Unincorporated Summit County
Storm Water
Management Plan
2020
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Appendix B  BMP Design Specifications
Appendix C  Summit County LID Design Specifications & Long-Term Stormwater Management Template
Appendix D  Ordinance 381
0.0 General Information

0.1 Introduction

The Federal Clean Water Act requires that storm water discharges from certain types of facilities be authorized under storm water discharge Permits. (See 40 CFR 122.26.) The goal of the storm water Permits program is to reduce the amount of pollutants entering streams, lakes and rivers as a result of runoff from residential, commercial and industrial areas. The original 1990 regulation (Phase I) covered municipal (i.e., publicly-owned) storm sewer systems for municipalities over 100,000 population. The regulation was expanded in 1999 to include smaller municipalities as well over 10,000 population. This expansion of the program to include small MS4s is referred to as Phase II. This Permit serves as a re-issuance or replacement of the previous General Permit for Discharges from Small Municipal Separate Storm Sewers (MS4s), UTR090000, issued December 9, 2002. This Permit is intended to cover new or existing discharges composed entirely of storm water from MS4s required by the State to obtain a Permit.

Unincorporated Summit County was designated a MS4 in a letter dated December 18, 2014 to Summit County from the Department of Environmental Quality (Appendix B). The first step in this process is to submit a Notice of Intent (NOI) to receive confirmation that the MS4 is covered under the general permit. The next step is to prepare a Storm Water Management Plan (SWMP) which should do the following:

1. Reduce the discharge of pollutants from the MS4;
2. Protect water quality; and
3. Satisfy the appropriate water quality requirements of the General Permit for Discharges from Small Municipal Separate Storm Sewers (MS4s), UTR090000

A SWMP is comprised of six minimum control measures that must be developed and implemented. These measures include:

1. Public Education and Outreach;
2. Public Involvement/Participation;
3. Illicit Discharge Detection and Elimination;
4. Construction Site Stormwater Runoff Control;
5. Long-Term Storm Water Management in New Development and Redevelopment (Post – Construction Storm Water Management); and
6. Pollution Prevention and Good Housekeeping for Municipal Operations.

They are discussed in the order given with the Measurable Goals, Implementation Schedule, and Fiscal Ability for each Best Management Practice (BMP). Fiscal Ability is the ability of the County to properly administer the BMP. The measurable goals are mandated by the EPA. A community must be showing improvement over time with these goals. The Implementation Schedule is also included in the section, indicating when the goals will be reached.

To be in compliance with the Utah MS4 program, the County must document all inspections, enforcement actions, and public education activities. Annual reports of financial and employee resources must be submitted to the State of Utah Department of Environmental Quality by or on October 1 of every year.

0.2 Community Information

Summit County is located in the northern part of Utah and occupies a rugged and mountainous area and was named as such due to the presence of 39 of the highest mountain peaks in Utah. As of the 2010
census, the population was 36,234 which are spread across 1,882 square miles. Of this area, approximately 10 square miles is covered by water. Portions of the Ashley National Forest and the Wasatch National Forest are in Summit County and include the Uinta Mountains, home of the highest peak in Utah. Rockport State Park is located within Summit County and is located on the Weber River which feeds Echo Reservoir. Annual precipitation in Summit County is averaged to be approximately 16 inches per year and snowfall averages 73 inches per year with more snowfall in the higher elevations.

History
Summit County was established in 1854 and Coalville was chosen as the County seat. Summit County was the home of the Northern Shoshone Indians hunting grounds until the arrival of the Mormon pioneers in 1847. The first settlers in Summit County chose their first settlement as Parley’s Park and then Wanship in 1854. When coal was discovered near Coalville, the Mormon established a settlement there. The mining of coal was soon overshadowed by the discovery of more valuable minerals in the Wasatch Mountains and Park City was established as a mining town. Mining continued until the 1950’s and Park City was on the verge of becoming a ghost town. Due to the rugged terrain and deep snow, the area soon rebounded with the introduction of skiing and the Park City area is now a renowned winter sports destination.

There are two distinct areas of Summit County. The Snyderville Basin consists of the land that is bordered by Salt Lake County on the west and Morgan County on the north. The boundary then heads south to the Silver Creek Junction area which is the intersection of Interstate 80 and US-40 and continues south to the Wasatch County boundary. The boundary then heads west along the Wasatch County border to the Salt Lake County border. The Snyderville Basin is illustrated in Figure 1.

Figure 1: Snyderville Basin Area of Summit County
Eastern Summit County remains very rural with five other municipalities: Francis; Kamas; Oakley; Coalville; and Henefer. Agriculture is the main economic driver in eastern Summit County however recreational opportunities are available with activities such as fly-fishing, cycling, snow-machining, dog-sledding, and other outdoor activities. The high Uintas are part of the Eastern Summit County area and the entire Eastern Summit County is beginning to grow due to the population of the Snyderville Basin wishing for a more rural lifestyle. Eastern Summit County is illustrated in Figure 2.

![Figure 2: Eastern Summit County](image)

**Storm Drain System**
The storm drain system consists of swales and ditches in the majority of Summit County. The exceptions are areas of the Snyderville Basin that include neighborhoods such as the Kimball Junction area, Silver Springs and the Canyons Ski Resort. These storm systems are privately owned and maintained by various Homeowners associations. A majority of storm water from the Snyderville Basin eventually flows into East Canyon Creek which joins the Weber River in Morgan. The remaining storm water flows into silver creek which joins the Weber river in Wanship and flows into Echo Reservoir. Storm water from the Kamas Valley and the south side of the Uinta Mountains flows into either the Weber or Provo Rivers. Storm water also flows from the western portion of the Uinta Mountains into Chalk Creek which joins the Weber River near Coalville above Echo Reservoir. Many tributaries of the Bear river flow from the northern slope of the Uinta mountains and are contained mostly in national forest. Small sections of these tributaries and the Bear River enter unincorporated Summit county before crossing the border into Wyoming.

**Sanitary Sewer System**
Sanitary sewer service is provided to the Snyderville Basin area by the Snyderville Basin Water Reclamation District (SBWRD). They operate two water treatment plants, one near the Jeremy Ranch area and one near Interstate 80 and Highway 40, and treat all the sanitary waste from Park City and unincorporated Summit County within the geographic region of the Snyderville Basin.

In Eastern Summit County, each of the five municipalities offers a sanitary sewer treatment system. In Henefer, Francis, and Kamas, sanitary waste is treated by the use of sewer lagoons. In Oakley, a
membrane bioreactor plant was constructed in 2003 to treat sanitary waste from the City limits, and in Coalville, a mechanical plant is used to treat all sanitary waste generated from areas within the city limits. In unincorporated Summit County, wastewater from resident and commercial areas are treated by septic systems with drain fields.

0.3 Responsible Persons

The responsible persons for the Storm Water System are the current Public Works Director, and the Stormwater Manager:

Derrick Radke, Public Works Director  
1775 South Hoytsville Road  
Coalville, UT  84017  
Office: 435.336.3970

Kelsey Christianesn, Summit County Stormwater Manager  
60 North Main  
PO Box 128  
Coalville, UT  84017  
Office: 435.336.3292

0.4 Threatened or Endangered Species

The construction of storm water facilities in Summit County may result in effects to threatened or endangered (T&E) species. Threatened and endangered species are overseen by the Utah Division of Wildlife Resources. Current lists of T&E Species can be found at the following link:


Listed species for Summit County are:

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown (Grizzly) Bear - Historically</td>
<td>Ursus arctos</td>
<td>LT Extirpated</td>
</tr>
<tr>
<td>Canada Lynx - Historically</td>
<td>Lynx canadensis</td>
<td>LT</td>
</tr>
<tr>
<td>Bonytail</td>
<td>Gila elegans</td>
<td>LE</td>
</tr>
</tbody>
</table>

Definitions:

**LT** = A taxon that is listed by the U.S. Fish and Wildlife Service as "threatened" with becoming endangered.

**Extirpated** = An “endangered,” “threatened,” or “candidate” taxon that is “extirpated” and considered by the United States Fish and Wildlife Service to no longer occur in Utah.

