs were both 2.8%. The effluent therefore showed  $\leq 35.7$  TUC in both the survival and growth endpoints. The concurrent reference toxicant test results were within laboratory control chart limits and indicated typical sensitivity of the test population. All TAC were met in both the effluent bioassay and the reference toxicant bioassay.

Results of the echinoderm fertilization test showed that effluent that was tested produced a toxic response to the test organisms at the two highest test concentrations. The LOEC for fertilization was therefore 1.4% and the NOEC was 0.7%, with a TUC of 142.8, meeting the allowable permit trigger level of not exceeding 143 TUC. Based on the results of the three-species testing and past years' results, it was recommended to continue to use the urchin as the most sensitive species for the toxicity testing to be conducted in the subsequent quarters of 2011 and until the three-species comparison is repeated in 2012.

The WET testing for the third quarter with echinoderms was performed on a sample collected 7-8 August 2011. Results of the echinoderm fertilization test conducted during the third quarter showed a significant decrease in egg fertilization occurred at the 2.8% and 1.4% effluent concentrations when compared to the seawater-only controls. The LOEC for fertilization was therefore 1.4% and the NOEC was 0.7%, with a TUC of 142.8, meeting the allowable permit trigger level. The bioassay also met all TAC.

The WET testing for the fourth quarter with echinoderms was performed on samples collected 1-2 November, 2011. Results of the echinoderm fertilization test conducted during the fourth quarter showed significant decrease in egg fertilization occurred at the three highest effluent concentrations when compared to the seawater-only controls. The LOEC for fertilization was therefore 0.35% and the NOEC was 0.175%, with a TUC of 571.4, which exceeded the chronic toxic trigger of 143 TUC. All TAC were met in both the effluent and reference toxicant bioassay, although the reference toxicant test did indicate that the test organisms were particularly sensitive. As required by the permit, an additional confirmatory test is to be conducted when chronic toxicity is indicated. Two confirmatory tests were conducted on 13-14 December 2011 with two different laboratories. Both laboratories found acceptable levels of toxicity with LOECs of 1.4 and 2.8%, NOECs of 0.7 and 1.4%, and TUC of 71.4 and 142.8 which were all within the permit trigger level that would require additional testing.

### **3.1.5 Part 503 Sludge Monitoring Data**

The AWWU operates a sludge incinerator at the Asplund WPCF for which the permit requires sludge monitoring twice per year as part of the Toxic Pollutants and Pesticides/Pretreatment monitoring. AWWU performed the Part 503 sludge monitoring with a minimum frequency of once every 60 day period (6 times/year). These data will be submitted along with other incinerator operational information to EPA by 19 February 2012 as a separate report; however, for completeness and for comparison purposes, this information has been included here as well.



Results of the sludge monitoring for metals for the year are presented in Table 13. Metals concentrations were extremely low compared to allowable limits and were usually very similar to those seen historically. In 2009, levels of chromium and zinc were found to be high during the June sampling event, but this was not seen during either 2010 or 2011. The only metal that had historically been elevated for some sampling events was arsenic. In 2011, the highest concentration of arsenic in the sludge was 5.71 mg/kg compared to the allowable limit of 99 mg/kg. As mentioned above, no actual sludge limits exist in the current NPDES permit. Allowable limits are site-specific and were calculated by the permittee per Part 503 regulations (CH2M Hill 2008). EPA may issue sludge only permits in the future; in the interim, 40 CFR Part 503 regulations are “self-implementing”.

### **3.2 RECEIVING WATER QUALITY MONITORING RESULTS**

Water quality sampling of the receiving water was conducted on 14 - 15 June 2011, concurrent with the summer dry sampling. Sampling results are contained in the following subsections.

#### **3.2.1 Plume Dispersion Sampling**

##### **Drogue Tracking Results**

Drogues were released on 14 June 2011 at the ZID station for the ebb and flood tidal cycles and on 15 June 2011 at the control station for the flood tidal cycle. Three drogues were deployed during each tidal cycle and four stations sampled along each drogue track.

##### **ZID Site**

The Point Woronzof ebb drogue drop and tracking cycles were performed during the morning and early afternoon of 14 June 2011. The predicted tidal range during ebb stage was 33.7 feet (Figure 5 and Table 14; NOAA Tides and Currents, 2011). A composite of the ebb drogue deployments is depicted in Figure 6 and is very similar to that seen in previous years.

The ebb drogues traveled from approximately 3.0 to 4.7 nautical miles, all three traveling in a west southwesterly direction. Table 14 also lists the individual drogue travel times as well as average drogue speed. No eddies were observed during these drogue tracks, nor did any of the drogues become grounded during their tracks. The first ebb (E1) drogue was released at 06:43 Alaska Daylight Time (ADT), about 30 minutes (min) after high tide. This drogue tracked southwest but north of the shoal that was evident at low tide. The drogue traveled at an average speed of 117 centimeters per second (cm/s) over its entire track of approximately 3.0 nautical miles. The second ebb drogue (E2) was released at 08:30 ADT and also tracked north of the shoal, traveling west southwest with an average speed of 139 cm/s, traveling approximately 4.7 nautical miles. The third drogue (E3) was released at 11:00 ADT, almost five hours after high slack. The third drogue followed a similar path to the E1 and E2 drogues traveling in a west southwesterly direction. This drogue traveled approximately 3.2 nautical miles at 93 cm/s over its entire track. The relationship of drogue tracks with respect to the tide are shown in Figure 5.

Flood drogue tracks are depicted in Figure 7. The tidal range during flood stage was 32.3 feet (Figure 5 and Table 14; NOAA, 2011). The first flood drogue (F1) was deployed on 14 June at 13:46 ADT at low slack water at the outfall. This drogue traveled easterly along the shoreline on

**Table 13. Part 503 Discharge Monitoring Data for Sludge Metals**

**Figure 5. Tidal Information for Receiving Water Sampling, Ebb and Flood Tides**

**Table 14. 2011 Drogue Tracking Information**

**Figure 6. Summary of Ebb Drogue Tracks and Receiving Water Sampling Locations at Point Woronzof, 14 June 2011**

**Figure 7. Summary of Flood Drogue Tracks and Receiving Water Sampling Locations at Point Woronzof, 14 June 2011**

the east side of Point Woronzof for approximately 1.0 nautical mile at an average speed of 30 cm/s before looping back towards shore and entering the shallow intertidal area where it grounded and was retrieved. The fact that this drogue looped back along the shore is evidence of a small eddy in the lee of Point Woronzof. The second flood drogue (F2) was deployed at 15:57 ADT, approximately 2½ hours after low slack. This drogue was transported initially to the northeast then more easterly and further offshore than the first drogue and was tracked for about 2.8 nautical miles at an average speed of 130 cm/s before it was retrieved. The third flood drogue (F3) was deployed at 17:23 ADT, 4 hours after low slack water, and tracked for about 1½ hours. The third drogue traveled in a northeast direction as had the second drogue for more than a mile, then moved further out from the shoreline, where it continued moving northeast in the central Knik Arm Channel with an average speed of 143 cm/s. This drogue was tracked for approximately 4.6 nautical miles and was recovered 0.5 nautical miles offshore and to the west of the Port of Anchorage.

### **Control Site**

The Point MacKenzie control drogues were deployed and tracked on 15 June 2011. The predicted tidal range during the flood tide was 32.8 ft. Tidal information is provided in Figure 8 and Table 14 (NOAA, 2011). A composite of the three drogue trajectories at the control site is presented in Figure 9 which is very similar to prior years. The relationship of drogue tracks with respect to the tide and when sampling took place are shown in Figure 8.

The three control drogues had very similar tracks with the first drogue tracking closest to shore and the last drogue tracking furthest offshore in the center portion of the Knik Arm Channel. The first drogue was released at 14:55 ADT, 45 minutes after low tide, and traveled to the east and then to the northeast parallel to the shoreline. This drogue traveled 3.9 nautical miles with an average speed of 148 cm/s over the entire track before being retrieved north of Port MacKenzie 0.5 nautical miles from shore. The second drogue (C2) was released at 16:43 ADT, 2½ hours into the flood tidal cycle, and tracked for about one hour. This drogue had an average speed of 200 cm/s over the entire track and moved towards the northeast and slightly offshore from the first drogue track. The second drogue eventually was retrieved north of Port MacKenzie after traveling 4.3 nautical miles. The third control drogue (C3) was released at 18:13 ADT, approximately 4 hours after low slack water. The drogue traveled in a manner similar to the first and second drogues and slightly further offshore, moving northeast into the central channel with an average speed of 209 cm/s, traveling 4.4 nautical miles when it was retrieved approximately 1 nautical mile from shore.

