George Wuerch, Mayor

Anchorage Parking Lots: 2002 Best Management Practices Guidance

Document No. WMP CPg02002

MUNICIPALITY OF ANCHORAGE
WATERSHED MANAGEMENT PROGRAM

NOVEMBER 2002

WATERSHED MANAGEMENT

Office of Planning, Development & Public Works

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WATERSHED MANAGEMENT

Office of Planning, Development & Public Works

Contents

Acronyms and Abbreviations

ADOT&PF	Alaska Department of Transportation and Public Facilities
AMC	Anchorage Municipal Code
DCM	Design Criteria Manual
DPW	Department of Public Works
MOA	Municipality of Anchorage
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollutant Discharge and Elimination System
OGS	oil and grit separator
SWPPP	Storm Water Pollution Prevention Plan
WMP	Watershed Management Program
WMS	Watershed Management Section

Executive Summary

This guidance manual presents recommendation for required management practices for parking lots with areas maintained in the Municipality of Anchorage (MOA) by MOA, the State of Alaska, and other public or private entities. These practices apply to all lots, paved and unpaved, greater than 2,000 square feet, exclusive of parking areas for single family residences and duplexes. The design elements and maintenance practices described below are recommended requirements for parking lots.

Required Design Elements

For all parking lots, paved or unpaved:

- Provide for on-site storage of the first 0.2 inches of rainfall
- Control and treat meltwater from any on-site snow storage
  - Store or infiltrate all meltwater on site OR
  - Discharge all meltwater through an on-site MOA-approved grit separator OR
  - Discharge to sanitary sewer OR
  - Move all stored snow to MOA-permitted private snow disposal facility before April 15
- Provide MOA-approved erosion control on-site and at all points of surface discharge of storm water from the site

In addition, for all paved lots:

- Provide control and treatment for storm water sediment washoff from any MOA water quality design storm event (2-year 6-hour)

Also, for all heavy- or special-use paved lots:

- Provide oil and grit separator (OGS) treatment for storm water runoff resulting from any MOA water quality design storm event (2-year 6-hour) using MOA-approved systems for lots that have one or more of the following:
  - More than 2 acres of parking area OR
  - More than 100 vehicles per day per 1,000 square feet of building area OR
  - Fuel transfer facilities handling in excess of 1,500 gallons per year OR
  - Vehicle maintenance or storage lots servicing 10 or more vehicles per year over 10 tons gross weight

Maintenance Requirements

The following are recommended maintenance requirements for all parking lots:

- Prepare and maintain at an assigned property management office a site storm water maintenance plan or checklist listing annual maintenance practices and schedules
- Sweep all paved lots using tandem mechanical/vacuum or mechanical/regenerative air sweepers, broom, or other approved sweeper, two times annually at a minimum, on the following schedule:
  - Once following spring melt and prior to May 15
  - Once between August 15 and October 15
- Clean and maintain all on-site detention and storage facilities annually
- Clean and maintain all grit or oil and water separator devices on the following schedule:
  - Once between May 1 and June 15
  - Once between September 1 and October 15

These are recommended to become requirements for design practices and maintenance. Many options for meeting these requirements can be adapted to specific lots. Descriptions of these options and references to others are included in this guidance manual.

Introduction

This guidance manual presents recommended required design elements and management practices for parking lots in MOA maintained by MOA, the State of Alaska, and other public or private entities. It also presents options for meeting these requirements that can be adapted to specific situations.

Types of storm water runoff in this guidance include both rainfall and snowmelt runoff. Parking lots refer to all off-street parking areas that are greater in area than 2,000 square feet, exclusive of parking areas for single family residences and duplexes. Paved parking includes both public and private paved surfaces used to provide immediate site access, parking, or storage for motorized vehicles. Unpaved parking includes all soils or other pervious or semipervious surfaces used to provide immediate site access, parking, or storage for motorized vehicles.

Parking lots are among the most pernicious land uses in any watershed with respect to receiving water bodies. Parking lots not only collect pollutants that are deposited from the atmosphere, they also accumulate pollutants that are applied for traction on snow and ice and that leak, drip, or wear off cars and trucks. Water quality concerns for storm runoff from parking lots include particulate and suspended sediment, turbidity, and metals, oil, and grease associated with sediment and turbidity.

In addition, no other surface produces more runoff and delivers it faster than a parking lot. More storm water runoff combined with accumulated pollutants can lead to higher loadings of potentially harmful pollutants to receiving waters. Increased runoff increases the volume and flow rate of discharged water, which can cause downstream flooding, erosion, and loss of riparian habitat. It also increases the required size of downstream drainage structures such as pipes and treatment structures.

Objective

The design features and maintenance procedures described in this guidance manage the impacts of storm water discharges on receiving waters, including surface waterbodies and municipal piped storm water system, in two ways:

- Minimizing the volume of discharged storm water
- Minimizing the discharge of storm water-borne pollutants

This guidance recommends specific requirements to reduce downstream impacts in a general sense. This document does not prescribe performance criteria for specific requirements; these will be developed in other MOA efforts.

The objective of this guidance manual is to provide the following:

- Recommendations for required design elements and maintenance of Anchorage-area parking lots
- Site designers and parking lot owners, operators, and managers with information needed to design, maintain, and operate parking lots and associated drainage systems to meet the recommended requirements, to be efficient, and to protect surface water quality

Laws and Regulations

Off-street parking lot design and plan review is established under Anchorage Municipal Code (AMC). Code provisions (AMC 21.45.080) require landscaping as part of parking lot design. Discharge of storm water from parking lots in conditional use areas is subject to the approval of the MOA Department of Public Works (DPW) (AMC 21.50.100). This guidance for parking lots includes design and maintenance considerations that will aid in developing plans for MOA review and approval.

Storm water drainage from parking lots is subject to the permit requirements of the National Pollution Discharge Elimination System (NPDES) Municipal Separate Storm Sewer Systems (MS4) permit issued jointly to the Alaska Department of Transportation and Public Facilities (ADOT&PF) and MOA. If the parking lot serves as part of an industrial facility, the entire facility must be covered under a separate NPDES *permit for storm water discharges from industrial activities*. If construction of a new parking lot disturbs more than 1 acre (effective March 2003), the development activity must be covered under an NPDES *permit for storm water discharge from construction sites*. For either an industrial or construction site storm water discharge permit, a Storm Water Pollution Prevention Plan (SWPPP) with specific requirements must be developed and implemented. Those requirements are not comprehensively included in this guidance; however, the practices illustrated in this guidance can be incorporated into a SWPPP.

Overview of Parking Lot Storm Water Management

Storm water controls are used to reduce two components of runoff:

1. Increased volume and rate of runoff
2. Increased concentration of pollutants in runoff

Parking lot design elements are employed to minimize the amount of runoff that is discharged to surface waters or storm sewers, to reduce exposure of runoff to potential pollutants, and to treat storm water to reduce pollutants before it is discharged. Maintenance practices are focused on reducing the contaminant load that is picked up by storm water and maintaining storm water drainage and treatment structures in proper working order.

Potential criticisms of drainage controls for parking lots in the Anchorage area include (a) claims that winter freezing prevents effective operation and (b) concern that the suggested storm water controls take up too much land area. These areas of concern are addressed below.

COLD CLIMATE CONSIDERATIONS. Most freezing problems are due to water in areas susceptible to freezing. Water, as it expands when it freezes, causes cracking, heaving, and other damage. To prevent these problems, proper design and maintenance practices must be employed. Proper practices include the following:

- Frost heave – Frost heave occurs in ice-rich soils. To prevent frost heave, assure that all structures are bedded on clean, well-draining gravel. Assure that this bedding material will not clog with finer sediment that will inhibit drainage. Provide a minimum 3-foot depth of cover and appropriate backfill to reduce the potential for frost heaving.

