2015 ANNUAL MEETING SUMMARY APDES Permit No. AKS-052558 February 25, 2015

Municipality of Anchorage	Alaska Department of Transportation and Public Facilities

Watershed Management Services
Project Management and Engineering Division
Municipality of Anchorage

Meeting Agenda

2015 Watershed Update

Tuesday, February 24, 2015
At the BP Energy Center
900 E. Benson Blvd.

The Municipality of Anchorage and Alaska Department of Transportation and Public Facilities
Welcome you to the APDES Watershed Update highlighting
Anchorage Storm Water Permit Compliance Activities

BIRCH Room

9:30 APDES Program Update
Presentation and Poster Session

10:30 Anchorage DCM - Stormwater Design Criteria and Implementation
Receive One (1) PDH on request
Followed by DCM Q&A
and LID Projects in Anchorage

12:00 Concluding Remarks

ASPEN Room

10:00 Green Infrastructure Working Group –
Stop by during the poster session and learn about what the group has been working on.

10:30 Chester Creek Watershed Plan and
Community Outreach Discussion

Posters

- Snow Disposal Site Assessment
- Monitoring
  - Wet Weather Monitoring
  - Dry Weather Monitoring
  - Pesticides Assessment
- Sweeping and OGS Performance Study
- Low Impact Development Projects
- Rain Gardens
- Watershed Public Education
- Chester Creek Plan

We're pleased to have you join us for all or a portion of the 2015 Watershed Update
Refreshments provided

You can find additional information on the stormwater permit at anchoragestormwater.com

Program Slides

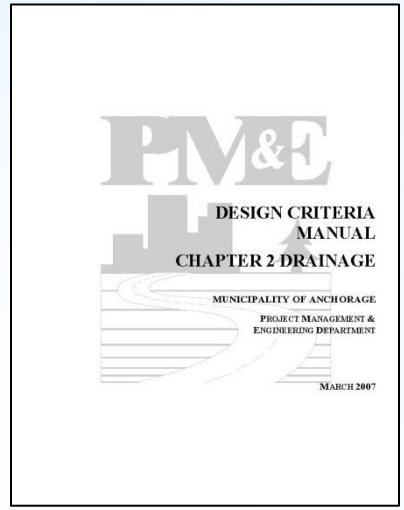
Drainage Design Criteria

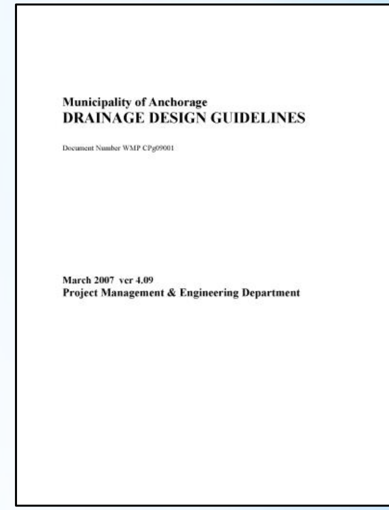
Discussion of changes to current stormwater and drainage-related criteria, and presentation of the Draft Anchorage Stormwater Manual

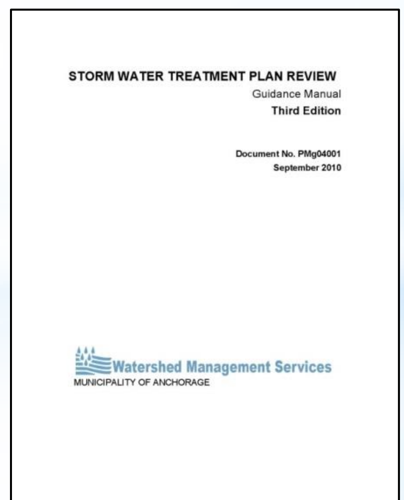
Existing Drainage Criteria

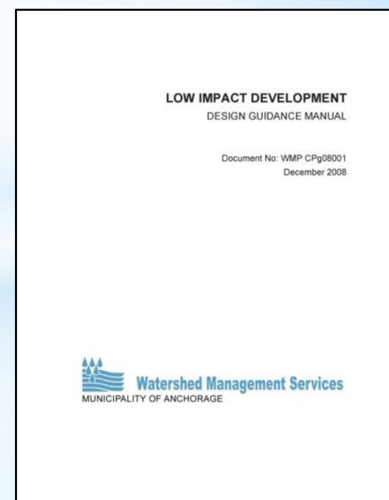
Existing criteria is presented in four manual:

1. Design Criteria Manual (DCM) Chapter 2 Drainage
2. Drainage Design Guidelines
3. Stormwater Treatment Plan Review Guidance Manual
4. Low Impact Development Design Guidance Manual


PM&E
DESIGN CRITERIA MANUAL
CHAPTER 2 DRAINAGE
MUNICIPALITY OF ANCHORAGE
PROJECT MANAGEMENT & ENGINEERING DEPARTMENT
MARCH 2007


Municipality of Anchorage
DRAINAGE DESIGN GUIDELINES
Document Number WMP CPg09001
March 2007 ver 4.09
Project Management & Engineering Department


STORM WATER TREATMENT PLAN REVIEW
Guidance Manual
Third Edition
Document No. PMg04001
September 2010
Watershed Management Services
MUNICIPALITY OF ANCHORAGE


LOW IMPACT DEVELOPMENT
DESIGN GUIDANCE MANUAL
Document No: WMP CPg08001
December 2008
Watershed Management Services
MUNICIPALITY OF ANCHORAGE

Update Process

Why is the MOA updating the criteria?