### **Summary of Receiving Water Quality Data**

The summer water quality sampling for all analysis types was conducted concurrently with the drogue tracking studies on 14 - 15 June 2011. As discussed previously, three drogues were released at the ZID for both ebb and flood tides 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 their being retrieved. In the current NPDES permit, the ZID boundary is located 650 m distance from the outfall diffuser. To accomplish the ZID site sampling station, 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 dropped and the within-ZID station was immediately sampled. The distance from the outfall diffuser to the drogue was monitored with

**Figure 8. Tidal Information for Receiving Water Sampling, Control Tide**



**Figure 9. Summary of Control Drogue Tracks and Receiving Water Sampling Locations at Point MacKenzie, 15 June 2011**

the DGPS, and upon reaching 650 m distance from the diffuser, the ZID-boundary station was immediately 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 due to the large wire angles of sampling gear, safety concerns, quickness needed in sampling, and less representative sampling that would result.

In the field, in addition to unique sample numbers, samples were coded on their labels by location and depth to provide an easy summary of the water quality measurements obtained. The station designation is 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 station along the drogue's path. The final character represents surface (S), mid-depth (M), or bottom (B) sample. The waters of the inlet are extremely well-mixed both vertically and horizontally, as indicated by the CTD data. During the survey, water temperatures as seen in the surface, middle, and bottom samples were in a narrow range with a minimum of 10.95 °C and a maximum of 12.52 °C (Table 15). Salinities were found to vary from a minimum of 13.65 parts per thousand practical salinity units (psu) to a maximum of 17.92 psu. Salinities were generally found to increase slightly during the flood and decrease on the ebb, as is typical for estuaries. As has been seen often times 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. Values for pH ranged from 8.12 to 8.27 with little to no vertical stratification and no noticeable difference between the outfall and control sites. Values for DO collected in-situ by the CTD ranged from 9.10 to 9.67 mg/L with most concentrations being at or near 100 percent saturation (UNESCO, 1973).

Representative hydrographic profiles of water quality are presented for a ZID boundary station during ebb tide, Station E1-2, and a typical control station, Station C1-1 (Figure 10). The water column was found to be fairly well mixed from the surface to the bottom at all stations, although some stations exhibited some temperature and salinity stratification as seen at Station E1-2. This stratification was not attributed to the outfall but was due to freshwater influences from local river inputs. Refer to Appendix C7 for CTD profile plots and detailed data from each water quality station.

Surface samples were obtained at each station for the analysis of color, TRC, fecal coliform bacteria, and turbidity. Color values were found to range < 5 to 5 color units on the platinum-cobalt scale, except for one elevated color value of 20 that was seen at Station F1-1. The one high value was seen in a sample obtained directly over the outfall at low slack water. This high value probably was the result of the outfall, but it was located within the mixing zone, and is therefore not considered an exceedance of AWQS criteria of 15 color units.

During 2011, all measured receiving water TRC concentrations were below the MDL of 0.010 mg/L except for one value of 0.015 mg/L measured at Station F1-1 at low slack water within the mixing zone. The average TRC concentrations during the effluent sampling on 14 June was 0.45 mg/L, which is much lower than the MAEC based on the AWQS. It should be noted that the lowest MDL that is achievable 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 substantially less than the 0.10 mg/L limit that ADEC considers reasonable for regulatory purposes. This year the ion selective electrode method (SM4500 Cl-G) was used for the receiving water sampling to reduce interferences from common oxidizing agents, temperature, turbidity, or color; but all TRC methods are subject to positive interferences in estuarine or marine waters.

**Table 15. Hydrographic and Water Quality Data, 14 – 15 June 2011**

Table 15pg 2

Table 15pg 3

Table 15pg 4

Table 15pg 5

**Figure 10. Sample Hydrographic Profiles from Outfall and Control Stations, June 2011**



Fecal coliform values this year were quite low and ranged from < 1.8 to 4.5 FC/100 mL. Many of the fecal coliform concentrations were reported as < 1.8; this included 21 out of 24 samples at the ebb and flood stations combined and 13 out of 16 samples at the control stations. The overall median for fecal coliform for all of the outfall stations (both ebb and flood) was < 1.8 FC/100 mL; the median at the control stations was < 1.8 FC/100 mL. Turbidity values for water samples collected during the monitoring ranged from a low of 61 Nephelometric Turbidity Units (NTU) to a high of 577 NTU with lower values seen near the surface and near slack tide, with generally higher levels overall seen at the control locations.

In addition to routine monitoring conducted at each receiving water quality station, supplemental surface samples were collected at the first three stations (diffuser, ZID boundary, and nearfield) along the first flood drogue trajectory at both the outfall and control sites that represented worst-case low water and low flow conditions. A sample of final effluent was also obtained at the same time for comparison. These supplemental samples were analyzed for BETX, polycyclic aromatic hydrocarbons (PAHs), dissolved and total recoverable trace metals, cyanide, and TSS.

The maximum dissolved arsenic, cadmium, copper, nickel, and zinc concentrations were seen at Station F1-1 located at low slack water above the diffuser, within the ZID (Table 16). The highest dissolved silver concentration was seen at the outfall Station F1-3 and the remaining metals (chromium, mercury, and lead) were not detected at any location. The higher dissolved concentrations seen at Station F1-1 were probably a discharge related effect; however, all dissolved metals concentrations except copper were less than AWQS and SSWQC for the Point Woronzof area. Dissolved copper reported at 5.65 µg/L at Station F1-1 was higher than the AWQS of 3.1 µg/L, however this criterion does not apply to this station as it is located within the ZID mixing zone. All dissolved metals concentrations met AWQS at all ZID boundary, near field, and control stations.

Total metals concentrations were also quite variable with the highest levels for all metals except for chromium seen at the outfall stations. These results can be directly attributed to generally higher ambient TSS levels at these stations. The TSS level at Station F1-2 (260 mg/L) was the highest of any station followed by Station C1-3 (250 mg/L), and F1-1 and F1-2 (240 mg/L). Overall, total metal concentration differences seen between the outfall and control locations were not large. Total suspended solid results ranged from 240 to 260 mg/L at the outfall stations compared to 160 to 250 mg/L at the control stations. The effluent sample had a TSS concentration of 34 mg/L.

Cyanide concentrations were found to be low at all receiving water stations including both the outfall and control locations. Cyanide concentrations ranged from a low 0.39 µg/L at F1-3 to a high of 0.61 µg/L at Station F1-1. Receiving water samples for cyanide were found to be well within the AWQS of 1 µg/L at all locations. The cyanide concentration in the effluent sample collected in conjunction with the receiving water sampling was 2.4 µg/L which is well below the MAEC of 181 µg/L.

Hydrocarbon analyses results are presented in Table 17. Total aromatic hydrocarbons (TAH) defined by the AWQS as BETX (EPA Method 624 samples from the concurrent summer dry sampling) was determined by summing benzene, ethylbenzene, toluene, and total xylenes. For values reported as ND, the detection limit was used in the summation. Concentrations of TAH at the water quality stations ranged from ND (<0.294) to 3.44 µg/L with the highest concentration seen at Station C1-1. Concentrations of TAH were all below the AWQS of 10 µg/L at all

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

**Table 17. Supplemental Receiving Water and Effluent Hydrocarbon Analyses.**

PARAMETER	CONTROL FLOOD SAMPLES			ZID FLOOD SAMPLES			EFFLUENT <sup>a</sup>
	C1-1S	C1-2S	C1-3S	F1-1S	F1-2S	F1-3S	
<b>Volatile Organics (EPA 602) in µg/L with reporting limit in parenthesis</b>							
Benzene	0.88	<(0.040)	<(0.040)	0.080 J	0.080 J / 0.070 J	<(0.040)	0.10 J
Toluene	1.6	<(0.039)	<(0.039)	1.4	0.24 J / 0.24 J	0.070 J	8.1
Ethylbenzene	0.18 J	<(0.040)	<(0.040)	0.10 J	<(0.040) / <(0.040)	<(0.040)	0.47 J
Xylenes (Total)	0.78 J	<(0.175)	<(0.175)	0.28 J	0.180 J / 0.180 J	<(0.175)	1.51
TAH (as BETX)	3.44	0.294	0.294	1.86	0.54 / 0.53	0.325	10.18
<b>Polynuclear Aromatic Hydrocarbons (PAH) by GC/MS in µg/L</b>							
TPAH	0.2313	0.0536	0.0597	0.3412	0.0699	0.1355	2.4984
<b>Total Aqueous Hydrocarbons (TAqH) in µg/L</b>							
TAqH <sup>b</sup>	3.67	0.348	0.354	2.20	0.61 / 0.60	0.460	12.68

*a* Effluent value from EPA 624 24-hour composite.

*b* Defined by the State of Alaska as BETX analytes plus PAH analytes from EPA Method 610 analysis; these calculated values include the full suite of PAH analyte values measured by GERG.

