Cordova Stormwater Design Study Report

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ACRONYMS AND ABBREVIATIONS

AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
ADOT	Alaska Department of Transportation
AMSA	Area Meriting Special Attention
APDES	Alaska Pollutant Discharge Elimination System
BMP	best management practice
CRWP	Copper River Watershed Project
DRO	diesel-range organics
EPA	U.S. Environmental Protection Agency
GRO	gasoline-range organics
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPS	non-point source
PAM	polyacrylamide
PCB	polychlorinated biphenyl
SWPPP	Storm Water Pollution Prevention Plan
VOC	volatile organic compound

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1.0 INTRODUCTION

The nine watersheds surrounding the City of Cordova, Alaska, contribute to the larger Prince William Sound watershed, a critical and productive habitat for salmon and other aquatic organisms in Alaska. Human activity in the Cordova watersheds can affect the quantity and quality of water in the area surrounding Cordova and in Prince William Sound. Stormwater runoff can carry pollutants and, when combined with non-point source (NPS) pollution from the watersheds surrounding Cordova, lead to degradation of habitat and water quality in the area.

The Copper River Watershed Project (CRWP) has procured funding and commissioned this Stormwater Design Study Report as one of several projects to sustain and improve the conditions of the aquatic habitat near Cordova. This project is funded by a grant from the Alaska Department of Environmental Conservation (ADEC) to conduct engineering studies and produce a report on stormwater treatment alternatives and NPS pollution remedies for Cordova. This report builds on the watershed delineation and characterization studies in the *Cordova Stormwater Study – Phase I Design Study Report* (CRWP 2008).

1.1 SITE DESCRIPTION AND HISTORY

Cordova is located at the southeastern end of Prince William Sound in the Gulf of Alaska. The community was built next to Orca Inlet, at the base of Eyak Mountain. The watershed area encompasses 61.4 square miles of land and 14.3 square miles of water. Annual precipitation is 167 inches, and average snowfall is 80 inches. Cordova originated as a major shipping port at the terminus of the Copper River and Northwestern Railroad in 1907. In the early 1940s, fishing became the community's economic base (Alaska Department of Commerce, Community, and Economic Development 2009).

The city of Cordova has nine watersheds. Each was analyzed for major possible NPS and stormwater pollution sources and probable contaminants in the Phase I Report (CRWP 2008). The watersheds feed three primary receiving bodies directly affected by the city's activities:

Odiak Pond, Eyak Lake, and Orca Inlet. This report will focus on stormwater and NPS solutions for input into these three receiving bodies.

1.2 STORMWATER

Stormwater is the result of precipitation from rain and snowfall events that is unable to percolate into the ground and thus runs overland or over impervious surfaces. This runoff picks up debris, sediment, chemicals, and other pollutants that could compromise water quality when discharged as untreated stormwater to receiving water bodies.

In some cases, stormwater is considered a point source for pollution when the stormwater is condensed into one discharge point that may be subject to the National Pollutant Discharge Elimination System (NPDES) Permit Process or other regulations (Section 1.5). The City of Cordova currently does not meet criteria to be subject to the NPDES stormwater requirements, but best management practices (BMP) used to mitigate stormwater pollutants can be applied to reduce potential effects of contaminants on the surrounding habitat. Section 2.0 provides an overview of general BMPs.

1.3 NON-POINT SOURCE POLLUTION

NPS pollution comes from such diffuse sources as rain, melting snow, and stormwater flow from rooftops, parking lots, ditches, and streets all over the community. The flowing water picks up pollutants that cannot be readily traced to a single source. The best ways to reduce NPS pollution and its effects on local water bodies and habitats is use of BMPs and community-wide involvement.

1.4 CONTAMINANTS OF CONCERN

Table 1-1 shows contaminants commonly associated with stormwater pollution; these contaminants are typical of developed areas. Previous investigations indicated that the watersheds near Cordova have been or may be adversely affected by one or more of these contaminants.

Table 1-1
Common Stormwater Contaminants

Stormwater Pollutant	Example Sources	Potential Impacts
Nutrients (Nitrogen, Phosphorus)	Animal waste, fertilizers, failing septic systems, atmospheric deposition, vehicular deposition	Algal growth, reduced clarity, other problems associated with eutrophication (oxygen deficits, release of nutrients and metals from sediments)
Sediments (Suspended, Deposits)	Construction sites, other disturbed and/or nonvegetated lands, eroding banks, road sand	Increased turbidity, reduced clarity, lower dissolved oxygen, deposition of sediments, smothering of aquatic habitats including spawning sites
Organic Material	Leaves, grass clippings	Oxygen deficit in receiving waters, fish kills, turbidity
Pathogens (Bacteria, Viruses)	Animal waste, failing septic systems, dumpsters	Human health risks associated with drinking water supply, consumption of affected shellfish and recreational beach contamination
Hydrocarbons (Oil, Fuel)	Industrial processes, automobile wear, emissions and fluid leaks, waste oil	Toxicity of water column and sediment, bioaccumulation through the food chain
Metals (Lead, Mercury, Copper)	Industrial processes, normal wear of automotive brake linings and tires, automobile emissions and fluid leaks, metal roofs	Toxicity of water column and sediment, bioaccumulation in aquatic species and through the food chain, fish kills
Synthetic Chemicals (PCBs, Pesticides)	Pesticides (herbicides, insecticides, fungicides, rodenticides), industrial processes	Toxicity of water column and sediment, bioaccumulation through the food chain, fish kills
Chlorides	Road salting and uncovered salt storage	Toxicity of water column and sediment
Trash and Debris	Litter washed through storm drain networks, commercial parking lots adjacent to surface water, overflowing trash barrels and dumpsters	Degradation of surface water aesthetics, threat to wildlife

Note: Adapted from New Hampshire Department of Environmental Services 2002

1.5 APPLICABLE REGULATIONS

Regulations to minimize contamination and adverse community effects associated with stormwater and NPS pollution are currently managed by both state and federal entities. Although some of these regulations may not apply to the City of Cordova, the BMPs used in the permit process and/or the intent of the regulations can provide guidelines to reduce pollution impacts in Cordova watersheds.

Current State of Alaska regulations that may apply to Cordova stormwater discharge or NPS pollution include Water Quality Standards (Alaska Administrative Code [AAC], Title 80, Section 70), Wastewater Disposal (18 AAC 72), and Solid Waste (18 AAC 60). The Alaska Pollutant Discharge Elimination System (APDES) (18 AAC 83) is the state equivalent of NPDES. In addition, ADEC is in the process of taking over primacy and permitting for pollutant discharge systems, a transfer which will be finalized 31 October 2009. In the meantime, regulations are partially handled by the state and partially by the U.S. Environmental Protection Agency (EPA).

NPDES regulations have three basic activity components: industrial, municipal stormwater, and construction. Under these three components, NPDES requires permits for specific activities in locations that meet particular criteria. Under Section 401 of the Clean Water Act, the State of Alaska certifies the general EPA permits. A database of current permit holders can be found on the EPA stormwater website (EPA 2009).

1.5.1 Industrial Activities

The first NPDES component addresses discharges associated with industrial activities. Twenty-nine separate industrial sites—including gravel pits, landfills, marinas, and large wastewater treatment plants exceeding 1 million gallons per day—may require an NPDES multisector general permit (EPA). As part of the process, the permit holder must submit an application/notice of intent (NOI) and develop a Storm Water Pollution Prevention Plan (SWPPP).

1.5.2 Municipal Stormwater Activities

The second NPDES component is municipal stormwater regulations. Two phases of regulation for municipal stormwater exist although neither phase applies to Cordova. Phase I regulations require medium and large cities or certain counties with populations of 100,000 or more to obtain NPDES permit coverage for their stormwater discharges. Phase II regulations require regulated small stormwater systems in urbanized areas to obtain NPDES permit coverage for their stormwater discharges. Cordova does not meet the population criterion for Phase I regulation (100,000 residents) or Phase II urbanized area criteria for population (50,000 residents) or density (1,000 people per square mile). Although not required by law for Cordova, the mitigation techniques and six BMPs provided in these regulations are useful in reducing stormwater impacts. Section 2.0 reviews Phase II stormwater regulation BMPs, in addition to other recommended practices.

1.5.3 Construction Activities

The third NPDES component is construction general permitting. A Construction General Permit is required for all land greater than 1 acre that will be disturbed by excavation or clearing. As part the process, an NOI must be submitted and a SWPPP developed. As of 27 March 2009, the NOI database listed six active construction items for Cordova (EPA 2009).

A regulation that applies to runoff water quality in Cordova is 18 AAC 72, Wastewater Disposal. 18 AAC 72.500(a) states "a person who disposes of non-domestic wastewater into or onto land, surface water, or groundwater in this state must have a permit issued by the department under this chapter or under 18 AAC 83 for that disposal." Snow disposal is a form of nondomestic wastewater (ADEC 2009a, 2009b). Additionally, ADEC considers snow to be a solid waste, as debris-entrained snow and urban snow cannot, except under emergency permit for marine waters, be stored on water bodies (Alaska Department of Transportation [ADOT] 2003). Although the practice of direct disposal of snow into water bodies has been discontinued across the U.S and Canada, it is still a common practice in many Alaskan communities. In Alaska, regulatory control over snow storage is selectively applied and not enforced on a statewide basis (ADOT 2003). Snow disposal practices could introduce contaminants into watersheds in Cordova, with the full extent of the effects of these disposal practices not known.

