2018 Dry Weather Screening Report
APDES Permit No. AKS052558

FINAL REPORT

December 2018

MUNICIPALITY OF ANCHORAGE

WATERSHED MANAGEMENT SERVICES

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1.0 Introduction

1.1 Background

The U.S. Environmental Protection Agency (EPA) issued the Municipality of Anchorage (MOA) and the Alaska Department of Transportation and Public Facilities (ADOT&PF) a Municipal Separate Storm Sewer System (MS4) permit under the National Pollutant Discharge Elimination System (NPDES) in 1999. To meet the requirements of the permit, the MOA Watershed Management Services (WMS) initiated a Dry Weather Screening (DWS) program in 1999 to identify potential illicit discharges to the MS4. This program was conducted during the dry season (typically May through mid-July) each year through 2009.

The EPA re-issued the permit in 2009 prior to the State of Alaska receiving primacy to operate the NPDES program. The re-issued permit became effective February 1, 2010, under the administration of the Alaska Department of Environmental Conservation (ADEC) as an Alaska Pollutant Discharge Elimination System (APDES) MS4 permit. The permit expired on January 31, 2015, and ADEC re-issued the permit with revisions, effective August 1, 2015 (APDES Permit No. AKS052558). The expiration date of the current permit is July 31, 2020.

The APDES permit continues the requirement of DWS and subsequent follow-up actions to identify illicit discharges and associated pollutants to the MS4.

1.2 Problem Definition

The MS4 permit requires that the MOA implement an illicit discharge management program to reduce the unauthorized and illegal discharge of pollutants to the MS4 (Section 3.5). An illicit discharge is defined as any discharge to a MS4 that is not entirely composed of stormwater.[1] Illicit discharges, such as those from industrial process wastewater, domestic wastewater, car wash water, and other sources, can inadvertently introduce pollutants both directly and indirectly to the storm sewer system. Flow from storm drain outfalls during dry weather is generally an indicator of illicit discharges to the MS4.

1.3 Screening Program

DWS is conducted to identify illicit discharges to the MS4 within the MOA. Identification is the first step to eliminating these illicit discharges. To identify potential illicit discharges, field screening and laboratory testing techniques are used to identify obvious pollutant concentrations in what is expected to be clean stormwater. Guidance on illicit discharge screening identifies a list of 15 indicator parameters that can be used to confirm the presence of illicit discharges, noting that generally only 3 to 5 of these parameters need to be used to characterize the discharge for subsequent identification and elimination of the discharge (CWP and Pitt, 2004).

[1] Excepting any discharges authorized under an NPDES permit and discharges resulting from fire-fighting activities (40 Code of Federal Regulations [CFR] §122.26(b)(2)).

The MS4 permit establishes minimum requirements for the DWS program (Section 3.5.4). The Quality Assurance Plan (QAP) for the MS4 permit monitoring programs includes the full DWS monitoring plan. The QAP, including the DWS methodology, was updated in 2016 to comply with the re-issued permit revisions (MOA 2016a).

The MS4 permit requires the MOA to sample dry weather flow from at least 15 stormwater outfalls per year, and to have an additional 30 outfalls prioritized for sampling as alternates should a targeted outfall be dry. The permit also requires that sampled outfalls be geographically dispersed and represent all major land uses within the Municipality. The permit specifies screening for seven parameters: pH; total chlorine; detergents; total copper; phenols; fecal coliform bacteria; and turbidity. Benchmark or threshold exceedances are used to trigger MOA investigative action and provide information to support that action.

2.0 Project Summary

2.1 Watershed Prioritization

There are 12 watersheds within the area regulated by the MS4 permit. The DWS methodology established in the QAP includes a methodology to rank the 12 watersheds in order of priority for screening (MOA 2016a). Watersheds are prioritized at the beginning of each five-year permit cycle. The results of the watershed prioritization for the current permit cycle are described in the 2016 DWS Report (MOA 2016b) and summarized in Table 1.

Table 1. Watershed Prioritization for the 2016-2020 MS4 Permit Cycle

Rank	Watershed
1	**Ship Creek**
2	**Chester Creek**
3	Campbell Creek
4	Fish Creek
5	Furrow Creek
6	Rabbit Creek
7	Eagle River
8	**Hood Creek**
9	Peters Creek
10	Potter Creek
11	Mirror Creek
12	Glacier Creek

Note: Bold watersheds were sampled in 2018.