J The result is an estimated value

< Below (method detection limit).

stations, including both outfall and control stations. With the exception of toluene at Stations C1-1 (1.6 µg/L) and F1-1 (1.4 µg/L) and benzene at Station C1-1 (0.88 µg/L), all BTEX constituents tested below method reporting limits across all stations. The effluent sample had a TAH concentration of 10.18 µg/L, which is significantly less than the MAEC of 1,810 µg/L.

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. The TPAH values ranged from 0.0597 to 0.563 µg/L at the control stations and from 0.0699 to 0.3412 µg/L at the outfall stations. The TPAH concentration measured in the effluent sample was 2.4984 µg/L. Total aqueous hydrocarbons (TAqH) as determined by the summation PAHs plus BETX were calculated for the six stations and effluent (Table 17). Concentrations of TAqH were below the AWQS of 15 µg/L at all stations, including both outfall and control stations. Control stations ranged in TAqH from 0.354 to 3.67 µg/L, while outfall station TAqH concentrations ranged from 0.4605 to 2.20 µg/L. The concentration of TAqH in the effluent was estimated at 12.68 µg/L, compared to the MAEC of 2,715 µg/L.

### **3.2.2 Intertidal Zone and Stream Bacterial Sampling**

Intertidal zone and stream bacteriological sampling was performed on 14 June 2011 (Table 18). Refer to Figure 3 for a map of the intertidal station locations and Figure 11 for stream locations. Intertidal sampling began approximately 2 hours prior to high tide at 18:10 ADT and was completed at 18:53 ADT. Two replicates were taken at all intertidal stations. Stream sampling was conducted from 11:49 to 12:17 ADT on 14 June 2011. All stream samples were collected above any tidal influence so as to represent of only stream inputs. In addition, replicate effluent samples were collected at the plant at 13:25 ADT on this date for fecal coliform analysis.

Fecal coliform concentrations found in Fish, Chester, and Ship Creeks, that were sampled prior to the creeks entering Knik Arm, were lower than those seen in 2010 ranging from a low <1.8 FC/100 mL in the first replicate at Chester Creek to a high of 220 FC/100 in the first replicate collected from Fish Creek. The replicate plant effluent samples taken on the same day showed fecal concentrations of 4.5 and 7.8 FC/100 mL. Fecal coliform concentrations in the intertidal were low this year and ranged from < 1.8 to 4.5 FC/100 mL. The highest fecal concentration (4.5 FC/100 mL) was seen in the first replicate at Station IT-5, 250 m southwest of the diffuser. Overall, the intertidal fecal coliform bacteria levels were found to be very low at locations in 2011.

**Table 18. Summary of Bacterial Analyses, 14 June 2011**

**Figure 11. Stream and Intertidal Fecal Coliform Bacteria Sampling Locations**

## 4.0 QUALITY ASSURANCE/QUALITY CONTROL

### 4.1 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 property which was assessed through duplicate and triplicate sampling and analysis. Accuracy is 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 to calibration standards. Comparability is a measure of the confidence with which one data set or method can be compared to another which 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 represent 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 then could be compared to laboratory variability. Completeness is a measure of the amount of valid data obtained that then can be 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, by the analysis of quality control (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, KLI 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 included 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 chain-of-custody procedures. The chain of custody procedures

document the handling of each sample from the time the sample was collected to the arrival of the sample 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.

## **4.2 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. The 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 provide 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 the study results are representative of conditions existing at the sampling sites.

### **4.2.1 Documentation**

For observations made in the field, cross-checking between personnel was used as the primary method of quality control. These included, for example, review of navigational information recorded on the drogue field log. As described in Section 2.5, sample documentation began in the field using pre-printed log forms, labels, chain-of-custody (COC) forms, and pre-determined sample identification numbers that were 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 KLI Anchorage office upon return from the survey. Electronic backup copies of all field forms and other data were also made and stored offsite and a complete copy of these records has also been included in the Appendices of this report.

Sample integrity and identification were ensured by the COC program. The chain of custody procedure documented the handling of a sample from the time the sample was collected to the receipt of the sample at the analytical laboratory. At the time of shipment, the field personnel kept a copy of the completed chain of custody form, and the original accompanied the samples to the laboratory.



#### **4.2.2 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 described in Section 2.0. Coolers were securely packed with ice packs as required and custody sealed with signed and dated fiber tape for shipment. Upon receipt by the laboratory the condition of the samples were noted on the COC form including; cooler temperature, broken or missing samples, etc.

#### **4.2.3 Navigation**

As described previously, navigation was accomplished with a DGPS system. The accuracy of the DGPS coordinates were verified by positioning the vessel over the diffuser during a low slack tide when the boil was evident and comparing DGPS readings with the known outfall location. Historical intertidal stations were re-acquired using a hand-held DGPS, distance and bearings, and visual sightings to temporary benchmarks and landmarks. All station information was entered on the appropriate field logs and reviewed by the field leader.

#### **4.2.4 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 the instruments used for field measurements of temperature, salinity, DO, and pH were calibrated and checked with appropriate standards prior to and after each sampling event. The standards of calibration are in accordance with applicable criteria such as the U.S. Bureau of Standards, American Society of Testing and Materials (ASTM) Standards or National Institute of Standards and Technology (NIST), and follow the instrumentation manufacturer's recommended procedures.

Temperature calibration was ensured by pre-calibration at the factory with calibration checks of the electronic temperature sensor against a research grade NIST traceable thermometer. The electronic sensor for salinity (conductivity) was also pre-calibrated at the factory and field checked against six ambient water samples which were collected for the analysis of salinity (SM 2520B). The DO probe was also pre-calibrated at the factory and field checked by comparison to saturated seawater. For pH, the probe was pre-calibrated using three known buffer solutions and checked in the field with a second field probe and three known buffer solutions.

#### **4.2.5 Sampling Variability**

Sampling variability was documented by sampling three replicates at one station 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 pH, DO, temperature, and salinity were performed at one station in order to check reading variability from the probe's electronic sensors. This field sampling variability check was performed to show the natural variability of the receiving water which could then be compared to laboratory variability.

#### **4.2.6 Field Check Samples**

Field check samples include trip blanks for volatile organic analyses for EPA Methods 602 and 624, field blanks, field generated duplicates, standard reference materials (SRMs), or other

samples of known concentration that may be sent to the laboratory. With the exception of the trip blanks which are initiated at the laboratory, field blanks and field duplicates samples were sent to the laboratory as blind samples to ensure unbiased reporting of results.

### **4.3 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 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 on 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 for analytical methodology and procedures; a rigorous system of documenting and validating measurements; maintenance and calibration of instruments; and the analysis of quality control samples for precision and accuracy tracking. The pertinent methods descriptions 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.

#### **4.3.1 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 standard operating procedures (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 was any data that did not meet acceptable quality criteria. Typical data qualifiers included those denoting estimated concentrations (J) or not detected (ND or U), method blank contamination (B), and matrix interference (X). A full list of potential data qualifiers is included with the laboratory data reports in the Appendices and any data that was qualified by the laboratory was also qualified in the data tables in this report.

#### **4.3.2 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.

### 4.3.3 Quality Control Procedures

Internal laboratory quality control checks included the use of surrogate solutions and quality control samples such as procedural (or method) blanks, matrix spike/spike duplicates, standard reference materials (SRMs), method required QC check samples, and duplicates as specified in the EPA approved analytical procedures. In addition, contract laboratories took part in EPA's annual DMRQA and WP programs to verify accuracy of their data. Surrogate compounds were spiked into samples as appropriate to assess individual sample matrix effects on sample analysis. This included QC samples such as procedural blanks and matrix spike samples. Surrogate compound analyses were reported in percent recovery. Whenever possible, QC samples such as MS/MSD have been run on samples from this program, however in some cases where insufficient volume existed the laboratories have performed standard batch QC. Results from quality control samples allowed the laboratory to assess quality assurance 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 sample case narrative.

Method blanks 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 sample matrix spikes and matrix spike duplicates (MS/MSD) were run on the organic analyses collected as part of both the in-Plant and receiving water monitoring components of the program. These spike samples are 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 are 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 guidance documents (e.g. EPA, 1994a and 1994b).

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

For receiving water quality samples, analytical and instrument variability was checked by laboratory splitting of one larger-volume field sample per sampling event into triplicates and analyzing the subsamples for the various water quality parameters that included color, fecal coliform, TRC, and turbidity. The 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, the following summary of QA/QC procedures apply:

- Color: Fresh color standards were made prior to the beginning of the program. Samples were allowed to settle and decanted in the field and either pre-treated with paper filtration or centrifuged to remove turbidity and reported as "true color".
- Turbidity: The instrument was calibrated with a series of standards provided by the manufacturer. Due to the high turbidity in Cook Inlet, all samples were run at either the 10X or 100X scale on the nephelometer to ensure that the measured turbidities were within the range of the instrumentation. In addition, select samples were run in duplicate.
- Total Residual Chlorine: TRC was quantified with an ion selective electrode probe (SM4500 Cl-G) which requires a blank, blank spikes, and a series of laboratory calibration standards. To account for seawater matrix interference issues, the method blank and calibration standards were prepared with Cook Inlet background seawater.
- Hydrographic CTD: Sensors are factory calibrated at a minimum of once per year and field checked with either a refractometer or secondary salinometer for conductivity, research grade NIST traceable thermometer or secondary probe system for temperature, laboratory standards or secondary probe system for pH, and saturated water or secondary probe for dissolved oxygen.