- Four manuals was confusing and difficult to use.
- National and State stormwater management requirements have changed.
  - Changes are required per our APDES permit
- The design community, PM&E, Street Maintenance, etc. requested modifications.

Primary Goals of the Criteria Update

- Consolidate the existing four manuals
- Incorporate new stormwater regulations
- Provide easy-to-use guidance for designers and stormwater professionals
- Incorporate requested changes from the community.

Update Process

Timeline of Update Process

2010

- MOA APDES permit called for manual updates.
- First attempt at updating included only adding new requirements.

2011

- Adding new criteria across 4 existing manuals created confusion.
- MOA realized a complete restructure was needed.

2012

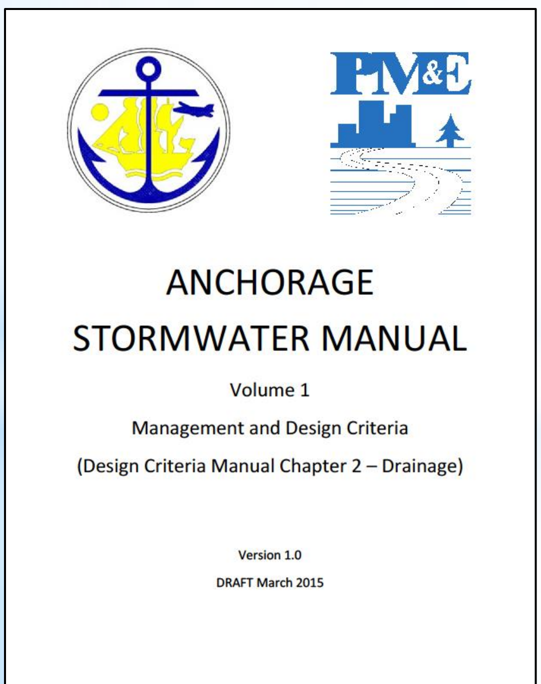
- Reorganization of the existing and new criteria was proposed.
- MOA provided input and suggestions for improvement.

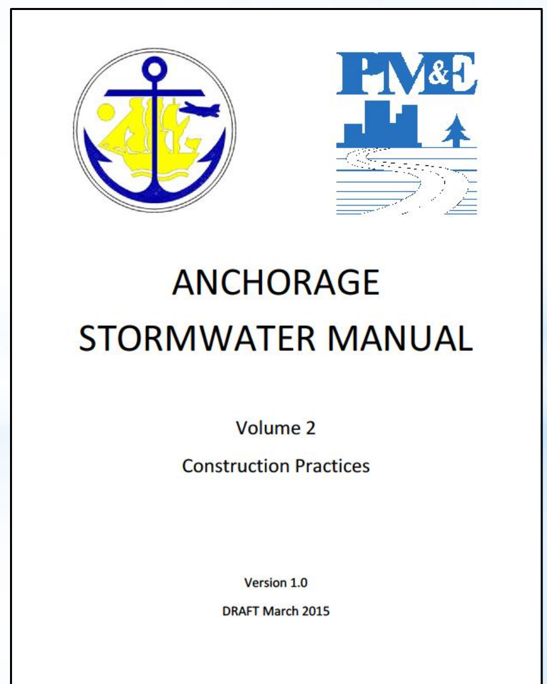
2013-2014

- Committee of local design professionals met bi-weekly from March of 2013 to May of 2014 to review and provide input on criteria updates.
- Started with four existing manuals, and worked toward a new consolidated format.

New Draft Criteria

- The four existing manuals are consolidated into two volumes. Draft Anchorage Stormwater Manual (ASM) Volumes 1 & 2
  - Volume 1 presents management and design criteria.
  - Volume 2 presents construction practices.


ANCHORAGE
STORMWATER MANUAL
Volume 1
Management and Design Criteria
(Design Criteria Manual Chapter 2 – Drainage)
Version 1.0
DRAFT March 2015


ANCHORAGE
STORMWATER MANUAL
Volume 2
Construction Practices
Version 1.0
DRAFT March 2015

New Draft Criteria - Notable Changes

Notable Changes from Current Criteria

Project classifications

- Exempt Projects – specialized types of projects that are exempt from most permanent stormwater management requirements.
- Small Projects – projects that disturb less than 10,000 sf of land
- Large Projects – projects that disturb more than 10,000 sf of land

New Draft Criteria – Notable Changes

Stormwater Treatment

- Treatment through the use of green infrastructure (GI) is required for large projects, unless GI is determined to be infeasible.
- Treatment of runoff generated from the first 0.52 inches of rainfall
- Criteria for a suite of GI “tools” is provided along with adaptations for site constraints (e.g. high water table, poorly infiltrating soils, lack of space, etc.)
    - Bioretention
    - Filtration
    - Infiltration, etc.