- Lack of infiltration – Frozen, ice-rich soils are not permeable. However, coarse materials, such as sands and gravel, that drain adequately can function well. Infiltration facilities can be effective with the following provisions:
  - Install on sites that have depth to groundwater greater than 3 feet and soil permeability greater than 1 inch per hour
  - Oversize the facility for the expected volume of water, equip with a drain pipe, and provide a top "beehive" inlet structure to provide for expansion of frozen water
  - Provide pretreatment, such as filter strips or sediment traps, to reduce fine sediment that will clog the facility. Pretreatment devices must be regularly maintained.

- Vegetative practices – Recognize that biofiltration facilities only treat storm water seasonally. Provide overflow or bypass routes for snowmelt.

NOT ENOUGH ROOM. Properly planned parking lots can incorporate space for drainage controls. Retrofitting existing parking lots, especially in the Central Business District, presents more challenges. Nevertheless, increased storm water flows should be handled on each site that generates it. Not providing proper detention facilities at the source means that larger facilities must be built at the end of the pipe, a cost borne by others who do not use the site. The following points support the requirements in this guidance document:

- Provide smaller and fewer parking spaces. Both shorter (Rushton, 2003) and fewer (Bergman, 1991) stalls are relevant considerations for many parking lot situations.
- Use required landscaped areas for detention and/or treatment. Since landscaped areas are required by municipal code for parking lots, landscaped areas can serve double duty. When properly designed, built, and maintained, landscaped areas can provide

biofiltration, detention, infiltration, or snow storage functions as well as meeting municipal code requirements.

- Use buried structures. Detention and infiltration chambers can be installed beneath vegetated medians to provide detention that reduces peak flows while limiting the footprint of a detention facility.

Design Elements

This section lists the recommended required design elements and outlines suggested design features that can meet those requirements.

Required Design Elements

Recommended required design elements for all parking lots, paved or unpaved, include the following:

- Provide for on-site storage of the first 0.2 inches of rainfall
- Control and treat meltwater from any on-site snow storage
  - Store or infiltrate all meltwater onsite OR
  - Discharge all meltwater through an on-site MOA-approved grit separator OR
  - Discharge to sanitary sewer OR
  - Move all stored snow to an MOA-permitted private snow disposal facility before April 15
- Provide MOA-approved erosion control on-site and at all points of surface discharge of storm water from the site

In addition, for all paved lots, include the following:

- Provide control and treatment for storm water sediment washoff from any MOA water quality design storm event (2-year 6-hour)

Also, for all heavy- or special-use paved lots, perform the following:

- Provide oil and water separator treatment for storm water runoff resulting from any MOA water quality design storm event (2-year 6-hour) using MOA-approved systems for any lots that have one or more of the following:
  - Greater than 2 acres of parking area OR
  - More than 100 vehicles per day per 1,000 square foot of building space OR
  - Fuel transfer facilities handling in excess of 1,500 gallons per year OR
  - Vehicle maintenance or storage lots servicing 10 or more vehicles per year over 10 tons gross weight

Design features that can meet these recommended requirements are described in the following sections. These features can be grouped by the following functions:

- Minimize paved (impervious) surfaces

- Prevent erosion and disperse drainage
- Provide storm water detention/infiltration
- Provide storm water treatment for sediment and in some cases oil

Design Features

Design features that can be used to meet the required design elements are described in this section. Overall design considerations for parking lots are described in Appendix A.

MINIMIZE PAVED AREA

The following practices can be used in a retrofit situation, (e.g., when lots are restriped or resurfaced) as well as for new designs. In existing parking lots, vertical features such as lights, curbed islands, or bollards may limit flexibility for changing parking stall size or spacing. Although not an exhaustive list, some effective practices include the following:

- Consider one-way traffic flow, rather than two-way flow through parking lots
- Reduce stall width
- Shorten stall length, allowing vehicles to overhang pervious areas
- Size more of the required stalls for compact cars
- Reduce the number of stalls by careful consideration of required parking lot size
- Use 90-degree stall angle; it has the least pavement per vehicle as compared to 30-degree, 45-degree, or 60-degree stall angles
- Reduce paved areas that do not contribute to parking lot functions

Other ways to reduce the paved footprint include the following:

- Use porous pavement to surface overflow parking areas. Some porous pavement technologies, such as asphalt-concrete, are not applicable in areas where sanding is common. However, other types of porous pavement can be used when adequate underdrainage, such as a sand or gravel bed, is provided (Figure 1). The application of porous paving stones in Toronto has had good results (Jankovic, 1998).
- Encourage and/or provide incentives to tenants to carpool, vanpool, and use public transit or other means of commuting
- Consider sharing parking with neighboring businesses whose peak parking lot usage does not coincide

Figure 1 Porous Pavement – UAA Arts Building

PREVENT EROSION AND DISPERSE DRAINAGE

Erosion control is required to reduce the sediment load in storm water. Erosion control can consist of several elements:

- Dispersing drainage, which minimizes flow concentration and velocity; this reduces the ability of storm water to mobilize sediment
- Reducing the amount of sediment exposed to storm water runoff
- Providing sediment traps where flow velocity is slowed and sediment can settle out

Erosion and sediment control practices are outlined in the MOA's Erosion and Sediment Control Guidance Manual (MOA WMP, 1995). Practices included in the manual that are suited for parking lots include the following:

- Seeding and sodding
- Preserving natural vegetation
- Stabilizing channels and protecting outlets

Other specific storm water drainage management practices to reduce discharged runoff and/or associated sediment load include the following:

- Grading the lot to direct storm water runoff into landscaped areas
- Maximizing sheet flow to keep flow from becoming concentrated and having higher energy to mobilize pollutants

- Providing maximum dispersion of flows towards landscaped areas by providing numerous curb cuts (one every 10 feet)
- Removing sections of existing curb and installing curb outlets at regular intervals or in appropriate areas to allow storm water to flow onto well-vegetated areas
- Directing runoff away from high traffic areas towards less-used areas of the lot
- Using flow-splitting devices (notched weirs) to direct low flows to vegetated or infiltration areas and divert higher flows to higher-capacity detention areas (Echols, 2002)
- Separating large paved areas, such as adjacent parking lots or single large (greater than 0.5 acres) lots, with landscaped areas to break up large impervious surfaces and to filter runoff from the area

PROVIDE DETENTION OR INFILTRATION FACILITIES

All paved parking lots must employ features that will reduce the peak flow rate and/or peak volume that the sites would otherwise generate. At a minimum, storage must be provided for the first 0.2 inches of rainfall on a daily basis. Snowmelt must also be stored onsite unless it is discharged to the sanitary sewer system, removed before it melts, or treated before discharge. Types of facilities that provide storage for storm water include the following:

- Retention basins
- Infiltration facilities
- Bioretention features
- Sedimentation basins

Retention basins, sedimentation basins, and vegetative practices are described in Chapter 2 of the MOA's Design Criteria Manual (MOA DPW 2002). Infiltration facilities are described in Appendix B.

PROVIDE SEDIMENT AND OIL TREATMENT

Sediment can be treated with several types of devices:

- Commercial cylindrical grit separators
- Biofiltration features
- Catch basins

Application of each of these devices described in Appendix C.