The Hood Creek, Potter Creek, Ship Creek, and Chester Creek watersheds were investigated in 2018. No potentially suitable outfalls were identified in the Peters Creek, Potter Creek, Mirror Creek, or Glacier Creek watersheds, (see Section 2.2 Outfall Sample Locations), so Ship Creek

and Chester Creek were evaluated. Maps of the investigated watersheds are provided in Appendix A.

2.2 Outfall Sample Locations

The following procedures are used to identify the 15 outfalls to be sampled within the watersheds:

1. The DWS program will only evaluate samples from outfalls that both: 1) fit the definition of an outfall provided at 40 CFR 122.26(b)(9),[2] and 2) are owned by the MOA or ADOT&PF. Outfalls fitting these criteria will be preliminarily identified from the MOA hydrography geodatabase (HGDB; MOA 2018a).[3] Samples from pipes or ditches that are privately owned or from pipes that convey streamflow will not be considered part of the DWS program. Additionally, sedimentation basin outfalls and outfalls emptying into them will not be considered for sampling in this program.
2. Prior to field reconnaissance each year, the list of complaints received by MOA during the previous year that involve discharges into or from the MS4 will be consulted to identify any associated outfalls for potential sampling (MOA 2018b).
3. Each of the three watersheds selected for investigation will be divided approximately in half (an upper watershed and a lower watershed). If there are not five "complaint" outfalls within the watershed, outfalls will be added beginning at the mouth of the lower half and the beginning of the upper half of the urbanized watershed until five sample sites have been identified. These are the primary sampling sites within that watershed. The same process will be used to identify ten alternate outfall sites in each watershed.
4. An alternate site will be selected for sampling when a primary site is dry or is completely submerged when the field team arrives to sample. Other reasons that require an alternate site to be sampled will be assessed on a case-by-case basis.
5. Unresolved complaint sites will have the highest priority for sampling, then sampling will begin at the furthest downstream outfall identified for sampling.

Prior to the 2018 field effort, potentially suitable outfalls were identified through a geographic information system (GIS) analysis using the HGDB. Only two potentially suitable outfalls were identified in the Potter Creek watershed, and no suitable outfalls were identified in the Peters Creek, Mirror Creek, or Glacier Creek watersheds. A review of dry weather screening reports from 2011 to 2015 shows that no outfalls suitable as primary targets or alternates for sampling have been identified in these watersheds. Most of the MS4 network within these watersheds

[2] "Outfall means a point source as identified by 40 CFR 122.2 at the point where a municipal separate storm sewer discharges to waters of the United States and does not include open conveyances connecting two municipal separate storm sewers, or pipes, tunnels, or other conveyances which connect segments of the same stream or other waters of the United States and are used to convey waters of the United States."

[3] As of 2017, MOA WMS updates the HGDB weekly. The most current version of the HGDB is available for download at http://anchoragestormwater.com/datalibrary.html. HDR downloaded the HGDB prior to reconnaissance activities on May 23, 2018 and following completion of sampling activities on October 23, 2018.

consists of open conveyances along roads. Inclusion of these watersheds within the watershed prioritization for the dry weather screening program should be reevaluated during the next update of the QAP.

The field team performed reconnaissance trips to locate targeted sites identified during GIS review of the HGDB to ensure the outfalls were otherwise suitable for sampling (safe legal access, flowing water during dry weather conditions, etc.). The outfalls identified in Potter Creek were determined to not be suitable for sampling, and additional outfalls were investigated in Ship Creek and Chester Creek. Outfalls in these watersheds were sampled previously during the current permit cycle, in 2016. Outfalls that were not included in the 2016 program were targeted for sampling in 2018.

Using these procedures, 15 outfalls within the Hood Creek, Ship Creek, and Chester Creek watersheds were selected for sampling in 2018. To evenly distribute the sampled outfalls, five outfalls in each watershed were sampled.

The intent of the reconnaissance trips was also to identify 10 alternate outfalls within each watershed for a total of 30 alternates as required by the MS4 permit. The QAP allows for outfalls to be passed over for sample consideration if the team cannot access the outfall due to lack of safe access or private property concerns. Additionally, although the HGDB for the watersheds in the Anchorage bowl is fairly accurate, the precise location and nature of an outfall is not always provided in the GIS data. For example, many outfalls drain into a culvert passing under a road, or are open drainage ditches. Lack of safe legal access, poor outfall condition that precludes collection of an isolated sample of flow from the MS4, or lack of flow during reconnaissance, disqualify the outfall from sampling consideration. These conditions were recorded and the team moved to the next outfall. Notes recorded during reconnaissance were recorded in field log books (Appendix B).