#### **4.3.4 Method Detection Limits**

Depending on each laboratory's adopted terminology, the method detection limits (MDLs), practical quantitation limits (PQLs), or method reporting limits (MRLs) for the various analytes were determined using the appropriate method as described in the EPA methods for a particular analysis. These MDLs, PQLs, and MRLs were reported with the data (see appendices) and are included in summary data tables as appropriate. Concentrations below the PQL, or MRL were typically qualified with either a "U" or "ND" code for non-detect or "J" when reported as an estimated value.

#### **4.4 DATA REVIEW AND VALIDATION**

Data were verified by performing comparisons of final data against the 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 the 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 chemical data as appropriate. The primary goals of these review and validation procedures are to ensure that the data:

- are representative of conditions in the study area
- are accurate
- demonstrate the required level of precision
- are comparable with data from other NPDES programs
- are acceptable for use as a tool to evaluate permit compliance

- allow 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 Data Review* (EPA 1994a), or *U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review* (EPA 1994b). Items reviewed during data validation included sample holding times, results for laboratory method blanks, matrix spike/spike duplicates (MS/SD), check standards or SRMs, field and laboratory duplicates, field and trip blanks, report completeness, and laboratory performance (i.e., ability to achieve method detection limits 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 when they occurred. For example, a number of matrix interferences were noted by the laboratory in their analysis of the influent and effluent samples, and have been appropriately qualified in the tables in this report .

## **4.5 QUALITY ASSURANCE/QUALITY CONTROL RESULTS**

### **4.5.1 Field Instrumentation and Sampling Quality Control Results**

For influent, effluent, and sludge monitoring, field-generated duplicate effluent samples were collected for the analysis of enterococci bacteria during both the June and August 2011 sampling. Results for these duplicate analyses are provided in Table 9 and Table 10, and the appendices, and were found to be acceptable. Results from duplicate field samples collected for certain parameters during the receiving water sampling such as volatile organics, cyanide, turbidity, and TSS are reported in the appropriate tables (Table 15, Table 16, and Table 17), and were found to be within acceptance limits. Results of field and laboratory triplicate analyses are presented in Table 19.

Field blanks were collected for several parameters during each sampling event by pouring HPLC-grade deionized (DI) water into the appropriate sampling containers with the correct preservative. Trip blanks consisted of DI blank samples prepared at the laboratory that went through the same shipping and handling procedures as all the other sample containers of each analytical type; these remained unopened in the field.

The field blanks (FB), trip blanks (TB), and method blanks (MB) analyzed using EPA Method 624 showed trace (J) levels of toluene and o-xylene that were a number of orders of magnitude below the reporting limit, therefore that data were not qualified (Appendix C). The FB, TB, and MB analyzed in conjunction with the Summer-Dry sampling showed trace levels for a number of the metals and volatile organics, however all levels were low and estimated (J) concentrations that did not require qualification of the data (Appendix A). Similar results were seen during the Summer-Wet sampling where trace levels of some metals were seen in the MB and volatile organic constituents were seen in the FB, TB, and MB but all were low and estimated (J) concentrations and did not affect monitoring data (Appendix B). All blank levels seen during 2011 were extremely low with respect to concentrations seen in the samples and did not require qualification of the data.

**Table 19. Sampling and Laboratory Variability for Water Quality Samples, 14 and 15  
June 2011**

Sampling variability for water quality parameters (fecal coliform, color, turbidity, and TRC) was determined by analyzing three discrete surface samples taken at Station C2-2S (Table 19). Where appropriate, the mean, standard deviation, and coefficient of variation are included in Table 19 to provide a measure of variability for parameters. The coefficient of variation for the various sample types was found to be 0% for color, 0% for TRC and 1.8% for turbidity.

Three replicate fecal coliform field samples were also collected at Stations C2-2 and C2-3. The samples yielded results of 2, <1.8 and <1.8 FC/100 mL. Mean, standard deviation, and coefficient of variation for fecal coliform were determined to be a mean of 1.87 FC/100 mL, a standard deviation of 0.12, and a coefficient of variation of 6.2%. The  $\pm 95\%$  confidence limits for each sample were also within the confidence limits of the method.

Variability and calibration checks of the electronics probe were done by performing repeated profiles of temperature, pH, DO, and salinity at one station (C2-2). Results of these calibration checks for the Seabird CTD show that probe variability for temperature, salinity, pH, and DO was extremely low in all cases with a maximum coefficient of variation of  $\leq 0.22\%$ ; seen in DO, with lower variability seen for temperature, salinity, and pH (Table 20). In addition, sensors were checked in the field against a second multi-probe system, and all of the CTD sensors were factory-calibrated prior to field deployment. The salinity, temperature, DO, and pH probes were found to be accurate and within calibration during the survey.

#### **4.5.2 Laboratory Quality Control Results**

Full analytical data and laboratory case narratives are provided by the laboratories and are included in the appendices. Laboratory duplicate analyses, where performed, were found to have a high degree of precision and were within the acceptance criteria for relative percent difference (RPD). Laboratory duplicates were performed for a number of organic analyses and were found to be within acceptance limits.

In addition to the standard laboratory QC procedures, color and turbidity samples collected at Station C3-1 during the receiving water sampling were split in the laboratory and analyzed in triplicate. Mean, standard deviation, and coefficient of variation are reported in Table 19 for these samples. Coefficient of variation was shown to be 0% for color and 1.9% for turbidity. For analyses where samples were run in duplicate, such as turbidity and color, the relative percent difference between duplicates was calculated. The RPDs for laboratory duplicate analyses were found to generally be very low and within acceptable limits. Duplicate results for turbidity ranged from 0.4 to 5.2% RPD. Color duplicate results showed 0% difference between duplicates. All TRC analyses were read in duplicate and tested below detection limits for a 0% RPD for all samples except one which had an RPD of 0.50%.

Laboratory accuracy was assessed through the use of surrogate recoveries, sample and control spikes and duplicates, and SRMs. Detailed QA/QC results for all contract laboratory analyses are provided in the appendices corresponding to each analysis. Surrogates are compounds that were added to each sample and QC sample that were analyzed by GC methodology, such as volatile organic compounds (EPA 624/8260), semi-volatile organic compounds (EPA 625/8270), pesticides (EPA 8081, 8082 and 8141), and dioxins (EPA 8290). Some instances of surrogate recoveries outside QC recovery limits were found during the 2011 influent, effluent, and

**Table 20. Seabird SEACAT SBE-19 CTD Probe Variability Check, 15 June 2011**



sludge monitoring effort. These deviations are discussed in the case narratives that were provided by each laboratory which fully detail all QC issues for both sampling events and explain any QC deviations; these are provided in the appendices. As indicated by the laboratories, in all instances the data were not significantly affected by any QC issue.

Matrix spike (MS), matrix spike duplicate (MSD), laboratory control spike (LCS), and duplicate control spike (DCS) are samples and blanks that are spiked with target compounds of interest to determine percent recovery and relative percent difference between duplicates. Whenever possible, MS/MSD samples were run on samples from this program, however in some cases where insufficient volume existed, the laboratories performed standard batch QC. The QC criteria as specified in the EPA protocol include an acceptable recovery range and an RPD that should not be exceeded. Total metals, dissolved metals, cyanide, volatile organic compounds, and semi-volatile organic compounds met QC criteria for MS, MSD, LCS, and DSC with few exceptions for all analyses on the program. No deviations were found in the QC data that affected the overall quality of the data reported for the monitoring program. Detailed case narratives were provided by each laboratory which fully detail all QC issues for both sampling events and explain any QC deviations; these are provided in Appendices A1, A2, B1, B2, C1, C2, C3, and C4.

Trace metals analyses for the receiving water testing were supported through the use of SRMs, which are quality control reference materials with known metals values that are obtained from the National Bureau of Standards, National Institute of Standards and Technology, or other certified standards. These SRMs were analyzed by the laboratories at the same time as the project samples in order to ensure laboratory accuracy. Results of the analyses of SRMs should fall within acceptable limits and can be expressed as percent recovery. All metals SRM results were within acceptance limits (Appendix C).