Per 18 AAC 72.600, nondomestic disposal systems must have prior written ADEC approval of engineering plans for new construction and stormwater disposal plans for new systems to be compliant with ADEC wastewater and APDES regulations.

1.6 PROJECT GOALS AND OBJECTIVES

Objectives for this project include the following:

- Identify and prioritize the stormwater pollution threats to the watershed.
- Identify the range of BMPs (including mechanical, biological, and general practice) for stormwater mitigation and treatment techniques to address each watershed threat identified.
- Discuss the feasibility of implementing suggested BMPs.
- Provide a rough order of magnitude (+/- 30 percent) cost associated with each BMP.

After compiling a general list of BMPs, Jacobs personnel conducted a site visit to Cordova on 7 and 8 April 2009. During this visit, Jacobs toured the watersheds and met with CRWP and key stakeholders to gather information about the major areas of concern. Jacobs personnel collected measurements of culverts, parking lots, runoff areas, and other locations to assist in developing a general design for BMP implementation at key sites.

This Design Study Report reviews pollution input from the watersheds to the three major receiving water bodies in Cordova and recommends BMPs to address major issues. Site BMPs are evaluated for cost, feasibility and effectiveness. Using this evaluation, the solutions can then be prioritized through discussion with the stakeholders. A PowerPoint presentation summarizing the report will be submitted separately.

2.0 BEST MANAGEMENT PRACTICES

BMPs are the primary means of controlling stormwater discharge and therefore limiting pollutants and other environmental impacts. Several types of BMPs can be used to attain this goal, including structural, educational, source control, and maintenance practices. Sections 2.1 to 2.4 summarize these common and applicable BMPs from EPA's *National Menu of Best Management Practices for Stormwater* (EPA 2009) and stormwater regulatory requirements. Selection of the most appropriate BMP is highly dependent on site-specific factors, including target pollutants, site size and limitations, cost, maintenance, and aesthetics. This list of general BMPs is intended for use as a discussion tool with the City of Cordova and other stakeholders about stormwater and NPS pollution prevention and mitigation.

2.1 STRUCTURAL

Structural BMPs are devices used for the entrapment or treatment of stormwater pollutants. These BMPs are generally mitigative and are intended to be used in conjunction with other management practices. A wide variety of structural BMPs exists, with many including slight variations on similar practices:

- **Biofilters** are a pollution control technique using living material to capture and biologically degrade process pollutants. Common uses include processing wastewater, and capturing harmful chemicals or silt from surface runoff. A variety of BMP subcategories are available for biofiltration.
- **Grass swales** refer to vegetated, open-channel management practices designed specifically to treat and attenuate stormwater runoff. As runoff flows along these channels, it is treated through vegetation slowing the water to allow sedimentation, filtering through a subsoil matrix, and/or infiltration into the underlying soil.
- **Vegetated filter strips** are vegetated surfaces designed to treat sheet flow from adjacent surfaces. Filter strips function by slowing runoff velocities and filtering out sediment and other pollutants and by providing infiltration into underlying soil. Filter strips were originally used as an agricultural treatment practice and have evolved into an urban practice.
- **Bioretention cells/rain gardens** are landscaping features adapted to provide onsite treatment of stormwater runoff by directing it into shallow, landscaped depressions in parking lots or other urban locations to be filtered through a mulch and prepared-soil mix. The filtered runoff can be collected in a perforated underdrain and returned to the storm drain system.

- **Infiltration basins or trenches** are shallow impoundments designed to retain excess water until it is able to infiltrate soil. This practice is believed to have high pollutant removal efficiency and can also help recharge ground water, thus increasing baseflow to stream systems.
- **"Manufactured devices"** is a broad category term to describe various devices that may have storage, flow-through, filter media, or other methods of stormwater treatment. A variety of BMP subcategories are available for manufactured devices.
- **Swirl separators/hydrodynamic structures** are manufactured devices that have been widely applied to stormwater inlets in recent years. Swirl separators are modifications of traditional oil-grit separators that create a swirling motion as stormwater flows through a cylindrical chamber. The concept behind this design is that sediments settle out as stormwater moves in this swirling path, and additional compartments or chambers are sometimes present to trap oil and other floatables. Several different types of proprietary separators are available, each incorporating slightly different design variations, such as off-line application.
- **Catch basins/storm drain inlets** are manufactured devices placed at inlets to the storm drain system. They typically include a grate or curb inlet and a sump to capture sediment, debris, and pollutants. Catch basins are used to capture floatables and settle some solids, and they act as pretreatment for other treatment practices by capturing large sediments. The effectiveness of a catch basin depends on its design (e.g., the size of the sump) and on maintenance procedures to regularly remove accumulated sediment from the sump. Inserts designed to remove oil and grease, trash, debris, and sediment can improve the efficiency of catch basins. Some inserts are designed to drop directly into existing catch basins, while others may require retrofit construction.
- **Retention ponds** are constructed basins that have a permanent pool of water to treat incoming stormwater runoff by allowing particles to settle and algae to take up nutrients.
- **Riparian buffers** are areas along a shoreline, wetland, or stream where development is restricted or prohibited to physically protect and separate a stream, lake, or wetland from future disturbance or encroachment. If properly designed, a buffer can provide stormwater management and can act as a right-of-way during floods, sustaining the integrity of stream ecosystems and habitats.

2.2 EDUCATIONAL

Educational BMPs are used to limit stormwater pollutants at the source through community education and outreach. These BMPs are generally designed to teach the public about behaviors and activities that can generate stormwater pollutants and measures that may be taken to limit the impacts.

- **Public education and outreach on stormwater impacts** (a Phase II component) is used to educate a community on the pollution potential of common activities and increase awareness of the direct links between land activities, rainfall runoff, storm drains, and local water resources. This gives the public clear guidance on steps and specific actions it can take to reduce stormwater pollution potential. This type of education and outreach has a broad spectrum of possibilities, ranging from presenting information about stormwater and drainage pathways in the community to educating homeowners on the impacts of chemical use and animal waste on the watershed.

- **Public involvement/participation when developing a stormwater management program** (a Phase II component) provides for opportunities for public involvement to be built into the fundamental process of community stormwater management. This may include opportunities for the public to participate through positions on a local stormwater management panel or opportunities for direct-action, educational, and volunteer programs such as riparian planting days, volunteer monitoring programs, storm drain marking, or stream cleanup programs. Groups such as watershed groups and conservation corps teams who want to participate in promoting environmental causes should be encouraged and offered opportunities to participate in the stormwater management program.

2.3 SOURCE CONTROL

Source control BMPs are used to limit stormwater pollutants at the source by taking measures to detect and eliminate behaviors and activities that result in stormwater pollution.

- **Illicit Discharge Detection and Elimination** (a Phase II component) is generally any discharge into a storm drain system that is not composed entirely of stormwater. Exceptions include water from fire-fighting activities and discharges from facilities already under NPDES permit. Illicit discharges are a problem because, unlike wastewater, which flows to a wastewater treatment plant, stormwater generally flows to waterways without any additional treatment. Illicit discharges often include pathogens, nutrients, surfactants, and various toxic pollutants. An effective illicit discharge program needs to be both reactive and proactive: reactive in addressing spills and other illicit discharges to the storm drain system and proactive in preventing and eliminating illicit discharges through education, training, and enforcement.
- **Construction Site Stormwater Runoff and Control** (a Phase II component) is used to reduce pollutants in stormwater runoff from construction sites that disturb 1 or more acres. Uncontrolled stormwater runoff from construction sites can significantly impact rivers, lakes, and other water bodies. Sediment from construction sites can reduce the amount of sunlight reaching aquatic plants, clog fish gills, smother aquatic habitat and spawning areas, and impede navigation. This BMP generally seeks to achieve erosion control and prevent sediment migration. Numerous erosion-control BMPs are commercially available and aid in the control of erosion, runoff, and sediment. A limited list of common erosion control BMPs is as follows:
  - **Silt fences** are used as temporary perimeter controls around sites where construction activities will disturb the soil. They can also be used around the interior of the site. A silt fence consists of a length of filter fabric stretched between anchoring posts spaced

at regular intervals along the site at low areas. The filter fabric should be entrenched in the ground between the support posts. When installed correctly and inspected frequently, silt fences can be an effective barrier to sediment leaving the site in stormwater runoff.

- **Filter berms/socks** are physical barriers placed perpendicular to sheet flow runoff to retain sediment and thus control erosion from disturbed areas. These barriers can be composed of a wide variety of materials, from straw and mulch for temporary use to stone for permanent diversion. The berm provides a three-dimensional filter that retains sediment and other pollutants (e.g., suspended solids, metals, oil, and grease) while allowing cleaned water to flow through. Filter berms are generally placed along the perimeter of a site, or at intervals along a slope, to capture and treat stormwater that runs off as sheet flow. A filter berm also can be used as a check dam in a small drainage ditch.
- **Seeding** is used to control runoff and erosion on disturbed areas by establishing perennial vegetative cover from seed. It reduces erosion and sediment loss through permanent stabilization. This practice is economical and adaptable to different site conditions and allows selection of a variety of plant materials. Similar to seeding, small plants or shrubs may be planted to minimize erosion (especially along stream banks) and provide stabilization.
- **Chemical stabilization** provides temporary soil stabilization. Chemicals are sprayed onto the surface of exposed soil to hold it in place and minimize erosion from runoff and wind. Spray chemicals are easily applied to the surface of the soil, can stabilize areas where vegetation cannot be established, and provide immediate protection.

