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2016 Dry Weather Screening Report

APDES Permit No. AKS052558

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MUNICIPALITY OF ANCHORAGE

WATERSHED MANAGEMENT SERVICES

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WATERSHED MANAGEMENT

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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, MOA initiated a dry weather screening 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. ASK052558). The expiration date of the current permit is July 31, 2020.

The permit continues the requirement of dry weather screening 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 storm water.[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

Dry weather screening 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 storm water. 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).

The MS4 permit establishes minimum requirements for the dry weather screening program (Section 3.5.4). The Quality Assurance Plan (QAP) for the MS4 permit monitoring programs

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

includes the full dry weather screening monitoring plan (MOA 2016a). The QAP, including the dry weather screening methodology, was updated in 2016 to comply with the re-issued permit revisions.

The MS4 permit requires the MOA to sample dry weather flow from at least 15 storm water 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 further action and provide information to support that action.

When a dry weather screening parameter exceeds a threshold, field teams will immediately notify the MOA Project Manager of the location and parameter of exceedance so that follow-up actions can be initiated. For fecal coliform results that exceed the thresholds, the laboratory Project Manager will be requested to notify the Contract Quality Assurance (QA) Officer immediately after the analysis is complete (within approximately 24 hours). The Contract QA Officer will immediately notify the MOA Project Manager for follow-up action. Follow-up actions are described in the flow chart in Attachment E-1 of Appendix E (Dry Weather Screening Monitoring Plan) in the QAP (MOA 2016a).

2.0 Project Summary

2.1 Sampling Location Selection

Outfalls sampled under the dry weather screening program are selected in a semi-systematic way. The dry weather screening methodology established in the QAP includes a methodology to rank the 12 watersheds within the area regulated by the MS4 permit in order of priority for screening (MOA 2016a). As in the previous permit cycle, outfalls within three watersheds will be sampled each year. The 2016 sampling was the first year of the dry weather screening program in this permit cycle, and so outfalls within the top three ranked watersheds were sampled. During the second year (2017), outfalls in watersheds ranked 4 through 6 will be sampled, and so on throughout the permit cycle. Over the five-year duration of the MS4 permit qualifying outfalls representing a variety of land uses in all 12 watersheds will be sampled, in compliance with permit stipulations.

The method for ranking the 12 watersheds takes into consideration many attributes of the watershed. These include:

- outfalls that discharge to an impaired water body
- evidence of contamination in the three years prior to ranking
- percentage of impervious cover
- the proportion of commercial/industrial land uses (including schools and parks)

To prioritize the watersheds for this permit cycle, the watersheds were ranked using the following criteria and scoring system.

1. Does any of the watershed drain to a Category 4 or 5 impaired waterbody[2] for one of the pollutants of concern (POCs)?

   a. If not, assign 0 points to the watershed
   b. If yes, assign 3 points to the watershed

2. Calculate the number of outfalls with threshold exceedances over the 2011 to 2015 period divided by the number of outfalls sampled in that watershed over the five year period and compare to the table below for point assignments. They count as multiple exceedances if the same outfall had exceedances for 2 or more POCs on the same date.

% of outfalls sampled with threshold exceedances	Points
≥80	15
60-79	12
40-59	9
20-39	6
1-19	3
0	0

3. Assign points to the watersheds within the Anchorage bowl, Eagle River, and Girdwood, based on the relative impervious area based on the most recent GIS layers.[3]

% Impervious Area	Points
>90	5
70-89	4
50-69	3
<50	1

[2] Section 303(d) of the Clean Water Act requires states to list any waterbodies that do not meet water quality standards. Category 4 impaired waterbodies are those that have a Total Maximum Daily Load (TMDL) for one or more pollutant in place, have an active pollution control program, or are impaired by something other than a pollutant (i.e. channelization). Category 5 impaired waterbodies are those that are contaminated above established water quality standards with no TMDL in place, but requires a TMDL or pollution control plan. Category 5 impaired waterbodies are included in the Alaska Section 303(b) list (ADEC 2016).

[3] Watershed boundary data source: MOA Hydrography Geodatabase (2016c). Impervious surface GIS data source: National Land Cover Database (USGS 2015).

4. Assign points to the watershed based on the percent of commercial and industrial land uses based on GIS zoning layers[4] within the Anchorage bowl, Eagle River, and Girdwood areas as listed in the table below:

% Commercial/Industrial	Points
>80	4
60-79	3
40-59	2
20-39	1
<20	0

5. Add points for each watershed.

6. Rank the watersheds from highest to lowest.

Using the above criteria, the 12 watersheds were scored and ranked as shown in Table 1.

Table 1. Criteria scores and ranking of watersheds within the MS4 permit area.

Rank	Watershed	Category 4 or 5 Water Body	Percent Exceedances	Impervious Area	Commercial/ Industrial	Total Score
1	**Ship Creek**	3	3	1	1	8
2	**Chester Creek**	3	3	1	0	7
3	**Campbell Creek**	3	3	1	0	7
4	Fish Creek	3	0	1	1	5
5	Furrow Creek	3	0	1	0	4
6	Rabbit Creek	3	0	1	0	4
7	Eagle River	3	0	1	0	4
8	Hood Creek	0	0	1	2	3
9	Peters Creek	0	0	1	0	1
10	Potter Creek	0	0	1	0	1
11	Mirror Creek	0	0	1	0	1
12	Glacier Creek	0	0	N/A	N/A	0

Note: Bold watersheds were sampled in 2016.

The watershed boundaries for the 12 watersheds were acquired from the MOA hydrography geodatabase (HGDB; MOA 2016b). Only the areas of the watersheds within the MS4 permit area were included in the GIS analysis steps of the watershed prioritization. Glacier Creek was excluded from the GIS analysis because the Glacier Creek watershed boundary as it is mapped in the HGDB does not cover most of the developed area of the community of Girdwood. This is not expected to affect the results of the prioritization as Girdwood has significantly less impervious area and commercial/industrial land than the Anchorage Bowl and Eagle River.

[4] Land use GIS data source: MOA (2015).

Additionally, dry weather screening reconnaissance in 2013 did not identify any outfalls in the Glacier Creek watershed that were suitable for sampling (MOA 2013).

After the watershed prioritization was conducted, there were three ties among eight of the watersheds. The percent impervious surface area of the watershed was used to break ties between watersheds that received the same total score to produce the final ranking in Table 1. Based on the prioritization, Ship Creek, Chester Creek, and Campbell Creek watersheds were selected for investigation in 2016. Maps of these watersheds are included as Appendix A.

To identify the 15 outfalls to be examined within the watersheds, the following procedures are used:

1. The Dry Weather Screening program will only evaluate samples from outfalls that both 1) fit the definition of an outfall provided at 40 CFR 122.25(b)(9), and 2) are owned by the MOA or ADOT&PF. Outfalls fitting these criteria will be preliminarily identified from the HGDB. Samples from pipes or ditches that are privately owned or from pipes that convey streamflow will not be considered part of the Dry Weather Screening 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 that involve discharges into or from the MS4 will be consulted to identify any associated outfalls for potential sampling. The complaint outfalls will be identified on a map.
3. Each of the three watersheds 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.