Method blanks (or procedural blanks) were also analyzed for all analyses where required and appropriate on the monitoring program. Method blanks consist of pure, organic- or metal-free reagent grade water that is run through the analysis process and used to verify that analyte concentrations are accurate and do not reflect contamination. No method blank issues were found that affected the data for this program. Some trace levels were seen in a number of constituent at very low levels that were estimated concentrations below the laboratory's reporting limits for the program. Trace levels of metals were detected at estimated concentrations below their MRLs in the method blanks for the low level analyses that were performed. This is typical for low level metals analyses, in that trace levels are seen in method blanks in the low parts per trillion range and are not an indication of contamination as they are not statistically significant. Metals concentrations seen during the program were typically 2-3 orders of magnitude higher than those seen in the method blanks and all other QC criteria were within acceptance limits, therefore no further action was necessary or taken. The method blank analyses performed with the TSS analyses showed no results above method detection limits.



## 5.0 DISCUSSION

### 5.1 INFLUENT, EFFLUENT, AND SLUDGE MONITORING

The NPDES permit for the Asplund WPCF requires compliance with applicable State water quality standards as promulgated in Chapter 70 of the Alaska Administrative Code 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 SSWQC for the Point Woronzof area of Cook Inlet for turbidity and the dissolved fraction of arsenic, cadmium, hexavalent chromium, copper, lead, mercury, nickel, selenium, silver, and zinc. Since the issuance of the current permit, EPA has approved ADEC's proposed 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; Sept. 15, 2006 letter to ADEC). Except for cadmium and mercury, where the dissolved standard changed from 9.3 to 8.8 µg/L for cadmium and from 0.025 to 0.94 µg/L for mercury, all other AWQS metals criteria are the same as those in the SSWQC. Even though EPA has approved the use of dissolved metals criteria for the AWQS, the current SSWQC will most likely remain in affect 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 2009), 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 the parameters of concern in regards to the requirements of the NPDES permit or the AWQS as well as historical data from the WPCF, other POTWs, and other EPA data.

#### 5.1.1 Influent and Effluent Monitoring

Table 21 lists permit effluent limitations and marine water quality criteria that are applicable to the current NPDES permit; it includes each of the parameters required to be monitored by the permit. Most of the values shown are the chronic toxicity criteria for salt water aquatic life. Chronic toxicity criteria concentrations are lower than acute toxicity criteria concentrations; therefore, the more stringent of the two values were used here for comparison. The MAEC for each constituent was calculated from the outfall design dilution factor of 142:1 (conservative substances) or 180:1 (non-conservative; TRC, ammonia, etc.), the water quality criteria, and the natural background concentrations as determined historically at the control site near Point MacKenzie. Inclusion of the natural background concentration into this calculation is necessary since it lowers the MAEC as a result existing pollutant concentrations in the receiving water as required by EPA and ADEC discharge modeling procedures. For conservative constituents, 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.

To determine compliance with State water quality standards, Table 21 values have been compared with effluent values found in Table 8 through Table 11 as well as those in Table 16 and Table 17. The AWWU 2011 maximum effluent concentrations shown in Table 21 were the maximum encountered during the calendar year either during AWWU's in-plant monitoring, the

**Table 21. NPDES Requirements, State of Alaska Water Quality Standards, and AWWU 2011 Maximum Concentrations for Effluent Comparisons**

**Table 21PG 2**



toxic pollutant and pesticide monitoring events, pretreatment monitoring, or the supplemental effluent monitoring that was performed as part of the receiving water sampling. For metals, both total and dissolved concentrations in the effluent were compared against their MAEC, since 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, the permit limitations for all parameters were met for the 2011 program year. When the MAECs in Table 21 were compared to all of the 2011 data including: AWWU's self-monitoring effluent data, the toxic pollutant and pesticides sampling events (June and August 2011), the pretreatment monitoring data, and the effluent data from the receiving water sampling, metals and cyanide values were all below their MAECs. The highest concentrations of either total or dissolved metals seen in 2011 were all well below their respective MAECs.

The one metal that most closely approached its MAEC at any time was copper, and this was considerably below its MAEC. The maximum concentration of total copper detected in the effluent was 36.3 µg/L compared to a MAEC of 317 µg/L. The highest dissolved copper concentration that was seen in the effluent was 23.9 µg/L. All other effluent dissolved metals concentrations were found to be much less than their respective MAECs.

Those metals without AWQS, while analyzed as both total and dissolved metals as called for by the permit, are compared to total recoverable metal MAECs as provided by EPA criteria and include antimony, beryllium and thallium. Total metals concentrations for beryllium and thallium were below detection limits, and thus well below their MAECs. As in past years, total recoverable metals detected in the influent and final effluent were compared with data from an EPA study of 40 Publicly Owned Treatment Works (POTWs) in Table 22 (EPA, 1982a). Without exception, 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 self-monitoring program are presented in Table 23 and Table 24. It should be noted that prior to 2000 when the permit requirements changed, dissolved metals had only been analyzed in a single sample of effluent collected each year during the receiving water sampling. Beginning in August 2000, dissolved metals from the effluent have been analyzed in both the summer wet and summer dry sampling events and as part of the pretreatment monitoring. Concentrations are very low and fairly consistent over time. Concentrations of total recoverable metals concentrations seen in the influent and effluent during 2011 fell within the range of concentrations seen during prior years. Concentrations of dissolved metals were generally found to fall within the range of concentrations seen over the prior five years as seen in Table 23. In 2008 through 2011, cyanide concentrations were typical of the long term average whereas in 2007 cyanide appeared to be slightly elevated although barely outside the historic range. Overall, the long-term results for metals and cyanide have always been well within their MAECs and always met AWQS and permit criteria.

Total arsenic concentrations in the final effluent have remained fairly steady over the last five years, and 2011 values remained well within the historic range. The maximum total arsenic concentration in final effluent seen during 2011 was 2.79 µg/L, compared to an MAEC of 4,882

**Table 22. Comparison Between Influent/Effluent Analysis Results for Anchorage and 40 POTWs**



**Table 23. Comparison of Toxic Pollutants and Pesticides in Anchorage's Final Effluent to the Previous Five Years**

**Table 23 p2**

**Table 23 p3**

**Table 23 p4**

**Table 24. Historical Discharge Monitoring Data (1986 - Present) for Influent and Effluent Total Metals and Cyanide**

µg/L (Table 21). Arsenic values are not a serious concern for this permit in terms of effluent, since the concentration in the final effluent has always been so much lower than the MAEC.

During 2011, cyanide concentrations in the effluent ranged from ND (< 3) to 8 µg/L, well below the MAEC of 181 µg/L. Cyanide had been a constituent of concern in the prior permit because it approached or even exceeded the prior MAEC of 50 µg/L in some years. In 1986 it was observed that the effluent cyanide concentrations often exceeded the influent concentrations by an order of magnitude. This trend continued during subsequent years of sampling and was the subject of a special investigation that concluded that the measured increase in cyanide between the influent and effluent was the result of the treatment plant's incinerator. Cyanide formed in the incinerator during sludge incineration was returned to the plant during the stack scrubbing process. Subsequently, cyanide decreased and this was believed to be due to the change in the scrubber water source from recirculated primary effluent to well water.

The most restrictive criteria of growth and propagation of fish, shellfish, other aquatic life, and wildlife was used for the hydrocarbon limits presented in Table 21. The MAECs for TAqH and TAH as BETX were met again this year, the levels detected in the effluent were all found to be substantially below their MAECs. The parameter of TAqH was analyzed in effluent only during the receiving water quality sampling, and the TAqH concentration was 12.68 µg/L as compared to the MAEC of 2,715 µg/L. The maximum BETX (TAH) value of 10.87 µg/L (measured by EPA method 624) was seen during the August 2011 toxic pollutant and pesticide sampling, and this value fell well below the MAEC of 1,810 µg/L.

The MAEC for total ammonia was met again this year, with effluent values exhibiting a maximum of 40.2 mg/L as compared to the MAEC of 217 mg/L for the chronic limit and a MAEC of 1,466 mg/L for the acute limit. These MAECs are based on saltwater acute criteria of 8.1 mg/L and saltwater chronic criteria of 1.2 mg/L, which are a function of temperature, salinity, and pH as presented in the AWQS. For comparison in this report the criteria were based on a salinity of 20 psu, temperature of 15 °C, and a pH of 8.0 units.

In addition to the MAECs that are based on the AWQS criteria, a number of other effluent limitations are specified in the NPDES permit. These daily, weekly, and monthly limitations for effluent concentrations and loading include: pH, TRC, BOD<sub>5</sub>, TSS, and fecal coliform (Table 21). All results for these parameters met all permit limitations for 2011.

For fecal coliform, the permit limitation of a monthly geometric mean (of at least five samples) that shall not exceed 850 FC/100 mL was not exceeded this year, with the maximum monthly geometric mean of 22 FC MPN/100 mL. 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 of 2011.