Structural Stormwater Controls	RUNOFF		SUITABLE TO MEET SW MANAGEMENT REQUIREMENT		IMPLEMENTATION CONSIDERATIONS		
	Rate Control	Volume Reduction	Green Infrastructure Treatment	Detention and Peak Flow Control	Accepts Hotspot Runoff	Separation from Groundwater[5] (feet)	Separation from Drinking Water Mains (feet)
Bioretention Facilities	Moderate	Moderate	✓	✓	Yes[3]	2[6]	0
Soakaway Pits	Moderate	High	✓	✓	No[7]	2	10
Infiltration Basins	Moderate	High	✓	✓	No[7]	2	10
Infiltration Trenches	Moderate	High	✓	✓	No[7]	2	10
Vegetative Swales	Moderate	Moderate	✓	✓	No[7]	2	0
Pervious Pavement	Moderate	High	✓	✓	No	2	10
Chamber Systems	High	High	✓	✓	No[7]	2	10
Wet Ponds	High	Low	✓	✓	No[7]	N/A	10
Dry Ponds	High	Low[1]	*[3]	✓	No[7]	N/A	10
Oversized Pipes	High	Low		✓	Yes[4]	N/A	10
Filter Strips	Low - Moderate[2]	Low – Moderate[2]	✓	✓	No[7]	2	0
Constructed Wetlands	Moderate - High	Moderate	✓	✓	Varies[3]	N/A	10
Natural Vegetation Retention/ Tree Canopy	Low-Moderate	Low-Moderate	✓		No[7]	N/A	N/A
Landscaped Depressions	Moderate	Moderate	✓	✓	No[7]	2	N/A
Sedimentation Basins	High	Low	✓	✓	No[7]	2	10
Oil and Grit Separators	Low	Low			Yes	N/A	10

(1) May provide some volume reduction depending on permeability of native soil.
(2) Increased performance when level spreaders are incorporated into the design.
(3) Yes, under specific conditions. See design criteria section for further detail.
(4) Hotspot runoff still requires treatment.
(5) Minimum separation distance between the seasonal high groundwater table elevation and the bottom of structural stormwater controls.
(6) Modifications are available for locations with high groundwater. See specific design criteria section for further detail.
(7) May be allowable with appropriate pre-treatment.

New Draft Criteria – Notable Changes

Stormwater Treatment

- In some cases, GI may not be feasible. Forms provided to help designers and the MOA make this determination.
- Separate forms for Site Design vs. Roadways
  - Form guides the designer through site conditions and other constraints that might preclude the use of GI.
  - Can also be used to request approval of GI through "Alternative Compliance." This would apply if a conflicting MOA regulations were precluding the use of GI.
- Infeasibility is usually the result of multiple constraining elements. (E.g. surface space AND high groundwater.)
- If GI is infeasible, traditional treatment and extended detention are required.

New Draft Criteria – Notable Changes

Site Development
Low Impact Development/Green Infrastructure vs. Traditional Treatment Determination
or
Request for Alternative Compliance

1. Project Name____
2. Project Location____
3. Project Owner:____
4. Project Contact Name_______________Phone_______________Email_______________
5. Project Description/Purpose ___________________________________

____

6. Request Type

   ☐ Approval of Traditional Stormwater Treatment
   ☐ Alternative Compliance Request

7. This project is

   ☐ New Development ☐ Re-development

8. Describe the following site parameters. Attach soils logs, field testing results, and laboratory testing results, as applicable.

   a. General Native Soil Condition
      ☐ Gravels
      ☐ Sandy gravels
      ☐ Gravely sands
      ☐ Sands
      ☐ Silty sand
      ☐ Sandy silt
      ☐ Silt
      ☐ Clay/Silt
      ☐ Other (please describe)___________________________

   b. Saturated Soil Percolation Rate (if field percolation testing was performed)
      ☐ <0.5 inches/hour
      ☐ 0.5 to 1 inches/hour
      ☐ 1 to 3 inches/hour
      ☐ 4 to 8 inches/hour
      ☐ >8 inches/hour
      ☐ Testing has not been performed

   c. Depth of groundwater table is__________ feet below finished ground surface on ____________ (date).

   d. Site Area (Acres/SF) ___________________ Land Use Zoning Designation ____________________

   e. Area and description of impervious surfaces ____

   f. Average site slope: Existing_____________ Proposed ______________________________________

Site Development
Low Impact Development/Green Infrastructure vs. Traditional Treatment Determination
or
Request for Alternative Compliance

9. Check all types of facilities that were considered, including facilities that may be a combination of one or more of these.

   ☐ Bioretention
   ☐ Chamber Systems
   ☐ Infiltration Basin
   ☐ Filter Strips
   ☐ Vegetated Swales
   ☐ Soak-away Pits
   ☐ Pervious Pavement
   ☐ Canopy Cover/Vegetation Retention
   ☐ Infiltration Basin
   ☐ Use of Landscaping for Stormwater Management
   ☐ Other (please list)_______________________________

10. Check all modifications that were considered.

    ☐ Addition of a sub-drain
    ☐ Addition of a bypass or overflow
    ☐ Application of the 20% area allowance? (See description in ASM Vol 1 Chapter 3, Section 3.2.2.1)
    ☐ Soil amendments
    ☐ Application of a different technique (e.g. filtration if infiltration is not feasible)
    ☐ Other (please list) ____________________________________

11. Provide a sketch that depicts the general site drainage. (Locations of drainage features, receiving systems, flow directions, etc.