- **SWPPPs** are documents that describe pollution prevention practices and activities that will be implemented on a site. They include descriptions of the site and of each major phase of planned activity, roles and responsibilities of contractors and subcontractors, and inspection schedules and logs. SWPPPs also can document changes and modifications to the construction plans and associated stormwater pollution prevention activities.
- **Snow disposal methods** include community planning and disposal site selection, characteristics, and preparation to limit stormwater runoff from melting snow. Snow removed from roads and parking lots can contain pollutants such as road salt, sand, litter, animal waste, and automotive pollutants (metals and oil). As snow melts, these pollutants can be transported into surface water or groundwater. Controlling snow disposal methods can aid in the limitation of pollutant transportation.

2.4 MAINTENANCE

The effectiveness of stormwater BMPs depends upon regular maintenance and control, such as the following:

- **Street maintenance** is practiced in most urban areas, often as an aesthetic practice to remove trash, sediment buildup, and large debris from curb gutters. Street-sweeping programs can remove tons of debris a year from city streets, minimizing pollutants in stormwater runoff. In colder climates, street sweeping can be used during spring snowmelt to reduce pollutants in stormwater runoff from road salt, sand, and grit.

- **Vehicle and equipment maintenance** includes parts cleaning, vehicle fluid replacement, and equipment replacement and repair. Automotive maintenance facilities are considered to be stormwater "hot spots" that generate significant loads of hydrocarbons, trace metals, and other pollutants that can affect the quality of stormwater. Fluid spills and improper disposal of materials result in pollutants, heavy metals, and toxic materials entering groundwater and surface water supplies, which can create public health and environmental risks. Municipal facilities can reduce the effects of automotive maintenance practices on stormwater runoff and, consequently, local water supplies by properly storing automotive fluids and thoroughly cleaning up spills (a Phase II component).
- **Post-construction activities** to address stormwater runoff (a Phase II component) can be applied by developers and property owners through BMPs after construction activities are complete.
- **Pollution prevention/good housekeeping** to address stormwater runoff (a Phase II component) can be applied by a facility through BMPs such as facilities maintenance.
- **Facilities maintenance** aims to manage stormwater at municipal facilities to prevent pollutants released during city activities from entering storm drain systems or receiving waters. A municipality should inventory its facilities and associated activities to assess potential impacts on stormwater quality and revise activities or implement new measures as needed. These activities and control measures should be described in a SWPPP or similar document that describes management actions to be taken to reduce pollution from the site or activity. All municipal facilities maintenance staff should receive training on BMPs and guidance on how to use appropriate stormwater practices during typical maintenance operations and facility management activities.
- **City policies** promote public welfare by guiding, regulating, and controlling the design, construction, use, and maintenance of any development, activity, or behavior that may impact stormwater pollution. These policies should be developed with the community to educate residents and guide BMPs across the watershed.

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3.0 SITE-SPECIFIC DETAILS

The land around Cordova is comprised of nine watersheds delineated and characterized in the Phase I Report (CRWP 2008). These watersheds flow through multiple outfalls and NPSs into three primary receiving waters: Odiak Pond, Eyak Lake, and Orca Inlet. Each watershed and outfall has unique contaminants and issues of concern; therefore, solutions to manage stormwater and pollution will be site specific.

Areas of concern in the nine watersheds (Figure 3-1) previously identified as significant potential pollution contributors (CRWP 2008) form the basis for this Design Study Report. NPS issues are addressed under community-wide solutions (Section 3.4). Each unique outfall or problem area is addressed by the following:

- Stating the problem area or outfall point
- Suggesting possible contamination or issues related to this area
- Suggesting alternatives to deal with the problem or area

Section 4.0 provides a comparative analysis of the alternatives.

3.1 ODIAK POND

Odiak Pond is a small water body near the Cordova hospital. It hosts the largest watershed in the community, with 139 acres of drainage. Approximately 60 percent of the land in the Odiak Pond watershed is developed, with a majority defined as residential. Near the pond are a hospital, parking area, snow storage areas, helicopter pad, highway, old capped landfill, culvert outfalls from stormwater, an influent stream that drains several residential areas and runs along the Copper River Highway, and a raised walkway with a gazebo that extends over the pond. The residential areas are in the large, outlying sections of the watershed.

Odiak Pond outflows into Odiak Slough, which is tidally influenced by Orca Inlet. Odiak Pond outflow consists of three culverts that run under and perpendicular to the Copper River Highway and are 48, 54, and 60 inches in diameter (Appendix A, Photo 1). Odiak Slough has a small watershed that is 87-percent developed (CRWP 2008).

Odiak Pond shows signs of contamination. The heavy growth of foreign grasses in the pond indicates a damaged or destroyed wetland system (CRWP 2008). Heavy pollutant loads, such as salt, metals, and other stormwater-related pollutants, usually cause this type of destruction. Sources of pollution for Odiak Pond analyzed in this report include the Cordova hospital parking lot, influent stream near the highway, old landfill, snow storage sites, and NPS pollution.

3.1.1 Cordova Hospital Parking Lot

The primary concern at this location was sediment loading into Odiak Pond, with sheen noted in the water at the outfall from the parking lot into Odiak Pond. Excess sediment appears to be a winter issue connected to the sanding of roads, parking lots, and walkways. In a meeting on 7 April 2009, the Public Works Director and acting City Manager, Gary Squires, stated that the city does not use chemicals in the sanding process.

The Cordova hospital parking lot has a built-in trench drain system that is flush with the pavement in the southeastern section. The trench drain is approximately 40 feet long and 2 feet wide. At the time of the Jacobs site visit in April 2009, the end of the trench drain nearest the hospital was filled with sediment. The sediment level dropped as the trench approached the discharge point at the northeastern section of Odiak Pond (Appendix A, Photo 2). The area of discharge has visible sediment buildup, foreign grasses, and an orange/ brown tinge.

Because of the abundance of aquatic plant life at the outfall, the noted sheen may be the result of biogenic, rather than petrogenic, sources. Organic sampling is recommended for this location to determine the nature of the sheen before selecting a potential remedy for the site. Samples should be analyzed for diesel-range organics (DRO), residual-range organics, and gasoline-range organics (GRO) with silica-gel cleanup. If results indicate a biogenic source for the sheen, alternatives to prevent fuel-contaminated runoff will not be necessary, and only sediment issues will need to be addressed.

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The following alternatives were considered for addressing sediment contamination at this site:

Alternative 1: Parking Lot Cleanup Program

This alternative focuses on educational BMPs along with the physical removal of dirt, gravel, and debris. Volunteers could clean up the parking lot in the spring or multiple times during the winter, weather permitting. The use of volunteers would keep the cost of this option low although it may incur difficulty in execution and quality of cleanup. Professional parking lot cleaning would cost between $200 and $1,000 annually.

Alternative 2: Catch Basin Filter

This alternative uses structural BMPs to address the removal of dirt, gravel, and debris prior to outfall to Odiak Pond. The 40-foot by 2-foot trench drain in the hospital parking lot accumulates stormwater runoff and associated sediment. The addition of a catch basin filter to this drain may limit the sediment entering Odiak Pond.

Catch basin filters are used as pretreatment for other stormwater management practices and provide capture for sediments and other pollutants impacting water quality. Two basic catch basin filter varieties exist for filtering runoff: One type consists of a series of trays providing filtration at multiple levels (preferable if only sediment needs to be addressed at the site), and another uses filter fabric to remove pollutants from stormwater runoff (EPA 2009). If fuel-related pollutants are found to be a concern at this site, the selected catch basin filter should address petroleum product removal as well as sediment.

Maintenance is key to the effective use of catch basin filters. Typical maintenance includes trash removal if a screen or other debris-capturing device is used and removal of sediment (often using a vactor truck). Disposal of removed trash and sediment can be complex when pursuing an environmentally acceptable disposal method. Sediment may not always be landfilled, land-applied, or introduced into the sanitary sewer system due to hazardous waste, pretreatment, or ground water regulations (EPA 2009).

A typical catch basin insert will cost between $100 and $2,000. Capital cost for these inserts depends on the level of maintenance possible in the system. If inserts can be changed monthly, an insert from the low end of the price range may be appropriate. If frequent maintenance is not possible, inserts at the high end of the price range are more practical. Installation costs are not included in the pricing for catch basin inserts. The labor may range from less than an hour of unskilled labor for the simple inserts to a full day of skilled labor for the more complex catch basins. The highest pollutant removal costs associated with catch basin filters are long-term maintenance costs.