2.2 Outfall Sample Locations

Fifteen outfalls within the Ship Creek, Chester Creek, and Campbell Creek watersheds were sampled. Prior to any field effort, potential sampling sites were identified through a GIS analysis using the HGDB and a GIS file showing the locations of known illicit discharges to the MS4 between 2012 and 2015 (MOA 2016c). The procedures listed above were used to target high priority outfalls for sampling. The field team performed reconnaissance trips to locate the sampling sites and ensure the outfalls were otherwise suitable for sampling (safe access, flowing water during dry weather conditions, etc.). Notes recorded during the reconnaissance trips were recorded in field log books (Appendix B).

To evenly distribute the sampled outfalls, five outfalls in each watershed were sampled. The intent was to also identify 10 alternate outfalls within each watershed for a total of 30 alternates as required by the MS4 permit; however, only 10 flowing outfalls were identified in the Ship Creek watershed. In total, 41 potential alternate sampling locations were identified between the three watersheds (5 on Ship Creek, 17 on Chester Creek, and 19 on Campbell Creek). More than the 30 required alternate sites were identified because some of the alternate sites had low flow, or would be difficult to sample due to poor outfall condition or access, and were considered low priority alternates.

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. Both of these conditions disqualify the outfall from sampling consideration. These conditions were recorded and the team moved to the next outfall.

Table 2 lists the outfalls that were investigated in each of the watersheds. Outfall identification codes are numbers assigned to all nodes in the HGDB MS4 network. Maps of the watersheds and the outfalls sampled are presented in Appendix A.

Table 2. Outfalls Investigated and Sampled During 2016 Dry Weather Screening Program

Outfall Code	Activity; Category	Latitude	Longitude	Location Description and Notes
Ship Creek				
71-1	Examined; Alternate	61.22342	-149.89125	South bank, 100 feet upstream of South Boat Launch Rd. bridge. Submerged at high tide.
436-1	Sampled	61.22407	-149.88733	North bank, east of Ocean Dock Rd. Good condition.
1363-1	Sampled	61.22357	-149.88627	South bank, below pedestrian bridge from King's Landing.
550-2	Sampled	61.22343	-149.88534	South bank, just east of The Bridge restaurant.
396-1	Examined; Alternate	61.22372	-149.88486	North bank, below A St. bridge.
119-1	Examined; Not suitable	61.22327	-149.88040	South bank, 100 feet downstream of Ship Creek Dam. Perched, corroded. Not flowing.
46-1	Could not locate	61.22405	-149.88039	North bank, 100 feet downstream of Ship Creek Dam. Could not locate, likely completely submerged.
151-3	Examined; Not suitable	61.22392	-149.87938	North bank, EOP is on Whitney Rd. Drains in to slough above dam. Outfall crushed. Not flowing.
491-1	Sampled	61.22328	-149.87575	South bank at Eagle St. Outfall flows into naturalized channel to creek.
213-1	Examined; Alternate	61.22363	-149.86916	South bank behind Allied Alaska Moving and Storage (E. Ship Creek Ave. and Ingra St.).

Outfall Code	Activity; Category	Latitude	Longitude	Location Description and Notes
Ship Creek				
82-1	Examined; Alternate	61.22364	-149.86821	North bank, EOP empties in to pond south of E. Whitney Rd.
154-1	Examined; Not suitable	61.22340	-149.86515	North bank, EOP 1,400 feet from creek where railroad tracks cross E. Whitney Rd. Overgrown with vegetation. Water in outfall is backed up and not flowing into creek.
944-1	Could not locate	61.22317	-149.86427	North bank, below Ship Creek Trail bridge. HGDB does not show connected network.
189-1	Examined; Not suitable	61.22305	-149.85828	South bank, N. Post Rd. and Viking Dr. Outfall is buried in sediment within creek.
96-2	Sampled	61.22447	-149.84553	South bank at N. Sitka St. EOP perched about 3 feet, scour pool below. Flow path to creek is naturalized, no obstructions.
245-1	Examined; Alternate	61.22774	-149.83298	North bank at Yakutat St.
690-1	Could not locate	61.22988	-149.82772	South bank across from William Jack Hernandez Sport Fish Hatchery. EOP at Taylor St. and Parsons Ave. could not be located.
Chester Creek				
Chester Creek Mainstem				
549-1	Could not locate	61.20822	-149.92430	North bank, below Westchester Lagoon fish overlook. Could not locate EOP below Coastal Trail; could not locate EOP on U St. due to construction.
419-6	Examined; Alternate	61.20623	-149.92585	South bank, flows in to ponded area below Coastal Trail at Woodworth Cir. Outfall slightly dented but in good condition. Trickle flow.
117-1	Examined; Alternate	61.20280	-149.91663	South shore Westchester Lagoon below overlook on Hillcrest Dr. Outfall is in good condition. Trickle flow discharging into swale.
452-1	Could not locate	61.20523	-149.91188	North shore of Westchester Lagoon at the bottom of Minnesota Hill. Could not locate outfall.
163-5	Could not locate	61.20410	-149.90501	South bank at Spenard Rd. bridge. Could not locate outfall on creek. May not be connected to network; culvert under W. 19th Ave?
308-1	Could not locate	61.20417	-149.90433	South bank north of parking area on W. 19th Ave. Linear ponded feature, but could not locate EOP.
679-21	Examined; Alternate	61.20473	-149.89995	South bank at Bunker St. Outfall discharges into slough 140 feet south of creek. Flowing slowly, flow path to creek is not obstructed.

Outfall Code	Activity; Category	Latitude	Longitude	Location Description and Notes
Chester Creek				
Chester Creek Mainstem				
676-1	Examined; Not Suitable	61.20387	-149.89352	North bank at Valley of the Moon park (approximately 300 feet downstream of pedestrian bridge from W. 19th Ave.). Two EOPs. Top outfall dry, bottom outfall submerged in creek.
296-1	Sampled	61.20344	-149.88357	West side of A St. Outfall is on top of culvert conveying creek under A St. Some trash in flow path, but no obstruction.
Unnamed Outfall	Examined; Not Suitable	61.20117	-149.88135	South bank, EOP is approximately 600 feet south of creek on north side of Chester Creek connector to Fireweed Ln. Outfall drains network 103. Discharges into swale, trickle flow. Does not outfall to Chester Creek, likely infiltrates into ground.
302-2	Examined; Not Suitable	61.20197	-149.88009	South bank, EOP at N. Cordova St. approximately 800 feet south of creek. Outfall is completely obstructed by sediment and leaves. Water is ponded in flow path below outfall. Does not outfall to Chester Creek, likely infiltrates into ground.
499-17	Examined; Alternate	61.20251	-149.87651	North bank at Anchorage Football Stadium, approximately 200 feet downstream of pedestrian bridge over creek. Outfall crushed and half buried in sediment. Flowing.
499-1	Examined; Alternate	61.20253	-149.87583	North bank at Anchorage Football Stadium, approximately 60 feet downstream of pedestrian bridge over creek. Good condition. Flowing.
525-2	Examined; Alternate	61.20257	-149.87466	South bank at Eagle St. Good condition. Flowing.
Unnamed Outfall	Examined; Alternate	61.20260	-149.87470	North bank directly across creek from 525-2. No outfall or connected network shown in HGDB. No manhole, ditch, or other evidence of network observed. Outfall is rusted and unravelling, perched 1 foot above creek. Trickle flow.
299-22	Examined; Alternate	61.20257	-149.87428	North bank, approximately 200 feet upstream of pedestrian bridge. Poor condition. EOP submerged 5 feet into creek, but bottom of pipe is rusted out at stream bank and that is where water is flowing out to creek. Trickle flow.
299-20	Sampled	61.20257	-149.87415	North bank, approximately 20 feet upstream of 299-22. Poor condition. EOP partially submerged 5 feet into creek, but bottom of pipe is rusted out at stream bank. Sample collected where water is flowing out through hole in pipe.