12. Are there conflicting MOA regulations that are preventing/inhibiting the use of Green Infrastructure? (For example, if adequate space is not available due to parking space requirements).

    ☐ No ☐ Yes: Code or Regulation Reference____

13. Provide an explanation for why LID/Green Infrastructure is not feasible for this project or describe the alternative compliance that is requested. When considering LID/GI feasibility, address the relevance of modifications. Use additional sheets and attach supporting information if needed.

New Draft Criteria - Notable Changes

Detention and Downstream Impacts

- Draft criteria presents two options for peak flow control
- Option 1 – maintains the requirements in the current DCM/DDG.
  - Peak flows for design events can be increased 5% and a D/S Impact Analysis is required.
- Option 2 - New
  - No increase in peak flows, but D/S impact analysis is not required.
- Flood bypass is still required
- D/S Impact Analysis requirements have changed
  - 10% Point is omitted

New Draft Criteria - Notable Changes

Rainfall Design Storms

- Separate rainfall design storms are presented for Girdwood.
  - Data came from NOAA's Atlas 14 Precipitation-Frequency Atlas of the United States
- MOA is considering updating design events for Anchorage based on the same source.

New Draft Criteria - Notable Changes

Design Requirement	Design Storm	Application	Anchorage and Eagle River Total Depth (inches)	Girdwood Total Depth (inches)
Conveyance Design	10-year, 24-hour	Minor Drainageway[1] and Major Drainageway[1]	1.77	5.72
	100-year, 24-hour	Streams	2.48	8.20
Water Quality Treatment	90th Percentile, 24-hour	Green Infrastructure Water Quality Treatment	0.52	0.52
Extended Detention	1-year, 24-hour	Channel Protection	1.09	3.35
Peak Flow Control	2-year, 24-hour	Peak Control / Channel Protection	1.26	4.05
	10-year, 24-hour	Peak Control / Channel Protection	1.77	5.72
	100-year, 24-hour	Peak Control / Channel Protection	2.48	8.20

New Draft Criteria - Notable Changes

Reporting Requirements

- Requirements for drainage reports has been standardized.
- O&M requirements includes a legal agreement for maintaining sw controls & a self-inspection that is required annually. (Jeff to discuss this in detail later.)

Hydrologic Methods and Computations

- Completely re-organized
- Consolidated, condensed, and simplified.
- Manual incorporates recommended references for each method presented.
- Intended to be more applicable and user-friendly.

New Draft Criteria - Notable Changes

Criteria for Pipes, Manholes, Culverts, etc.

- Information has been reorganized, but is largely unchanged
  - Minimum velocity for HDPE pipe has been increased
  - Lift station criteria are updated
  - Freeze protection criteria are updated, and criteria for thaw systems are provided.

Icing Control Design

- Updated based on stream icing research and paper by WMS.

New Draft Criteria – Notable Changes

Memo is available that discusses the changes in more detail.

- Memo presents each main section of the DCM and DDG and discusses where that information can be found in the ASM.
- Most of the STPRGM is in ASM Volume 2. Should be available next month.

ASM Volume 1 is online at PM&E website.

Questions?

Posters

Dry Weather Screening

Parameters for 15 outfalls yearly

Parameter	Threshold
pH	≤ 4 or ≥9 STD
Total Chlorine	≥ 1.0 mg/L
Detergents	≥ 1.0 mg/L
Total Copper	≥ 1.0 mg/L
Total Phenols	≥ 0.5 mg/L
Turbidity	≥ 250 NTU
Fecal Coliform	≥ 400 cfu/100 mL

cfu = colony forming unity

When a parameter exceeds the above threshold follow-up sampling occurs.

Program Objective

Water samples are collected during periods of at least 48 hours of dry weather (typically May and June) from storm drain outfalls that flow directly into creeks. The objective is to identify potential illicit discharges using laboratory tests and field screening techniques. Flow from storm drain outfalls during dry weather can be an indicator of improper discharges to the storm sewer system.

Program Outline

- 12 major watersheds were identified for sampling
- Watersheds were prioritized based on four criteria
  - Listed as impaired waterbody
  - Evidence of contamination in 3 years prior to ranking
  - Percentage of impervious cover
  - Proportion of commercial/industrial land use
- At least three watersheds are examined in a single year following the established prioritization
- The goal is to sample five outfalls in each watershed (15 in a year)
- Watersheds are divided into lower and upper portions and outfalls are divided between the two portions.
- Outfalls must be flowing during dry weather and not have been tested in a previous year during the permit cycle.

2012

2012 Ship Creek outfall – low tide

Fifteen outfalls were sampled in the following watersheds:

- Ship Creek
- Chester Creek
- Furrow Creek

Sample results showed an exceedance for fecal coliform at an outfall on Ship Creek.

- Initial sample result: 76,400 cfu/100 mL
- Follow-up sample results: 754 cfu/100 mL
- Follow-up sample result at nearest up gradient manhole: 29 cfu/100 mL
  - During follow up sampling the outfall was submerged due to high tide. Sampling was performed after the tide receded.
  - It is likely that the source of fecal coliform is from high tide washing material into the outfall.