PROVIDE TREATMENT FOR OIL

For runoff from paved heavy-use parking lots and for snowmelt that is discharged as storm water, an oil and water separator is recommended requirement. Parking lots with high traffic turnover or specialized vehicles are more susceptible to discharge of oil. These parking lots include several types:

- Paved parking areas greater than 2 acres
- Commercial or industrial areas with on site parking that accommodates 100 vehicles per day per 1,000 square feet of gross building area (e.g., convenience stores, fast food restaurants, grocery stores, shopping malls, discount warehouses).
- Commercial or industrial areas that are subject to storage of a fleet of 10 or more diesel vehicles over 10 tons gross weight (e.g., yards that house trains, buses, heavy equipment, truck fleets, delivery services, auto and truck dealerships).
- Areas of commercial or industrial sites that provide petroleum storage or handling in excess of 1,500 gallons per year (e.g. petroleum storage yards, airports, utility areas, fuel stations).

These parking lots require adequate controls to prevent oil from running off with storm water and to minimize the discharge of oil with storm water, due to either acute (spill) or chronic incidents of oil in contact with storm water.

Two types of oil and water separators are considered effective:

- Baffle type (American Petroleum Institute) type separators
- Coalescing plate type separators, which are appropriate for storm water discharges from small drainage areas, such as fuel stations (they are more compact; however, they are more subject to plugging).

Both of these should be considered for parking lots and industrial facilities where petroleum products are handled. Other MOA-approved oil separator treatment devices may be used.

For lots that are subject to chronic discharges of low concentrations of oil, other than the lots listed above, other types of treatment should be considered. For instance, certain commercial grit separators have integrated screens and/or absorbents designed to capture oil. Since oil is often found in association with grit, removal of grit will also reduce oil in the discharged storm water.

Design Feature Integration

Treatment trains consisting of one or more of design elements should be used to increase system efficiency. Examples include the following:

- A retrofit situation may reverse the slope for a portion of a parking lot so that it drains to a biofiltration area and the remainder of the lot may drain to a piped drainage system. A cylindrical grit separator would be used at the end of the piped storm sewer system before discharge to the municipal piped storm water system or to receiving water.
- Recessed parking islands may be used to capture runoff and to store snow. A portion of the parking lot can be graded to drain to the recessed islands. Overflow inlets would be connected to piped storm drain system to collect overflow. The piped overflow would be discharged to a vegetated swale before discharge to receiving water.

Maintenance Practices

This section lists recommended maintenance requirements and describes general maintenance procedures.

Maintenance Requirements

The following are recommended **maintenance requirements** for all parking lots:

- Prepare and maintain at an assigned property management office a site storm water maintenance plan or checklist listing annual management practices and schedules
- Sweep any paved lots using tandem mechanical/vacuum or mechanical/regenerative air sweepers, broom, or other approved sweeper at a minimum on the following schedule:
  - Once following spring melt and prior to May 15
  - Once between August 15 and October 15
- Clean and maintain all on-site detention and storage facilities annually
- Clean and maintain all grit separators and oil and water separator devices on the following schedule:
  - Once between May 1 and June 15
  - Once between September 1 and October 15

Maintenance Practices

Elements of each of the required maintenance practices are described below. In addition, parking lot maintenance should include litter removal and landscape maintenance.

MAINTENANCE PLAN

Parking lot owners or operators must have a written Operations and Maintenance Plan or a Maintenance Checklist that is updated as required. Paved lots greater than 5,000 square feet for commercial and industrial businesses must have a plan; a checklist must be available for all other parking lots. An example checklist is included in Appendix D. The plan should identify owners, parties responsible for maintenance, an inspection and maintenance schedule, and a description of standard maintenance practices. The checklist must include an inspection and maintenance schedule and a list of maintenance activities. Implementation of the plan must be assured, such as required filing of completed inspection and maintenance forms. Similarly, maintenance checklists should be completed as required by the schedule. Accountability for carrying out the plan or checklist must be a condition of any parking lot maintenance contract.

MAINTENANCE OF STORAGE AND TREATMENT FACILITIES

Storage and treatment facilities must be maintained to function properly.

Treatment facilities, such as commercial grit separators, sediment traps, detention area forebays, and oil separators require routine and periodic maintenance, which includes the following:

- Sediment removal, at a minimum of two times per year
- Inspection for integrity and structural soundness, at a minimum of two times per year
- Structural repair or replacement when required

Storage facilities, including infiltration and bioretention areas and sedimentation and retention ponds, require the following maintenance:

- Annual maintenance
  - Inspection for differential settlement, cracking, erosion, leakage, tree growth, condition of sediment trap at the inlet, and vigor and density of vegetation
  - Erosion control on areas of exposed soil
  - Tilling to increase infiltration for infiltration facilities
  - Sediment removal from forebays and gravel filter strips when more than 60 percent of the original storage volume has been lost
- Periodic maintenance when required
  - Removal of debris after major storm events (as needed)
  - Sediment removal from sedimentation ponds when more than 50 percent of the original volume has been lost (20-year cycle)
  - Restoration of infiltration capacity for infiltration facilities
  - Structural repairs, particularly of outlet structures and embankments

PARKING LOT SWEEPING PRACTICES

A primary way to reduce the amount of sediment in parking lot runoff is to sweep. Anchorage area studies have shown that regular sweeping can remove 50 percent and more of the sediment on parking lot surfaces (MOA WMP, 2002). Sweeping reduces the sediment available for washoff with storm water. In addition, sweeping reduces dust and enhances air quality.

Sweeping is very effective at removing larger sized sediment. While larger particles are less likely to be washed off, over time and with traffic, they are milled into finer sizes that will be

washed off with storm water runoff. Recommended parking lot sweeping practices for paved lots include the following:

- For a given sweeping pass, use a sequence of mechanical sweeper followed by either a vacuum sweeper or a regenerative air sweeper. This will allow the removal of larger particles first by the mechanical sweeper, then the removal of finer particles, resulting in more efficient operation by each type of sweeper. For smaller parking lots, hand sweeping is recommended. Sweeper technology continues to improve; other MOA-approved sweepers may be used.
- At a minimum, sweep once before May 15 or as snowmelt conditions permit to remove winter sand and once between August 15 and October 15, with the last sweep as close to the first snowfall as can be predicted. This last sweep will reduce the amount of sediment available for runoff in the following spring breakup. More frequent sweeping, including a second pass following breakup (before May 15) and another before the August rains (between June 15 and August 15) are recommended for lots that have high usage or high particulate buildup.
- Assure that operators are adequately trained for optimal use of the street sweeping vehicle. Training should include instruction on sweeper speed, brush adjustment and rotation rate, and sweeping patterns.

LITTER REMOVAL

Waste and litter can be mobilized by runoff and be discharged with storm water. Waste and litter that pile up in parking lots may trap windblown sediment that in turn is discharged with storm water. Parking lots with high turnover or drop-off facilities (e.g. for recycling or goodwill), or lots that allow 24-hour occupancy have more traffic, and consequently attract and receive more trash and waste than other lots. All lots, and particularly those that receive more trash, should have active litter control management. A variety of methods can be used to actively control either:

- Scheduling routine trash patrols to remove waste
- Enforcing the anti-littering code (AMC 8.75.050)
- Disposing of old, unused equipment to reduce contamination of the storm water
- Establishing training and spill prevention and response programs to prepare commercial and industrial employees; benefits include reduced contamination of storm water
- Adequately maintaining garbage bins to encourage proper disposal of waste OR provide none at all to discourage misuse of bins

- Reducing packaging and wrapping of goods to reduce the amount of garbage generated and disposed onsite

PARKING LOT SNOW DISPOSAL PRACTICES

Water quality concerns for snowmelt runoff include chlorides and other salts, suspended sediment, turbidity, and metals associated with sediment and turbidity. Proper management of this runoff can reduce pollutant loading in storm water discharge. Sites where snow has been stored may also have sediment and garbage that have been entrained in the snow over the winter. The following practices should be followed:

- Remove snow from parking areas in designated storage areas.
- Direct snowmelt runoff to biofiltration features or a grit separator. Snow may also be stored directly on biofiltration areas.
  - For biofiltration areas on which snow is stored, or to which snowmelt is directed, select or design a vegetative mix that is resistant to seasonal shallow burial (1 to 2 inches) of loose sand fill annually and to elevated salt and metals soil concentrations.
  - If biofiltration areas are used for snow storage, care should be taken that vehicles do not track the area before snow falls and the ground is frozen.
- Trash removal from snow storage sites is required. This should be done as soon as possible after melting snow exposes trash.
- If snow has been stored on pavement, sweep the paved area after all the snow and ice have melted.