**LE** = A taxon that is listed by the U.S. Fish and Wildlife Service as "endangered" with the probability of worldwide extinction.
A review of any site considered for storm water improvements should be made for these species during planning, design, and review. If possible impact may occur to these species, contact the Division of Wildlife Resources.

0.5 Historic Properties

The construction of storm water facilities may result in effects to historic properties. Historic properties may include houses, buildings, ditches, headwalls, or other constructed features that are 50 or more years old. Where historic features are potentially affected, a qualified historian must undertake the following:

- Determine the extent and characteristics of the historic property;
- Determine the effect on the historic property; and
- Coordinate findings with the State Historic Preservation Office.

There are many historic properties in Summit County as listed by the Utah Department of Heritage and Arts. They are listed at the link below:


If further information is needed, contact the State Historic Preservation Office at the following link:

http://history.utah.gov/state_historic_preservation_office/index.html

0.6 Local Water Quality Concerns

The water quality within Summit County is relatively good. Some of the stream or waterways in the County have been identified as protected under Section 303(d) of the Clean Water Act and the list is provided in the next section. The hope and intent of this SWMP is to possibly improve the water quality.

The storm water in Summit County is transported in swales, ditches, canals, and rivers that allow for large amounts of infiltration. For the most part, the existing system has worked well. Continued growth is expected to put some pressure on canal, ditch and swale capacities. Summit County is currently controlling increased storm water runoff from development with localized detention and retention facilities as a design standard for all commercial developments and residential developments over one acre.

Based upon the Total Maximum Daily Loads (TMDLs) of the river and creek listed below, target pollutants for Summit County have been identified as the following:

- Biochemical Oxygen Demand (BOD)
- Nitrate as N
- Total Nitrogen (TN)
- Total Phosphorous (TP)
- Total Dissolved Solids (TDS)
- Total Suspended Solids (TSS)
- E. coli
- Oil and Grease
- Turbidity
Summit County’s SWMP has been geared toward small rural applications, targeting the pollutants mentioned. The focus of this plan is meeting the requirements of the General Permit for Small MS4’s, trying to stay in harmony with the rural nature and act within the existing budget structure.

0.7 Impaired Waters

The water quality within Summit County is relatively good. Some of the streams or waterways in the County have been identified as protected under Section 303(d) of the Clean Water Act. They are listed in the table below.

<table>
<thead>
<tr>
<th>Watershed/Waterbody</th>
<th>Impaired Designated Use Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>East Canyon Creek-2</td>
<td>E. Coli, Temperature, Total Phosphorus</td>
</tr>
<tr>
<td>Kimball Creek</td>
<td>Arsenic, E. Coli</td>
</tr>
<tr>
<td>Silver Creek</td>
<td>Cadmium, Nitrate as Total N, pH, Arsenic; pH; Dissolved Oxygen, E. Coli, Cadmium, Zinc; Cadmium, Total Dissolved Solids</td>
</tr>
<tr>
<td>Rockport Reservoir</td>
<td>Temperature, Dissolved Oxygen</td>
</tr>
<tr>
<td>Echo Reservoir</td>
<td>Temperature, Dissolved Oxygen, Total Phosphorus</td>
</tr>
<tr>
<td>Echo Creek</td>
<td>Sedimentation; Total Dissolved Solids</td>
</tr>
<tr>
<td>Chalk Creek-1</td>
<td>E. Coli</td>
</tr>
<tr>
<td>Chalk Creek-3</td>
<td>pH, Sedimentation, Total Phosphorus</td>
</tr>
<tr>
<td>Chalk Creek-4</td>
<td>Sedimentation, Total Phosphorus</td>
</tr>
<tr>
<td>South Fork Chalk Creek</td>
<td>Sedimentation, Total Phosphorus</td>
</tr>
<tr>
<td>East Fork Chalk Creek</td>
<td>pH</td>
</tr>
<tr>
<td>Huff Creek</td>
<td>Sedimentation, Total Phosphorus</td>
</tr>
<tr>
<td>Provo River-6</td>
<td>Aluminum, Zinc</td>
</tr>
<tr>
<td>Yellow Creek</td>
<td>E. Coli</td>
</tr>
<tr>
<td>China Lake</td>
<td>Dissolved Oxygen, Temperature</td>
</tr>
<tr>
<td>Blacks Fork</td>
<td>pH, Aluminum</td>
</tr>
<tr>
<td>West Fork Smiths Fork</td>
<td>Aluminum, Zinc</td>
</tr>
<tr>
<td>West Fork Beaver Creek</td>
<td>Aluminum</td>
</tr>
<tr>
<td>Middle Fork Beaver Creek</td>
<td>Aluminum</td>
</tr>
<tr>
<td>Uinta River-4</td>
<td>pH, Aluminum, Zinc</td>
</tr>
</tbody>
</table>

0.8 Appendices

This Storm Water Management Plan includes several appendices, which are as follows:

- **Appendix A**  Summit County Stormwater SOP Manual
- **Appendix B**  BMP Design Specifications
- **Appendix C**  Summit County LID Design Specifications & Long-Term Stormwater Management Template
- **Appendix D**  Ordinance 381
1.0 Public Education and Outreach
Minimum Control Measure #1

1.1 Overview

The operator of a regulated small MS4 must implement a multimedia public education program to distribute educational materials to certain focus groups as listed below:

- Residents;
- Business, institutions, and commercial facilities;
- Developers and Contractors; and
- Industrial Facilities.
- Summit County staff

1.2 Summary of Existing Measures

Currently, Summit County contracts with Republic Services to provide garbage collection, waste services, and a recycling program. Educational materials are mailed to residents of Summit County informing them of the trash collection and recycling schedule as well as information on the types of recyclables that are accepted.

Summit County, in cooperation with Recycle Utah and other entities, participates annually in a Water Festival to educate elementary school students on items related to water quality. Summit County provides a model that illustrates the effectiveness of erosion control measures as they related to construction and stabilization of the ground. This continues to be a successful event in which participation and attendance is growing.

1.3 Plan and Implementation Measures

The Utah MS4 permit lists items that must be included in the SWMP. These are listed below with information regarding the targeted pollutant, type of BMP that will be used to satisfy the requirement, the targeted audience, how effectiveness will be measured, and a targeted completion date.

The BMPs that are considered to meet the goal of public education and outreach are listed below along with the associated code that is used in Table 1.

<table>
<thead>
<tr>
<th>BMP</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Educational Materials</td>
<td>EM</td>
</tr>
<tr>
<td>Classroom Education on Storm Water</td>
<td>CESW</td>
</tr>
<tr>
<td>Use of Media</td>
<td>UM</td>
</tr>
<tr>
<td>Employee Training</td>
<td>ET</td>
</tr>
<tr>
<td>Public Education and Participation</td>
<td>PEP</td>
</tr>
<tr>
<td>Target</td>
<td>Audience(s)</td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
</tr>
<tr>
<td><strong>4.2.1 Educate audiences (residence, institutions, industrial/commercial facilities, developers and MS4 owned facility staff) about impacts from storm water discharge, ways to avoid, minimize and reduce impacts of stormwater discharge, and actions taken to improve water quality</strong></td>
<td>Residents, Institutions, Industrial, Developers, County staff</td>
</tr>
<tr>
<td><strong>4.2.1.1 Target specific pollutants and provide information that describes potential impacts from stormwater discharges</strong></td>
<td>Residents, Institutions, Industrial, Developers, County staff</td>
</tr>
<tr>
<td>Minimum Control Measure 1</td>
<td><strong>4.2.1.2</strong> Provide and document information given to the general public of the Permittee’s prohibitions against and the water quality impacts associated with illicit discharges and improper disposal of waste.</td>
</tr>
<tr>
<td>--------------------------</td>
<td>------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Illicit discharge and waste</td>
<td>Residents, Institutions, Industrial, Developers, County staff</td>
</tr>
<tr>
<td>Trash, yard waste, chemicals</td>
<td>Institutions, Industrial &amp; Developers</td>
</tr>
<tr>
<td>Trash, yard waste, chemicals</td>
<td>Engineers, Const. contractors, Developers, Review staff, Planners</td>
</tr>
<tr>
<td>Illicit discharge and waste</td>
<td>Facility owned staff</td>
</tr>
<tr>
<td>Sediment control</td>
<td>MS4 Engineers, development staff, planners, and others</td>
</tr>
<tr>
<td>------------------</td>
<td>--------------------------------------------------------</td>
</tr>
<tr>
<td>Trash, yard waste, chemicals</td>
<td>Summit County community</td>
</tr>
<tr>
<td>All pollutants</td>
<td>All audiences</td>
</tr>
</tbody>
</table>
2.0 Public Involvement and Participation
Minimum Control Measure #2

2.1 Introduction

Involving the public is key to any successful SWMP. Representatives from stakeholder groups need to have the ability to be involved and participate in the program through various means. Groups that may be involved include:

- Residences;
- Commercial and Industrial Businesses;
- Trade Associations;
- Environmental Groups;
- Homeowner Associations; and
- Education Organizations.