Outfall Code	Activity; Category	Latitude	Longitude	Location Description and Notes
Chester Creek				
Chester Creek Mainstem				
484-1	Examined; Not Suitable	61.20158	-149.86853	North bank at New Seward Highway, north side of Chester Creek Trail. Outfall slightly dented. Not flowing.
86-1	Sampled	61.20158	-149.86848	North bank at New Seward Highway, south side of Chester Creek Trail.
25-1	Examined; Not Suitable	61.20145	-149.86553	North bank at Eastchester Park (across from Juneau Dr.). EOP is in creek and creek water is backwashing into outfall. Cannot collect isolated sample of outflow.
552-105	Examined; Not Suitable	61.20126	-149.86400	South bank, EOP is approximately 650 feet south of creek below Juneau St. Discharges into swale, flowing slowly. Water infiltrates before the end of swale and does not outfall to Chester Creek.
North Fork Chester Creek				
527-1	Examined; Not Suitable	61.20242	-149.84565	East bank at E. 20th Ave. Discharges into flow channel that is backed up and stationary all the way to creek. Outfall in good condition, flow channel is obstructed.
Chester Creek				
South Fork Chester Creek				
314-23	Examined; Alternate	61.20103	-149.84574	South bank at Maplewood St. EOP discharges into channel approximately 360 feet south of creek. Moderate condition, collar around outfall is rusted. Flow path to creek clear. Flowing.
509-12	Examined; Alternate	61.19965	-149.84118	South shore of Hillstrand Pond at E. 24th Ave. EOP is in pond, bottom of the pipe is rusted out. Flowing quickly.
347-1	Examined; Not Suitable	61.19971	-149.83862	North bank at Lake Otis Pkwy. Good condition. Not flowing.
30-1	Examined; Not Suitable	61.19967	-149.83858	South bank at Lake Otis Pkwy. Pipe is rusted out about 3 feet up from EOP. Not flowing.
418-1	Examined; Not Suitable	61.19557	-149.82927	West bank at E. Northern Lights Blvd. Good condition. EOP is in creek and creek water is backwashing into outfall. Cannot collect isolated sample of outflow.
542-1	Examined; Alternate	61.19549	-149.82925	East bank at E. Northern Lights Blvd. EOP is slightly submerged in creek. Good condition. Flowing.

Outfall Code	Activity; Category	Latitude	Longitude	Location Description and Notes
Chester Creek				
South Fork Chester Creek				
645-1	Sampled	61.19171	-149.82840	South bank, EOP is approximately 180 feet south of creek below UAA parking lot north of Seawolf Dr. Outfall flows into naturalized channel. Good condition, no obstructions in flow path.
700-10	Examined; Alternate	61.19077	-149.82540	North bank, EOP is in hill west of UAA Engineering & Computation Building approximately 130 feet east of creek. Flows into naturalized channel to creek, no obstructions. Good condition. Flowing quickly.
498-432	Examined; Not Suitable	61.18534	-149.81805	South bank at UAA trail pedestrian bridge from Dale St. and E. 40th Ave. 3-foot EOP is half submerged in creek and creek water is backwashing into outfall. Cannot collect isolated sample of outflow.
498-615	Could not locate	61.18495	-149.81767	South bank east of UAA trail from Dale St. and E. 40th Ave. Could not locate outfall or evidence of drainage in area.
4-1	Examined; Alternate	61.18495	-149.80516	South shore of University Lake at University Lake trail from Ambassador Dr. Good condition, grate approximately 65% clogged with trash. Water flowing through obstruction.
1293-1	Examined; Not Suitable	61.18675	-149.80421	North shore of University Lake near University Lake Dr. EOP in hill above lake. Outfall slightly dented, trash inside. Not flowing.
104-1	Examined; Not Suitable	61.18463	-149.79362	South bank at University Lake trail pedestrian bridge from Vance Dr. EOP is completely submerged in creek. Many small fish noted in scour pool within creek bed at the outfall.
339-1	Could not locate	61.18541	-149.79249	South bank west of Wesleyan Dr. Potential recent construction?
578-1	Could not locate	61.18545	-149.79246	North bank west of Wesleyan Dr. Potential recent construction?
683-1	Could not locate	61.18659	-149.79051	Outfalls into creek under Queen's Ct.
576-1	Examined; Not Suitable	61.18849	-149.78893	East bank, EOP is approximately 150 feet northwest of intersection of Sillary Cir. and Bisquier Dr. EOP is in creek and creek water is backwashing into outfall. Cannot collect isolated sample of outflow.
428-2	Could not locate	61.18854	-149.78888	West bank, across from 576-1. Could not locate. Large cottonwood fell landward where HGDB shows outfall location, outfall may have been crushed?

Outfall Code	Activity; Category	Latitude	Longitude	Location Description and Notes
Chester Creek				
South Fork Chester Creek				
98-2	Examined; Not Suitable	61.19174	-149.78169	East bank at E. 32nd Ave. Good condition, grate clogged with trash. Standing water in pipe level with creek, creek water is likely backwashing into outfall. Cannot collect isolated sample of outflow.
345-1	Examined; Not Suitable	61.18917	-149.78599	South bank on west side of Checkmate Dr. EOP is in creek and creek water is backwashing into outfall. Cannot collect isolated sample of outflow.
397-2	Examined; Not Suitable	61.18808	-149.77515	Outfalls into creek under Sapien Ct.
301-1	Could not locate	61.18778	-149.77445	East bank north of Image Dr. Could not locate.
236-1	Examined; Alternate	61.18292	-149.77221	South bank of Reflection Lake about 50 feet west of access point from Defiance St. EOP is perched approximately 2.5 feet, scour pool below outfall. Flowing quickly.
647-26	Examined; Not Suitable	61.18268	-149.77066	East side of Defiance St. Not an outfall. Branch of South Fork Chester Creek is piped from E. Tudor Rd. and daylights at Defiance St. HGDB shows network 674 outfalls into creek below E. 43rd Ave.
321-1	Examined; Not Suitable	61.19506	-149.76666	West bank south of E. Northern Lights Blvd. EOP is in creek and creek water is backwashing into outfall. Cannot collect isolated sample of outflow.
2-2	Sampled	61.19508	-149.76666	East bank south of E. Northern Lights Blvd. Poor condition, pipe is uncoiling and metal grate has fallen off. Bottom of pipe is rusted.
319-1	Examined; Alternate	61.19634	-149.76365	North bank west of Baxter Rd. Good condition, flow path somewhat obstructed by sediment and organic debris. Flowing slowly.
53-1	Examined; Not Suitable	61.19655	-149.76240	North bank, EOP is approximately 90 feet north of creek south of intersection of Tulane St. and Citadel Ln. Difficult to access due to many downed trees. Outfall is perched, standing water in channel below outfall but water infiltrates before reaching creek.
488-1	Examined; Primary	61.20247	-149.74862	North bank at Patterson St. Flow path on a slight upslope gradient, water flowing at time of reconnaissance visit. Selected as primary sampling location due to previously recorded illicit discharge from outfall (2013), but at time of sampling work crew was clearing vegetation and flow was obstructed. Could not sample.