Snow stored on a parking lot or adjacent surfaces must discharge either entirely to infiltration, through an approved sanitary sewer connection, or to an MOA-approved grit separator or other approved sediment treatment device.

Any snow stored on a parking lot that does not discharge in one of the three ways described above must be removed prior to April 15 and disposed at a municipally-permitted snow disposal site.

SPECIAL USE PARKING LOTS

Several maintenance practices should be used or paved areas in which fuel and petroleum-based products are handled:

- Confine transfer of fuels and oil to specified and contained areas. Separate these areas with curbing or other physical barriers

- Prohibit fuel transfer activities, such as incidental oil changes in parking lots
- Install emergency free oil spill traps with sufficient capacity to trap free product at points of discharge to piped storm sewer systems or receiving waters

LANDSCAPING MAINTENANCE

Landscaping is required by municipal code for parking lots in Anchorage. Some portion of storm runoff should be directed towards landscaped areas. Maintaining healthy landscaping enhances its ability to detain, filter, and reduce the volume of site runoff. The following practices should be employed:

- Require professional landscaping services to minimize fertilizer and pesticide use and restrict application to the growing season
- Require proper disposal of dead plant material, including windblown leaves and branches, grass cuttings, and pruned woody vegetation
- Inspect gravel filter strip and clean or replace if clogged
- Water and fertilize as required
- Inspect for insects and pests and treat as required
- Test the soil annually for pH and add amendments as necessary
- Replant as necessary; prune for shape and vigor
- Mow grass
- Mulch to reduce weed growth
- Remove or treat for weeds as necessary
- For areas where snow has been stored, remove sediment buildup when it has accumulated to 25 percent of original capacity or kills established vegetation

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Useful Web Sites

http://lowimpactdevelopment.org

http://www.cwp.org

http://ohioline.osu.edu

http://nemo.osu.edu

Appendix A
Site Factors Affecting Choices of Design Elements

Site-specific factors will affect which structural practices are applicable to a site, as discussed below.

- Retrofit or new construction – Site constraints can limit options in retrofit situations. Parking lot repaving or restriping present opportunities for modifying parking lots to improve storm water management.
- Type of facility parking lot serves – This will dictate the size of the parking lot as well as how aggressive storm water management must be. For instance, parking lots with high traffic (average daily traffic greater than 100 vehicles per 1,000 square feet of gross building area [WDoE, 2001]) require more stringent maintenance and parking lots that handle petroleum products require measures to contain oil spills.
- Size of parking lot – Bigger paved surfaces generate more volume and more peak discharges than smaller paved surfaces.
- Adjacent land uses – If a parking lot abuts a road, the public right-of-way may be available for storm water treatment. If the parking lot abuts a stream or wetland, setbacks may be required. Setbacks may reduce available land but also may be factored into landscaping requirements. Check with MOA Planning and Zoning.
- Type of structure or receiving water to which storm water is discharged - Storm water must have pretreatment before it is discharged beyond property boundaries, particularly if it is discharged to sensitive resource areas, such as closed basins and lakes that do not have surface outlets.
- Soil permeability – If soils are highly permeable (greater than 1 inch per hour), infiltration may be the preferred option for handling all but the highest storm flows. While this will work for summer runoff, it may not be practical for snowmelt, because the permeable soils may be isolated from snowmelt infiltration by a layer of frozen soil or ice. This drawback may be mitigated by:
  - Providing a bypass for snowmelt
  - Sizing the infiltration facility larger than the design storm volume
- Depth to groundwater / water table – When the seasonal depth to groundwater is less than 2 feet from the surface, the sensitivity of the groundwater aquifer should be evaluated before using infiltration for storm water discharge.
- Site slopes and topography – Most parking lots are built on fairly level slopes of less than 5 percent. These flat slopes lend themselves to sheetflow and vegetated treatment systems. However, in cases where cut and fill is used to achieve flat slopes for parking, the side

slopes of a parking area may be steep. In these cases, discharging runoff overland, down slopes greater than 10 percent, can lead to erosion. Alternative measures, such as flow spreader or piped storm sewers, should be considered.

- Maintenance access – All structural storm water management features require maintenance and access to these features in parking lots is not usually a problem. However, wide expanses of vegetated areas should not be crossed by heavy equipment, so vehicular access to overflow devices in these sites should be included in the design.

References

Washington State Department of Ecology (WDoE). 2001. Storm water Management Manual for Western Washington. Volume V. Runoff Treatment BMPS. Prepared by Washington State Department of Ecology Water Quality Program. August.

Appendix B
Infiltration Facilities

Infiltration basins, trenches, and chambers are all applicable on a limited basis. Key considerations are listed below.

Site Features

- Minimum soil infiltration rate of 1 inch per hour.
- Minimum 3-foot separation from seasonal high groundwater level
- Natural slopes less than 15 percent
- Soil clay content less than 20 percent and silt / clay content less than 40 percent; no fill soils
- Maximum contributing area less than 5 acres

Design Criteria

- Design for maximum dewatering time of 48 hours
- Provide pretreatment, such as washed gravel forebay, to reduce fine sediment
- Provide underdrain system and level control valve or subdrain pipe
- Maintain inflow velocities less than 3.5 cubic feet per second
- Provide vehicular access for maintenance of pretreatment and outlet facilities

Construction and Maintenance

- Construct and stabilize upstream development before constructing infiltration facility
- Sequence construction to minimize compaction of underlying soils and maximize facility life
- At a minimum, annually remove sediment from pretreatment facilities
- For sites with level control valve, open the valve in fall and close it following spring thaw

Conceptual design elements are shown in Figures B-1, B-2, and B-3 for infiltration chambers, infiltration trenches, and infiltration basins, respectively.