3.1.2 Influent Stream

A stormwater-infused stream that drains a large section of residential land enters Odiak Pond near the Copper River Highway (Figure 3-1). This stream collects water from a large drainage area to the west and northwest of the pond. As with all the overland flow from the watershed, it carries a variety of NPS pollutants directly into the pond. The site is not ideal for a treatment alternative where the stream enters Odiak Pond. The primary means of addressing this influent source is NPS BMPs. Section 3.4 discusses NPS pollution in more detail. If adjacent roadways are determined to be a major source of pollution and sediment input into this stream, alternatives addressed for Eyak Lake Roadways and Municipal Runway (Section 3.2.2) can be applied.

3.1.3 Old Landfill

A landfill capped in the 1960s exists on the north-northwest side of Odiak Pond (Appendix A, Photo 3). The surface of this landfill is groomed during the summer months for use as a park. While there is no evidence that this landfill is contributing to contamination in Odiak Pond, it is a potential source of contaminants to be aware of while assessing the water quality of the pond.

The following alternatives were considered for addressing possible contamination from this site:

Alternative 1: Monitoring Wells

Installation of three monitoring wells near the old landfill would provide a means to determine if the landfill is a contaminant source and to monitor the landfill in the future. Sampling for standard landfill criteria (including but not limited to metals, volatile organic compounds [VOC], and polychlorinated biphenyls [PCB]) over a 3-year period would provide baseline data for future management.

Cost to install a typical monitoring well is approximately $2,000, not including sample collection and analysis. Local drillers would be less expensive because mobilization charges would be reduced. Water analysis costs would vary depending on frequency and target analytes. Initial samples analyzed for DRO, GRO, VOCs, PCBs, pesticides, and herbicides would cost approximately $1,500 per well. The analyte list may be reduced after the first sample, based on the unique aspects of this landfill.

Alternative 2: Removal of the Landfill

This alternative focuses on the removal or relocation of the landfill from this site. Because the landfill has not been cited as a definitive source of pollution for Odiak Pond, the benefit of this removal would be unknown, and the cost would likely be in excess of $500,000 and could range into the millions, depending on the content and condition of the landfill.

3.1.4 Snow Storage Site

Next to the old landfill at Odiak Pond is a snow storage area (Appendix A, Photo 3). Plowed snow may be laden with contaminants such as sediments, hydrocarbons, organic material, trash, and debris. Similar snow piles have been determined to be a hazard to the environment, especially when directly melted into fresh water (ADOT 2003). As plant and animal life in the pond comes out of winter dormancy, it may be exposed to snow-pile contaminants. The primary means of addressing this meltwater influent source is through snow-storage and NPS BMPs. Section 3.4.2 discusses pollution originating from snow storage in more detail.

3.1.5 Non-Point Source Pollution

The Odiak Pond watershed covers 139 acres, and the stormwater system has multiple outfalls in or near the pond. NPS pollution will be a significant contributing factor in this watershed. Section 3.4 discusses NPS alternatives in more detail.

3.2 EYAK LAKE

Eyak Lake is the largest freshwater body in the Cordova area. The Lake is Y-shaped, with each arm approximately 2.5 miles from the center of the Y. The west arm of Eyak Lake extends slightly into the Cordova city limits and is the primary area reviewed in this study (Figure 3-1). This western section has outfalls from three of the city's watersheds: East Nirvana Watershed, Vina Young/Nirvana Watershed, and South Eyak Lake Watershed. These three watersheds comprise 123 acres of drainage and include culverts, streams, and overland flow along approximately 1 mile of western Eyak Lake shoreline. The drainage area is sloped, with approximately 33-percent developed land, a majority of which is residential.

The Eyak Lake Planning Group, a group of citizens and stakeholders associated with CRWP, advises the community on lake-related issues. Based on site work, background data collection, and discussions with the community and planning group members at meeting on 8 April 2009, the following concerns were analyzed as potential sources of pollution or BMPs for Eyak Lake: Area Meriting Special Attention (AMSA), roadway and municipal runway erosion, Nirvana Park outfall, construction, snow storage, and additional NPS issues (dog waste, abandoned vehicles, fuel tanks, and sediment).

3.2.1 Area Meriting Special Attention

In November 1986, the Eyak Lake AMSA was created by the City of Cordova. The AMSA is defined in Alaska Statute 46.40.210(1) as "a delineated geographic area within the coastal area which is sensitive to change or alteration and which, because of plans or commitments or because a claim on the resources within the area delineated would preclude subsequent use of the resources to a conflicting or incompatible use, warrants special management attention, or which, because of its value to the general public, should be identified for current or future planning, protection, or acquisition."

The Eyak Lake AMSA's Coastal Management Plan provides a way to manage this critical area, even though the bulk of the lake resides outside the Cordova city limits. The AMSA (Appendix B) addresses stormwater issues in multiple enforceable policies.

The following alternatives were considered to address stormwater pollution at this site:

Alternative 1: Use the Enforceable Policies Put Forth by the Eyak Lake AMSA

If enforced with regard to stormwater runoff, Eyak Lake AMSA policies would positively impact the drainage areas. The Eyak Lake AMSA's Coastal Management Plan gives the City of Cordova authority to review any state and federal permit issued within the AMSA, including construction general permits allowing the city to ensure BMPs are implemented and maintained at construction sites in the area. Costs for this alternative include time and effort to enforce these policies by the City Council and local stakeholders. The Eyak Lake Planning Group and CRWP can provide service announcements, brochures, and watchdog services to heighten awareness of these enforceable policies and to review development plans to ensure the policies are being implemented. The benefit of this alternative is that the policies are already in place.

Alternative 2: Updating Policies and Continued Active Management

The AMSA was drafted in 1986, and new situations or needs may have developed since then. The benefit of updating the policies is unknown at this time because of the intricacies of local government and community interaction. The cost associated with this would be considerable time and effort by watershed groups, citizens, committees, City Council, and stakeholders in the Cordova area.

3.2.2 Roadway and Municipal Runway Erosion

Lake Avenue, Power Creek Road, and the airport runway run adjacent to the north shore of Eyak Lake. There is little vegetation and natural filtration between the road and the lake, and as a result, sediment and road pollutants can flow directly into the water. The primary concern for this area of the lake is sediment, debris, and petroleum loading into Eyak Lake. Road sand is applied by the city and ADOT to provide better traction on snow and ice during wintertime. Section 3.4 further discusses sedimentation.

The following alternatives were considered for addressing sediment contamination at this site:

Alternative 1: Chemical Stabilizer

This alternative focuses on structural BMPs for removal of dirt, gravel, and debris prior to dispersal to Eyak Lake and maintenance practices to prevent sediment loading due to erosion.

The application of chemical stabilizer such as polyacrylamide (PAM) may reduce sediment erosion into Eyak Lake by providing temporary soil stabilization. PAM can be sprayed onto the surface of exposed soil, including roadways, to hold the soil in place and minimize erosion from runoff and wind. PAM is easily applied to the surface of the soil and can provide immediate protection (EPA 2009). The effectiveness of PAM application ranges from 70 to 90 percent. The effectiveness of PAM depends on soil type, application method, and the polymer's individual chemical characteristics. It will not be effective against any mechanical means of soil movement, including road grading. PAM is intended for application directly to soil and is not intended for use in conjunction with chip-sealing. PAM costs between $4 and $35 per pound; one pound can stabilize approximately 1 acre of land. PAM must be reapplied when visible signs of erosion appear. Lifecycle for reapplication is highly dependent on the disturbance of the soil (EPA 2009).

Alternative 2: Seeding

This alternative focuses on structural BMPs for removal of dirt, gravel, and debris prior to dispersal to Eyak Lake. Seeding is used to control runoff and erosion on disturbed areas by establishing perennial vegetative cover or vegetated filter strip. Seeding roadsides provides a vegetative strip to assist in the filtration of sediment and other pollutants from the sheet flow off of the road before it can reach a water body. It reduces erosion and sediment loss and provides permanent stabilization. This practice is economical, adapts to different site conditions, and allows selection of a variety of plant materials (EPA 2009).

Vegetation controls erosion by protecting bare soil surfaces from displacement by raindrop impacts and by reducing the velocity and quantity of overland flow. Seeding's advantages over other means of establishing plant cover include lower initial costs and labor needs. The effectiveness of seeding can be limited by high erosion during establishment, the need to reseed areas that fail to establish, limited seeding times, or unstable soil temperature and soil moisture content during germination and early growth. Seeding does not immediately stabilize soil; therefore, temporary erosion and sediment control measures are recommended to prevent pollutants being transported offsite during seed establishment (EPA 2009).

Perennial vegetative cover from seeding has been shown to remove between 50 and 100 percent of total suspended solids from stormwater runoff, with an average removal of 90 percent. The typical Alaskan roadside seed mix includes the following:

- Red fescue
- American sloughgrass
- Bering hairgrass
- Tufted hairgrass
- Polargrass
- Bluejoint
- Tilesy sagebrush
- Glaucous bluegrass
- Alpine bluegrass

- Kentucky bluegrass
- Beach wildrye
- Annual ryegrass
- Perennial ryegrass

Seeding costs range from $200 to $1,000 per acre and average $400 per acre. This price includes application but does not include any watering to promote initial growth. A water truck may be necessary. Maintenance costs range from 15 to 25 percent of initial costs and average 20 percent. Maintenance for seeded areas will vary depending on the level of use expected. Native species that are adapted to local weather and soil conditions reduce water and fertilizer input and lower maintenance overall (EPA 2009).