To involve these groups, Summit County currently follows the public notification process for public meetings. This allows members from each of the stakeholder groups to provide input into the SWMP. In addition to this notice, the County has placed the SWMP on the website for public review and comments. Annually, the County will review any comments on the program operation for the year and implement changes as needed. The County Council will review and approve any changes to the program.

2.2 Summary of Existing Efforts

The SWMP is updated annually and posted to the website, with a comment box for public input. The annual report is also posted to the website each year. Summit County utilizes local social media groups Nextdoor, Facebook pages, and twitter to provide information on where to comment on the program.

2.3 Plan and Implementation Measures

In order to help meet the goals and objectives of the SWMP, Summit County has chosen to adopt the following BMPs for use within our County as applicable. Each BMP is cross referenced alphabetically by code to a fact sheet that describes the BMP, its applicability, its limitations, and its effectiveness in the BMP Appendix.

<table>
<thead>
<tr>
<th>BMP</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community Hotline</td>
<td>CH</td>
</tr>
<tr>
<td>Public Education/Participation</td>
<td>PEP</td>
</tr>
<tr>
<td>Service Group Participation</td>
<td>SGP</td>
</tr>
</tbody>
</table>

In order to more fully realize the benefit of the BMP, the County has set the following goals. The goals set along with the existing efforts fulfill the requirements of the General Permit for Discharges from Small MS4’s.
<table>
<thead>
<tr>
<th>Pollutant(s)</th>
<th>Audience(s)</th>
<th>Desired Result</th>
<th>Measurable Goal</th>
<th>Milestone Date</th>
<th>BMP</th>
<th>Measure of Success</th>
<th>Goal Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Pollutants</td>
<td>General Public</td>
<td>4.2.2 Have a program or policy in place that allows for the public to provide input</td>
<td>Summit County’s website provides a comment box for public input to the Stormwater program</td>
<td>July 2020</td>
<td>PEP</td>
<td>Comment box utilized by community promoted through social media</td>
<td>Ongoing</td>
</tr>
<tr>
<td>All pollutants</td>
<td>General Public</td>
<td>4.2.2.1 Adopt a program/policy that allows the public to provide input to the SWMP</td>
<td>Summit County’s website provides a comment box for public input to the SWMP (also posted on website)</td>
<td>July 2020</td>
<td>PEP</td>
<td>Comment box utilized by community promoted through social media</td>
<td>Ongoing</td>
</tr>
<tr>
<td>All pollutants</td>
<td>General Public</td>
<td>4.2.2.2 New Permittees shall make the SWMP document available to the public for review and input within 180 days of receiving notification</td>
<td>Post the SWMP on the County website, update with permit modifications</td>
<td>June 2015 &amp; July 2020</td>
<td>PEP</td>
<td>SWMP is updated and posted on the website</td>
<td>Ongoing</td>
</tr>
<tr>
<td>All pollutants</td>
<td>General Public</td>
<td>4.2.2.3 Make updated SWMP document available to the public at all times</td>
<td>Summit County’s website provides a comment box and hotline # for public input to the SWMP (also posted on website)</td>
<td>Ongoing</td>
<td>PEP CH</td>
<td>SWMP is updated and posted on the website annually</td>
<td>Ongoing</td>
</tr>
<tr>
<td>All pollutants</td>
<td>All</td>
<td>4.2.2.4 Permittee must comply with state and local public notice requirements when implementing program</td>
<td>Summit County will public notice the updated SWMP and the Annual Report</td>
<td>Annually, Ongoing</td>
<td>SGP</td>
<td>Utilize the Park Record paper for public notices in the County</td>
<td>Ongoing</td>
</tr>
</tbody>
</table>

Minimum Control Measure 2
3.0  Illicit Discharge Detection and Elimination
Minimum Control Measure #3

3.1 Introduction

Illicit discharges are non-storm water discharges that enter into natural water bodies through various methods and means. The Illicit Discharge Detection and Elimination (IDDE) control measure is intended to prevent illicit connections and discharges to natural drainages by monitoring outfalls, performing inspections of County owned facilities and maintaining inventories of storm water infrastructure.

3.2 Summary of Existing Efforts

An existing County ordinance exists that allows the County to charge the negligent party for the cost of cleanup when a hazardous spill occurs.

Currently, reports of spills are handled through 911 Dispatch. When reported to dispatch, spill reports are logged and assessed and addressed by the Summit County Health Department, the Fire District that has jurisdiction in the area of the spill, and other local hazardous material response teams.

The county has not generally experienced problems with individuals or businesses illicitly connecting their sanitary waste water piping to storm drains. More common types of illicit discharges include septic tank overflows, spills from highway accidents, and concrete truck wash out water. Although it has not been documented, it is also suspected that some homeowners dump used oil, antifreeze and household chemicals into ditches.

3.3 Plan and Implementation Measures

In order to help meet the goals and objectives of the SWMP, Summit County has chosen to adopt the following BMPs for use within our County as applicable. Each BMP is cross referenced alphabetically by code to a fact sheet that describes the BMP, its applicability, its limitations, and its effectiveness in the BMP section,

<table>
<thead>
<tr>
<th>BMP</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community Hotline</td>
<td>CH</td>
</tr>
<tr>
<td>Public Education/Participation</td>
<td>PEP</td>
</tr>
<tr>
<td>Ordinance Development</td>
<td>OD</td>
</tr>
<tr>
<td>Illegal Dumping Controls</td>
<td>IDC</td>
</tr>
<tr>
<td>Map Storm Water Drains</td>
<td>MSWD</td>
</tr>
<tr>
<td>Employee Training</td>
<td>ET</td>
</tr>
<tr>
<td>Standard Operating Procedures</td>
<td>SOP</td>
</tr>
</tbody>
</table>

In order to more fully realize the benefits of the BMPs listed above, the County has set the following goals. The goals set along with the existing efforts fulfill the requirements of the Final Storm Water Phase II Rule for Illicit Discharge Detection and Elimination.