The permit limitations for monthly and weekly averages and daily maximum were met for BOD<sub>5</sub> and TSS. Amendments to the Clean Water Act, require at least 30% average monthly removal for both of these parameters. BOD<sub>5</sub> and TSS met this requirement on both an average monthly and annual basis with the lowest monthly removal of 43% for BOD and 75% for TSS. Removal of BOD<sub>5</sub> averaged 46% for the 2011 calendar year which is similar to that seen in 2009 and 2010 although higher than was seen during the previous four years where average annual removals ranged from 34 to 38%. The monthly removal for TSS ranged from 75 to 80% with an annual

average of 78%, about the same as reported for the last ten years and well above the required average monthly criteria of 30%.

Concentrations of other toxic pollutants and pesticides detected in the influent and final effluent were generally 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 (Table 22). 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 the Anchorage effluent this year and over the previous five years are shown in Table 23. These data indicated some variability over time, but a generally similar pattern overall. Levels were low and often below reporting limits. As in the past, the types and concentrations of measured organic compounds varied between the two sampling periods. Also, in some instances, large differences in pollutant concentrations occurred between the influent and effluent. Inconsistencies can be explained by looking at sampling methodology and plant operation in the case of point-source contaminants. If spikes of contaminants are occurring in the influent, these might be hit or missed during influent sampling. On the other hand, an effluent sample could contain the contaminant because of mixing in the clarifiers. Differences in concentrations in influent and effluent samples could also be due to lower TSS in the effluent samples and the residence time at the facility. This can be seen in Table 9 and Table 10, where greater variability usually occurs in the influent concentrations as compared to the effluent.

Historic discharge monitoring data (1986 - 2011) for other parameters of concern measured in the influent and effluent are presented in Table 25. Most parameters have remained fairly steady over time. Dissolved oxygen levels increased from 1986 with a peak in 1992, and then generally decreased over the next ten years. Levels of DO over the past six years including 2011 have been fairly consistent and generally in the range of 1.5 to 6 mg/L. Other constituents of potential concern such as TSS have remained fairly steady in both the influent and effluent over the past six years and within the range of that seen historically with an effluent range of 46 to 60 mg/L over the past six years. The BOD<sub>5</sub> effluent average during 2011 (146 mg/L) is similar to that seen in recent years and well within the range seen historically, with a range of 83 to 174 mg/L seen over the past six years. Average BOD<sub>5</sub> levels in the influent in 2011 were slightly higher than that seen over the prior five years yet still within the range seen historically.

The yearly average effluent fecal coliform bacteria concentration, reported at 10 MPN/100 mL for 2011, was similar to that seen in 2007 through 2010 and considerably lower than the prior few years. Elevated levels seen in 2004 were the highest yearly average seen on the program to date and were most likely the result of a program to optimize chlorine usage as described below. Lower fecal coliform values for 2007 through 2011 showing a downward trend are more in line with prior data, indicating that the disinfection efficacy at the WPCF has been improving.

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 control the chlorine dosage rate by adjusting it 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 has resulted in adequate coliform kills with far lower chlorine residuals and has substantially reduced the annual chlorine

**Table 25. Historical Discharge Monitoring Data (1986 - Present) for Influent and Effluent Non-Metals**



usage, but optimizing the disinfection process continues to be an on-going focus. Also, with the trending tools being developed in the new Hach Water Information Management System, it is believed that additional optimization of the disinfection processes may be possible.

The average TRC had dropped from 0.8 mg/L in 2001 to 0.4 mg/L in 2002, and since then has leveled out at approximately 0.35 mg/L. The average TRC in 2011 of 0.33 mg/L was within the average range of 0.29 to 0.38 mg/L seen during the prior five years. The average fecal coliform monthly average rose from 39 FC/100 mL in 2001 to a high of 325 FC/100 mL in 2004, and in 2011 has dropped back even further to 10 FC/100 mL. As noted above, there were no exceedances of fecal coliform permit limits in 2011.

Quarterly WET testing was conducted on 24-hr flow composite effluent samples during all four quarters of calendar year 2011. Echinoderm fertilization tests were performed during the first, third, and fourth quarters of 2011. Use of this test during the last two quarters of 2011 was based on the three-species screening test results from the second quarter, which had determined the sea urchin to again be the most sensitive species tested. With the exception of the fourth quarter WET testing, all results were found to be acceptable and below the permit specified TUc level (TUc < 143) that would trigger additional testing. The WET test conducted in the fourth quarter exceeded the trigger level with a TUc of 571.4 which required one additional test. AWWU conducted two additional tests, both of which indicated that the effluent was back within acceptable WET criteria levels, so no subsequent testing was necessary. In addition, AWWU initiated an extensive toxicity identification evaluation (TIE) in late 2011 to identify the potential source of toxicity in the effluent, results of which are not yet available.

***In summary, effluent chemistry monitoring indicated that with no exceptions, effluent concentrations of toxic pollutants and pesticides, metals and cyanide, and conventional parameters were much lower than their applicable permit limits and their MAECs. Fecal coliform also met all permit specified criterion in 2011. All toxic pollutants and pesticides 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 that the final effluent exceeded the permit trigger level for additional testing on one sample. The additional WET testing that was conducted indicated that the effluent was back within the WET acceptance range.***

### **5.1.2 Sludge Monitoring**

The current permit requires sludge monitoring twice per year, once each during the dry and wet conditions in summer as part of the toxic pollutant/pretreatment monitoring. There are no Part 503 monitoring requirements included in the permit, but sludge monitoring is required because the Part 503 regulations are self-implementing as described in Section 2.1.5. Part 503 monitoring of sludge at Asplund WPCF has been included in this report (Table 13) and will also be reported separately to EPA as required by the regulations by 19 February 2011.

While the current permit does not contain sludge limits for levels of toxic pollutants and pesticides, comparisons can be made for these data based on other treatment facilities' monitoring results and to the site specific allowable limits for metals that were determined for the facility (Table 26). In all cases, sludge metals were found to be substantially lower than the site specific allowable limits (Table 13). Again, data indicate that average concentrations of

**Table 26. Comparison Between Sludge Analysis Results for Anchorage and Typical and Worse Case Concentrations Used by EPA in Developing Median or Mean Environmental Profiles**

toxic pollutants and pesticides in Anchorage's sludge are generally lower than "typical" concentrations seen at other treatment facilities (Table 26)(EPA 1985c). In the 2011 503B metals sampling, arsenic ranged from < 3.54 to 5.71 µg/g with an average of 4.56 µg/g compared to a typical value of 4.6 µg/g and a 95<sup>th</sup> percentile value of 20.77 µg/g seen at other facilities.

Beryllium concentrations were all ND (<0.364) µg/g during the bi-monthly sludge sampling during 2011 (Table 13) although trace levels were seen during the priority pollutant and pesticide sampling effort (Table 9 and Table 10). The detection limit for beryllium is similar to the "typical" result from other municipal sludge of 0.313 µg/g and well within the 95<sup>th</sup> percentile value reported from other treatment works of 1.168 µg/g. Nickel ranged from a low of 7.71 µg/g to a high of 13.9 µg/g compared to a much higher "typical" concentration of 44.7 µg/g and a 95<sup>th</sup> percentile value reported from other treatment works of 662.7 µg/g. Chromium concentrations in sludge during 2011 ranged from 10.8 to 17.2 µg/g compared to the typical concentration seen at other POTWs of 230.1 µg/g. The average mercury concentration measured during the Part 503 sampling was 0.72 µg/g, well below the typical concentration of 1.49 µg/g seen in other POTW sludge. The other Part 503 metals that were tested, cadmium and lead, also fell well below typical concentrations seen at other facilities.

Other metals that were monitored for but not a requirement of the Part 503 regulations were copper, selenium, and zinc. Copper concentrations were below typical concentrations during both the June and August sampling. Zinc exceeded the typical concentration in August with a concentration of 730 µg/g compared to the typical concentration of 677.6 µg/g and a 95<sup>th</sup> percentile concentration of 4,580 µg/g. The selenium values reported for both the June and August 2011 sampling event were 2.2 and 2.6 µg/g, respectively, compared to the typical concentration of 1.11 µg/g and a 95<sup>th</sup> percentile concentration of 4.848 µg/g (Table 26).

Table 27 provides an overview of historical sludge data for total metals. In general, year 2011 data indicated similar concentrations of arsenic, cadmium, lead, and mercury compared to historical data over the last few years. As discussed previously, both chromium and nickel were found to be elevated during June 2009, but had dropped down to concentrations that were similar to the historic range for the remainder of the 2009 and 2010 and for all sampling in 2011.