Alternative 3: Road Maintenance Practices

This alternative focuses on maintenance BMPs for removal of dirt, gravel, and debris prior to dispersal to Eyak Lake. Some maintenance practices can significantly reduce the pollutants introduced into the stormwater system.

Streets, roads, highways, and parking lots accumulate significant amounts of pollutants that contribute to stormwater pollutant runoff to surface waters. Pollutants, including sediment, debris, trash, road salt, and trace metals can be minimized by street sweeping. Effective street sweeping programs can remove several tons of debris a year from city streets, minimizing pollutants in stormwater runoff. In colder climates, street sweeping can be used during spring snowmelt to reduce pollutants in stormwater runoff from road salt, sand, and grit (EPA 2009).

An effective municipal street sweeping program focuses on schedule, storage/disposal, and reuse. Designing and maintaining a street sweeping schedule can increase the efficiency of a program. Street sweeping is recommended as soon as possible after the snow melts. Special care should be taken to focus on those roadways with land uses that would show high pollutant concentrations and those roadways that have consistently accumulated proportionately greater amounts of materials over winter. Storage locations should be equipped with secondary containment and possibly overhead coverage to prevent stormwater runoff from contacting the piles of sweepings. The piles of sweepings should be covered with tarps to prevent generation of excessive dust. Although sweepings may contain pollutants, federal and state regulations may allow the reuse of sweepings for general fill, parks, road shoulders, and other applications as long as the material is not a threat to surface waters. Reuse of the material prevents entrance into a water body (EPA 2009).

Street sweeping programs are limited by costs. The capital cost for a new vacuum-style sweeper approaches $180,000 plus additional cost for operations and maintenance (EPA 2009). Costs to maintain sweeping schedules, storage, disposal, and reuse of collected materials would fall within the City of Cordova's operating budget.

3.2.3 Nirvana Park Outfall

The Nirvana Park Outfall discharge flow from the Vina Young/Nirvana Park watershed and stormwater system. The primary concern for this area is sediment, debris, and petroleum loading into Eyak Lake. The City of Cordova plans to add additional stormwater lines from a system installed in the drainage ditches in the Vina Young area to divert pollutants into the existing stormwater outfall system at Nirvana Park. These new outputs would also be addressed under the treatment alternatives considered.

A snow storage site is located next to Nirvana Park, near the outfall. During the site visit, the outfall was inaccessible due to a large snow storage mound that appeared to include debris and sediment (Appendix A, Photo 4). Sediment may not be just sand; it may be laden with contaminants from the street, parking lots, and other sources condensed into a small area at the snow pile, which edged out to the lake ice and covered the three large culverts in their entirety. Soluble contaminants tend to exit the snow pack early in the melt season, creating a time-varied concentration release of contaminants while the less soluble contaminants remain until the later phases. These contaminants adsorb to the sediments, adhere to the surface of the snow pack, and are often flushed all at once during a rain event later in the melt season (ADOT 2003).

The following alternatives were considered for addressing pollutants at this site:

Alternative 1: Hydrodynamic Separator

This alternative focuses on structural BMPs for removal of dirt, gravel, and debris prior to dispersal to Eyak Lake. The Nirvana Park outfall connects to the stormwater drains along Lake Road and discharges directly into Eyak Lake. The addition of a hydrodynamic separator upgradient to this outfall may limit debris, sediment, and petroleum loading into Eyak Lake.

Hydrodynamic separators are flow-through structures used to remove pollutants from stormwater. Depending on the type of unit, separation may be by means of swirl action or indirect filtration. Hydrodynamic separators come in a wide size range, some small enough to fit in conventional manholes. They are ideal for areas where land availability is limited or for use in potential storm water hot spots (EPA 2009).

Stormceptor® is a brand of hydrodynamic separator that has been used in Alaska and is designed to trap and retain a variety of NPS pollutants using a by-pass chamber and treatment chamber. Stormceptor® reports that it is capable of removing 50 to 80 percent of the total sediment load when used properly (EPA 2009). Stormceptor units range from 900 to 7,200 gallons and cost between $7,600 and $33,560, not including installation. A unit on the small end of this range would likely be the best fit for the Nirvana Park outfall. Installation cost is highly dependent on the resources and heavy equipment available for the work, whether City of Cordova workers are available to install the system or if a private contractor is needed to perform the installation. City of Cordova stormwater managers would be able to make the best cost estimate for installation based on local resource availability.

The need for maintenance of hydrodynamic separators is indicated by sediment depth; typically, when the unit is filled to within 1 foot of capacity, it should be cleaned. Typical maintenance includes removal of sediment, with costs similar to those of maintaining a catch basin. Most commonly a vactor truck, a piece of equipment with a large vacuum used for sewer and stormwater cleaning, is used for sediment removal. The cost of a new vactor truck ranges from $125,000 to $150,000, or $30,000 to $70,000 for a small vacuum trailer, but the city likely already owns this type of equipment. Regular visual inspections are recommended for units that may capture petroleum-based pollutants. Visual inspection is accomplished by removing the manhole cover and using a dipstick to determine the petroleum or oil accumulation in the unit (EPA 2009).

Alternative 2: Retention Pond

This alternative focuses on structural BMPs for removal of dirt, gravel, and debris prior to dispersal to Eyak Lake. The addition of a retention pond downgradient of this outfall may filter out sediment and petroleum loading into Eyak Lake.

Retention ponds are constructed basins that have a permanent pool of water throughout the year (or at least throughout the wet season). Ponds treat incoming stormwater runoff by allowing particles to settle and plants to take up nutrients. The primary removal mechanism is settling of sediment as stormwater runoff passes through into the pool; pollutant uptake, particularly of nutrients, also occurs through biological activity in the pond (EPA 2009).

Siting considerations for retention-pond construction include evaluation of flow to ensure the pond is large enough to retain stormwater before discharge and elevation drop from the pond inlet to the pond outlet to ensure that water can flow through the system. Ponds should be designed with a length-to-width ratio of at least 1.5:1 as well as features to lengthen the flow path through the pond, such as underwater berms designed to create a longer route through the water. Combining these two measures helps ensure that the entire pond volume treats stormwater. A vegetated buffer with shrubs or trees around the pond area can provide shading and consequent cooling of the pond water as well as protect the banks from erosion and provide some pollutant removal before runoff enters the pond by overland flow. Retention ponds should incorporate an aquatic bench (i.e., a shallow shelf with wetland plants) around the edge of the pond. This feature may provide some pollutant uptake, stabilize soil at the edge of the pond, and enhance habitat and aesthetic value (EPA 2009).

Cost for retention-pond construction is approximately $45,700 for a 1-acre-foot facility, including design and construction costs. One acre-foot or less appears to be a sufficient size to accommodate loading at the Nirvana Park outfall. Maintenance of retention ponds primarily focuses on inspection and maintenance of sediment load and removing any invasive vegetation. The annual cost of routine maintenance for retention ponds is estimated at 3 to 5 percent of the construction cost (EPA 2009).

3.2.4 Construction

Several subdivisions and construction sites located within the watershed area near Eyak Lake. Per EPA regulation (Section 1.5.3), construction sites that disturb greater than 1 acre of land require a Construction General Permit through the NPDES program. During the April site visit, construction sites that could benefit from temporary stormwater management BMPs were observed on the north side of the lake (Appendix A, Photo 5). Construction areas had cut banks that leaked water, causing small mud stream flows downgradient.

The following alternatives were considered for addressing the pollutants in the area:

Alternative 1: Construction Best Management Practices

This alternative focuses on source-control BMPs associated with construction site runoff for temporary mitigation of construction-based contaminants. Such BMPs include the use of straw bales, terracing, silt fencing, buffer strips, and other items that may be associated with the construction site's SWPPP. The following practices may assist in controlling construction runoff (EPA 2004):

- Divert stormwater away from disturbed or exposed areas of the construction site.
- Install BMPs to control erosion and sediment and manage stormwater.
- Inspect the site regularly and properly maintain BMPs, especially after rainstorms.
- Revise the SWPPP as site conditions change during construction and improve the SWPPP if BMPs are not effectively controlling erosion and sediment.
- Minimize exposure of bare soil to precipitation to the extent practicable.
- Keep the construction site clean by putting trash in trash cans, keeping storage bins covered, and sweeping up the excess sediment on roads and other impervious surfaces.

Costs associated with construction BMPs are highly variable, depending on what techniques are selected. Temporary erosion and sediment BMPs such as silt fences, straw bales, or filter rolls range from $5 to $10 per linear foot. Other controls are incorporated into the planning and labor associated with construction.

<u>Alternative 2: City-Managed SWPPP Reviews</u>

This alternative focuses on using local government to assist with the management and enforcement of SWPPPs (Appendix C). A city ordinance requiring reviews of SWPPPs would allow local review of each plan to ensure community goals for the protection of local habitat and minimization of stormwater runoff are met. City officials or local stakeholders, such as the Eyak Lake Planning Group, could review SWPPPs and provide input on plans to the state. By utilizing this alternative, local government would have control of the construction areas if a problem arises.