Initial enforcement of this rule will be by the Summit County Engineering and Health Departments with support from the Summit County Attorney and Sheriff’s Office.
<table>
<thead>
<tr>
<th>Pollutant(s)</th>
<th>Audience(s)</th>
<th>Desired Result</th>
<th>Measurable Goal</th>
<th>Milestone Date</th>
<th>BMP</th>
<th>Measure of Success</th>
<th>Goal Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA</td>
<td>MS4/County staff</td>
<td>4.2.3.1 Maintain map of the municipal stormwater system in the MS4</td>
<td>Develop a GIS map showing permit requirement items</td>
<td>Ongoing</td>
<td>MSWD</td>
<td>Track down previous system; Have procedure in place for new construction</td>
<td>Ongoing</td>
</tr>
<tr>
<td>All Pollutants</td>
<td>Contractors, Developers, County Council</td>
<td>4.2.3.2 Develop an ordinance to prohibit non stormwater discharges, including spills, illicit connections, etc and have an escalating enforcement procedures</td>
<td>Update ordinance to include permit requirements</td>
<td>Draft December 2020</td>
<td>OD</td>
<td>Council approved ordinance</td>
<td>Upon approval and adaption</td>
</tr>
<tr>
<td>All Pollutants</td>
<td>All Audiences</td>
<td>4.2.3.2.1 The IDDE program must have adequate legal authority to detect, investigate, eliminate and enforce against non stormwater discharges</td>
<td>Update ordinance to include permit requirements</td>
<td>Draft December 2020</td>
<td>OD</td>
<td>Council approved ordinance</td>
<td>Upon approval and adaption</td>
</tr>
<tr>
<td>All Pollutants</td>
<td>All Audiences</td>
<td>4.2.3.3 Implement a written plan to address non stormwater discharges to the MS4 including spills, illicit connections, sanitary sewer overflows and illegal dumping.</td>
<td>Create and implement a written plan</td>
<td>August 2020</td>
<td>IDC</td>
<td>Plan created with all permit requirements and implemented</td>
<td>Ongoing</td>
</tr>
<tr>
<td>All Pollutants</td>
<td>All Audiences</td>
<td>4.2.3.3.1 Create systematic procedures for locating and listing priority areas, the priority list must be updated annually</td>
<td>Create priority list using permit requirements and maintain list annually, possibly utilizing a GIS system in the future</td>
<td>August 2020</td>
<td>IDC</td>
<td>List created accurately and maintained annually</td>
<td>Ongoing</td>
</tr>
<tr>
<td>All Pollutants</td>
<td>All Audiences</td>
<td>4.2.3.3.2 Conduct annual field inspections of areas deemed priority</td>
<td>Inspections conducted annually and develop a documentation system</td>
<td>August 2020</td>
<td>IDC</td>
<td>Inspections successfully conducted annually</td>
<td>Ongoing</td>
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</tr>
<tr>
<td>All Pollutants</td>
<td>All Audiences</td>
<td>4.2.3.3 Conduct dry weather screening on all outfalls that discharge the Permittees jurisdiction to a water body once during 5 year permit term</td>
<td>Inspections conducted during permit term and develop documentation system</td>
<td>August 2020</td>
<td>IDC</td>
<td>Inspections successfully conducted during permit term</td>
<td>Ongoing</td>
</tr>
<tr>
<td>All Pollutants</td>
<td>All Audiences</td>
<td>4.2.3.3.4 If the Permittee discovers or suspects that a discharger may need a separate UPDES Permit the Permittee shall notify the Director.</td>
<td>Train staff on who needs UPDES Permit’s and once identified notify UDEQ-DWQ (5 UPDES permits identified in 2019)</td>
<td>Ongoing</td>
<td>IDC</td>
<td>Permits identified and proper permits obtained</td>
<td>Ongoing</td>
</tr>
<tr>
<td>All Pollutants</td>
<td>All Audiences</td>
<td>4.2.3.4 Implement an SOP for tracing the source of an illicit discharge</td>
<td>Create an SOP for tracing procedures of an illicit discharge</td>
<td>September 2020</td>
<td>SOP</td>
<td>SOP utilized for tracing illicit discharges</td>
<td>Ongoing</td>
</tr>
<tr>
<td>All Pollutants</td>
<td>All Audiences</td>
<td>4.2.3.5 Develop and implement standard operating procedures (SOP’s) for characterizing the nature of any illicit discharges found or reported to the Permittee</td>
<td>Create an SOP for characterizing illicit discharges</td>
<td>September 2020</td>
<td>SOP/CH</td>
<td>Compliance with this provision will be achieved by initiating investigation and following SOP</td>
<td>Ongoing</td>
</tr>
<tr>
<td>All Pollutants</td>
<td>All Audiences</td>
<td>4.2.3.5.1 Create and utilize an inspection report for Illicit Discharges</td>
<td>Create and utilize Summit County’s Illicit Discharge inspection report</td>
<td>June 2020</td>
<td>IDC</td>
<td>In coordination with DEQ-DWQ Incident Notification, follow up with Summit County’s inspection report</td>
<td>Ongoing</td>
</tr>
<tr>
<td>Pollutants</td>
<td>Audiences</td>
<td>Action</td>
<td>Description</td>
<td>Start Date</td>
<td>Type</td>
<td>Ongoing</td>
<td></td>
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</tr>
<tr>
<td>All Pollutants</td>
<td>All Audiences</td>
<td>4.2.3.6 Implement SOP for ceasing illicit discharges and appropriate notifications to agency’s</td>
<td>Create SOP/flow chart to be followed with illicit discharges; coordination with Health Dept SOP’s to determine who will take the lead</td>
<td>June 2020</td>
<td>SOP</td>
<td>Ongoing</td>
<td></td>
</tr>
<tr>
<td>All Pollutants</td>
<td>All Audiences</td>
<td>4.2.3.6.1 Permittee shall require immediate cessation of improper disposal practices</td>
<td>Create SOP/flow chart to be followed with illicit discharges; coordination with Health Dept SOP’s to determine who will take the lead</td>
<td>June 2020</td>
<td>SOP</td>
<td>Ongoing</td>
<td></td>
</tr>
<tr>
<td>All Pollutants</td>
<td>All Audiences</td>
<td>4.2.3.6.2 This permit does not impose strict liability on the Permittee</td>
<td>Use best management practices to find as many illicit discharges as possible in the County</td>
<td>June 2020</td>
<td>SOP</td>
<td>Ongoing</td>
<td></td>
</tr>
<tr>
<td>All Pollutants</td>
<td>All Audiences</td>
<td>4.2.3.6.3 All IDDE reports must be retained and available for request by the Director</td>
<td>Currently Illicit Discharge reports stored in the Engineering (S) drive</td>
<td>June 2020</td>
<td>IDC</td>
<td>Ongoing</td>
<td></td>
</tr>
<tr>
<td>All Pollutants</td>
<td>All Audiences</td>
<td>4.2.3.7 Permittees shall inform public employees, businesses, and the general public of hazards associated with illicit discharges and improper disposal of waste</td>
<td>Utilize public outreach program to distribute information</td>
<td>Forever ongoing</td>
<td>PEP/ET</td>
<td>Ongoing</td>
<td></td>
</tr>
<tr>
<td>All Pollutants</td>
<td>All Audiences</td>
<td>4.2.3.8 Permittees shall promote or provide services for the collection of household hazardous waste.</td>
<td>Summit County’s Public Works facility and 3 mile landfill accept household hazardous waste; Recycle Utah sponsors semi-annual collections</td>
<td>Continuous</td>
<td>PEP</td>
<td>Ongoing</td>
<td></td>
</tr>
</tbody>
</table>

Minimum Control Measure 3
<table>
<thead>
<tr>
<th>Pollutants</th>
<th>Audience</th>
<th>Measure</th>
<th>Hotline number/email</th>
<th>Note</th>
<th>Start Date</th>
<th>Responsible Party</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Pollutants</td>
<td>All Audiences</td>
<td>4.2.3.9 Permittee must publicly list a hotline for spills and other illicit discharges</td>
<td>Listed under Engineering MS4 page, record kept with Summit County inspection report</td>
<td>June 2016</td>
<td>PEP</td>
<td>Hotline number/email available on website, also in public outreach program</td>
<td>Ongoing</td>
</tr>
<tr>
<td>All Pollutants</td>
<td>All Audiences</td>
<td>4.2.3.9.1 Develop SOP for public referrals of illicit discharges and appropriate agency involvement</td>
<td>Create SOP/flow chart to be followed with illicit discharges; coordination with Health Dept SOP’s to determine who will take the lead</td>
<td>June 2020</td>
<td>SOP</td>
<td>Train appropriate employees and utilize flow chart and Health Dept SOP</td>
<td>Ongoing</td>
</tr>
<tr>
<td>All Pollutants</td>
<td>All Audiences</td>
<td>4.2.3.10 Permittees shall implement procedures for program evaluation which includes maintaining a database for mapping, tracking of the number and type of spills or illicit discharges identified; and inspections conducted.</td>
<td>Create flowchart that lines out who takes the lead (Health Dept (HD) vs Stormwater) on illicit discharges, create GIS database with HD</td>
<td>August 2020</td>
<td>IDC</td>
<td>GIS database utilized with HD and Stormwater</td>
<td>Ongoing</td>
</tr>
<tr>
<td>All Pollutants</td>
<td>Summit County staff</td>
<td>4.2.3.11 The permittee shall train all staff/contractors that may come in contact with illicit discharges</td>
<td>Create PowerPoint or other training mechanism to train appropriate staff annually</td>
<td>March 2020; updated July 2020</td>
<td>ET</td>
<td>Annual trainings completed</td>
<td>Ongoing</td>
</tr>
<tr>
<td>All Pollutants</td>
<td>All Audiences</td>
<td>4.2.3.6.12 All non stormwater reports must be retained and available for request by the Director</td>
<td>Currently Illicit Discharge reports stored in the Engineering (S) drive; Summit County open to further study requirements from DEQ-DWQ</td>
<td>June 2020</td>
<td>IDC</td>
<td>Properly utilize and store forms</td>
<td>Ongoing</td>
</tr>
</tbody>
</table>
4.0 Construction Site Runoff Control
Minimum Control Measure #4