2013

Fifteen outfalls were sampled in the following watersheds:

- Rabbit Creek
- Hood Creek
- Potter Creek
- Fish Creek
- Campbell Creek

Sample results showed an exceedance for fecal coliform at an outfall of a sedimentation pond on Campbell Creek.

- Initial sample result: 413 cfu/100 mL
- Follow-up sample result of sed. pond outfall (556-1): 327 cfu/mL
- Follow-up sample result on outfall draining into sed. pond (556-3) to track potential up-network contamination: non-detect

Sampling Effort Summary

Fifteen outfalls were sampled in the following watersheds:

- Fish Creek (3 outfalls)
- Campbell Creek (4 outfalls)
- Eagle River (4 outfalls)
- Ship Creek (4 outfalls)

Prior to the 2014 sampling effort all major identified watersheds in the Municipality of Anchorage had been examined. These four watersheds were revisited and outfalls that were sampled were not previously sampled during this permit cycle.

- ***No outfalls had an exceedance for any of the parameters.***
- Many outfalls that were examined were found to be damaged, clogged or submerged.

Dry Weather Screening Team: Isaac Watkins, Alena Gerlek, Christie Meyn– HDR

2014

Campbell Creek 447-64

Fish Creek 584-1

Ship Creek 189-1

Campbell Creek 551-1

Fish Creek 686-1

Ship Creek 119-1

Damaged, Clogged and Submerged Outfalls

Many more outfalls were examined than were selected as primary or alternate sampling locations. The main reason for not selecting an outfall for sampling was simply because it was dry. However, a number of the examined outfalls were not selected due to being submerged, clogged or damaged. The photos to the left are a selection of these outfalls from the various watersheds.

- Campbell Creek 447-64: End-of-pipe (EOP) bent and broken - Water flows out of cracks
- Campbell Creek 551-1: EOP completely submerged
- Fish Creek 584-1: EOP Clogged and crushed - Water exits through breaks in pipe underground
- Fish Creek 686-1: EOP completely submerged
- Ship Creek 189-1: Submerged and damaged
- Ship Creek 119-1: Jacked up and rusted out – Water flows out through rusted portion

2014 Low Impact Development Project Performance Monitoring

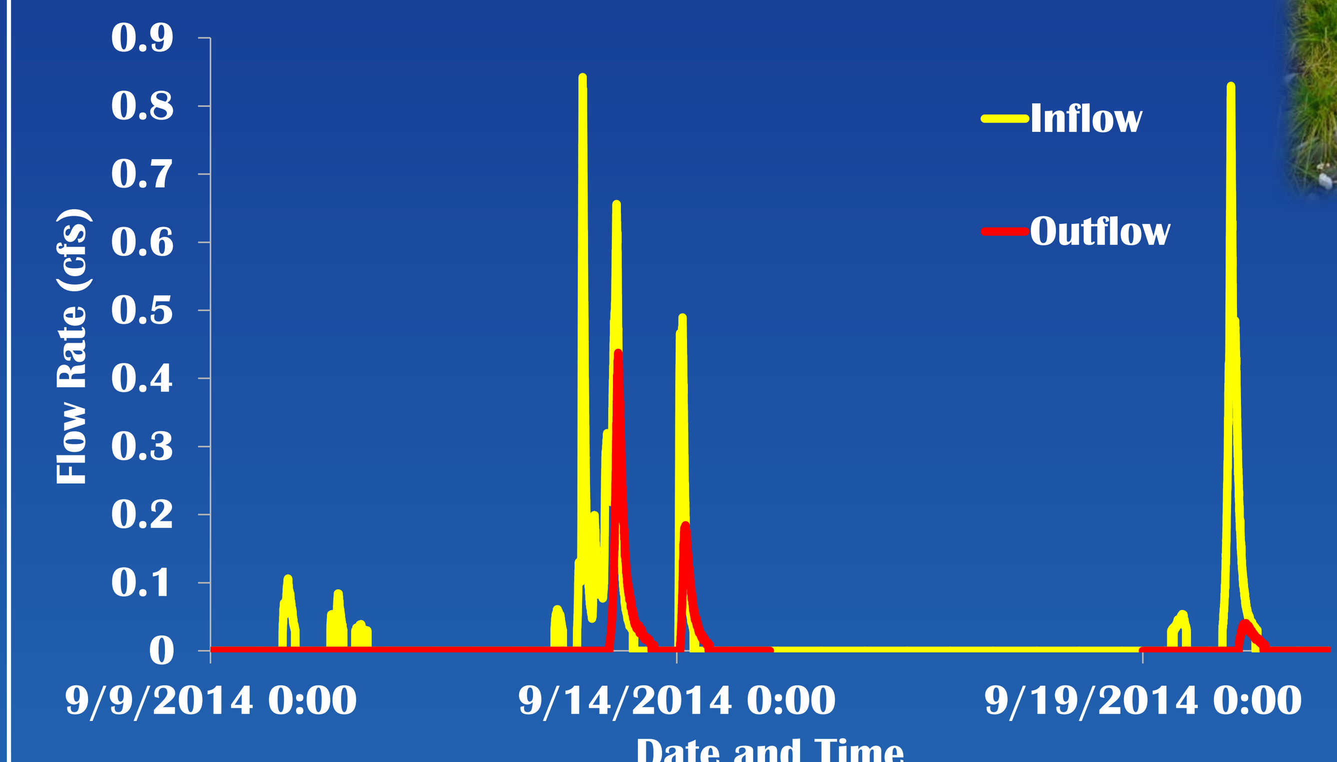
New Seward Highway -Infiltration Basin (ADOT&PF)