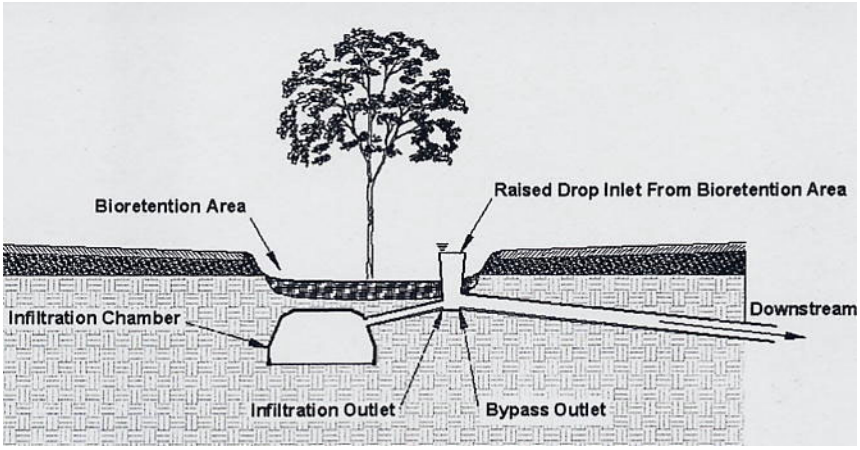


Figure B-1 Infiltration Chamber (Echols, 2002)

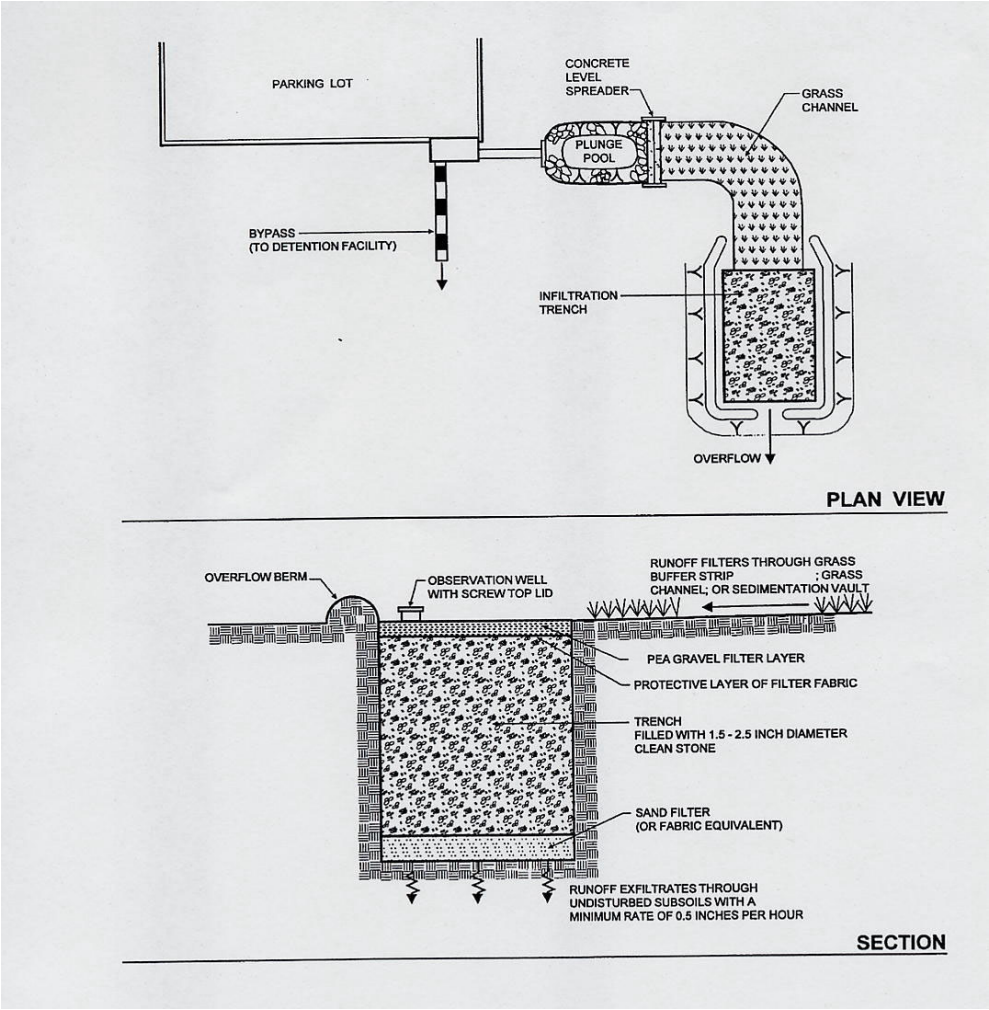


Figure B-2 Infiltration Trench (CWP, 2001)

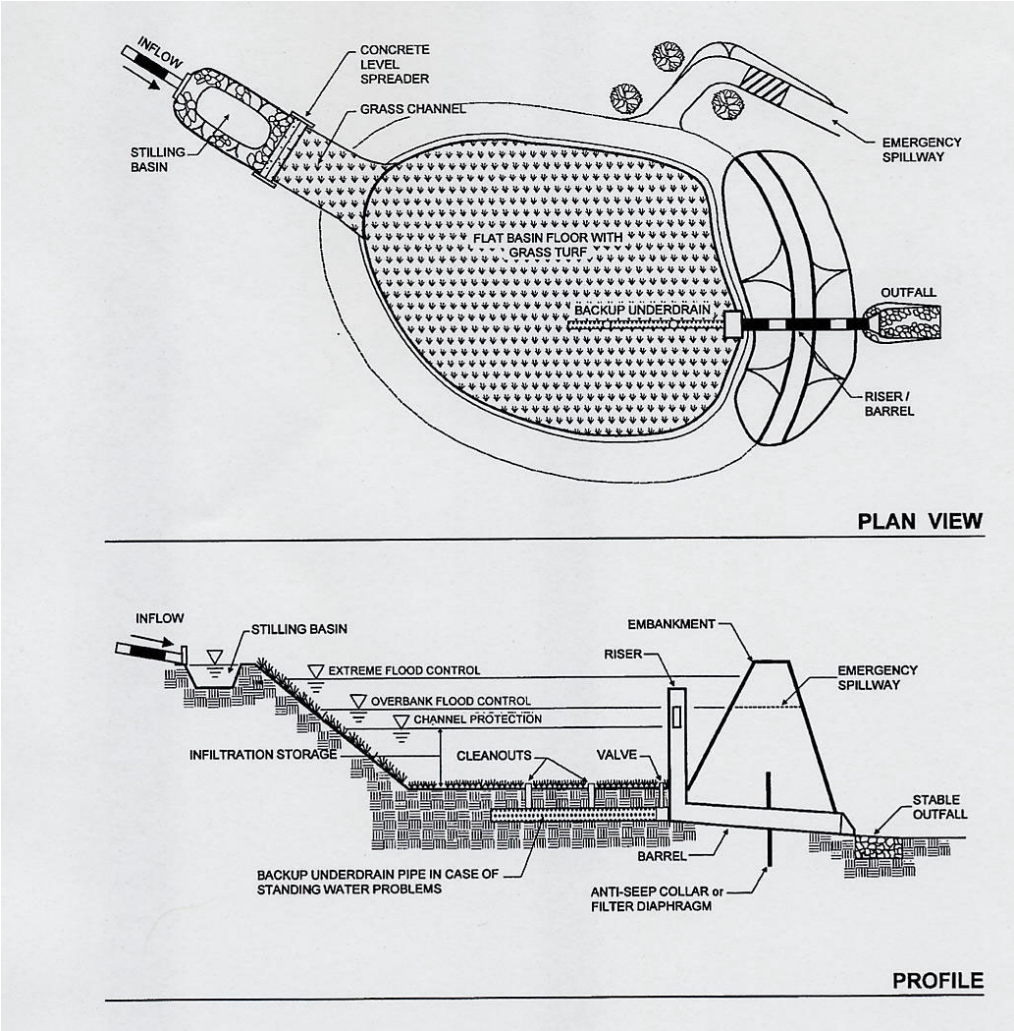


Figure B-3 Infiltration Basin (CWP, 2001)

References

CWP. 2001. New York State storm water Management Design Manual. Prepared for New York State Department of Environmental Conservation. Albany NY. October.

Echols, Stuart Patton. 2002. Split Flow Method: Introduction of a New storm water Strategy. In storm water Vol. 3, No. 5. July / August.