Outfall Code	Activity; Category	Latitude	Longitude	Location Description and Notes
Chester Creek				
South Fork Chester Creek				
553-1	Examined; Alternate	61.20274	-149.74362	East bank south of E. 20th Ave. Outfall overgrown with grass. Strong flow over 3-inch weir in outfall.
1449-1	Examined; Not Suitable	61.20714	-149.74020	North bank south of Creekside Center Dr. Outfall flows into vegetated channel. Standing water in pipe, not flowing.
884-1	Examined; Not Suitable	61.20735	-149.73948	South bank north of Creekside Center Dr. Outfall flows into channel with large rocks, no obstructions. Some organic debris and trash in outfall. Not flowing.
Unnamed Outfall	Examined; Alternate	61.20827	-149.72646	South bank below sedimentation basin at Windsong Park. Unnamed outfall drains network 3, not connected to sedimentation basin. No outfall ID in HGDB. 3-foot metal pipe with collar and grate, good condition. Flowing.
3-1	Examined; Not Suitable	61.20833	-149.72635	South bank, outfall from sedimentation basin at Windsong Park into creek. Not considered suitable for sampling. Two outfalls into sedimentation basin. South: Poor condition. 20-foot end section of pipe is separated, water draining onto ground through cracks in pipe. East: Good condition. Flowing quickly.
3-241	Examined; Not Suitable	61.20839	-149.72383	South bank west of Turf Ct. Pipe at slight upslope gradient. Bypass in OGS, outfall will only flow during high water.
Campbell Creek				
Campbell Creek Mainstem				
685-1	Examined; Not Suitable	61.13729	-149.92497	East bank south of W. Dimond Blvd. at the inlet to Campbell Lake. Standing water in pipe. Not flowing.
585-1	Sampled	61.13768	-149.92531	West bank north of W. Dimond Blvd.
17-1	Sampled	61.13771	-149.92496	East bank north of W. Dimond Blvd.
642-1	Examined; Alternate	61.13940	-149.92389	North bank along Greenbelt southeast of Sunny Cir. Outfall discharges into flow path approximately 150 feet north of creek.
400-1	Sampled	61.13995	-149.92185	North bank at Northwood St. and W. 88th Ave. Outfall discharges into flow path approximately 200 feet north of creek.
651-1	Examined; Alternate	61.14243	-149.91548	North bank at Greenhill Way.
556-1	Examined; Not Suitable	61.14310	-149.90940	North bank west of Minnesota Dr. Outfall from sedimentation basin, not considered suitable for sampling.

Outfall Code	Activity; Category	Latitude	Longitude	Location Description and Notes
Campbell Creek				
Campbell Creek Mainstem				
556-2-1	Examined; Not Suitable	61.14355	-149.90880	North bank west of Minnesota Dr. Not in HGDB, HDR assigned temporary ID in 2013. Outfall into east side of sedimentation basin, not considered suitable for sampling.
556-3	Examined; Not Suitable	61.14446	-149.90924	North bank west of Minnesota Dr. Not in HGDB, HDR assigned temporary ID in 2013. Outfall into north side of sedimentation basin, not considered suitable for sampling.
1367-26	Examined; Alternate	61.14174	-149.90757	South bank between Minnesota Dr. northbound lane and on ramp from W. Dimond Blvd.
548-1	Examined; Not Suitable	61.14173	-149.90657	South bank east of Minnesota Dr. Drainage ditch from W. Dimond Blvd. Standing water in culvert under bike path, flow path to creek is impounded with vegetation and sediment.
500-1-1	Examined; Not Suitable	61.14318	-149.90435	North bank. EOP is at trail access from Mentra St. and flow path is approximately 550 feet to creek. Standing water, not flowing.
1435-1	Examined; Not Suitable	61.14269	-149.90157	North bank at Campbell Creek Trail. No outfall, only surface runoff from Winners Cir.
495-1	Examined; Alternate	61.14294	-149.89951	North bank at Rovenna St. Outfall discharges approximately 500 feet north of creek and water in flow path may infiltrate before reaching creek.
297-1	Examined; Alternate	61.14522	-149.89607	North bank at trail from Summerset Dr. Outfall approximately 200 feet north of creek. Flow path heavily vegetated.
581-1	Examined; Alternate	61.14640	-149.89273	North bank west of Arctic Blvd. Outfall is along Campbell Creek Trail at Arctic Blvd. underpass approximately 500 feet north of creek. Flowing.
1477-1	Examined; Not Suitable	61.14880	-149.88621	West bank east of C St. at Taku Lake. Standing water in outfall. Flow path to creek is higher elevation than outfall.
546-1	Examined; Alternate	61.15200	-149.88193	East bank at Taku Lake parking lot. Outfall is approximately 200 feet east of creek. Flow path to creek is obstructed by organic debris and flowing slowly.
100-1	Examined; Alternate	61.15903	-149.87517	East bank east of foot path from Fairweather Dr. Two outfalls draining network 100, both flowing.
305-1	Examined; Not Suitable	61.15936	-149.87588	East bank east of Fairweather Park Loop. Water seeping through gravel surrounding outfall and flowing into ditch, but no water flowing from outfall. On-going construction on Fairweather Dr. including on connected network at time of reconnaissance. Not suitable for sampling this season.

Outfall Code	Activity; Category	Latitude	Longitude	Location Description and Notes
Campbell Creek				
Campbell Creek Mainstem				
1454-2	Sampled	61.16282	-149.87693	East bank at utility easement from Fairweather Dr.
474-1	Examined; Not Suitable	61.16365	-149.87797	East bank at Campbell Creek Greenbelt at Lynwood Dr. Not flowing.
468-1	Examined; Alternate	61.16606	-149.87359	East bank south of E. Dowling Rd. Trickle flow.
105-1	Sampled	61.17252	-149.86748	South bank east of Old Seward Hwy. across from the Peanut Farm.
Little Campbell Creek Mainstem				
300-1	Examined; Alternate	61.15322	-149.87347	North bank at Nathan Dr. Low flow, water in outfall slightly backed up.
190-1	Examined; Alternate	61.15324	-149.87325	South bank at Nathan Dr. Flowing.
South Fork Little Campbell Creek				
847-1	Examined; Alternate	61.14460	-149.84698	East bank south of E. Dimond Blvd. Outfall drains parking lot of Alaska USA Federal Credit Union. Flowing.
243-24	Examined; Not Suitable	61.14457	-149.83116	North bank at E. 84th Ave. and Pokey Cir. Not flowing.
1019-2	Examined; Not Suitable	61.14166	-149.82145	East bank behind houses on Little Brook Cir. Flow path from outfall to creek is approximately 300 feet, and obstructed by organic debris and trash. Not flowing.
Unnamed Outfall	Examined; Alternate	61.14121	-149.82088	East bank at E. 88th Ave. Unnamed outfall discharges approximately 100 feet east of creek on north side of road. No outfall or network connection shown in HGDB. New construction. Likely drains network 383.
383-1	Could not locate	61.14120	-149.82142	East bank at E. 88th Ave. Could not locate outfall where shown in HGDB. Unnamed outfall?
320-5	Could not locate	61.13998	-149.82146	West bank behind houses on Little Creek Dr. Bank may have eroded and crushed outfall.
Campbell Creek				
North Fork Little Campbell Creek				
62-1	Examined; Alternate	61.15905	-149.85387	South bank south of E. 68th Ave. Flow path to creek slightly obstructed by sediment and organic debris. Flowing.