3.2.5 Snow Storage

Limited space makes snow storage difficult in Cordova. During the site visit, a snow storage pile was observed partially on the shore and partially pushed onto the ice of Eyak Lake near the Nirvana Park outfall. Other small piles were visible around the lake's shore (Appendix A, Photo 6). Sediment- and debris-entrained snow can be laden with contaminants and may pose a hazard to the environment, especially when directly melted into fresh water. Plant and animal life coming out of winter dormancy in the water body will be exposed to these contaminants (ADOT 2003). The primary means of addressing this meltwater influent source is through the snow storage and NPS pollution BMPs. Section 3.4.2 discusses pollution originating from snow storage in more detail.

3.2.6 Non-Point Source Pollution

The NPS pollution aspect is critical for this western section of Eyak Lake in that the drainage area covers a large developed area and the stormwater system has multiple outfalls in the lake. The NPS issues that were considered for this area are snow storage, sediment, fuel tanks, abandoned vehicles, trash/debris, and dog waste. Section 3.4 discusses these NPS alternatives in more detail.

3.3 ORCA INLET

Orca Inlet is the Cordova's primary marine water body and has five associated watersheds: North Fill, Old Harbor, South Fill/New Harbor, High School, and Odiak Slough. These areas encompass approximately 265 acres of drainage, 63 percent of which is developed land. This drainage area has approximately 2.2 miles of shoreline with outfalls and watershed drainage, including culverts, streams, and overland flow. North Fill has dispersed runoff and only one known outfall, near the city impound lot. Old Harbor has four outfalls, and High School watershed has outfalls in the small estuary area between the High School and South Fill/New Harbor watersheds. An organized stormwater system throughout South Fill/New Harbor collects stormwater into underground piping and routes it to a 6-foot outfall pipe that discharges into Orca Inlet, off the end of Nicholoff Way. Many urban point and non-point issues are associated with this area's stormwater system. Sources of pollution in Orca Inlet analyzed in this report include main stormwater outfall, urban pollution, stormwater system design, and NPS pollution.

3.3.1 Main Stormwater Outfall

The main stormwater outfall (6-foot culvert) is the discharge point for much of the stormwater collected in the city of Cordova (Appendix A, Photo 7). The proposed stormwater system upgrade encompasses most of downtown Cordova as well as residential and industrial lands. The primary concerns for the area are sediment, debris, and petroleum loading.

The following alternatives were considered for addressing the issues associated with this site:

<u>Alternative 1: Hydrodynamic Separator</u>

This alternative focuses on structural BMPs for removal of dirt, gravel, and debris prior to dispersal to Orca Inlet. The addition of a hydrodynamic separator upgradient of the 6-foot culvert may limit debris, sediment, and petroleum loading into Orca Inlet. This alternative is similar in concept to that presented in Section 3.2.3 (Nirvana Park Outfall Alternative 1). As in the previous alternative, maintenance costs will include the use and/or purchase of a vactor truck. Because of the size of the piping in this portion of the stormwater system, a large hydrodynamic separator would be required, with cost approaching $20,000 to $30,000 plus installation fees. Installation cost is highly dependant on the resources and heavy equipment available for the work and whether City of Cordova workers are available to install the system or a private contractor is needed to perform the installation. Additionally, limited space may require digging into the roadway to access the stormwater system, increasing the installation costs for this alternative.

<u>Alternative 2: Catch Basin Filters</u>

This alternative focuses on structural BMPs to address the removal of dirt, gravel, and debris prior to dispersal to Orca Inlet. Numerous storm drains are present in this watershed. The addition of catch basin filters to some or all of these drains may limit the sediment entering Orca Inlet. This alternative is similar in concept to that presented in Section 3.1.1 (Cordova Hospital Parking Lot Alternative 2). The selection of drains for the addition of filtration should be based on load and contaminants present. Parking lots and curbs on high-traffic roads will likely have high pollutant loading.

A typical catch basin insert costs between $100 and $2,000. If inserts can be changed monthly, inserts from the low end of the price range may be appropriate for these drains to keep installation costs at a minimum. Maintenance is key, and the true pollutant removal cost associated with catch basins is the long-term maintenance cost.

3.3.2 Urban Pollution

Orca Inlet receives much of the urban stormwater from the city of Cordova. Many sources contribute to sediment, debris, and other pollutant loading in the stormwater, including roadways, commercial and residential buildings, parking lots, and sidewalks.

The following alternatives were considered for addressing these urban pollutants:

Alternative 1: Vegetative Buffers

As in many urban environments, the city of Cordova has limited vegetation throughout downtown and the industrial areas near the harbor. Vegetative buffers are vegetated surfaces designed to treat sheet flow from adjacent surfaces by slowing runoff velocities, filtering out sediment and other pollutants, and providing infiltration into underlying soil (EPA 2009).

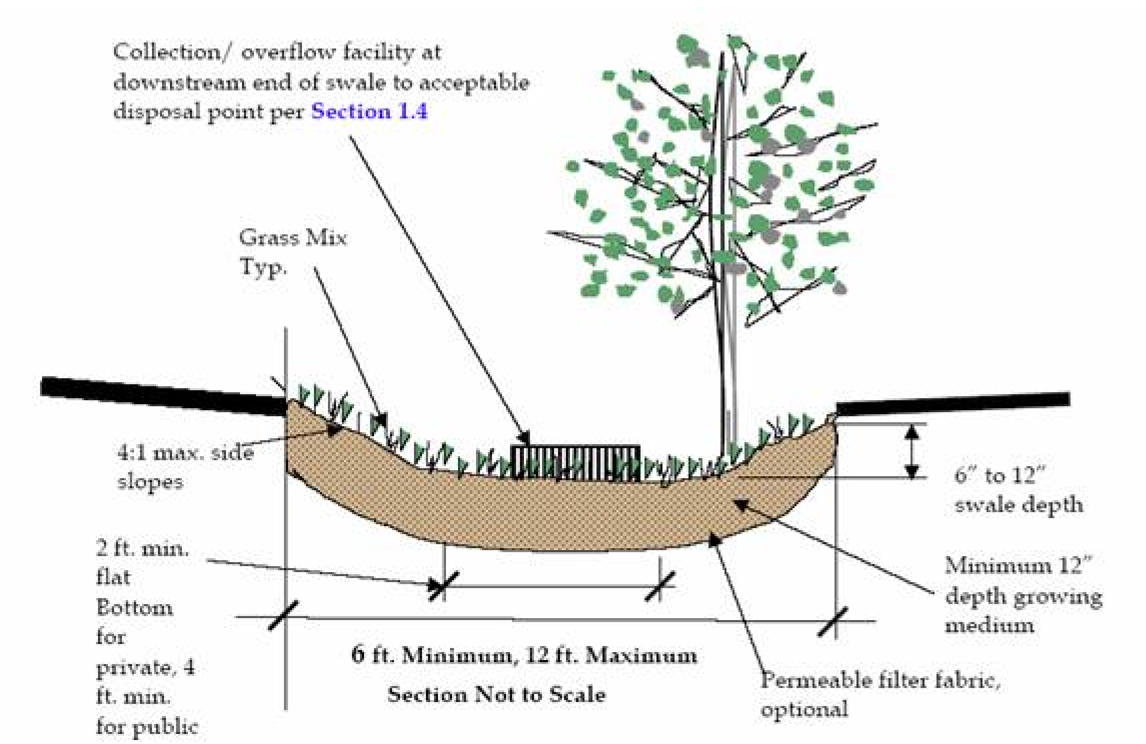

Figure 3-2 Typical Design for an Urban Vegetative Buffer

Source: City of Portland, 2009

Vegetative buffers are simple to design and install but can be difficult to site because of the amount of space required for installation. Typically, vegetative buffers are used to treat small drainage areas, such as roads and highways, roof downspouts, small parking lots, and pervious surfaces. The limiting design factor is not the drainage area the buffer treats but the length of flow leading to it. As stormwater runoff flows over the ground's surface, it changes from sheet flow to concentrated flow. Rather than moving uniformly over the surface, concentrated flow forms rivulets that are deeper and cover less area than sheet flow. When flow concentrates, it moves too rapidly to be effectively treated by a buffer. As a rule, flow concentrates within a maximum of 75 feet for impervious surfaces and 150 feet for pervious surfaces (EPA 2009).

Figure 3-3 Example of Urban Vegetative Buffer in Anchorage

Source: City and Borough of Juneau and U.S. Fish and Wildlife Service, 2008

Other design considerations include buffer slope and soil. Buffers should be designed on slopes between 2 and 6 percent. Slopes greater than this encourage the formation of concentrated flow. Except in the case of very sandy or gravelly soil, runoff ponds on the surface of slopes flatter than 2 percent. Filter strips should not be used on soils with high clay content because they require some infiltration for proper treatment. Poor soil that cannot sustain a grass cover crop is also a limiting factor (EPA 2009).

The construction cost of vegetative buffers is highly variable, depending on components. A rough estimate can be the cost of seed (approximately 30¢ per square foot) or sod (approximately 70¢ per square foot). Typical maintenance costs are about $350 per acre per year and may overlap with regular landscape maintenance costs (EPA 2009).

Alternative 2: Chemical Stabilizer

The application of chemical stabilizer such as PAM may reduce sediment erosion from roadways into the stormwater system and thus minimize sediment and pollutant loading into Orca Inlet. This alternative follows the same practices presented in Section 3.2.2 (Eyak Lake Roadway and Municipal Runway Alternative 1). Costs are $4 to $35 per acre.