Only 15 potential alternate outfalls were identified within the four watersheds examined (10 on Chester Creek and five on Ship Creek). The additional 14 outfalls in the Ship Creek and Chester Creek watersheds identified as suitable for sampling for the 2016 program but that were not reexamined in 2018 were considered to still be suitable alternates for the 2018 program.

Table 2 lists the outfalls sampled in 2018. Outfall codes are numbers assigned to all network nodes in the HGDB. All other outfalls investigated during reconnaissance and sampling activities are listed in Appendix B. All outfalls investigated are shown on the watershed maps presented in Appendix A.

Table 2. Outfalls Sampled During 2018 DWS Program

Outfall Code	Latitude	Longitude	Location Description and Notes
Hood Creek			
249-1	61.19187	-149.96829	West side of Jones Lake, from dead end of Wendy's Way. Trickle flow during sampling. Outfall is in good condition, partially filled with sediment.
486-1	61.19681	-149.96608	North of Nathaniel Ct. Discharges into flow channel through Earthquake Park to Cook Inlet. Steady flow. Good condition.

Outfall Code	Latitude	Longitude	Location Description and Notes
609-218	61.19768	-149.95933	East bank, north of Clay Products Dr. Steady flow. Good condition. Some organic and urban debris in grate over outfall.
502-16	61.20246	-149.95031	North of Marston Dr. approximately 400 feet west of Lynn Ary Park. Low flow. Outfall discharges into flow channel with a newly installed cross culvert below the Tony Knowles Coastal Trail, and flows to Cook Inlet.
1264-37	61.20462	-149.94258	North of the Coastal Trail approximately 800 feet east of Lynn Ary Park. Steady flow. Needs maintenance, bottom of pipe is eroded at the tide line.
Ship Creek			
71-1	61.22342	-149.89125	South bank, along Ship Creek Trail approximately 400 feet west of Alaska Railroad Corporation Headquarters. Steady flow. Only accessible at low tide. Partially crushed, partially filled with silt.
396-1	61.22374	-149.88490	North bank, south of E. Whitney Rd. below A St. Bridge. Two outfalls, east outfall is 396-1. Strong flow. Good condition.
396-2	61.22379	-149.88497	North bank, south of E. Whitney Rd. below A St. Bridge. Two outfalls, west outfall is 396-2. Steady flow. Good condition.
213-1	61.22363	-149.86916	South bank, north of Ship Creek Ave. and N. Ingra St., behind AAA Moving and Storage. Steady flow, slight metallic smell at time of sampling. Fair condition, bottom of pipe submerged in flow channel and eroding.
82-1	61.22364	-149.86821	North bank, south of E. Whitney Rd., behind industrial metal recycling facility. EOP is buried beneath organic and metal debris. Sample collected from flow channel, steady flow. Flow channel is impounded by Ship Creek Trail, forming small impounded pond.
Chester Creek			
679-21	61.20474	-149.89995	South bank, end of Bunker St. west of footpath. Discharges into flow channel that flows approximately 150 feet to Chester Creek. Slow, unobstructed flow in flow channel. Outfall is half submerged in flow channel, partially filled with gravel and cobbles.
489-357	61.20342	-149.88666	North bank, east of A. St. south of Chester Creek Trail. Lots of urban debris trapped in grate covering outfall. Needs maintenance to remove trash.
499-1	61.20251	-149.87593	North bank, south of Anchorage Football Stadium and Track at Chester Creek Sports Complex. Steady flow. Good condition.
552-105	61.20125	-149.86392	North bank, south of Eastchester Park, north of terminus of Juneau St. EOP above LID installation, flow does not reach Chester Creek. Metallic and sewer odor, sheen and suds, and tea-colored water discharging at time of sampling.
4-1	61.18485	-149.80513	South side of University Lake, north of University Lake Trail from Ambassador Dr. Lots of urban debris trapped in grate covering outfall. Garbage odor, tea-colored water discharging at time of sampling.