Outfall Code	Activity; Category	Latitude	Longitude	Location Description and Notes
Campbell Creek				
North Fork Little Campbell Creek				
692-15	Examined; Not Suitable	61.15930	-149.85373	North bank north of E. 66th Ave. Outfall from sedimentation basin at Meadow Park, not considered suitable for sampling. Three outfalls from network 692 into sedimentation basin. Northwest: drains from Brayton Dr. and New Seward Hwy. Two EOPs, one flowing, one not flowing. North: drains Meadow St., EOP on west side of Meadow St. Very overgrown with grass and clogged with sediment. Flowing. Northeast: drains E. 64th Ave. and Askeland Dr. Good condition, flowing.
692-24	Examined; Alternate	61.15931	-149.85329	South bank north of E. 68th Ave. Flowing slowly.
447-64	Examined; Alternate	61.16145	-149.83636	South bank at E. 66th Ave. and O'Brien St. 3 feet of pipe has separated and fallen into creek. Flowing.
317-1	Could not locate	61.16114	-149.83468	South bank at Lake Otis Pkwy. Could not locate, likely flows into creek under Lake Otis.
586-1	Examined; Not Suitable	61.15949	-149.83258	South bank at E. 68th Ave. Outfall is completely obstructed by sediment, likely clogged within network as water appears to flow overland from road surface above outfall. Flow path between outfall and creek is approximately 700 feet. No water in flow path.
155-3	Examined; Not Suitable	61.16106	-149.83049	South bank behind houses along Teshlar Dr. Not flowing.
612-1	Examined; Not Suitable	61.16106	-149.82861	South bank behind houses along Teshlar Dr. Not flowing.
427-2	Examined; Not Suitable	61.16106	-149.82723	South bank behind houses along Teshlar Dr. Not flowing.
1056-8	Examined; Not Suitable	61.16107	-149.82550	North bank, outfall from sedimentation basin at Carriage Dr. Not considered suitable for sampling. Two outfalls into sedimentation basin. North: drains Carriage Dr. Partially submerged, backwashing with water from sedimentation basin. Southeast: drains Baby Bear Dr. and Spruce St. Grate clogged with organic debris and trash. Backwashing with water from sedimentation basin.
1056-117	Examined; Alternate	61.16104	-149.82492	North bank at foot path south of sedimentation basin at Carriage Dr. Grate partially clogged with organic debris and trash. Flowing.

Outfall Code	Activity; Category	Latitude	Longitude	Location Description and Notes
Campbell Creek				
North Fork Little Campbell Creek				
736-1	Examined; Not Suitable	61.16038	-149.82401	South bank at Pebblebrook Cir. No EOP, only surface drainage from cul-de-sac.
408-1	Examined; Alternate	61.15877	-149.82142	South bank at Spalding Cir. Good condition. Flowing.
290-46	Examined; Not Suitable	61.15876	-149.81570	South bank at Cloudberry Cir. Standing water in pipe. Flow path obstructed by organic debris, not outfalling to creek.
1461-1	Examined; Not Suitable	61.15906	-149.81375	North bank at Bugle Ct. Good condition. Not flowing.
446-1	Examined; Alternate	61.15737	-149.80448	South bank west of Elmore Rd. Good condition, somewhat overgrown with grass. Flowing.
Campbell Creek				
Campbell Creek South Branch of Mainstem				
118-33	Examined; Not Suitable	61.12730	-149.84180	West bank at Independence Dr. at Nantucket Loop foot path. Outfalls into creek under road.
120-1	Could not locate	61.12708	-149.84137	East bank at Independence Dr. north of Valley Park Dr. HGDB shows EOP along Nantucket Loop foot path approximately 500 feet east of creek. Could not locate outfall, no flow path to creek.
120-1-1	Examined; Not Suitable	61.12681	-149.84086	East bank south of Valley Park Dr. Not in HGDB, HDR assigned temporary ID in 2013. Network not shown in HGDB, new construction. Organic debris in flow path. Not flowing.
120-13	Examined; Not Suitable	61.12623	-149.84083	East bank north of Ridge Park Dr. Outfall impounded by sediment and partially buried. Not flowing to creek.
120-29	Examined; Not Suitable	61.12542	-149.84113	East bank north of Ridgemont Dr. Not in HGDB, HDR assigned temporary ID in 2013. Network not shown in HGDB, new construction. Creek is not flowing in culvert under Ridgemont Dr., likely getting backed up and dispersing in woods south of Ridgemont Dr. Outfall not flowing.
120-22	Examined; Not Suitable	61.12480	-149.83754	North bank south of Ridgemont Dr. Standing water in pipe.
344-18	Examined; Not Suitable	61.12546	-149.83456	North bank east of Lake Otis Pkwy. Flowing swiftly, but HGDB shows short network. Majority of flow likely water from wetland/ephemeral reach on east side of Lake Otis Pkwy.

Note: EOP = end of pipe

2.3 Measured Parameters

The 2016 dry weather screening sampling effort was conducted similar to previous years' efforts. A sample was collected for laboratory analysis of fecal coliform while all the other parameters were analyzed in the field using test kits or water quality meters.

Table 3 provides the screening parameters required by the permit and the thresholds that were used to compare outfall sample results. Appendix E, Dry Weather Screening 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 storm water 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 storm water 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 outside the pH range) for one or more of the pollutant indicators are targeted for follow-up action.

Table 3. Parameters measured, sampling methods and screening thresholds.

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 col/100 mL – too numerous to count	≥ 400 col/100 mL