Appendix C
Structural Practices for Sediment Removal

All storm water from parking lots, including snowmelt and overflow from biofiltration areas that is discharged to piped storm sewer systems or receiving waters, should pass through a grit separating device. Three types of treatments, in order of effectiveness, are suggested:

- Commercial cylindrical grit separators
- Catch basins
- Biofiltration with minimum dimensions

For new construction, a grit separator is required and commercial cylindrical grit separators are the preferred devices. For existing parking lots in which space is limited, water quality inlets may be retrofitted to better treat the grit. They are not recommended for new construction and should only be used where regular and consistent maintenance can be assured. Biofiltration can serve either new or retrofitted parking lots. Minimum requirements for biofiltration features must be met for a unit to qualify as a grit-separating device. Application of these controls is shown in Table C-1.

Table C-1 Applications for Sediment Removal Structures

Structural Practice	Grit Separator	Catch Basin	Biofiltration
Contributing area	Less than 5 acres of connected impervious area	Less than 1 acre of connected impervious area	Less than 5 acres of connected impervious area
Sizing	• Quantity: treat the 2-year 6-hour storm • Quality: remove 25 percent of annual sediment load <100µm; 80 percent of annual sediment load => 100 µm	• Quantity: pass the 10-year storm • Chamber depth and diameter 4 times the outflow pipe diameter	• Minimum 25 feet longitudinally • Wide enough to allow sheet flow at design storm flow rates • Slope less than 1 percent
Phase of parking lot construction	New or retrofit	Retrofit only	New or retrofit

Key: µm – microns

Cylindrical Grit Separators

Commercial cylindrical grit separators should be considered at outfalls from basins that include parking lots and have a total impervious surface area between 1 and 5 acres. These types of grit separators have not been found to be cost-effective for basins with total impervious surfaces larger than 5 acres (MOA WMP, 2002). Typical sediment loading and gradation for parking lots are shown Table C-2.

Table C- 2 Typical Load and Gradation of Sediment in Parking Lots at Breakup

Initial Spring Load	Fines (1) g/ft^2	Other Particles g/ft^2	Total g/ft^2	Fines as Percent of Amount Removed by Spring Sweeping	Fines as Percent of Annual Washoff Load
Parking lots – median value	12	153	164	10 – 55	95 - 99

Key:
% - percent
(1) – < 106 microns (µm) diameter
g/ft^2 – grams per square foot
Source: (MOA WMP, 2001)

High efficiency commercial cylindrical grit separator manufacturers include Vortechnics, CDS, StormCeptor; others may also be approved by Project Management and Engineering (PM&E). Current design criteria recommended for these devices are as follows:

- Size the grit separator to achieve 80 percent removal of the annual load of inorganic sediment particles equal to or greater than 100 microns (µm) in diameter and 25 percent removal of the annual load of inorganic sediment particles less than 100 µm in diameter.
- Size the grit separator to treat, at a minimum, a 2-year 6-hour design storm flow, as specified in the MOA Design Criteria Manual, Chapter 2.
- Install a side discharge flood flow bypass weir at the inlet to the grit separator device for flows greater than the design flow.
- Install a heavy truck access route adjacent to the grit separator inlet, outlet, and cleanout manholes for maintenance.
- Incorporate straight-line access to entire trap compartment for a Vactor wand. All grit separator areas must be accessible in a straight line from access manholes.
- Incorporate free oil traps on all end-of-pipe grit separators. These may be an integral part of the grit separator.

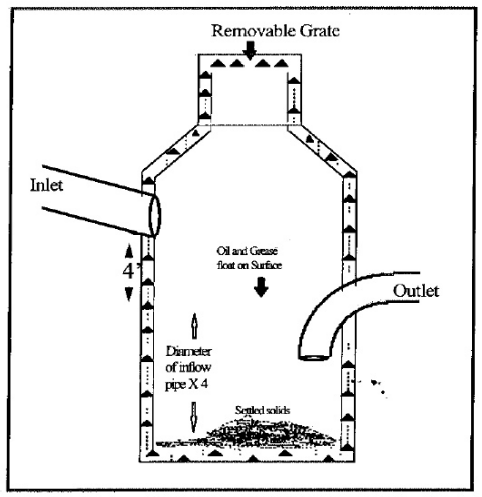
The effectiveness of these devices is reduced greatly if they are not cleaned out on a regular basis. In Anchorage, these should be cleaned a minimum of two times a year. Depending on parking lot loads, this frequency should be increased. In addition, absorbents should be changed on a regular basis in devices that use them.

Catch Basins

A catch basin, also known as a curb inlet or storm drain inlet, is an inlet to the piped storm drainage system that typically includes a grate or curb inlet where storm water enters the catch basin, and a sump to capture sediment, debris, and associated pollutants (Figure C-1). Catch basins can treat storm water by capturing large diameter sediment, although catch basins are not as efficient as cylindrical grit separators. Treatment performance is related to the volume of the sump. Optimal sizing can improve efficiency and, when optimally sized, these are sometimes referred to as water quality inlets. The following guidelines, expressed in terms of the outlet pipe diameter (D), can help improve sediment removal efficiency (storm water Center, 2002):

- The diameter of the catch basin should be equal to 4D.
- The sump depth should be at least 4D. This depth should be increased if cleaning is infrequent or if the area draining to the catch basin has high sediment loads.
- The top of the outlet pipe should be 1.5D below the elevation of the inlet to the catch basin.

Figure C-1 Deep Sump Catch Basin



If a site has good percolation and is more than 5 feet above groundwater, incorporating infiltration through the bottom of catch basin may be considered. However, over time as sediment is trapped, infiltration capacity may become limited and may decrease. The potential for contamination of groundwater should be evaluated on a site-specific basis.

Unless maintained, catch basins can become a source of pollutants through resuspension. Maintenance considerations include the following:

- At a minimum, clean the catch basin twice a year.
- Install a heavy truck access route adjacent to the catch basin inlet for maintenance.
- Incorporate straight-line access to entire trap compartment for a Vactor wand. All sediment trap areas must be accessible in a straight line from access manholes.

Biofiltration

Biofiltration areas are vegetated areas that convey or temporarily hold storm water. Storm water may be infiltrated, evaporated, taken up by the vegetation, or, for larger storm events, allowed to flow overland and be discharged off-site or to a piped storm sewer system.

Undisturbed natural wetlands or forested areas may be used as biofiltration areas or they may be constructed. Optimal coverage for the biofiltration areas is 5 to 10 percent of the entire paved surface. The parking lot is typically designed to drain, in whole or in part, to these areas. Municipal code requires landscaping for parking lots, and biofiltration features can be incorporated into site landscaping.

Site features that make biofiltration attractive include:

- Adequate area
- Natural topographic low areas
- Soils with medium to high percolation rates
- Slopes less than 5 percent

Constructed Biofiltration Areas

Biofiltration areas should be considered to the extent practical for new and existing parking lot storm water management. For instance, if an overflow device is available, existing elevated landscaping islands can be converted into depressed areas.

For ease of discussion, constructed biofiltration areas are divided into the following types:

- Recessed bioretention areas
- Vegetative swales
- Vegetative filter strips

Elements of constructed biofiltration areas are shown in Figure C-2 and described below.

Recessed bioretention areas can be used in place of the typical landscaped islands that are curbed and set higher than the paved parking lot grade (Figures C-3 and C-4). Pavement is graded so that the surface flow is towards rather than away from the islands. A bypass should be included in the design that can handle runoff in excess of the design flow and direct it towards an overflow structure.