2.3 Measured Parameters

Table 3 lists the screening parameters required by the permit and the sampling methods, reporting ranges, and the program thresholds for each parameter. Appendix E, DWS Monitoring Plan, of the QAP (MOA 2016a) provides rationale for screening parameter thresholds. The thresholds for all parameters were maintained from the previous MS4 permit cycle (MOA 2012a). Thresholds are established at concentrations sufficiently different from clean stormwater to detect potential illicit discharges. In a guidance manual, the Center for Watershed

Protection (CWP) and Robert Pitt (2004) recommend benchmarks (thresholds) orders of magnitude higher than ambient stormwater quality to reduce the incidences of false positives. Thresholds in Table 3 were established based on available environmental data and field test kit specifications. Values below the threshold are considered to be within an acceptable range for background concentrations. Values at or above the threshold concentration for a parameter indicate that the parameter may be above background concentrations. Outfalls with results that exceeded the threshold (or are outside the pH range) for one or more of the pollutant indicators are targeted for follow-up action.

Table 3. Sampling Methods, Reporting Ranges, and Thresholds for Measured Parameters

Parameter	Method	Reporting Range	Threshold
pH	pH test strips, YSI 556 hand-held probe	0 - 14 STD	≤ 4 or ≥9 STD
Total Chlorine	LaMotte Total Chlorine Octa-Slide Bar kit (3314) (EPA 330.5)	0.1 - 6.0 mg/L	≥ 1.0 mg/L
Detergents	Hach model DE-1 Toluidine blue colorimetric (Analytical Chemistry Method #38-791)	0.05 – 5.0 mg/L	≥ 1.0 mg/L
Total Copper	LaMotte model EC-70 Cuprizone Color Chart	0.05 – 4.0 mg/L	≥ 1.0 mg/L
Total Phenols	LaMott 4 Amino Anti-Pyrene (4 AAP) colorimetric (SM 5530C)	0.1 - 1 mg/L	≥ 0.5 mg/L
Turbidity	Hach 2100P Turbidimeter	0.1 - 1,000 NTU	≥ 250 NTU
Fecal Coliform	Standard Methods 9222D	1 colony/100 mL – too numerous to count	≥ 400 colonies/100 mL

2.4 Sampling Procedures

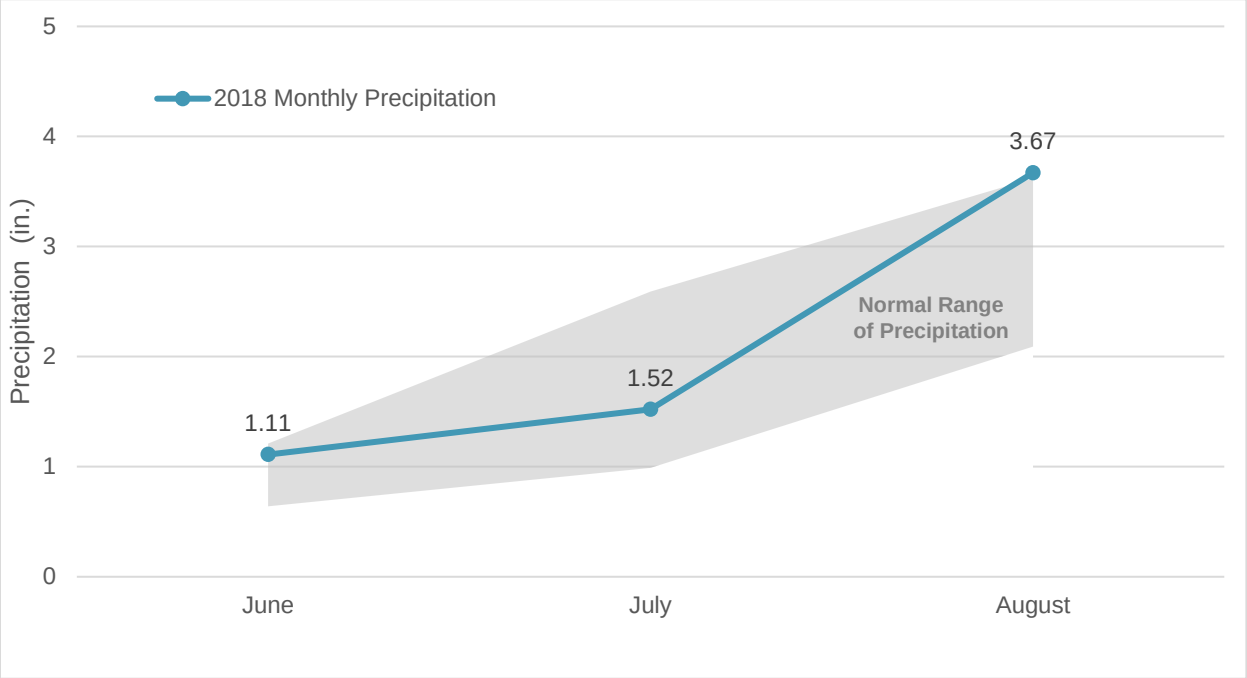
Sampling procedures were carried out in accordance with the methodology outlined in the QAP. No changes from previous years' sampling procedures were required in 2018.