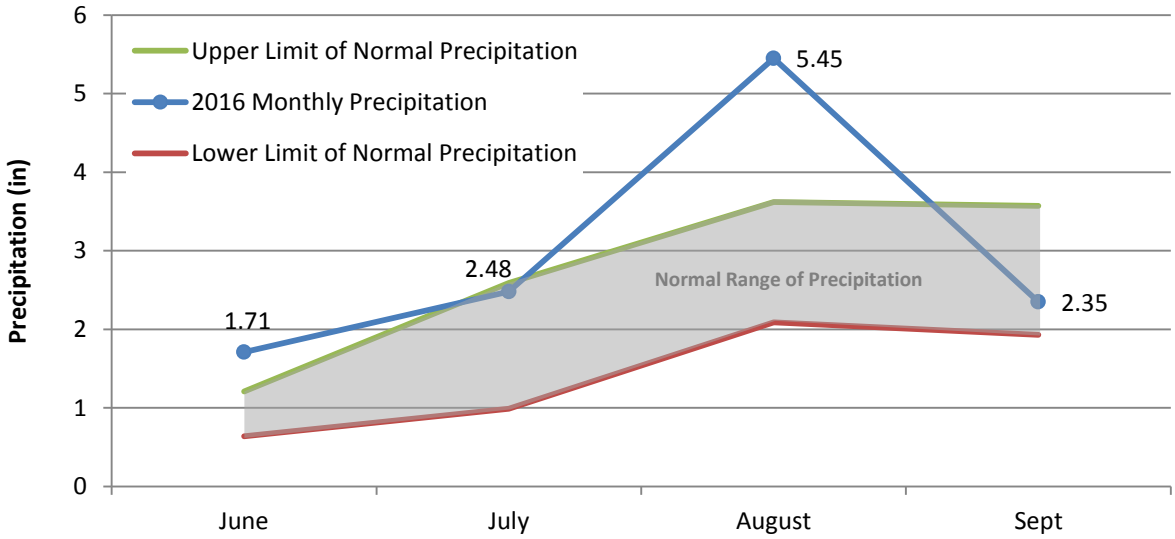
2.4 Sampling Procedures

2.4.1 Field Preparation, General Information, and Visual Observations

Field sampling was conducted after at least 48 hours of dry weather following a storm event that created runoff in the MS4. The National Weather Service Forecast website (NWS 2016) was consulted to determine appropriate sample timing when necessary. The MS4 permit stipulates that dry weather screening should be conducted between June 1 and August 30 of each year. Conditions in the Anchorage area in summer 2016 were wetter than normal. The total precipitation that fell in June and August 2016 was higher than the range of normal precipitation,

and the total precipitation for July 2016 was within 0.1 inch of the upper limit of normal precipitation for July (2.59 inches; Figure 1).

Figure 1. Monthly Precipitation in Anchorage, Summer 2016.



Notes: Precipitation data recorded at Ted Stevens International Airport.
Upper limit of normal precipitation = 75th percentile of monthly precipitation totals; lower limit of normal precipitation = 25th percentile of monthly precipitation totals.
Source: NWS 2016, NOAA 2016.

Because field sampling is contingent on a period of dry weather following a storm event, two of the 2016 sampling events were conducted after to August 30. Figure 2 shows the daily precipitation and 48 hour running total precipitation for the months of August and September 2016. The three dates when field sampling occurred are indicated by the arrows.

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 the laboratory. 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 probe
- LaMotte and Hach water quality field test kits
- Laboratory-supplied fecal coliform bottles
- Hach turbidimeter
- pH test strips

Upon arriving at the site, the team completed the General Information and Visual Observations sections of the field form in accordance with the guidelines on the back of the form (Appendix C). Photographs of the outfall were taken with the iPad (Appendix E). Additional information not included on data forms was recorded in the field log book (Appendix B).

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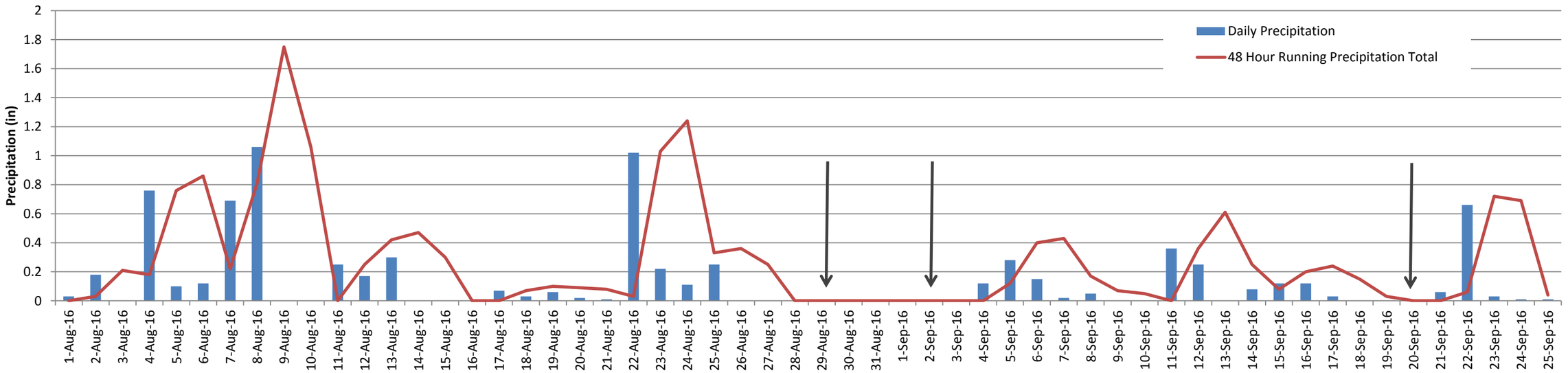
Figure 2. Daily Precipitation in Anchorage, August and September 2016.



Notes: Precipitation data recorded at Ted Stevens International Airport. Source: NWS 2016.
Black arrows indicate sampling dates.

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2.4.2 Flow Analyses

The field team determined the outfall flow using one of the methods described below (dependent on site conditions).

Primary method. Measure the length of time required to fill 1 gallon of a calibrated bucket or a 1-liter bottle using a stop watch. Calculate the flow in gallons per minute.

Secondary method (if the team was unable to measure the flow using the primary method). Visually estimate the flow as one of the following:

- Low - flow of water is not intense and moving very slowly
- Medium - flow of water is moving at a moderate pace
- High - flow of water is intense and moving very quickly

2.4.3 Water Quality Sampling

After measuring flow, the field team measured pH using a YSI 556 probe and verified the results with pH test strips. The probe was placed directly into flowing water where deep enough to submerge the probe. When the flow in the pipe was not deep enough to submerge the probe, a bucket was used to capture outfall water. The outfall water was permitted to continue to flow into and out of the bucket while the pH probe was submerged. The test strips were dipped directly into the flowing water.

A grab sample of the water flowing out of the end of pipe was then collected using a clean 1-liter HDPE plastic bottle. This water was used for all of the field test kits. Next, the sample bottle for laboratory analysis of fecal coliform was filled directly from the outfall flow.

After the water samples were collected, the field team recorded visual observations and measurements about the clarity of the water and its color.

Using the water from the 1-liter bottle, the field team measured total chlorine, detergents, turbidity, total phenols, and total copper with field kits in accordance with the field kit instructions (included in Appendix F of the QAP; MOA 2016a). 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).

2.5 Chain of Custody Records

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

2.6 Laboratory Sampling Procedures

Fecal coliform samples were collected in laboratory-supplied sample bottles. The project name, sample ID, sample date and time, and name of sampler 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.

An expedited turn-around time was requested for the results of the laboratory analysis in order to expedite follow-up sampling in the event of an exceedance of the fecal coliform threshold. Follow-up tasks were planned to take place after the laboratory results were available to reduce the field effort. To expedite the receipt of results, SGS provided the results through Engage, an on-line document portal.

2.7 Deviations from the QAP

Turbidity was not measured at three locations due to an equipment failure at the time of sampling.

The QAP (MOA 2016a) specifies that for fecal coliform results that exceed the thresholds, the laboratory Project Manager will notify the Contract QA Officer immediately after the analysis is complete (within approximately 24 hours). Laboratory results for the August 29th sampling date were provided to HDR on September 7 for the 6 outfalls on Campbell Creek. Five of these outfalls indicated fecal coliform colonies well below the 400 colonies per 100 ml threshold; the sixth outfall, 105-1, indicated 410 colonies per 100 ml, an exceedance of 10 colonies. This exceedance was not noticed by HDR project staff and therefore no follow up, as required by the QAP, occurred.

To prevent this situation in subsequent sampling, HDR will coordinate directly with the laboratory to highlight results which indicate an exceedance. Additionally, HDR will provide an interim report to the MOA after each sampling event that will include laboratory results and other findings.