Alternative 3: Seeding

The addition of seeding to roadsides can assist in the reduction of sediment and other pollutants. Like vegetative buffering, seeding can dramatically reduce pollutant loading into stormwater by allowing filtration of the stormwater. This alternative follows the same practices presented in Section 3.2.2 (Eyak Lake Roadway and Municipal Runway Alternative 2).

Alternative 4: Road Maintenance Practices

This alternative focuses on maintenance BMPs for removal of dirt, gravel, and debris prior to dispersal to Orca Inlet. Some maintenance practices can significantly reduce the pollutants introduced into a stormwater system. This alternative follows the same practices presented in Section 3.2.2 (Eyak Lake Roadway and Municipal Runway Alternative 3) and can additionally incorporate practices from Section 3.2.6 (Snow Storage).

3.3.3 Stormwater System Design

Until recently, Cordova's stormwater system plans had not been upgraded in approximately 20 years. Through a grant and volunteers, a set of plans outlining the stormwater system was developed in 2008. Because of the high volume of annual precipitation (approximately 167 inches) and heavy storm events, Cordova's stormwater system faces many challenges. Observations by community members indicate that the flow produced by this heavy rainfall causes a problem with the stormwater drain in the Post Office parking lot (Alexander 2009).

The flow volume to the stormwater grate in the Post Office parking lot is too great to be accommodated by the piping system currently in place. To address this concern and limit the addition of more sediment and contaminants to the stormwater system, the configuration and pipe size should be adjusted to accommodate the flow rates seen during storm events. This will likely include a gradual transition in direction and increased pipe size at this location. Such adjustments will not address any pollutants that have already accumulated in the stormwater system but will limit flooding and, thus, the introduction of large amounts of sediment and other pollutants entering the system in the stormwater.

Costs associated with this reconfiguration are dependant on the changes necessary and the resources available. A cost estimate of this repair is best performed after further research of the issue and with an understanding of the equipment and personnel available to perform the work.

3.3.4 Non-Point Source Pollution

NPS urban, commercial, and industrial pollution is the major contributor of pollutants to Orca Inlet. The NPS issues addressed for this section are snow storage, sediment, fuel tanks, junk cars, and trash/debris. Section 3.4 discusses these NPS alternatives in more detail.

3.4 COMMUNITY-WIDE NON-POINT SOURCE POLLUTION

NPS pollution is the leading cause of water quality degradation. Addressing this type of pollution is rarely straightforward and often consists of public education efforts.

3.4.1 Road Maintenance and Sedimentation

Cordova has 14.7 miles of roadway, approximately 4.5 miles of it paved, and a recent grant from the Denali Commission enabled 0.45 miles of chip-sealing on the community's roads. Chip-sealing reduces sediment loading for stormwater and provides a compromise between costly paving and dusty gravel roads. Studies have indicated possible cause for concern about the release of hydrocarbons on chip-sealed roads as the chip-sealing erodes.

ADOT personnel estimated that approximately 7,000 cubic yards of sand was used on area roads for traction this past winter by ADOT and the city (Mattson 2009). Discussion with community members indicated that the quantity of sand, while appearing extreme after snowmelt, seemed to fit the needs of the community throughout the winter months (Appendix A, Photo 8). Community members also indicated a preference for no salt or chemical near the water bodies. Effective street sweeping and maintenance is a critical part of Cordova's stormwater management.

The following alternatives were considered for addressing sediment pollution at this site:

<u>Alternative 1: Chemical Stabilizer</u>

The application of chemical stabilizer such as PAM may reduce sediment erosion from roadways into the stormwater system and thus minimize sediment and pollutant loading into Orca Inlet. This alternative follows the same practices presented in Section 3.2.2 (Eyak Lake Roadway and Municipal Runway Alternative 1). Costs are $4 to $35 per acre.

Alternative 2: Chip-Sealing and Vegetative Buffers

If additional chip-sealing is applied to roadways to reduce erosion and to meet other surface needs, such as ease of maintenance, then vegetative buffers may be employed to address additional runoff. Vegetative buffers (Section 3.3.2, Urban Pollution Alternative 1) may not be able to uptake substantial hydrocarbon pollution that runs off of chip-sealed areas. A rough estimate for the cost of seed or sod is, respectively, approximately 30¢ or 70¢ per square foot.

Alternative 3: Street Maintenance Plan

Road maintenance practices are an effective BMP for roadway-related contaminants (Section 3.4.1). An effective municipal street-sweeping program focuses on schedule, storage/disposal, and reuse. A comprehensive plan should affect a reduction in petroleum-related contamination, sedimentation, and metal pollution into receiving water bodies. Costs for plan development are associated with the labor required for plan development and are dependant on resources available.

3.4.2 Snow Storage

Disposing of or storing snow on water bodies does not comply with Alaska regulations (Section 1.5). This action is only allowed with an emergency permit, and storage must be on a marine water body. Snow storage on freshwater bodies is not permitted due to the water bodies' low tolerance to chloride, potential for sedimentation, and potential for stagnation or meromixis where there is permanent stratification in the water body (ADOT 2003).

A comprehensive snow storage plan can be used to address sediment and debris loading via snow contamination into local water bodies. Educational BMPs on the benefits of proper snow storage and problems with improper storage are an important component of this alternative. Snow storage areas should be established away from water bodies, preferably with a vegetative buffer, silt fence, or other sediment-catching device between the snow storage pile and the receiving water body (ADOT 2003). General environmental guidelines for snow storage sites include:

- The longer snow stays near the roadway, the more polluted it becomes.
- Snow from high-traffic areas becomes more polluted than snow from low-traffic areas.
- Placing snow on the downhill portion of storage sites and working uphill reduces meltwater pollution.
- Placing snow in a single larger pile, rather than multiple small piles, reduces meltwater pollution.
- Annual cleanup of trash and debris reduces incidence of trash complaints.
- Driving (and turning sharply with equipment) on pad surfaces can increase pollution in meltwater. Impacts are lessened when the ground is frozen.
- If a site has pollution-reducing features (ponds, berms, etc.), a management plan should be made for the site.
- Site grading can agitate deposited sediment and pollute runoff. Avoid grading unless hazards or large channels develop on the pad.

3.4.3 Residential Area

Residential areas have many NPS contaminants, such as sediment, fertilizers, pesticides, herbicides, trash/debris, waste fuels, and dog waste.

The following alternatives were considered for addressing NPS pollutant loading from residential areas:

Alternative 1: Education and Public Relations Campaign

This alternative focuses on educational BMPs for public outreach. The community should continue current educational outreach activities and strategize additional ways to get pollution-prevention messages to the community. Awareness of a problem and the potential impacts to the community can affect change in individual behaviors regarding waste disposal and thus contributions to NPS pollution.

Stormwater educational outreach should be continued at grade schools where CRWP personnel have workshops with the students once per month. The students are collecting valuable data on a monthly basis that can be used for future comparison. For example, third graders have been recording water-quality data such as temperature, pH, and turbidity as well as land issues such as existence of dog waste and trash.

As well as being a public nuisance, dog waste can introduce fecal coliform and diseases into local water bodies. Educational BMPs for public education and outreach could focus on how to address dog waste in local watersheds. Citizen groups could use a public service campaign similar to Anchorage Waterways Council's "Scoop the Poop" program (Anchorage Waterways Council 2009).

Alternative 2: Ordinances

Subdivision and city ordinances can be used to encourage "good housekeeping" techniques for residents. The BMPs listed in Section 2.0 could be incorporated into a city ordinance requiring proper disposal of trash, dog waste, and motor oil. State of Alaska guidelines for fuel tanks could contribute to ordinances for private storage tanks (ADEC 1999, 2009c).

3.4.4 Abandoned Vehicles

Abandoned vehicles can release fuel, metal, and other contaminants into surrounding water bodies. Volunteer groups or city maintenance workers can inventory, drain, and remove abandoned vehicles near the Cordova watersheds. Citywide volunteer cleanups can reduce the number of abandoned cars in the area.

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4.0 CONCLUSIONS AND RECOMMENDATIONS

Problem areas have been identified in association with stormwater loading into Odiak Pond, Eyak Lake, and Orca Inlet in the Cordova area. Section 3.0 presents possible alternatives for each of these issues. Table 4-1 provides a summary and analysis of these alternatives.