2.4.1 Field Preparation

The MS4 permit stipulates that DWS should be conducted between June 1 and August 30 of each year. Precipitation in the Anchorage area in summer 2018 was normal. The total precipitation that fell in June and July was within the normal range, and the total precipitation for August was slightly higher than normal (Figure 1).

Sampling was conducted after at least 48 hours of dry weather following a storm event that created runoff in the MS4. Recent precipitation recorded by the National Weather Service at the Ted Stevens Anchorage International Airport was consulted to determine appropriate sample timing when necessary (NWS 2018a). Sampling occurred on four days in June and July. Figure 2 shows the daily precipitation and 48 hour running total precipitation for summer 2018. The dates when sampling occurred are indicated by the black arrows.

Figure 1. Monthly Precipitation in Anchorage, Summer 2018



Notes: 2018 monthly precipitation data recorded at Ted Stevens International Airport. Source: NWS 2018b. Normal range of precipitation shown is the range between the 25th and 75th percentiles of monthly precipitation averages recorded at the Ted Stevens International Airport for the 30 year period from 1981 to 2010. Source: NOAA 2016.

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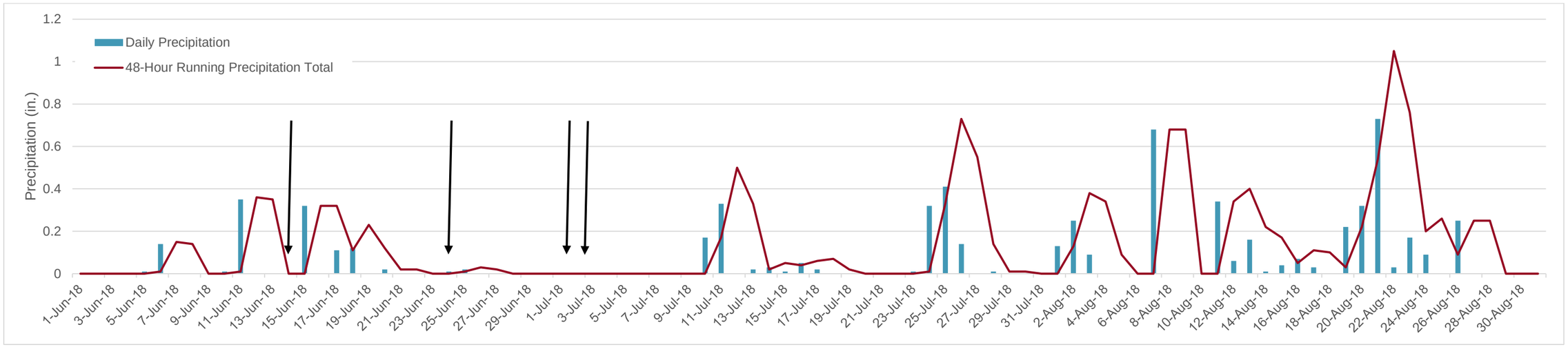
Figure 2. Daily Precipitation in Anchorage, Summer 2018



Notes: Daily precipitation data recorded at Ted Stevens International Airport. Source: NWS 2018b.
Black arrows indicate sampling dates.

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The field team conducted calibration and equipment blank analyses at the beginning of each day of sampling prior to entering the field. This equipment blank analysis examined each test kit by testing deionized water provided by SGS North America, Inc (SGS), the laboratory conducting fecal coliform analysis. The calibration and field test kit equipment blank data were recorded on the field data forms and are provided in Appendix C.

Each day before departing for field sampling the field team conducted a safety briefing. The team took the following items into the field:

- List of targeted outfalls (primary and alternate sites)
- GPS-enabled iPad loaded with HGDB and aerial imagery
- Field forms with guidelines
- Water quality analysis protocols (included in the QAP)
- Field sampling supplies
- Personal protective equipment
- YSI 556 hand-held meter
- LaMotte and Hach water quality field test kits
- Laboratory-supplied fecal coliform bottles
- Hach turbidimeter
- pH test strips
- Job Hazard Analysis and Travel Safety Forms

2.4.2 Sampling Activities

Sampling activities conducted at each outfall consisted of recording visual observations about the condition of the outfall and the discharging water, taking photographs of the outfall, measuring or qualitatively describing the flow of the discharging water, and collecting a sample for laboratory analysis of fecal coliform and two grab samples to measure all other parameters using field test kits or water quality meters. Detailed sampling methodology, including instructions for the field test kits, is included in the QAP (MOA 2016a).