4.1 Introduction

Runoff from construction sites can be a large contributing factor to storm water pollution. By controlling construction site runoff through planning, design, and construction BMPs, pollution to natural water bodies can be greatly reduced. Review of erosion control plans, Storm Water Pollution Prevention Plans (SWPPP’s) and regular site inspections aid in implementation of this control measure to reduce storm water discharges.

4.2 Summary of Existing Efforts

Summit County has had an erosion control ordinance in place since 2004 for construction site BMP’s. This ordinance outlines the requirements of SWPPP’s, inspections and acceptable BMP’s.

Summit County inspectors routinely visit construction sites in Summit County and have the ability to assess citations and notices of violation if there are storm water violations. Large development projects are visited on a monthly basis with SWPPP inspections being conducted bi-weekly for high priority sites.

Summit County has a website that is located at www.summitcounty.org. This website includes a stormwater MS4 page that includes both general and specific information. The stormwater division page is located under Engineering.

4.2 Plan and Implementation Measures

In order to help meet the goals and objectives of the SWMP, Summit County has chosen to adopt the following BMPs for use within our County as applicable. Each BMP is cross referenced alphabetically by code to a fact sheet that describes the BMP, its applicability, its limitations, and its effectiveness in the BMP section.

<table>
<thead>
<tr>
<th>BMP</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erosion Control Plan</td>
<td>ECP</td>
</tr>
<tr>
<td>Contractor Certification and Inspector Training</td>
<td>CCIT</td>
</tr>
<tr>
<td>Standard Operating Procedure</td>
<td>SOP</td>
</tr>
<tr>
<td>Ordinance Development</td>
<td>OD</td>
</tr>
</tbody>
</table>

In order to more fully realize the benefit of the BMP, Summit County has set the following goals. The goals set along with the existing efforts fulfill the requirements of the Phase II Rule for Small MS4’s.
In order to more fully realize the benefit of the BMP, the County has set the following goals. The goals set along with the existing efforts fulfill the requirements of the Final Storm Water Phase II Rule for Post Construction Runoff Control.

<table>
<thead>
<tr>
<th>Pollutant(s)</th>
<th>Audience(s)</th>
<th>Desired Result</th>
<th>Measurable Goal</th>
<th>Milestone Date</th>
<th>BMP</th>
<th>Measure of Success</th>
<th>Goal Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sediment, Construction Site Debris, Hydrocarbons</td>
<td>Contractors and Developers</td>
<td>4.2.4.1 Revise ordinance to require erosion control practices at construction sites</td>
<td>Ordinance updated to include erosion control at a minimum at sites &gt;1 acre or are part of the common plan, but may include additional construction sites</td>
<td>Draft December 2020</td>
<td>OD, PEP</td>
<td>Council approved ordinance</td>
<td>Ongoing</td>
</tr>
<tr>
<td>Sediment, Construction Site Debris, Hydrocarbons</td>
<td>Contractors and Developers</td>
<td>4.2.4.1.1 Revise ordinance to require SWPPP at construction sites &gt;1 acre or are part of the common plan</td>
<td>Ordinance updated to include SWPPP at sites &gt;1 acre or are part of the common plan</td>
<td>Draft December 2020</td>
<td>OD, PEP</td>
<td>Council approved ordinance</td>
<td>Ongoing</td>
</tr>
<tr>
<td>Sediment, Construction Site Debris, Hydrocarbons</td>
<td>Contractors and Developers</td>
<td>4.2.4.1.2 Require construction operators to obtain coverage under the Construction General Permit by obtaining an NOI through the State Data Exchange (CDX) system</td>
<td>Track operator coverage through the EPA’s Central Data Exchange (CDX) system</td>
<td>Ongoing</td>
<td>OD, PEP</td>
<td>95% of all required construction sites are currently covered, tracked through CDX</td>
<td>Ongoing</td>
</tr>
<tr>
<td>Sediment, Construction Site Debris, Hydrocarbons</td>
<td>Contractors and Developers</td>
<td>4.2.4.1.3 Revise ordinance to include access to inspect construction sites</td>
<td>Ordinance to include access</td>
<td>Draft December 2020</td>
<td>OD, PEP</td>
<td>95% of all required construction sites are currently covered, tracked through CDX</td>
<td>Ongoing</td>
</tr>
<tr>
<td>Sediment, Construction Site Debris, Hydrocarbons</td>
<td>Contractors and Developers</td>
<td>4.2.4.2 Develop a written enforcement strategy and implement the enforcement provisions of the ordinance or other regulatory</td>
<td>Create SOP’s for enforcement</td>
<td>Amend existing ordinance to include escalating enforcement provisions</td>
<td>Draft December 2020</td>
<td>OD</td>
<td>SOP’s utilized &amp; Council Approved Ordinance</td>
</tr>
<tr>
<td>Sediment, Construction Site Debris, Hydrocarbons</td>
<td>Contractors and Developers, County Council, Plan Reviewers</td>
<td>4.2.4.2.2 Documentation and tracking of all enforcement actions</td>
<td>Develop and begin using a construction site enforcement action log/database</td>
<td>ComplianceGO May 2020</td>
<td>OD</td>
<td>Create, use, and update log</td>
<td>Ongoing</td>
</tr>
<tr>
<td>Sediment, Construction Site Debris, Hydrocarbons</td>
<td>Contractors and Developers</td>
<td>4.2.4.3 Develop and implement checklist for pre-construction SWPPP review for construction sites</td>
<td>Develop checklist and begin to do pre-construction reviews of SWPPP’s</td>
<td>August 2019</td>
<td>ECP</td>
<td>Created Checklist and Conduct SWPPP reviews</td>
<td>Ongoing</td>
</tr>
<tr>
<td>Sediment, Construction Site Debris, Hydrocarbons</td>
<td>Contractors and Developers</td>
<td>4.2.4.3.1 Conduct a pre-construction meeting</td>
<td>Hold pre-construction meetings on all projects over an acre and common plans of development</td>
<td>Ongoing</td>
<td>PEP</td>
<td>Conduct and document (ComplianceGO) pre-construction meetings with checklist and inspection form</td>
<td>Ongoing</td>
</tr>
<tr>
<td>Target</td>
<td>Pollutant(s)</td>
<td>Audience(s)</td>
<td>Desired Result</td>
<td>Measurable Goal</td>
<td>Milestone Date</td>
<td>BMP</td>
<td>Measure of Success</td>
</tr>
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</tr>
<tr>
<td></td>
<td>Sediment, Construction Site Debris, Hydrocarbons</td>
<td>Contractors and Developers</td>
<td>4.3.4.3.2 Incorporate into the SWPPP review procedures the consideration of potential water quality impacts and procedures for pre-construction review which shall include the use of a checklist</td>
<td>At pre-construction meetings, sites will be identified through checklist as ‘High Priority’ or not</td>
<td>Checklist updated June 2020 and kept in ComplianceGO</td>
<td>ECP</td>
<td>Documented on High Priority Const Log/Database</td>
</tr>
<tr>
<td></td>
<td>Sediment, Construction Site Debris, Hydrocarbons</td>
<td>Contractors and Developers</td>
<td>4.2.4.4.1 Inspections of required construction sites at least monthly by qualified personnel</td>
<td>Develop SOP’s for construction site inspection and enforcement. Conduct monthly inspections of required construction sites</td>
<td>October 2019</td>
<td>SOP</td>
<td>90% of required construction sites are inspected monthly</td>
</tr>
<tr>
<td>Target</td>
<td>Audience(s)</td>
<td>Desired Result</td>
<td>Measurable Goal</td>
<td>Milestone Date</td>
<td>BMP</td>
<td>Measure of Success</td>
<td>Goal Completed</td>
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</tr>
<tr>
<td>Sediment, Construction Site Debris, Hydrocarbons</td>
<td>Contractors and Developers</td>
<td>4.2.4.4.2 The County must include a procedure for being notified by construction operators/owners of their completion of active construction so that verification of final stabilization and removal of all temporary control measures may be conducted</td>
<td>Train SWPPP inspectors, their supervisors, contractors and any personnel who grant final bond releases and the connection to the NOT process</td>
<td>Training Ongoing</td>
<td>ECP</td>
<td>90% of all construction sites are terminated appropriately</td>
<td>Training completed for inspectors, supervisors &amp; staff June 2020; Contractors ongoing</td>
</tr>
<tr>
<td>Sediment, Construction Site Debris, Hydrocarbons</td>
<td>Contractors and Developers</td>
<td>4.2.4.4.3 Conduct bi-weekly inspections on high priority construction sites</td>
<td>Inspect high priority sites bi-weekly</td>
<td>Ongoing</td>
<td>ECP</td>
<td>All high priority construction sites are inspected bi-weekly documented in ComplianceGO</td>
<td>Ongoing</td>
</tr>
<tr>
<td>4.2.4.4.4 – Not Applicable to Summit County at this time</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Sediment, Construction Site Debris, Hydrocarbons</td>
<td>Contractors and Developers</td>
<td>4.2.4.4.5 Documentation and tracking of all enforcement actions to a construction site enforcement action log/database</td>
<td>Develop and begin using</td>
<td>ComplianceGO May 2020</td>
<td>OD</td>
<td>Create, use, and update log</td>
<td>Ongoing</td>
</tr>
<tr>
<td>Sediment, Construction Site Debris, Hydrocarbons</td>
<td>County Staff</td>
<td>4.2.4.5 Provide training to County staff related to construction planning, permitting, reviews, inspection and enforcement.</td>
<td>Documented annual training</td>
<td>Ongoing</td>
<td>CCIT</td>
<td>Documented annually</td>
<td>Ongoing annually</td>
</tr>
<tr>
<td>Sediment, Construction Site Debris, Hydrocarbons</td>
<td>All staff involved in the SWMP</td>
<td>4.2.4.6 Maintain a documented program of permitted active construction sites</td>
<td>Establish and utilize a software that can maintain documentation (ComplianceGO)</td>
<td>Ongoing</td>
<td>ECP</td>
<td>Successful when the software system is fully implemented</td>
<td>ComplianceGO implemented May 2020</td>
</tr>
</tbody>
</table>
5.0 Long Term Storm Water Management in New Development and Re-Development