3.0 Results

3.1 Field and Laboratory Results

The results of 2016 dry weather screening are provided in Table 4. Complete laboratory analysis reports are provided in Appendix D. A single outfall (Campbell Creek 105-1) exceeded the threshold for fecal coliform. No parameter at any other outfall exceeded the assigned threshold.

Table 4. Sample Results for Field Parameters and Laboratory Analyses

Watershed	Outfall ID	Date	Flow (gal/min)	pH	Total Chlorine (mg/L)	Detergents (mg/L)	Total Phenols (mg/L)	Turbidity (NTU)	Total Copper (mg/L)	Fecal Coliform (colonies/ 100mL)
Ship Creek	436-1	9/2/2016	Low	7.5 D = 7.5	<0.5 D <0.5	<0.05 D <0.05	<0.1 D <0.1	-	<0.05 D <0.05	2.0 D = ND
Ship Creek	1363-1	9/2/2016	2 Medium	7.0	<0.5	<0.05	<0.1	-	<0.05	2.0
Ship Creek	550-2	9/2/2016	2 Medium	7.5	<0.5	<0.05	<0.1	-	<0.05	3.0
Ship Creek	491-1	9/20/2016	Low	7.0	<0.5	<0.05	<0.2	1.48	<0.05	1.0
Ship Creek	96-2	9/20/2016	High	8.0	<0.5	<0.05	<0.2	1.17	<0.05	1.0
Chester Creek	296-1	9/20/2016	Medium	7.0	<0.5	<0.05	<0.1	12.1	<0.05	*268*
Chester Creek	299-20	9/20/2016	Medium	7.0 D = 7.0	<0.5 D <0.5	<0.05 D <0.05	<0.1 D <0.1	3.16 D = 3.30	<0.05 D <0.05	ND D = ND
Chester Creek	86-1	9/20/2016	Medium	7.0	<0.5	<0.05	<0.1	50.0	<0.05	1.0
Chester Creek	645-1	9/20/2016	Medium	7.0	<0.5	<0.05	<0.1	1.24	<0.05	9.0
Chester Creek	2-2	9/20/2016	Medium	7.0	<0.5	<0.05	<0.1	5.52	<0.05	2.0
Campbell Creek	585-1	8/29/2016	-	-	<0.5 D <0.5	<0.05 D <0.05	<0.1 D <0.1	-	<0.05 D <0.05	24 D = 13
Campbell Creek	17-1	8/29/2016	-	-	<0.5	<0.05	<0.1	-	<0.05	34
Campbell Creek	400-1	8/29/2016	-	-	<0.5	<0.05	<0.1	-	<0.05	7.0
Campbell Creek	1454-2	8/29/2016	-	-	<0.5	<0.05	<0.1	-	<0.05	ND
Campbell Creek	105-1	8/29/2016	-	-	<0.5	<0.05	<0.1	-	<0.05	**410**

Notes: D = duplicate sample; ND = not detectable
Bold results are exceedances. *Italicized* results are notably higher than other sites, but are not exceedances.

Three outfalls to Ship Creek were sampled on September 2, 2016. Turbidity was not recorded at these sites due to an equipment failure. The field team noted that the water sampled from these outfalls was clear, not cloudy or muddy, and likely well below the threshold for turbidity (250 NTU).

Five outfalls to Campbell Creek were sampled on August 29, 2016. The field forms for these sites were lost after the sampling event. The field team noted that all of the parameters tested using the field kits were below the reporting ranges, and turbidity did not exceed the threshold at any of the sites. Notes on these outfalls are included below:

585-1. The outfall is in good condition. A moderate amount of trash and organic debris was stuck in the grate, but was not obstructing flow. Flow from the outfall was moderate. No sheen or scum was observed on the water flowing from the outfall, and the water was clear without cloudiness or color.

17-1. The outfall is in good condition. A significant amount of trash, mostly plastic bags, was clogging the grate, but was not obstructing flow. The short flow path from the end-of-pipe to the creek is overgrown with emergent vegetation (grasses) but is not impounding the outfall. Flow from the outfall was moderate. No sheen or scum was observed on the water flowing from the outfall, and the water was clear with some cloudiness potentially from sediment trapped within the trash in the grate.

400-1. The outfall is in good condition. A minimal amount of trash was stuck in the grate, but was not obstructing flow. Flow from the outfall was moderate. There was approximately 1 inch of water within the pipe, which dispersed within the wider flow path below the outfall. The rocks within the flow path below the outfall had some red staining. No sheen or scum was observed on the water flowing from the outfall, and the water was clear with some minimal cloudiness. Two species of non-native plants, dandelion (Taraxacum officinale) and oxeye daisy (Leucanthemum vulgare) were noted to be growing on a straw wattle placed across the flow path below the outfall.

1454-2. The outfall is in good condition. No trash or organic debris was stuck in the grate. There is some emergent vegetation growing within the short flow path from the end-of-pipe to the creek, but flow is not obstructed. Algae is growing within the wetted portion of the flow path, suggesting this outfall flows regularly. Flow from the outfall was moderate to high. There was approximately 1 inch of water within the pipe. No sheen or scum was observed on the water flowing from the outfall, and water was clear without cloudiness or color.

105-1. The outfall is in good condition. A moderate amount of trash and organic debris was stuck in the grate, and water was flowing out through the obstruction. Flow from the outfall was moderate. No sheen or scum was observed on the water flowing from the outfall, and the water was clear with no cloudiness or color.

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), standard methods (APHA 2005), and EPA-approved protocols and guidelines.

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 storm drain outfall to avoid mixing with the stream water. Field analyses met the sensitivities prescribed in the QAP (MOA 2016a).

Field replicate samples were taken at Ship Creek 436-1, Chester Creek 299-20, and Campbell Creek 585-1 to determine field precision and variability. Results of the field duplicate samples are presented in Table 5. For the field test kits, the QAP requires that percent difference between primary and duplicate 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 (RPD) be calculated between the primary and duplicate samples and be within 60%.

Table 5. Field Replicate Variance From Primary Sample

Parameter	QAP standard	Ship Creek 436-1	Chester Creek 299-20	Campbell Creek 585-1
pH	± 0.2 pH units	0 pH units	0 pH units	-
Total Chlorine	30%	0%	0%	0%
Detergents	30%	0%	0%	0%
Total Phenols	30%	0%	0%	0%
Turbidity	± 1 NTU	-	0.14 NTU	-
Total Copper	30%	0%	0%	0%
Fecal Coliform	60%	**200%**	-	59.5%

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

Most of the results fall within the QAP standards. One QC sampling location, Ship Creek 436-1, exceeded the variance threshold for fecal coliform. Fecal coliform is widely variable and large variations are expected. However, the absolute difference between the primary and duplicate sample at this site is only 2 colonies per 100 milliliters (col/100mL). Because the fecal coliform load for the primary sample at this site was not detectable, the result of 2 col/100mL in the duplicate sample resulted in a large variance. This result was not flagged and no follow-up action was required.

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

The results of the 2016 dry weather screening sampling effort adds to the data set of previous years' sampling efforts (MOA 2008, 2009, 2011, 2012b, 2013, 2014, 2016d). Of the eight parameters tested at each of the 15 outfalls sampled, only fecal coliform had an exceedance at a single outfall.