The sample bottle for laboratory analysis of fecal coliform and grab samples for field test kits were filled directly from the outfall flow. The two grab samples were collected using a clean 750-milliliter (mL) amber glass bottle (for the detergents test kit) and a clean 1-liter HDPE plastic bottle (for all other field test kits and measurements). Field test kits were recorded as soon as possible after sample collection, and field measurements were recorded and compared against the thresholds described in Table 3.

The field team conducted replicate sample analyses at a rate of at least 15 percent per day per parameter (minimum of one per day). The field team also collected replicate samples for the laboratory analysis of fecal coliform at a rate of 15 percent per day (minimum of one per day).

Completed data sheets are included as Appendix C, and photographs of sampled outfalls are included as Appendix D.

2.4.3 Follow-Up Activities

HDR provided results of the field measurements to the MOA WMS immediately following every sampling day. SGS provided results of the fecal coliform analysis to HDR as soon as the results were available (typically within 24 hours), and HDR provided these results to the MOA WMS.

The QAP outlines notification procedures and follow-up activities to be performed when a sample exceeds the program threshold for any parameter (MOA 2016a). No sample exceeded the threshold for any parameter in 2018.

2.4.4 Deviations from QAP

The YSI meter used to measure pH was calibrated at the beginning of every sampling day; however, the field team noticed a deviation of up to 1 pH unit between the pH recorded by the YSI and the pH strips used for data validation at most sites. The pH measured using both the YSI and the pH strips was recorded on field forms.

Replicate sample analyses were not conducted on July 3, 2018. The QAP requires that replicate sample analyses be conducted at a minimum of once per sampling day. The field team overlooked the replicate analyses on one of the four days of field sampling.

2.5 Chain of Custody Records

The field team leader completed a chain of custody record which included each fecal coliform sample collected during a single field day for sample tracking. The original form was delivered with the samples to SGS. Copies of the chain of custody records are included in the laboratory analysis reports provided in Appendix E.

2.6 Laboratory Sampling Procedures

Fecal coliform samples were collected in laboratory-supplied sample bottles. The project name, sample ID, and sample date and time were clearly marked on the sample bottle labels. Samples were stored in a cooler with gel ice and a temperature blank while in the field. The samples were delivered to SGS within six hours to satisfy the short hold time of the fecal coliform samples. Fecal coliform was analyzed using standard method 9222D.

SGS provided results of the laboratory analysis to HDR via email or telephone immediately after the analysis was complete (typically within 24 hours). The expedited turn-around time allows for expedited follow-up sampling in the event of an exceedance of the fecal coliform threshold. SGS provided a full report of the analysis through Engage, an on-line document portal, within a week.

3.0 Results

3.1 Field and Laboratory Results

The results of the 2018 DWS sampling effort adds to the data set of previous years' sampling efforts (MOA 2008, 2009, 2011, 2012b, 2013, 2014, 2016c, 2016b, 2017). The 2018 sample results are provided in Table 4. Complete laboratory analysis reports are provided in Appendix E.

No parameter at any outfall exceeded the assigned threshold (shown in Table 3).