Minimum Control Measure #5

5.1 Introduction

The intent of Long Term Storm Water Management is to maintain post-construction runoff conditions to those of pre-construction runoff. This pertains to both quantity and quality.

Long Term Storm Water Management applies to sites over one acre in size and sites less than one acre when part of a common plan of development. Applicability of this minimum control measure also pertains to private and public development sites.

When re-development of an area occurs within the community, considerations to reduce storm water runoff and improve water quality must be applied.

5.2 Summary of Existing Efforts

Currently, the County has an existing Ordinance that requires maintenance covenants for long term stormwater management and is currently being updated to the Small MS4 permit requirements. The County also collects bonds at the time of building permit and holds them until final stabilization of the site is complete.

Summit County is currently implementing the retentions, detention and infiltration of the 80th percentile storm event. Most developments incorporate a retention pond system with some utilizing injection wells.

5.3 Plan and Implementation Measures

In order to help meet the goals and objectives of this SWMP, Summit County has chosen to adopt the following BMPs for use within our County as applicable. Each BMP is cross referenced alphabetically by code to a fact sheet that describes the BMP, its applicability, its limitations, and its effectiveness in the BMP section.

<table>
<thead>
<tr>
<th>BMP</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Educational Materials</td>
<td>EM</td>
</tr>
<tr>
<td>Ordinance Development</td>
<td>OD</td>
</tr>
<tr>
<td>Land Use Planning/Management</td>
<td>LUPM</td>
</tr>
<tr>
<td>Standard Operating Procedure</td>
<td>SOP</td>
</tr>
<tr>
<td>BMP Inspection and Maintenance</td>
<td>BMPIM</td>
</tr>
<tr>
<td>Employee Training</td>
<td>ET</td>
</tr>
<tr>
<td>Infrastructure Planning</td>
<td>IPL</td>
</tr>
<tr>
<td>Pollutant(s)</td>
<td>Audience(s)</td>
</tr>
<tr>
<td>------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>All Pollutants</td>
<td>All Audiences</td>
</tr>
<tr>
<td>All Pollutants</td>
<td>MS4 Staff, County Council</td>
</tr>
<tr>
<td>Pollutant(s)</td>
<td>Audience(s)</td>
</tr>
<tr>
<td>----------------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>All Pollutants</td>
<td>MS4 Staff, Contractors and Developers</td>
</tr>
<tr>
<td>All Pollutants</td>
<td>MS4 Staff, Contractors and Developers</td>
</tr>
<tr>
<td>All Pollutants</td>
<td>MS4 Staff, Contractors and Developers</td>
</tr>
<tr>
<td>All Pollutants</td>
<td>MS4 Staff, Contractors and Developers</td>
</tr>
</tbody>
</table>