ADOT&PF recently widened the New Seward Highway (NSH) from Dowling Rd to Tudor Rd, and used LID techniques to manage stormwater. Runoff from a significant portion of the roadway improvement area (about 9.4 acres with 6.7 acres of impervious surface) was directed to an infiltration basin. The basin collects and infiltrates small rainfall events and allows larger events to overflow to an adjacent ditch that flows to Campbell Creek. The basin was designed to collect and infiltrate runoff from design events up to the 90th percentile event—0.52 inches of rain in 24-hours. The basin is approximately 150 feet long and 45 feet wide, with gentle side slopes and an average depth of two feet. The basin inlet is a 24-inch diameter culvert on the southwest side of the basin, and the outlet is a small earthen berm on the north side.

NSH Infiltration Basin

Monitoring In order to determine how well the basin was performing at retaining and attenuating flows, the basin inflow and outflow were measured using 90-degree, v-notch weirs and pressure transducers. By comparing inflow and outflow, we can determine the amount of water stored/infiltrated by the basin. Data was collected from July to October of 2014. The monitoring results showed that for the entire recording period, the basin only produced an outflow three times, during a 12-day rainy period.

Basin inlet (left) and outlet (right)



The graph above shows the basin's inflow and outflow hydrographs for a 12-day period of rain. On Sept 13, 0.35 inches of rain fell in one hour.

Native Soils Percolation testing was done before construction of the basin and resulted in perc rates ranging from 2.1 to 6.3 inches per hour. These are average to moderately low infiltration rates for the Anchorage area. Interestingly, the infiltration basin was used as a sediment trap during construction, which is expected to have further reduced it's infiltration capacity. Despite these limitations, it is out-performing design expectations.

Storm Event	Runoff Volume			Peak Flow		
	Inflow (cf)	Outflow (cf)	Percent Decrease	Inflow Peak (cfs)	Outflow Peak (cfs)	Percent Decrease
Aug 24-25 (0.89 in/24 hrs)	3,508	0	100%	0.33	0.00	100%
Oct 11 (0.56 in/24 hrs)	2,070	0	100%	0.22	0.00	100%
Sept 13-14 (0.66/24 hrs)	13,990	6,031	57%	0.84	0.44	48%
Sept 19-20 (0.69/24 hrs)	7,194	560	92%	0.83	0.04	95%
Sept 9-20 (3.03/12 days)	28,514	6,592	77%	0.84	0.44	48%

This table shows the inflow and outflow volume and peak flow for some of the significant storm events that occurred during the monitoring period.

Ship Creek Hatchery Rain Gardens & Site Design (ADOT&PF)

The parking lot of the Ship Creek Hatchery was reconstructed as part of a project that converted the old site into a hatchery in 2011. The hatchery is located immediately adjacent to Ship Creek, and the entire site design is centered around minimizing direct stormwater runoff to Ship Creek. The topography of the site's green areas are contoured to capture water, and flat curbs are used in lieu of traditional curbs around parking lot landscape features to allow stormwater from pavement to flow into the landscaping. The site includes two primary landscaped rain gardens, which were the focus of this monitoring effort.

Ship Creek Hatchery Site Overview

Rain Gardens The two rain gardens collect runoff from approximately 18,850 sf of parking lot. The rain gardens are designed to accept and infiltrate small storm events and bypass larger events. Water that enters the rain gardens but is not infiltrated is allowed to overflow the earthen sides of the gardens. Overflow is directed to Ship Creek via overland flow. Both rain gardens are fully vegetated with grass-like vegetation.

Above left: Wildlife enjoying the West garden after a large rain event. Above right: Flat curb allowing overland flow to the west garden. Left: Overview of east garden.

Monitoring The rain gardens were monitored from July to October of 2014. The sheet/overland inflow & outflow made on-site instrumentation impractical. Instead, inflow hydrographs were developed using EPA's Storm Water Management Model (SWMM) with rainfall data from Merrill Field Airport. Outflow was determined by comparing inflow volume to the design capacity of each rain garden, and was confirmed through on-site inspection during or following significant rain events. The results show that the design capacity of the rain gardens was not exceeded during the monitoring period. In other words, there was no outflow from either garden. This was verified by visual inspection.

Below: Summary of the West Rain Garden Performance. Design storage capacity = 3,100 cf.

Storm Event	Runoff Volume			Peak Flow		
	Inflow (cf)	Outflow (cf)	Percent Decrease	Inflow Peak (cfs)	Outflow Peak (cfs)	Percent Decrease
July 24-25 (0.64 in/24 hrs)	521	0	100%	0.02	0.00	100%
Aug 24-25 (0.78 in/24 hrs)	654	0	100%	0.03	0.00	100%
Oct 11 (0.69 in/24 hrs)	565	0	100%	0.03	0.00	100%

Below: Summary of the East Rain Garden Performance. Design storage capacity = 3,200 cf.