Table 4. Sample Results for Field Parameters and Laboratory Analyses

Watershed	Outfall ID	Date	Flow	pH	Total Chlorine (mg/L)	Detergents (mg/L)	Total Phenols (mg/L)	Turbidity (NTU)	Total Copper (mg/L)	Fecal Coliform (colonies/ 100mL)
Hood Creek	249-1	6/14/2018	Low	6.66 R = 7.0	<0.5 R <0.5	<0.05 R <0.05	<0.1 R <0.1	6.10 R = 6.22	<0.05 R <0.05	8.0 R = 1.0
Hood Creek	486-1	6/14/2018	Low	6.25	<0.5	0.1	<0.1	*18.7*	<0.05	ND
Hood Creek	609-218	6/14/2018	Medium	6.42	<0.5	<0.05	0.1	1.37	<0.05	ND
Hood Creek	502-16	6/14/2018	Low	6.43	<0.5	0.05	<0.1	0.69	<0.05	6.0
Hood Creek	1264-37	6/14/2018	Low	6.15	<0.5	<0.05	<0.1	0.48	<0.05	ND
Ship Creek	71-1	7/3/2018	High	6.01	<0.5	0.15	<0.1	*20.8*	<0.05	ND
Ship Creek	396-1	7/2/2018	High	7.0	<0.5	0.15	<0.1	1.55	<0.05	3.0
Ship Creek	396-2	7/2/2018*	High	7.0	<0.5	0.1	<0.1	0.76	<0.05	ND
Ship Creek	213-1	7/2/2018	Medium	7.0 R = 7.0	<0.5 R <0.5	0.05 R = 0.1	<0.1 R <0.1	1.94 R = 1.62	<0.05 R <0.05	2.0 R = 1.0
Ship Creek	82-1	7/2/2018	Medium	7.0	<0.5	0.1	<0.1	1.33	<0.05	*62*
Chester Creek	679-21	6/25/2018	Low	7.0 R = 7.0	<0.5 R <0.5	0.1 R = 0.05	<0.1 R <0.1	0.18 R = 0.16	<0.05 R <0.05	ND R = ND
Chester Creek	489-357	6/25/2018	Medium	7.0	<0.5	0.05	<0.1	5.58	<0.05	1.0
Chester Creek	499-1	6/25/2018	Medium	7.0	<0.5	0.05	<0.1	0.75	<0.05	ND
Chester Creek	552-105	7/3/2018	Medium	7.0	<0.5	*0.175*	<0.1	13.0	<0.05	10
Chester Creek	4-1	7/3/2018	Medium	7.0	<0.5	0.1	<0.1	22.9	<0.05	*318*

Notes: R = replicate sample; ND = not detectable

Italicized results are notably higher than other sites, but are not exceedances.

*Physical parameters at SHP 396-2 were measured on July 2, 2018. The fecal coliform sample collected did not contain sufficient volume for testing, and a second sample was collected on July 3, 2018.

3.2 Quality Assurance and Quality Control

Quality assurance and quality control (QA/QC) procedures were followed according to the QAP (MOA 2016a). The procedures included analytical checks (field replicates, equipment blanks), instrument calibration, and procedures to assess data for precision, accuracy, representativeness, comparability, and completeness.

SGS is certified by the EPA and the Alaska Drinking Water Program, and has an approved QA/QC program. Analytical methods and testing procedures were in adherence with the QAP (MOA 2016a) and standard methods (APHA 2005).

3.3 Data Validation

Verification analyses for laboratory parameters were conducted by SGS. The data review was focused on criteria for the following QA/QC parameters and their overall effects on the data:

- Data validation
- Sample handling (chain of custody)
- Holding time compliance
- Field replicate comparison

Samples were collected from the water flowing from the end of pipe at the outfall to avoid mixing with the stream water. Field analyses met the sensitivities prescribed in the QAP (MOA 2016a).

Replicate samples were collected at one outfall in each watershed to determine field precision and variability. For the field test kits, the QAP requires that percent difference between primary and replicate samples is calculated. The results need to be within the precision of the equipment used. For the fecal coliform samples analyzed at the laboratory, the QAP requires that relative percent difference be calculated between the primary and replicate samples and be within 60%. The variance between the primary and replicate samples are presented in Table 5.

Table 5. Replicate Sample Variance from Primary Sample

Parameter	QAP standard	Hood Creek 249-1	Ship Creek 213-1	Chester Creek 679-21
pH	± 0.2 pH units	**0.44 pH units**	0 pH units	0 pH units
Total Chlorine	30%	0%	0%	0%
Detergents	30%	0%	**67%**	**67%**
Total Phenols	30%	0%	0%	0%
Turbidity	± 1 NTU	0.12 NTU	0.32 NTU	0.02 NTU
Total Copper	30%	0%	0%	0%
Fecal Coliform	60%	**156%**	**67%**	0%

Note: Bold values indicate replicate variance that exceeds the QAP standard.

Most of the results fall within the QAP standards. One QC sampling location exceeded the variance threshold for pH, two locations exceeded the variance threshold for detergents, and two locations exceeded the variance threshold for fecal coliform. None of the outfalls that exceeded the variance thresholds have been sampled during previous years' DWS programs.