Figure C-2 Biofiltration Elements

(Scheuler, 1995)

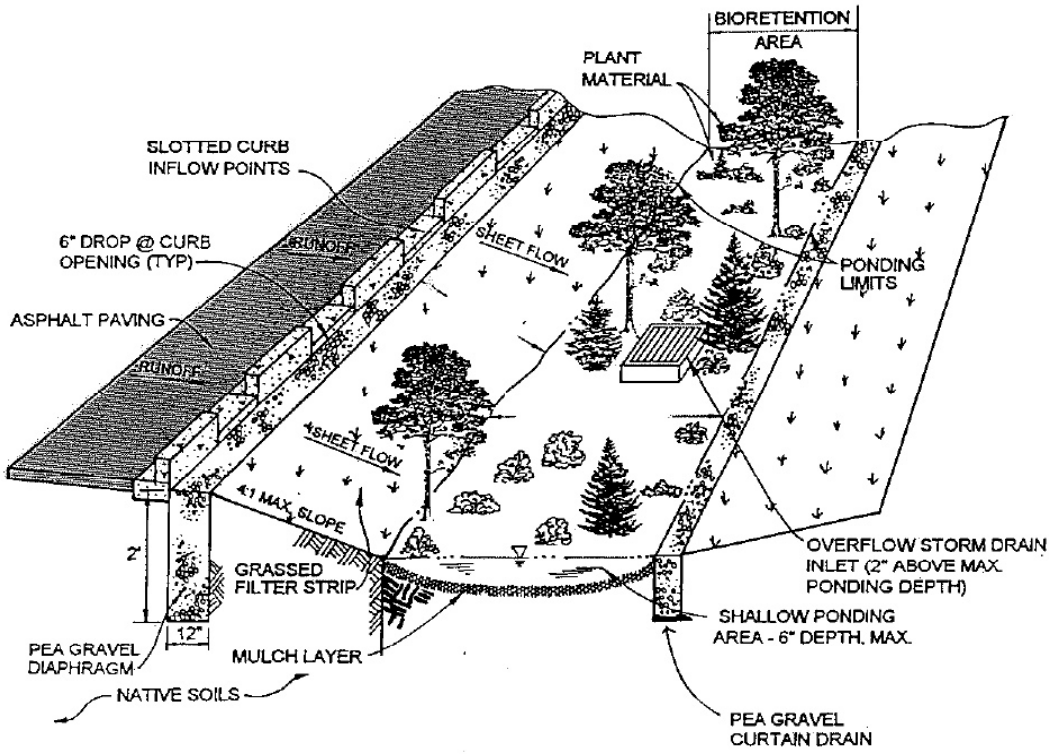
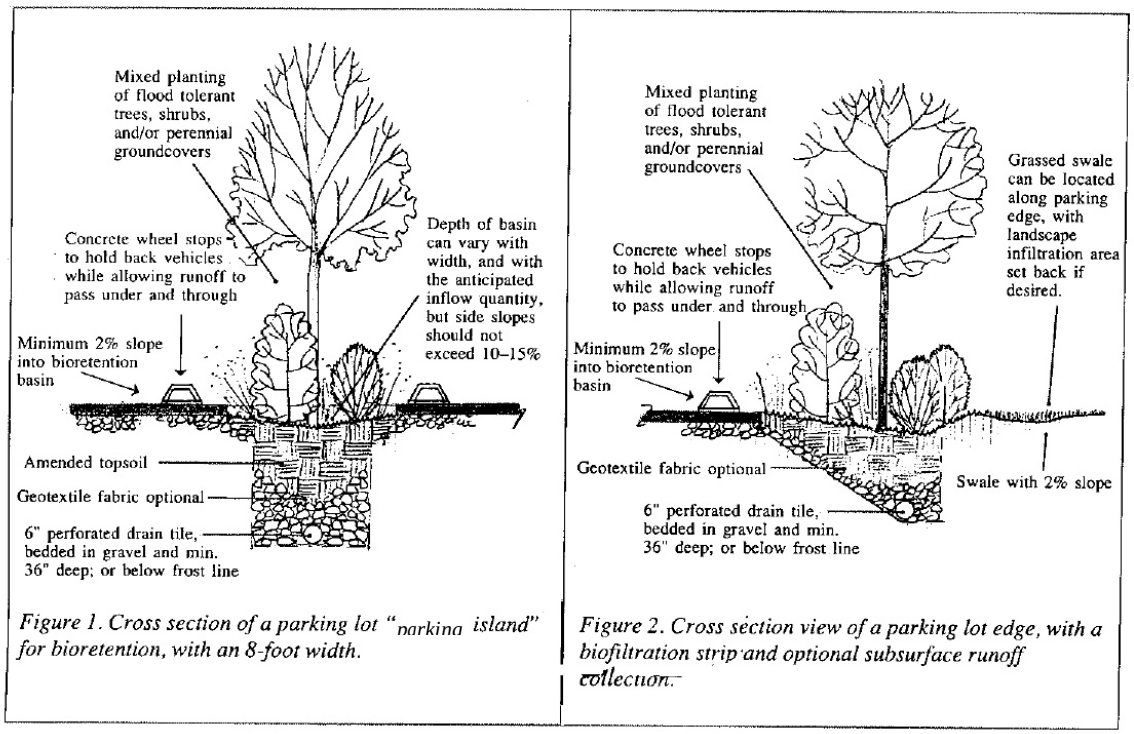


Figure C-3 Grassy Bioretention Area (Tudor and Denali, Anchorage)

Figure C-4 Recessed Bioretention Area

(Quigley and Lawrence, 1999)



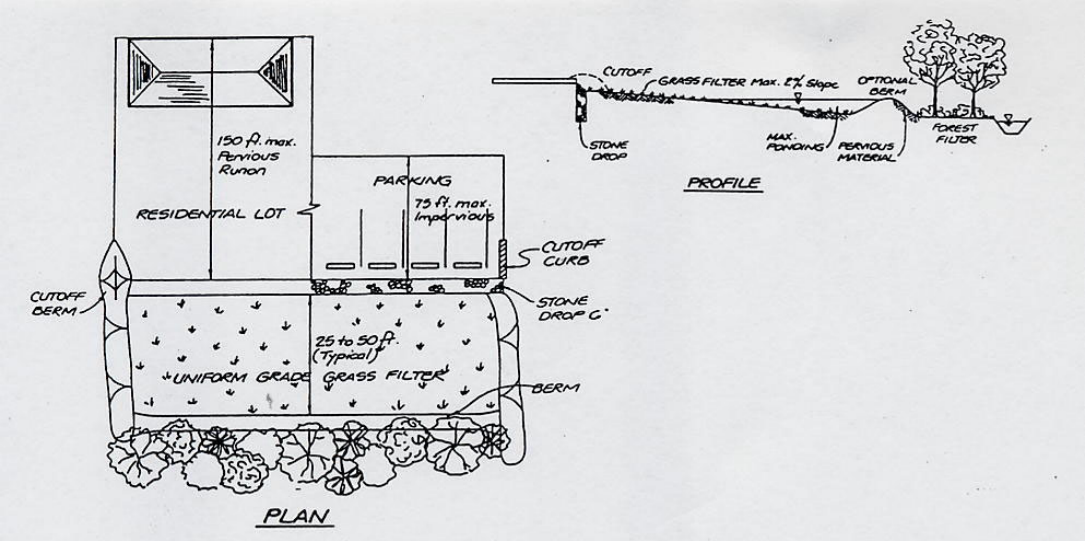
Vegetated swales and filter strips rely on vegetation to slow runoff velocities and filter out other pollutants from storm water runoff. The transition area from paved surface to vegetation should be a narrow (1 to 2 feet wide) expanse of pea gravel "stone drop" that will dissipate the flow energy and cause deposition of larger particles before reaching the vegetated areas.