Storm Event	Runoff Volume			Peak Flow		
	Inflow (cf)	Outflow (cf)	Percent Decrease	Inflow Peak (cfs)	Outflow Peak (cfs)	Percent Decrease
July 24-25 (0.64 in/24 hrs)	406	0	100%	0.02	0.00	100%
Aug 24-25 (0.78 in/24 hrs)	509	0	100%	0.02	0.00	100%
Oct 11 (0.69 in/24 hrs)	440	0	100%	0.02	0.00	100%

2014 Low Impact Development Project Performance Monitoring

West Dowling Parking Lot Rain Garden (ADOT&PF)

The West Dowling parking lot is located on the north side of West Dowling Rd, west of the intersection of West Dowling Rd and the Old Seward Highway. The parking lot is immediately adjacent to Campbell Creek and provides public parking access for users of the popular Campbell Creek trail. The area was re-constructed when West Dowling Road was widened in 2012. Runoff from the 8,600 sf parking lot flows to a rain garden that provides infiltration of small to mid-size storm events, with an overflow for larger events. Water enters the rain garden via sheet flow from the parking lot. The outlet is an earthen berm, and overflow from the rain garden is directed to Campbell Creek.

Parking lot and rain garden

Rain garden outlet

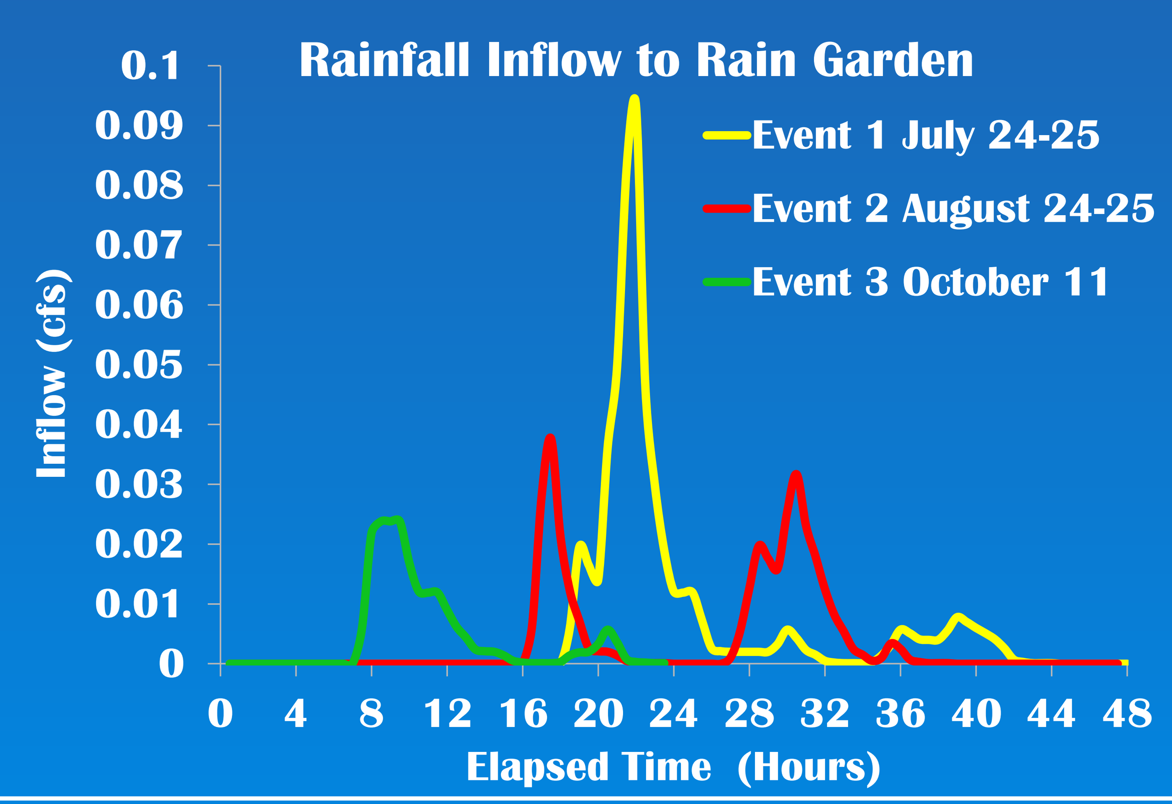
Monitoring The rain garden was monitored from July to October of 2014. The inflow and outflow characteristics of this garden made on-site instrumentation impractical. Instead, inflow hydrographs were developed using EPA's Storm Water Management Model (SWMM) using rainfall data from Anchorage International Airport. Outflow was determined by comparing inflow volume to the design capacity of the rain garden, and was confirmed through on-site inspection during or following significant rain events. The results show that the combined storage capacity and infiltrative capacity of the rain garden were not exceeded during the monitoring period. In other words, there was no outflow from the garden. This was verified by visual inspection.

Below: Summary of the West Rain Garden Performance. Design storage capacity = 375 cf.