Hood Creek 249-1 exceeded the variance threshold for pH. The primary sample was measured using the YSI, and the replicate sample was measured using the pH strips when the YSI was observed to be deviating from the pH strips by up to 1 unit. The difference is precision between these methods accounts for the variance in these samples. This result was not flagged for follow-up action.

Ship Creek 213-1 and Chester Creek 679-21 exceeded the variance threshold for detergents. The results of the primary and replicate samples at both sites were recorded at the lowest end of the detection limit for the method used. The absolute difference between the primary and replicate samples at both sites was 0.05 mg/L, which is smaller than the increments on the color disc (0.1 mg/L). The primary and replicate samples at these sites were below the exceedance threshold for detergents, and these results were not flagged for follow-up action.

Hood Creek 249-1 and Ship Creek 213-1 exceeded the variance threshold for fecal coliform. Fecal coliform is widely variable and large variations are expected. Both the primary and replicate samples at these sites were below 8 colonies/100mL, and the absolute difference between the primary and replicate samples was 7 colonies/100mL at Hood Creek 249-1 and 1 colony/100mL at Ship Creek 213-1. The percent difference between small values exaggerates the small absolute difference between the values. The primary and replicate samples at these sites were below the exceedance threshold for fecal coliform, and these result were not flagged for follow-up action.

Sample custody was adequately maintained for the samples. The coolers transporting the fecal coliform samples were held at temperatures of less than 10°C. The holding times were met for all samples.

4.0 Discussion

4.1 Threshold Exceedances

No parameter exceeded the threshold at any outfall sampled in 2018. Of the outfalls sampled in 2018, four have been previously sampled under the MOA WMS dry weather screening program. Table 6 summarizes the results of previous years' sampling at these outfalls.

Table 6. Summary of Previous Sampling

Watershed	Outfall Number	Year Sampled	Sampling Results and Notes
Hood Creek	609-218	2013	No exceedances.
Ship Creek	71-1	2012	Listed in the 2012 report as outfall 81-79. Fecal coliform exceeded threshold (76,400 colonies/100mL). Follow-up sample also exceeded threshold (754 colonies/100mL). Up-network sample was below threshold (29 colonies/100mL), no further action taken.
Ship Creek	396-1	2012	No exceedances.
Chester Creek	489-357	2015	Listed in the 2015 report as outfall 486-1. No exceedances. Grate clogged with significant litter and debris at time of sampling.

4.2 Observations from Reconnaissance Trips

During reconnaissance trips prior to sampling, 34 outfalls to Hood, Potter, Ship, and Chester creeks were investigated. Of these, 16 were determined to be not suitable for sampling. Reasons that outfalls were deemed not suitable include that they were not flowing during dry weather conditions, that the network connected to the outfall conveys both stormwater and a segment of piped creek, that they were damaged or submerged, and/or that access was limited due to unsafe conditions or private property. Outfalls that were observed to be clogged, damaged, or submerged and may require maintenance are listed in Table 7. All outfalls investigated in 2018 are listed in Appendix B.

Table 7. Damaged, Clogged and Submerged Outfalls

Watershed	Outfall Number	Type of Issue	Notes
Chester Creek	504-1	Submerged	Submerged in creek, cannot sample.
Chester Creek	889-1	Obstructed	Outfall is in good condition but flow path is obstructed with sediment and vegetation.
Chester Creek	509-12	Damaged	Bottom of pipe is eroded.
Chester Creek	489-357	Clogged	Large amount of trash is trapped in grate, needs to be cleaned out.
Chester Creek	499-17	Damaged	Outfall is crushed, filled with sediment, and backwatered.
Chester Creek	426-23	Damaged	Outfall is crushed, buried, and backwatered.
Chester Creek	464-1	Submerged	Backwatered, cannot sample.
Potter Creek	101-1	Infiltration	Appears to convey stream or groundwater.
Ship Creek	550-2	Submerged	Backwatered at low tide, cannot sample.
Ship Creek	1363-1	Submerged	Backwatered at low tide, cannot sample.

4.3 Future DWS Sampling

Outfalls in the Campbell Creek, Fish Creek, and Furrow Creek watersheds will be investigated and targeted for sampling in 2019. Outfalls in these watersheds have been previously sampled under the current permit cycle (MOA 2016b, 2017). Outfalls that were sampled in 2016 or 2017 will not be selected for sampling in 2019. Field notes from previous years' reconnaissance and sampling activities in these watersheds will be reviewed prior to field activities in 2019 to guide selection of outfalls for sampling.

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