The result of the fecal coliform analysis from outfall 105-1 was 410 col/100mL, which exceeds the program threshold for fecal coliform (400 col/100mL) by 10 col/mL. Outfall 105-1 is located across from the Peanut Farm on the south bank of Campbell Creek east of the Old Seward Highway. The outfall is connected to network 105, which runs along East 54th Avenue between the Old Seward Highway and Juneau St., East 56th Avenue between the Old Seward Highway and the Seward Highway, and the Old Seward Highway from East 54th Avenue to one lot south of East 58th Court (north of Alaska Rubber & Rigging Supply).

Network 105 drains MS4 subbasin 1221. This subasin, comprising 86.5 acres, extends south of the creek to East Dowling Road between the Old Seward Highway and the Seward Highway. Land use in the subbasin is primarily industrial with some commercial use. The MOA Solid Waste Services Central Transfer Station is within this basin on East 56th Avenue. There are also four large vacant lots within the subbasin.

4.2 Observations from Reconnaissance Trips

During reconnaissance trips prior to sampling, 112 outfalls to Ship, Chester, and Campbell creeks were investigated. Of these, 55 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 they were outfalls from sedimentation basins, that they were damaged or submerged, and that access was limited due to unsafe conditions or private property. Many outfalls along Chester Creek were partially submerged and water from the creek was backwashing into the pipe such that any outfall from the storm system could not be isolated for sampling. An additional 17 outfalls that are shown on the HGDB could not be located. Outfalls that were observed to be clogged, damaged, or submerged and may require maintenance are listed in Table 6.

Table 6. Damaged, Clogged and Submerged Outfalls

Watershed	Outfall Number	Type of Issue	Notes
Ship Creek	119-1	Damaged	Perched and corroded.
Ship Creek	46-1	Unknown – Submerged?	Could not locate outfall. Likely completely submerged within creek.
Ship Creek	151-3	Damaged	Crushed.
Ship Creek	189-1	Submerged	Completely submerged, buried in sediment within creek.

Watershed	Outfall Number	Type of Issue	Notes
Chester Creek	676-1	Submerged	Two EOPs associated with outfall ID. Bottom outfall is completely submerged within creek.
Chester Creek	302-2	Clogged	Outfall is completely obstructed by sediment and organic debris.
Chester Creek	Unnamed outfall	Damaged	Unnamed outfall at 61.20260°N, -149.87470°W. Rusted and unravelling.
Chester Creek	299-22	Damaged	Very corroded.
Chester Creek	299-20	Damaged	Very corroded.
Chester Creek	25-1	Submerged	Partially submerged, cannot sample.
Chester Creek	418-1	Submerged	Partially submerged, cannot sample.
Chester Creek	498-432	Submerged	Partially submerged, cannot sample.
Chester Creek	4-1	Clogged	Grate clogged with considerable amount of trash.
Chester Creek	104-1	Submerged	Completely submerged.
Chester Creek	576-1	Submerged	Partially submerged, cannot sample.
Chester Creek	428-2	Unknown-Damaged?	Could not locate outfall. May have been crushed by falling tree?
Chester Creek	98-2	Submerged	Partially submerged, cannot sample.
Chester Creek	345-1	Submerged	Partially submerged, cannot sample.
Chester Creek	321-1	Submerged	Partially submerged, cannot sample.
Chester Creek	2-2	Damaged	Poor condition. Pipe is uncoiling and corroded, metal grate has fallen off.
Campbell Creek	320-5	Unknown – Damaged?	Could not locate outfall. May have been buried in eroding bank?
Campbell Creek	586-1	Clogged	Outfall is completely clogged with sediment.
Campbell Creek	120-13	Clogged	Outfall impounded by sediment and partially buried.

Field teams also noted areas where recent construction may have resulted in changes to the storm system that are not reflected on the HGDB. The HGDB may need to be updated in these locations to ensure that dry weather screening, as well as any other MS4 permit compliance activities, can be conducted in the future. These areas include:

4.2.1 Ship Creek

- The King's Landing project is located adjacent to Ship Creek near the mouth by the railroad depot. This project, among other improvements, included a rain garden which treats the nearby surface parking lots. No water quality testing has been conducted to collect data as to its effectiveness. The HGDB may need to be updated to reflect any associated rerouting and/or changes to the MS4 network.

4.2.2 Chester Creek

- North of Westchester Lagoon at U Street. U Street was under construction during the reconnaissance visit and the field team could not locate outfall 549-1. This outfall was noted as requiring maintenance in the 2015 dry weather screening report (MOA

2016d). The HGDB may need to be updated to reflect any associated rerouting and/or changes to the MS4 network.

- Chester Creek Trail across from Eagle Street. An unnamed outfall was noted discharging to the creek. No outfall or network is shown on the HGDB. If this outfall is connected to the MS4, the HGDB needs to be updated to include the outfall and its connected network.
- Wesleyan Drive. The field team could not locate outfalls 578-1 and 339-1. Wesleyan Drive was under construction during the reconnaissance visit. The HGDB may need to be updated to reflect any associated rerouting and/or changes to the MS4 network.
- Debarr Road and Muldoon Road. Extensive realignment of Chester Creek is not reflected on the HGDB. The HGDB needs to be updated to reflect any associated rerouting of the MS4 network and/or new outfalls.

4.2.3 Campbell Creek

- Fairweather Drive. The network connected to outfall 305-1 was under construction during the reconnaissance visit. The HGDB may need to be updated to reflect any associated rerouting and/or changes to the MS4 network.
- Valley Park Drive, Ridge Park Drive, and Ridgemont Drive. This subdivision was constructed over the past several years. The HGDB needs to be updated to reflect new routing and nodes. HDR temporarily assigned outfall IDs to several unnamed outfalls in this area in 2013 (MOA 2013); these outfalls have yet to be mapped in the HGDB.
- East 88th Avenue between Rosalind Loop and Little Brook Street. The field team was unable to locate outfall 383-1. There is an outfall on the north side of East 88th Avenue is not shown on the HGDB. The field team could not ascertain to which network it is connected. The HGDB needs to be updated to reflect the accurate connections to the MS4 and outfall locations.

Outfalls in the Ship Creek, Chester Creek, and Campbell Creek watersheds will likely be sampled again during the current permit cycle. By ensuring that the HGDB contains up to date and accurate information on the MS4, the MOA will facilitate prompt response to reports of illicit discharges and thorough dry weather screening in the future.

4.3 Future Dry Weather Screening Sampling

Outfalls in the Fish Creek, Furrow Creek, and Rabbit Creek watersheds will be sampled in 2017. Outfalls in these watersheds were last sampled in 2014 (Fish Creek), 2013 (Rabbit Creek), and 2012 (Furrow Creek). Field notes from reconnaissance and sampling activities in these watersheds as well as reports from these years (MOA 2012b, 2013, 2014) will be reviewed prior to field activities in 2017 to guide selection of outfalls for sampling.

Additional data management protocols will be implemented during future sampling efforts. These protocols will be developed prior to commencement of 2017 dry weather screening sampling to ensure that field forms, field notebooks, and site photographs are properly backed up and stored.

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Appendix A

Watershed Maps

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Appendix B

Field Notes

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Appendix C

Field Data Forms

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Appendix D

Laboratory Analysis Reports

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Appendix E

Outfall Sampling Photographs

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