Storm Event	Runoff Volume			Peak Flow		
	Inflow (cf)	Outflow (cf)	Percent Decrease	Inflow Peak (cfs)	Outflow Peak (cfs)	Percent Decrease
July 24-25 (1.46 in/24 hrs)	1,011	0	100%	0.09	0.00	100%
Aug 24-25 (0.89 in/24 hrs)	603	0	100%	0.04	0.00	100%
Oct 11 (0.56 in/24 hrs)	366	0	100%	0.02	0.00	100%

Native Soils

Notice that the inflow volume exceeded the storage capacity of the rain garden in each of the storm events analyzed. Percolation testing prior to construction of the rain garden showed that the native soils are very free-draining, with percolation rates approximately 45-inches per hour (below top soil layer). The fact that this rain garden did not overflow during the monitoring period is not surprising given the fast infiltration rates of the native soil. In cases like these, care should be taken to ensure that percolation rates are not too fast, so as to avoid potential groundwater contamination.



Russian Jack Springs Parking Lot (MOA)

Porous Asphalt The MOA continued visual monitoring of the porous asphalt at Russian Jack Springs Park parking lot. The one-acre parking lot includes a combination of traditional and porous asphalt. The 2014 monitoring identified some maintenance concerns that were addressed to help ensure asphalt longevity.

Rock Mulch

Woodchip Mulch

Russian Jack Springs Parking Lot Overview

Woodchip mulch (shown on the right above) was migrating from landscape planters, being crushed by traffic, and clogging the asphalt pores. The woodchip mulch was replaced with rock mulch in some areas and grass seeding in other areas. The parking lot was swept to prevent the problem from worsening.

Vehicle Ruts and Mud

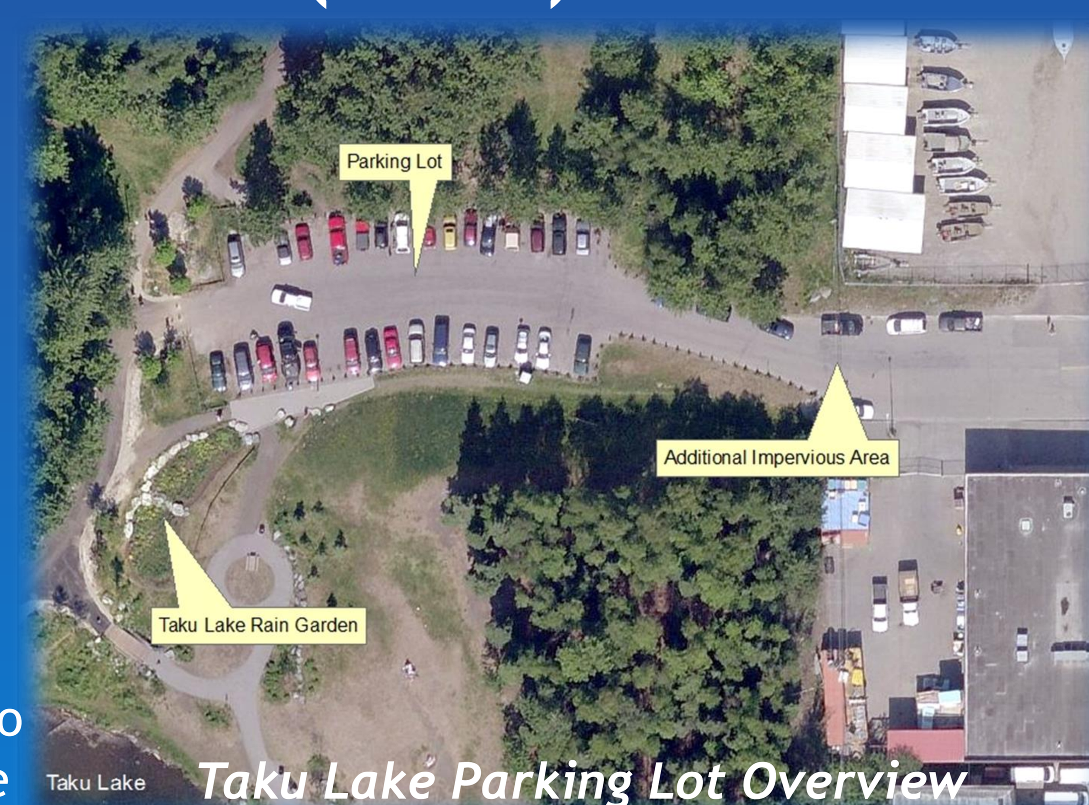
Area cleaned up and re-seeded

Infiltration Gallery Unauthorized vehicular access to the area east of the parking lot caused the ruts and mud seen in the above photo. This area is upstream of the infiltration gallery and the mess created concern for sediment loading of the gallery. To remedy the problem, the area was blocked from future access and re-seeded.

The infiltration gallery, shown to the left, did not show signs of decreased performance. Water levels were checked during or immediately following three significant rainfall events, and standing water was not observed.

Taku Lake Parking Lot Rain Garden (MOA)

The MOA continued visual monitoring of the rain garden at Taku Lake Park. The parking lot accepts stormwater runoff from the Taku Lake parking area (12,150 sf) as well as a portion of King St. The rain garden provides treatment and retention of small storm events through plant uptake, top soil saturation, and infiltration. Excess water is collected in a perforated subdrain which outlets near Taku Lake.



Taku Lake Parking Lot Overview

Taku Lake Rain Garden

The monitoring results showed that the rain garden is performing well. It continues to provide infiltration and storage for small rain events, and detention of larger events. Outflow from the rain garden's underdrain was only observed once and that was during the site visit on July 25. The July 24-25 event produced 1.46 inches of rain and rain garden outflow is expected under these circumstances.