## **5.2 WATER QUALITY MONITORING**

### **5.2.1 Plume Dispersion Sampling**

To test the hypothesis that the water quality at the ZID boundary was not degraded with respect to the water quality at the nearfield and control stations, the non-parametric Kruskal-Wallis Test (Zar, 1984) was employed which determined whether significant differences occurred within the sample group. If significant differences were observed, an ad hoc multiple comparison test was utilized to perform pair-wise tests of significance ( $\alpha = 0.05$ ). The results of these tests for the June survey period as a function of water quality parameters are presented in Table 28. Non-detect values were replaced with half the detection limit value for statistical testing.

Data from the receiving water survey showed statistically significant differences between the three outfall groupings (within-ZID, ZID boundary, and nearfield stations) and a grouping that included the control stations for salinity at the surface, middle, and bottom. As can be seen in Table 28, significant salinity differences between stations were between the control and nearfield station for all three depths. These differences were the result of the control stations being

**Table 27. Historical Discharge Monitoring Data (1986 - Present) for Metals in Sludge.**  
 Concentrations are in mg/kg dry weight. Results for years 1986-2005 represent the range of the results for monthly minimum (Min) and maximum (Max) as available. Results for 2006-2011 represent Part 503 sludge monitoring values.

Year	Arsenic	Beryllium*	Cadmium	Chromium	Lead	Mercury	Nickel
1986-2005 Min	1.7	ND(0.02)	0.7	3.38	10	<0.02	7
<b>1986-2005 Max</b>	151	0.37	10.0	55	468	7.3	53
2006 Avg	3.8	0.06	2	17	26	0.86	15
2006 Min	1.9	ND	1.23	13	18.2	0.390	11.9
2006 Max	5.94	0.15	3	25	39.3	1.70	19
2007 Avg	5.00	N/A	1.56	14.5	18.9	0.818	11.0
2007 Min	ND(3.2)	ND(0.307)	0.986	12.8	9.8	0.576	9.43
2007 Max	7.85	ND(3.38)	2.37	15.8	25.1	1.04	13.4
2008 Avg	4.73	N/A	1.35	13.7	21.4	0.812	11.5
2008 Min	ND	0.08 J	1.02	9.77	15.4	0.357	8.34
2008 Max	5.40	ND (0.42)	1.80	24.0	31.2	1.93	13.6
2009 Avg	3.85	0.49	1.11	26.17	17.70	0.541	59.34
2009 Min	ND	ND	0.66	7.90	10.60	0.231	7.23
2009 Max	6.34	1.75	1.77	122.0	25.80	0.885	400.0
2010 Avg	4.87	N/A	1.52	12.53	19.10	0.96	10.94
2010 Min	2.23	ND (0.314)	1.01	7.94	12.60	0.403	7.52
2010 Max	9.21	ND(0.329)	2.53	16.20	24.80	2.140	14.5
2011 Avg	4.76	<0.341	1.30	14.00	17.73	0.72	11.23
2011 Min	3.75	ND (0.317)	0.86	10.80	11.30	0.54	7.71
2011 Max	5.71	ND(0.364)	1.99	17.20	24.10	0.95	13.90

N/A Not applicable      ND Not detected

slightly less saline; however, though significant differences were found, these differences were very small. In the past the control stations have often been found to be less saline as a result of increased river influence on the north side of Knik Arm as a result of freshwater inputs from the Matanuska and Knik Rivers.

Temperature and DO were found to be significantly different between the control and the three outfall stations for the surface and middle depths with the control site being slightly warmer and lower in DO. For the bottom depths, the control site was found to be different from the near-field sites for DO and the control was different from both the near-field and within ZID for

temperature. Turbidity was not found to be significantly different between any sites for the surface, but differences were seen between the control site and the near-field for the middle depth, and between the control and all outfall sites for the bottom depth. No statistically significant differences were seen for pH, color, fecal coliform, or TRC for any depth.

**Table 28. 2011 Station Group Differences at the 5 Percent Significance Level as Determined by the Nonparametric Kruskal-Wallis and Steel-Critchlow-Fligner Tests**

All pH values fell well within the AWQS of 6.5 - 8.5 and values did not vary more than 0.2 pH units that would be attributed to the outfall, as required by the AWQS. For color, concentrations were found to be all either at or below the detection limit of 5 color units except for one sample located within the mixing zone and taken directly over the outfall at low slack water (Station F1-1) that was found to have a concentration of 20 color units. In 2007, color was found to be elevated at all locations compared to most prior years, and was believed to be due to the naturally high suspended sediment levels in the samples from Knik Arm that were not completely removed from the samples during the laboratory analysis. During 2008 through 2011, an additional preparation step was added where color samples were allowed to settle and decanted in the field prior to submittal to the laboratory. Upon reaching the laboratory the samples were processed by either filtration or centrifuging which resulted in much more representative sample analysis results. It is anticipated that this additional procedure will be continued in future years.

In addition to the standard water quality sampling, concentrations of total aromatic hydrocarbons (TAH) as BETX and TAqH 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). For TAH, TAqH, and PAH, the outfall stations were not found to be statistically significantly higher than the control locations. The outfall Station F1-1 and the control Station C1-1 did have BTEX values that were above the MRL, however, they were well below, the AWQS of 10 µg/L. Although care was taken during sampling, the source of the BTEX may have been from exhaust fumes from the research vessel. TAqH concentrations were calculated for all six stations using the MDL as the value for all non-detects yielding a maximum of 3.67 µg/L that was seen at Station C1-1, significantly less than the AWQS of 15 µg/L at all locations. In addition, comparison of TAqH and TPAH concentrations indicate that levels were elevated only at the within ZID station at low slack water (F1-1), as has sometimes been seen in the past. All TPAH levels were relatively low.

Total suspended solids, cyanide, 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 TSS and cyanide. For dissolved metals, significant differences were seen for cadmium, nickel, and zinc as a result of elevated levels at the within ZID sample above the outfall. However, none of these three metals exceeded AWQS in any of the samples tested.

Statistically significant differences were seen for the total recoverable metals cadmium and silver due to the higher concentrations at the outfall site as a result of higher TSS levels. Although not statistically significant, levels of most dissolved metals were found to be slightly higher at Station F1-1 that is located within the ZID above the outfall. This probably is an outfall related effect, although all concentrations (except copper as noted previously) were still well below AWQS, even within the ZID.

A comparison of the water quality data listed in Table 15 with the marine receiving water quality criteria for the State of Alaska (Table 21 and Table 29) indicates that none of the parameters listed in Table 15 exceeded AWQS outside the ZID. All of the TRC concentrations were below the PQL of 0.01 mg/L for all locations on the ZID boundary or outside of the ZID. As previously noted, all TRC methods are subject to positive interferences in estuarine or marine waters. Based on the maximum daily effluent TRC concentration (0.93 mg/L) measured during 2011 and a dilution credit of 180:1 in the NPDES permit, the highest potential estimate of TRC concentration at the ZID boundary would be 0.005 mg/L which meets AWQS at all receiving

**Table 29. State of Alaska Water Quality Standards for Receiving Water**

water locations outside of the ZID. Also, although the analysis was only able to achieve a PQL of 0.01 mg/L, ADEC considers a PQL of 0.1 mg/L that is 10 times higher to be the reasonable and achievable limit for regulatory purposes.

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 17, these standards were not exceeded during the receiving water sampling for any location. Two stations (F1-1 and C1-1) had measurable BETX concentrations which pushed the total BTEX value to a maximum of 3.44 µg/L; still well below the AWQS of 10 µg/L. In addition, for "contact recreation", the 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 during the receiving water sampling program during 2011 and none was observed on adjoining shorelines.

All the dissolved metals tested in receiving water (Table 16) as part of this program met the AWQS as shown in Table 21 at all locations on the ZID boundary and outside of the ZID including the control stations. These included: arsenic, cadmium, copper, chromium, lead, mercury, nickel, silver, and zinc. One copper sample taken at Station F1-1 was found to be higher (5.65 µg/L) than the AWQS of 3.1 µg/L, but this sample was taken above the outfall from within the NPDES permit specified ZID and therefore is not a violation of AWQS. Testing of antimony, beryllium, selenium, and thallium in receiving water is not required by the permit and was not performed in 2011. Since the adoption of the 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.

All cyanide samples collected during the receiving water sampling were below the State-specified criteria of 1 µg/L for marine aquatic life. The highest cyanide concentration that was seen in 2011 was at Station F1-1 with a value of 0.61 µg/L. The cyanide concentration in the effluent sample, that was measured at the same time as part of the receiving water sampling, was reported at a concentration of 2.4 µg/L, well below the MAEC of 181 µg/L.