Minimum Control Measure 5
<table>
<thead>
<tr>
<th>Minimum Control Measure 5</th>
<th>MS4 Staff, Contractors and Developers</th>
<th>4.2.5.2 Develop and adopt an ordinance or other regulatory mechanism that requires long-term post-construction stormwater controls at new development and re-development sites.</th>
<th>Amend ordinance that meets requirements of the new permit</th>
<th>Draft Ordinance December 2020</th>
<th>OD</th>
<th>Ordinance adopted by Council</th>
<th>Ongoing</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Pollutants</td>
<td>MS4 Staff, Contractors and Developers</td>
<td>4.2.5.2.1 Ordinance must include enforcement provisions for long-term stormwater controls</td>
<td>Amend ordinance that meets requirements of the new permit</td>
<td>Draft Ordinance December 2020</td>
<td>OD</td>
<td>Ordinance adopted by Council</td>
<td>Ongoing</td>
</tr>
<tr>
<td>All Pollutants</td>
<td>MS4 Staff, Contractors and Developers</td>
<td>4.2.5.2.2 All Permittees shall adopt and implement SOPs or similar types of documents for site inspection and enforcement of post-construction storm water control measures</td>
<td>Review and customize SOPs for inspection and enforcement of post-construction control measures</td>
<td>August 2020</td>
<td>SOP</td>
<td>Review and utilize SOP’s</td>
<td>Ongoing</td>
</tr>
<tr>
<td>All Pollutants</td>
<td>MS4 Staff, Contractors and Developers</td>
<td>4.2.5.2.3 Ordinance must include access to inspect private properties</td>
<td>Amend ordinance that meets requirements of the new permit</td>
<td>Draft Ordinance December 2020</td>
<td>OD</td>
<td>Ordinance adopted by Council</td>
<td>Ongoing</td>
</tr>
<tr>
<td>All Pollutants</td>
<td>MS4 Staff, Contractors and Developers</td>
<td>4.2.5.2.4 Permanent structural BMP’s shall be inspected once during installation and once post-construction by qualified personnel</td>
<td>Stormwater team member inspects during construction and bond is not released until final completion inspection</td>
<td>Standard Summit County Engineering practice</td>
<td>BMPIM</td>
<td>Inspections completed and bonds released</td>
<td>Ongoing</td>
</tr>
<tr>
<td>All Pollutants</td>
<td>MS4 Staff, Contractors and Developers</td>
<td>4.2.5.2.5 Annual inspections completed for maintenance need and annual report submitted, once every five years Permittee inspection completed</td>
<td>Summit County to implement long term stormwater management plans (LTSWMP) and agreements for SC Permittees</td>
<td>Template completed December 2019, Update July 2020</td>
<td>BMPIM</td>
<td>Template utilized for all required sites</td>
<td>Ongoing</td>
</tr>
<tr>
<td>All Pollutants</td>
<td>MS4 Staff, Contractors and Developers</td>
<td>4.2.5.3.1 Adopt and implement procedures for site plan review to evaluate water quality impacts</td>
<td>LTSWMP template utilized, preconstruction checkbox</td>
<td>Template completed December 2019, Update July 2020</td>
<td>BMPIM</td>
<td>LTSWMP template utilized</td>
<td>Ongoing</td>
</tr>
<tr>
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</tr>
<tr>
<td>All Pollutants</td>
<td>MS4 Staff, Contractors and Developers</td>
<td>4.2.5.3.2 Review post construction plans to include long-term stormwater management measures</td>
<td>LTSWMP template utilized, reviewed prior to preconstruction meeting</td>
<td>Template completed December 2019, Update July 2020</td>
<td>BMPIM</td>
<td>LTSWMP template utilized</td>
<td>Ongoing</td>
</tr>
<tr>
<td>All Pollutants</td>
<td>MS4 Staff, Contractors and Developers</td>
<td>4.2.5.4 Inventory: Must maintain an inventory of all post-construction structural stormwater control measures</td>
<td>Utilize LTSWMP template and maintain inventory in ComplianceGO</td>
<td>Template completed December 2019, Update July 2020, ComplianceGO April 2020</td>
<td>BMPIM</td>
<td>LTSWMP template and ComplianceGO utilized</td>
<td>Ongoing</td>
</tr>
<tr>
<td>All Pollutants</td>
<td>MS4 Staff, Contractors and Developers</td>
<td>4.2.5.4.1 Each entry to the inventory must include basic information on each project</td>
<td>Template update July 2020 to ensure all permit requirements included</td>
<td>July 2020</td>
<td>BMPIM</td>
<td>LTSWMP template and ComplianceGO utilized</td>
<td>Ongoing</td>
</tr>
<tr>
<td>All Pollutants</td>
<td>MS4 Staff, Contractors and Developers</td>
<td>4.2.5.4.2 Based on inspections pursuant to Part 4.2.5.2.5, update inventory where changes occur</td>
<td>Create and utilize LTSWMP inspection template</td>
<td>August 2020</td>
<td>BMPIM</td>
<td>Utilize LTSWMP inspection template</td>
<td>Ongoing</td>
</tr>
<tr>
<td>All Pollutants</td>
<td>MS4 Staff, Contractors and Developers</td>
<td>4.2.5.5 Permittees shall insure all staff involved in post-construction stormwater management receive annual training</td>
<td>Create PowerPoint for LTSWMP training and train appropriate staff</td>
<td>June 2020</td>
<td>ET</td>
<td>Document and conduct training annually</td>
<td>Ongoing</td>
</tr>
</tbody>
</table>
6.0 Pollution Prevention/Good Housekeeping
Minimum Control Measure #6

6.1 Introduction

The intent of the Pollution Prevention/Good Housekeeping control measure is to maintain and construct County owned facilities in such a way to prevent pollutants from entering into the storm water system. This is accomplished by developing and implementing an operation and maintenance program, outlining standard operation procedures (SOPs) and defining roles and responsibilities of staff overseeing the SWMP.

6.2 Summary of Existing Efforts

The County currently maintains catch basins, detention ponds, and pipes and culverts as needed. Summit County also participates in a recycling program and provides recycling containers for residents to use at the curb.

Summit County operates with a limited amount of equipment. This equipment is primarily cleaned and maintained at the Public Works Department facility located in Wanship. Equipment is fueled at this location as well. The County also stores equipment and materials at the Wanship facility and other facilities throughout the County. Salt and sand are stored under cover to reduce transport of pollutants during rain events.

Table 6-1 provides a list of activities potential sources of pollutants that result from the activities.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Pollutant</th>
<th>Potential Source</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Construction</strong></td>
<td>Sediment</td>
<td>Poor erosion control practices on hillsides, undeveloped property, right-of-way for construction sites</td>
</tr>
<tr>
<td><strong>Residential and Parks</strong></td>
<td>Nutrients</td>
<td>Yard debris, garbage, fertilizer and pesticide use, rat poison, pyrotechnics</td>
</tr>
<tr>
<td><strong>Transportation and Commercial</strong></td>
<td>Metals</td>
<td>Paint, plastics, pottery pigments and glazes, automobile tires, common galvanized coatings, pesticide use, root killer application on sewer lines, old lead paint an glazes, wood preservatives, batteries</td>
</tr>
<tr>
<td><strong>Residential</strong></td>
<td>Oxygen demanding Substances</td>
<td>Yard debris, animal wastes, organic chemical use</td>
</tr>
<tr>
<td><strong>Parks and Residential</strong></td>
<td>Bacteria and Viruses</td>
<td>Human and animal (pets and aquatic life) waste, sanitary sewer infiltration into storm drain system, decomposing yard waste</td>
</tr>
<tr>
<td><strong>Commercial and Residential</strong></td>
<td>Oil, Grease, and Hydrocarbons</td>
<td>Asphalt surface leaching, spills, leaks, construction activities</td>
</tr>
<tr>
<td><strong>Residential and Parks</strong></td>
<td>Floatables</td>
<td>Street refuse, industrial yard waste</td>
</tr>
</tbody>
</table>
6.3 Plan and Implementation Measures

In order to help meet the goals and objectives of this SWMP, Summit County has chosen to adopt the following BMPs for use within our County as applicable. Each BMP is cross referenced alphabetically by code to a fact sheet that describes the BMP, its applicability, its limitations, and its effectiveness in the BMP section.

<table>
<thead>
<tr>
<th>BMP</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Operating Procedures</td>
<td>SOP</td>
</tr>
<tr>
<td>Employee Training</td>
<td>ET</td>
</tr>
<tr>
<td>Housekeeping Practices</td>
<td>HP</td>
</tr>
</tbody>
</table>