Vegetated swales are designed to handle channelized flow at design storm flow rates. These drainage swales are constructed to promote a dense turf by placing proper soil mixtures (sandy loam) and seed mixtures. Swale size should be matched to the design flow rate, which in turn is influenced by the size of the parking lot. In general, swales are appropriate for smaller parking lots or subdivision of larger parking lots.

Filter strips are designed to promote sheet flow at the design storm flow rate. Because flow rates must be low to be sustained as sheetflow, filter strips are only recommended for very small parking lots or portions of larger lots (Figure C-5). The discharge end of the filter strip is typically a stream buffer or other open space.

Figure C-5 Grass Filter Strip

(Scheuler, 1995)



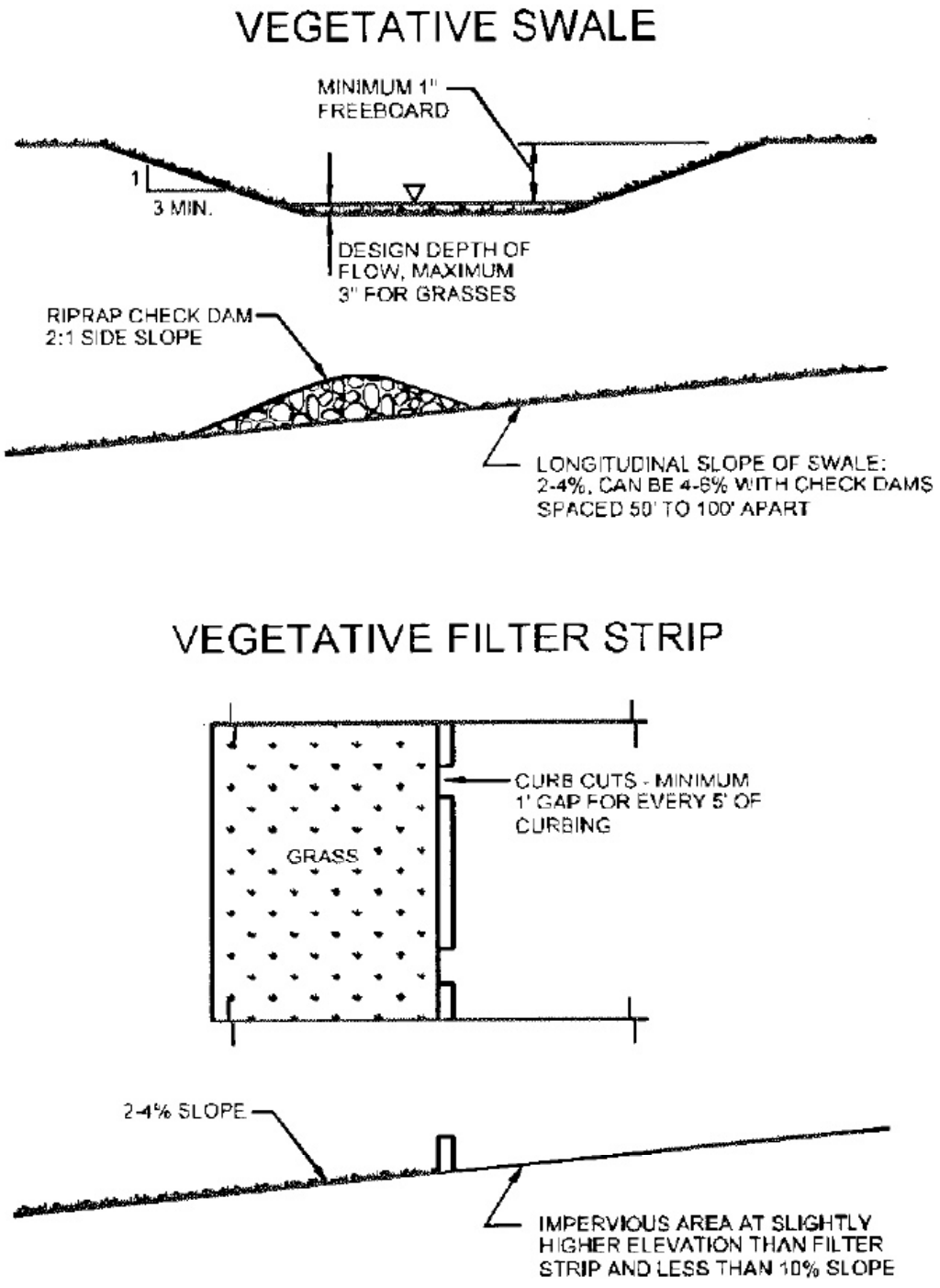
Design requirements for vegetative swales and filter strips are illustrated in Figure C-6 and more fully described in the proposed revisions to the MOA Design Criteria Manual (MOA DPW, 2002). A list of appropriate plants is provided in the Design Criteria Manual. Use salt-tolerant plants near heavily traveled roads and where snow is stored. Trees that shed large, persistent leaves, that drip sap on vehicles, or that attract moose should be avoided.

Maintenance requirements for constructed biofiltration facilities include the following:

- Inspect gravel diaphragm and replace if clogged
- Water and fertilize as required
- Inspect for insects and pests and treat as required
- Test the soil annually for pH and add amendments as necessary
- Replant as necessary; prune for shape and vigor
- Mow grass
- Mulch to reduce weed growth
- Remove or treat for weeds as necessary
- For areas where snow has been stored, remove sediment build-up when it has accumulated to 25 percent of original capacity or kills established vegetation

Figure C-6 Vegetative Swale and Filter Strip Design Elements

(MOA DPW, 2002)



Natural Biofiltration Areas

Retain natural vegetation and soils to the extent practical (Figure C-7). Since areas that are conserved in their natural state are not exposed to erosion during construction, it is desirable to conserve as much original soil at the site as possible. In addition, undisturbed soils retain their natural perviousness and hydrology, reducing potential for additional runoff. Site clearing should be limited to the minimum area required for building footprints, construction access, and safety setbacks (Scheuler, 2000).

Figure C-7 Native Vegetation as Bioretention Area – UAA Campus, Anchorage

A pre-construction inspection should be conducted to define the limits of disturbance. The results of this inspection should be used in site planning.

Retention of native vegetation can be incorporated into the landscaping plan and the construction SWPPP. The SWPPP can aid in phasing the project so that existing vegetation, including trees, is adequately protected and that cleared areas, including staging areas, are limited to the extent practicable.

Maintenance requirements for these areas are very low and include the following:

- Water as required in dry periods
- Inspect for insects and pests and treat as required

References

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- Storm water Center. 2002. Pollution Prevention Fact Sheets: Catch Basins. http://www.storm watercenter.net.

Appendix D
Example of Maintenance Checklist

Parking Lot Location _____

Date _____ Time _____

Inspector _____

Maintenance Item	Satisfactory/ Unsatisfactory	Comments
Pavement Condition ✔ Asphalt cracking, spalling ✔ Potholes ✔ Deterioration at edges ✔ Standing water, puddles		
Evidence of Erosion ✔ Bare soil ✔ Obvious channeling		
Landscaping ✔ Health of vegetation ✔ Mowing when needed		
Forebays, gravel filter strips ✔ Obviously trapped sediment ✔ More then 50% storage volume remaining		
Catchbasins and Grit Separators ✔ Obviously trapped sediment ✔ Inlet clear of debris ✔ Outlet clear of debris		
Detention Areas ✔ Sloughing embankments ✔ Outlet condition		
General Site ✔ Presence of trash, debris		

Other Site Observations:

Actions to be Taken: by (date)