Table 4-1
Summary and Analysis of Alternatives

Problem Area/Issue	Solution Alternatives	Analysis
Odiak Pond		
Cordova Hospital Parking Lot	Volunteer parking lot cleanup	\$200-\$1,000 annually. May not catch runoff at the correct time. Would likely not affect petrogenic source of sheen unless a street sweeper was used.
	Catch basin filter	\$100-\$2,000 for capital cost. Installation cost depends on the complexity of the system selected. True cost lies in long-term maintenance of the system. Disposal of trash and sediment may be costly.
Influent Stream Near Highway	NPS pollution BMPs	Sections 3.4 (NPS) and 3.2.2 (Eyak Lake Roadways and Municipal Runway)
Old Landfill	Install monitoring wells	\$6,000 to install and develop three wells. Analytical sampling costs for landfill monitoring would be approximately \$1,500 per well for the first analysis before analytes could be eliminated.
	Remove landfill	High cost (estimated \$500,000 to several million). Site is not known to be a source of pollution, so the benefit of removal is unknown.
Snow Storage Sites	NPS pollution BMPs	Section 3.4.2
NPS Pollution	NPS pollution BMPs	Section 3.4
Eyak Lake		
AMSA	Use enforceable AMSA policies	Cost includes time and effort by City Council and local stakeholders and possible watershed groups and citizen committees. Benefit is to use policies already in place.
	Update policies in AMSA, continue active management	Cost includes time and effort by watershed groups, citizen committees, City Council, and local stakeholders. Benefit is to renew and focus attention on a sensitive area important to the community.
Roadways and Municipal Runway	PAM application	\$4-\$35/acre. Benefit in reducing erosion from runoff. Not effective against road grading or other mechanical causes of erosion.
	Roadside seeding	\$400/acre, on average. Maintenance costs average 20% of initial cost. Use of native species will minimize maintenance costs. Can remove 90% of solids from stormwater runoff but does not control the source. May be used in conjunction with chip-sealing to minimize pollutant runoff.
	Road maintenance practices	\$180,000 for new vacuum-style street sweeper. Sweeping can remove several tons of debris, dirt, and sand from roads per year. Most of the cost falls to the city operating budget to maintain sweeping schedules, storage, disposal, and reuse of collected materials. Storage areas must include BMPs to contain/minimize runoff at storage site.

Table 4-1
Summary and Analysis of Alternatives
(continued)

Problem Area/Issue	Solution Alternatives	Analysis
Nirvana Park Outfalls	Hydrodynamic separator	$7,600-$33,560, depending on volume of runoff. Small, lower-priced unit may be applicable. Effective in removing 50-80% of sediment and may be a good choice for sensitive receiving waters. Installation and maintenance costs are not captured in capital costs. An additional $30,000 to $150,000 may be incurred if no vactor truck is available for maintenance.
	Retention pond	$45,700 for design and installation of 1-acre-foot facility. Annual maintenance costs average 3-5% of initial cost. Location would support a pond of adequate size. Water feature with associated aesthetic value may be preferable to mechanical feature.
Construction	Construction BMPs	Construction sites of any size can follow BMPs to reduce runoff, but only sites >1 acre are required to implement these by regulation.
	City-managed SWPPP reviews	Cost would include time and effort by watershed groups, citizen committees, and/or City Council to review proposed SWPPPs for construction sites. Benefit is to have local stakeholders reviewing the plans and providing enforcement for BMP implementation.
Snow Storage Sites	NPS pollution BMPs	Section 3.4.2
NPS Pollution	NPS pollution BMPs	Section 3.4
Orca Inlet		
Main Stormwater Outfall	Hydrodynamic separator	Approximately $20,000-$30,000 plus installation costs likely, involving removing and replacing a section of roadway. Additional costs if no vactor truck is available.
	Catch basin filters	$100-$2,000 for capital cost. Installation cost not included. Low-cost filters are preferred for ease of maintenance but require more frequent maintenance. Number of filters needed should be determined by sediment loading. Disposal of trash and sediment may be costly.
Urban Pollution into Stormwater System	Vegetative buffers	$0.30-$0.70/square foot plus installation costs for any area where sheet flow is less than 75 feet long on impervious surface. Maintenance costs are approximately $350/acre/year but may be combined with other landscape maintenance. Benefits are relatively low cost and aesthetic benefits in town.
	PAM application	$4-$35/acre. Benefit in reducing erosion from runoff. Not effective against road grading or other mechanical causes of erosion.
	Roadside seeding	$400/acre, on average. Maintenance costs average 20% of initial cost.
	Road Maintenance Practices	Section 3.4.1
Stormwater System Design	Redesign system at Post Office	Engineering design plans not clear, and total cost is unknown.
NPS Pollution	NPS pollution BMPs	Section 3.4
Community-Wide NPS Pollution		
Road Maintenance and Sedimentation	PAM application	$4-$35/acre. Benefit in reducing erosion from runoff. Not effective against road grading or other mechanical causes of erosion.
	Chip-sealing and vegetative buffers	$0.30-$0.70/square foot plus installation costs for any area where sheet flow is less than 75 feet long on impervious surfaces. Benefits are relatively low cost and aesthetic benefits in town.
	Compile and utilize citywide, municipal,	Cost includes time and effort by watershed groups, citizen committees, City Council, and local stakeholders.

Table 4-1
Summary and Analysis of Alternatives
(continued)

Problem Area/Issue	Solution Alternatives	Analysis
	and ADOT street maintenance plan	
Snow Storage Sites	Compile and utilize citywide, municipal, and ADOT snow removal and storage plan	Cost includes time and effort by watershed groups, citizen committees, City Council, and local stakeholders.
Residential Areas	Education and public relations campaign	Cost includes time and effort by watershed groups and citizen committees.
	Ordinances	Cost includes time and effort by City Council and local stakeholders.
Abandoned Vehicles	Education, inventory, and cleanup	Will reduce the number and impact of abandoned cars.

Note: For definitions, see the Acronyms and Abbreviations section.

Based on the analysis of alternatives, recommendations for Odiak Pond, Eyak Lake, Orca Inlet, and community-wide NPS pollution were developed (Sections 4.1 to 4.4). The mitigation procedures selected for each problem area or issue were selected based on a balance of key criteria for performance. These criteria include effectiveness of the alternative, ease of implementation, severity of the potential problem/impact to the watershed, and cost of implementation.

4.1 ODIAK POND RECOMMENDATIONS

Four main problem areas were identified for Odiak Pond and recommendations developed for each of these areas. In addition, the recommendations provided in Section 4.4 can be implemented to improve the quality of water discharged into Odiak Pond.

Discharge into Odiak Pond from the hospital parking lot appears to adversely affect water quality at the outfall. Sampling is recommended for the outfall to determine if any petroleum-related products are being discharged into the pond. Once the pollutant type has been identified, the installation of a catch basin filter to the drain in the hospital parking lot is recommended to assist in pollutant capture. The system can be installed with low capital costs if regular maintenance is possible.

The influent stream upgradient of Odiak Pond is not in an ideal location for a treatment option. The stream drains a large residential area. Educational BMPs and road maintenance are the best options for this influent source.

The close proximity of the Old Landfill to Odiak Pond suggests that the landfill may be a source for pollutants. The main concern at this time is public perception unless the presence of contaminants in the landfill can be confirmed. Installation of monitoring wells is recommended if there is evidence of contaminants in Odiak Pond, but this should be considered a low priority for the Odiak Pond area as a whole.

Sediment and entrained debris from snow storage sites should be managed by provision of alternative snow storage areas and the use of construction-type BMPs, such as silt fencing around snow storage areas.

4.2 EYAK LAKE RECOMMENDATIONS

Five main problem areas were identified for Eyak Lake and recommendations developed for each. In addition, the recommendations in Section 4.4 can be implemented to improve the quality of water discharged into Eyak Lake.

The AMSA lists enforceable policies for the Eyak Lake area. These policies should be reviewed and updated, and the efforts of the active Eyak Lake Planning group should be used to provide input into the implementation of these policies.

Erosion from roadways and the municipal runway should be addressed by reducing the erosion potential of the roadway, thereby treating the source of pollution. PAM application would reduce erosion but may not meet needs for other surface uses. If the community decides to apply chip-sealing, roadside seeding alternative is preferable as it may provide a vegetative buffer for potential hydrocarbon runoff.

The Nirvana Park outfall can support a retention pond. This alternative has a greater aesthetic appeal than the hydrodynamic separator, but both options have maintenance costs, installation requirements, and other considerations that must be weighed.

To address construction concerns, the city or other citizens group given authority through ordinance should review submitted SWPPPs to ensure they meet community goals for pollution control.

Sediment and entrained debris from snow storage sites are a concern for Eyak Lake, and the recommendations for Odiak Pond apply to this location.

4.3 ORCA INLET RECOMMENDATIONS

Pollution input at Orca Inlet is generally related to urban sources. The overall best approach would need to be discussed by the community. Combining alternatives, such as catch basin filters, vegetative buffers, and parking lot and roadway sweeping, may provide the best solution. If pollution input cannot be controlled, a hydrodynamic separator can be installed to treat accumulated pollutants before they are discharged to the inlet.

4.4 COMMUNITY-WIDE NON-POINT SOURCE RECOMMENDATIONS

A community-wide road maintenance plan addressing municipal and state roadways would be beneficial. Such a plan could address a combination of the suggested alternatives, such as PAM, chip-sealing, and vegetative buffers or scheduled street sweeping and a stated community preference for no salt-based chemical use in the direct vicinity of water bodies. Likewise, a coordinated snow storage plan would suggest appropriate snow storage locations, establish temporary erosion control measures during winter (e.g., straw bales, silt fences), educate the public about the benefits of proper snow storage, and enforce state regulations addressing snow storage on frozen water surfaces.

Educational campaigns such as CRWP's "Don't Run Off Salmon Campaign" (CRWP 2009) should be continued to address residential NPS input and increase community awareness.

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APPENDIX A

Photo Log

APPENDIX B

Area Meriting Special Attention Document and Map

APPENDIX C

Storm Water Pollution Prevention Plan Checklist