***In summation, statistical analyses of the 2011 receiving water quality data indicated that water quality outside the ZID was not degraded with respect to control stations for any parameter as a result of the outfall. Differences that were noted in some parameters such as salinity and temperature were attributed to riverine influences and were not caused by the Asplund WPCF discharge. All AWQS were met in 2011 for the Asplund WPCF receiving water quality program. Although dissolved metal parameters appeared to be slightly elevated at the within ZID station directly over the outfall as compared to control stations with statistically significant differences seen for cadmium, nickel and zinc, all parameters were well below AWQS at all locations at or outside of the mixing zone. Statistically significant differences between the outfall and control site were seen for the total metals cadmium and silver due to elevated TSS levels at the outfall site. No statistically significant differences were seen for cyanide or hydrocarbons between the outfall and control locations and all cyanide and hydrocarbon concentrations were below AWQS at all locations in the receiving water including those within the mixing zone.***



## 5.2.2 Fecal Coliform Bacteria

In the past, the ADEC has indicated that one of their primary concerns is bacterial contamination of the shoreline by the Asplund WPCF discharge, indicated by fecal coliform bacteria concentrations. Because the 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 the mean fecal coliform concentration not exceed 200 FC/100 mL and that not more than 10% of the samples exceed 400 FC/100 mL. State marine water quality criteria for the harvesting for consumption of raw mollusks and 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 the 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 the criteria for secondary recreation is most applicable; however, these criteria are not the most restrictive. Therefore, the most restrictive criteria used were that the 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% shall exceed 40 FC/100 mL (seafood processing and aquaculture for raw consumption; Table 29).

Statistical tests indicated that fecal coliform concentrations were not significantly different between the within-ZID, ZID boundary, and the nearfield outfall station groups as compared to the control stations (refer to Table 28). Fecal coliform concentrations were very low again this year, and values ranged from <1.8 to 4.5 FC/100 mL at the outfall stations (including the ZID stations) and a range of <1.8 to 2 FC/100 mL at the control stations. The median at the control stations was <1.8 FC/100 mL, and the median at the 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 control site had a geometric mean of 1.84 FC/100 mL, while that at the all the outfall stations (inside and outside the ZID) was 1.89 FC/100 mL, both well below the criterion of 20 FC/100 mL. No samples at either the outfall or control stations exceeded the criteria of not more than 10% of the measurements may exceed 40 FC/100 mL. The highest fecal coliform concentration (4.5 FC/100 mL) was seen this year at a ZID boundary outfall station (F2-2) at mid tide level.

The range of fecal coliform concentrations for all intertidal samples collected during 2011 was lower than that seen in 2010 and ranged from a low at <1.8 to 4.5 FC/100 mL, with a median of <1.8 FC/100 mL and a geometric mean of 1.94 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. The highest coliform concentrations were seen at Station IT-5, 250 m southwest of the outfall. Intertidal samples also met the criterion of not more than 10% of the samples may exceed 40 FC 100/mL. In the past, elevated fecal concentrations have sometimes been seen in

the intertidal area that were attributed to heavy waterfowl use of the area, and not believed to be the result of the effluent discharge. The area is also heavily used in the summer by hikers that access the beach at Pt. Woronzof and often use the area for walking their dogs. These high concentrations were not seen in 2011.

Elevated fecal coliform bacteria concentrations were seen in one of the three area creeks that were sampled in 2011 where testing was performed on the water prior to entering Knik Arm. Historical data have indicated that these three streams have had much higher levels of fecal coliform than the waters that were tested in the vicinity of Point Woronzof. The two replicate fecal coliform concentrations measured in Fish Creek were 220 and 79 FC/100 mL. Replicate concentrations measured in Ship Creek were much lower at 4.5 and 6.8 FC/100 mL, while those at Chester Creek were <1.8 and 2.0 FC/100 mL. The fecal coliform concentrations from both Fish and Ship Creeks that discharge into Knik Arm were much greater than that seen in the receiving water at the intertidal, outfall, or control locations.

Fecal coliform concentrations in the effluent samples collected in conjunction with the receiving water, intertidal sampling, and stream sampling were also low at 7.8 and 4.5 FC/100 mL for the two replicates. These values were within the range of average monthly effluent values reported for the Asplund WPCF, which in 2011 ranged from 2 to 22 FC/100 mL (Table 8).

***In summary, fecal coliform concentrations in 2011 were found to be very low in the receiving water area. No statistically significant differences were seen between station groupings for the ZID, ZID-boundary, or nearfield stations as compared to the control location. Fecal coliform samples collected during the receiving water sampling program met all AWQS criteria, including all outfall stations both within and outside the ZID. Area creeks in 2011 were again found to be elevated and within the historical range for fecal coliform stream concentrations seen in prior years. It is clear from both this data and historic data 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 may cause elevated fecal coliform levels that are higher than those being discharged by the Asplund WPCF into Cook Inlet.***

## 6.0 CONCLUSIONS

The following conclusions were based on results from the 2011 monitoring effort as compared to the current NPDES permit and State of Alaska water quality standards:

- The influent, effluent, and sludge chemical monitoring showed, that with no exceptions, the Asplund WPCF met the NPDES permit requirements and complied with all applicable AWQS. AWWU's self-monitoring of TRC, pH, fecal coliform bacteria, BOD<sub>5</sub>, and TSS showed compliance with all permit effluent limitations throughout 2011.
- AWWU's self-monitoring of TRC and pH showed that the permit limit for daily maximum TRC levels in the effluent was never exceeded and pH was within permit limits throughout 2011.
- The permit limit for the monthly maximum geometric mean of 850 fecal coliform colonies per 100 mL by most probable number (FC/100 mL) technique was not exceeded in 2011. The fecal coliform monthly criteria "that not more than 10% of the effluent samples shall exceed 2600 FC/100 mL" was also not exceeded in any month during 2011.
- AWWU's self-monitoring of TSS and BOD<sub>5</sub> showed compliance with both regulatory and permit effluent limitations. TSS and BOD<sub>5</sub> were well within the daily, weekly, and monthly criteria for the entire year. Average monthly removals for BOD<sub>5</sub> and TSS of greater than 30% are required by the amendment to the CWA (40 CFR Part 125; Final Rule). The removal rate for both TSS and BOD<sub>5</sub> met the 30% minimum removal requirement for all months during 2011. Annual removals were 78% for TSS and 46% for BOD<sub>5</sub> which indicate an exceptional level of primary treatment is being achieved.
- Total aromatic hydrocarbons (TAH), total aqueous hydrocarbons (TAqH), and total ammonia concentrations in the effluent were all found to be below their maximum allowable effluent concentrations (MAECs) as calculated from AWQS throughout 2011.
- Concentrations of metals and cyanide in the effluent never exceeded their MAECs at any time during any of the 2011 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 under 40 CFR Part 503 and most were either not-detected or within the established range or lower than values from a national study of secondary treatment plants. Most metals fell at or below the typical concentrations and all metals were below 95<sup>th</sup> percentile worst case values (EPA 1985c).
- Whole effluent toxicity testing conducted quarterly were below the permit trigger level for additional testing for all tested species and events in 2011 except for one high and apparently anomalous result in the 4<sup>th</sup> quarter of 2011. Two confirmatory tests were conducted in the 4<sup>th</sup> quarter that established that the effluent was below the trigger level.

- 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 the water quality at the ZID boundary was not degraded with respect to the water quality at the nearfield and control stations, statistical comparisons were employed. Conventional parameters such as salinity, temperature, and turbidity did show significant differences between sites, however, these were not ascribed to the outfall but were due to river influences at the control stations. No statistically significant differences were seen for pH, TRC, TSS, color, or fecal coliform.
- 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.
- Supplemental receiving water quality samples obtained as part of the plume dispersion monitoring indicated that dissolved metals were all below the AWQS at all locations on the ZID boundary and outside of the ZID including the control stations. Statistically significant differences between the outfall and control station groupings were seen for the dissolved metals cadmium, nickel, and zinc due to higher concentrations within the ZID. Total metals were elevated at all locations compared to the dissolved as a result of the naturally high suspended sediment load. Statistically significant differences were seen for cadmium and silver due to variable ambient TSS levels.
- All cyanide concentrations in the receiving waters were found to be below the receiving water quality criterion limit of 1.0 µg/L and no statistically significant differences were detected between concentrations at the control and outfall stations.
- Supplemental receiving water samples also demonstrated that TAH and TAqH met the AWQS at all locations. The outfall stations were not found to be statistically significantly higher than the control locations for TAH or TAqH.
- Turbidity and color met the AWQS at all stations. TRC was at or below the detection limit of 10 µg/L at all locations except for one sample located within the ZID, as compared to the AWQS of 7.5 µg/L for chronic, 13.0 µg/L for acute marine water use, and 100 µg/L as ADEC's practical quantitation limit for regulatory purposes. Based on the highest maximum daily effluent TRC concentration of 930 µg/L seen during 2011 and a 180:1 dilution credit, it is estimated that maximum TRC in the receiving water would be 5 µg/L before reaching the ZID boundary and would meet all AWQS for TRC.

## CONCLUSIONS

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 the EPA to reissue the NPDES permit with 301(h) variance. The Asplund WPCF is operating within regulatory requirements and is showing no measurable impacts to the marine environment.

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