In order to more fully realize the benefit of the BMP, the County has set the following goals. The goals set along with the existing efforts fulfill the requirements of the Final Storm Water Phase II Rule for Pollution Prevention/Good Housekeeping.
<table>
<thead>
<tr>
<th>Pollutant(s)</th>
<th>Audience(s)</th>
<th>Desired Result</th>
<th>Measurable Goal</th>
<th>Milestone Date</th>
<th>BMP</th>
<th>Measure of Success</th>
<th>Goal Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Pollutants</td>
<td>MS4 Staff</td>
<td>4.2.6.2 Permitees shall develop and keep a written inventory current of permittee-owned or operated facilities</td>
<td>Complete listing of MS4 owned/operated facilities</td>
<td>June 2019</td>
<td>HP</td>
<td>List is complete</td>
<td>June 2019</td>
</tr>
<tr>
<td>All Pollutants</td>
<td>MS4 Staff</td>
<td>4.2.6.3 All permitees must identify “high-priority” facility owned sites and set up monitoring for control measures</td>
<td>Complete assessments and identify “high priority” facilities</td>
<td>June 2019</td>
<td>HP</td>
<td>Assessments are complete and documentation kept on file</td>
<td>June 2019</td>
</tr>
<tr>
<td>All Pollutants</td>
<td>MS4 Staff</td>
<td>4.2.6.4 Each “high priority” facility identified above must develop a SWPPP</td>
<td>Review, customize and update appropriate SWPPP’s</td>
<td>May 2020</td>
<td>HP</td>
<td>SWPPP’s developed and maintained</td>
<td>Ongoing</td>
</tr>
<tr>
<td>Pollutant(s)</td>
<td>Audience(s)</td>
<td>Desired Result</td>
<td>Measurable Goal</td>
<td>Milestone Date</td>
<td>BMP</td>
<td>Measure of Success</td>
<td>Goal Completed</td>
</tr>
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</tr>
<tr>
<td>All Pollutants</td>
<td>MS4 Staff</td>
<td>4.2.6.5.1 At least once per month, a visual inspection of “high-priority” facilities, including all storm water controls, must be performed</td>
<td>Inspections conducted monthly and logged in ComplianceGO</td>
<td>June 2020</td>
<td>HP</td>
<td>Complete inspections logged in ComplianceGO</td>
<td>Ongoing</td>
</tr>
<tr>
<td>All Pollutants</td>
<td>MS4 Staff</td>
<td>4.2.6.5.2 At least twice per year, the permittee must conduct a comprehensive inspection of “high-priority” facilities</td>
<td>Inspections conducted semi-annually for pollutant generating areas and logged in ComplianceGO</td>
<td>June 2020</td>
<td>HP</td>
<td>Complete inspections logged in ComplianceGO</td>
<td>Ongoing</td>
</tr>
<tr>
<td>All Pollutants</td>
<td>MS4 Staff</td>
<td>4.2.6.5.3 At least once annually, the permittee must conduct a comprehensive inspection of stormwater discharges</td>
<td>Inspections conducted annually for stormwater discharges and logged in ComplianceGO</td>
<td>June 2020</td>
<td>HP</td>
<td>Complete inspections logged in ComplianceGO</td>
<td>Ongoing</td>
</tr>
<tr>
<td>All Pollutants</td>
<td>MS4 Staff</td>
<td>4.2.6.6 Develop and implement SOP’s for facilities</td>
<td>Identify, develop and implement SOP’s</td>
<td>June 2019 (Ongoing Updates)</td>
<td>SOP</td>
<td>Identify, develop and implement SOP’s</td>
<td>Ongoing</td>
</tr>
<tr>
<td>All Pollutants</td>
<td>MS4 Staff</td>
<td>4.2.6.6.1 Develop and implement SOP’s for protecting water quality</td>
<td>Identify, develop and implement SOP’s</td>
<td>June 2019 (Ongoing Updates)</td>
<td>SOP</td>
<td>Identify, develop and implement SOP’s</td>
<td>Ongoing</td>
</tr>
<tr>
<td>All Pollutants</td>
<td>MS4 Staff</td>
<td>4.2.6.6.2 SOP’s and schedule for street sweeping and stormwater system maintenance</td>
<td>Develop SOP’s and schedule (every other week)</td>
<td>June 2020 (every other week)</td>
<td>SOP</td>
<td>SOP’s being followed and documented</td>
<td>Ongoing</td>
</tr>
<tr>
<td>Pollutants</td>
<td>Responsible Party</td>
<td>Minimum Control Measure</td>
<td>Details</td>
<td>Due Date</td>
<td>Responsible</td>
<td>Status</td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td>--------------------</td>
<td>-------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
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<td></td>
</tr>
<tr>
<td>All Pollutants</td>
<td>MS4 Staff</td>
<td>4.2.6.6.3 Ensure proper disposal and documentation of all waste/wastewater for stormwater maintenance</td>
<td>Develop log for documenting proper disposal methods</td>
<td>June 2020</td>
<td>HP</td>
<td>Ongoing</td>
<td></td>
</tr>
<tr>
<td>All Pollutants</td>
<td>Summit County Staff</td>
<td>4.2.6.6.4 Ensure vehicle and equipment wash water disposed of properly</td>
<td>Wash area identified, logged in Public Works SWPPP</td>
<td>June 2020</td>
<td>HP</td>
<td>Ongoing</td>
<td></td>
</tr>
<tr>
<td>All Pollutants</td>
<td>MS4 Staff</td>
<td>4.2.6.6.5 Develop a spill prevention plan with local fire department’s</td>
<td>Copy of spill prevention plan</td>
<td>June 2020</td>
<td>HP</td>
<td>Ongoing</td>
<td></td>
</tr>
<tr>
<td>All Pollutants</td>
<td>MS4 Staff</td>
<td>4.2.6.6.6 Maintain an inventory of floor drains</td>
<td>Inventory kept with facility owned log</td>
<td>June 2020</td>
<td>HP</td>
<td>Ongoing</td>
<td></td>
</tr>
<tr>
<td>All Pollutants</td>
<td>MS4 Staff</td>
<td>4.2.6.7 Ensure contractors are using proper stormwater techniques</td>
<td>RSI certified inspectors do site visits throughout the project duration</td>
<td>Ongoing</td>
<td>HP</td>
<td>Ongoing</td>
<td></td>
</tr>
<tr>
<td>All Pollutants</td>
<td>MS4 Staff</td>
<td>4.2.6.8 Implement process for all new flood management structural controls</td>
<td>Currently new development required to design for 100 year flood event, if deemed necessary in the future new structures will be reviewed for functional design standards/water quality</td>
<td>Ongoing</td>
<td>HP</td>
<td>Ongoing</td>
<td></td>
</tr>
<tr>
<td>All Pollutants</td>
<td>MS4 Staff</td>
<td><strong>4.2.6.8.1</strong> Existing flood management structural controls must be assessed to determine whether changes or additions should be made to improve water</td>
<td>No known Summit County owned/maintained structural controls, periodically reviewed</td>
<td>Ongoing</td>
<td>HP</td>
<td>Periodically confirm no Summit County owned structures</td>
<td>Ongoing</td>
</tr>
<tr>
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</tr>
<tr>
<td>All Pollutants</td>
<td>MS4 Staff</td>
<td><strong>4.2.6.9</strong> Develop a plan to retrofit existing developed Summit County owned facilities adversely impacting water quality</td>
<td>Facility owned sites identified for need to retrofit, plans kept with facility owned log</td>
<td>June 2020</td>
<td>HP</td>
<td>Plans updated when necessary</td>
<td>Ongoing</td>
</tr>
<tr>
<td>All Pollutants</td>
<td>MS4 Staff</td>
<td><strong>4.2.6.10</strong> Annual training for staff with any impact with stormwater</td>
<td>Annual trainings conducted in April, SOP trainings at monthly safety meetings (few SOP’s per meeting)</td>
<td>June 2020</td>
<td>ET</td>
<td>Summit County staff making valuable stormwater contributions</td>
<td>Ongoing</td>
</tr>
</tbody>
</table>
GLOSSARY OF TERMS

**Authorized Enforcement Agency**: Employees or designees of the director of the municipal agency designated to enforce this ordinance.

**Berm**: An earthen mound used to direct the flow of runoff around or through a structure.

**Best Management Practices (BMPs)**: Includes schedules of activities, prohibitions of practices, maintenance procedures, design standards, and other management practices to prevent or reduce the discharge of pollutants directly or indirectly into the waters of the United States. BMPs also include treatment requirements, operating procedures, educational activities, and practices to control plant site runoff spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

**Bio-chemical Oxygen Demand in 5 (BOD5)**: A measure of the amount of oxygen that is consumed by bacteria as it breaks down organic matter in a sample during a five day period under standardized conditions. It is generally considered to be a measure of organic material in the water.

**Capital Improvement Plan (CIP)**: A plan developed by the County to identify and prioritize improvements that need to be made in upcoming years.

**Clean Water Act (CWA)**: The federal Water Pollution Control Act (33 U.S.C. § 1251 et seq.), and any subsequent amendments thereto.

**Code of Federal Regulations (CFR)**: Annual edition is the codification of the general and permanent rules published in the Federal Register by the departments and agencies of the Federal Government. It is divided into 50 titles that represent broad areas subject to Federal Regulations.

**Construction Activity**: Activities subject to the National Pollutant Discharge Elimination System (NPDES) Construction Permits. These include construction projects resulting in land disturbance of 5,000 square feet or more. Such activities include but are not limited to clearing and grubbing, grading, excavating, and demolitions.

**Conveyance System**: Any channel or pipe for collecting and directing the storm water.

**Culvert**: A covered channel or large diameter pipe that directs water flow below the ground surface.

**Degradation**: Biological or chemical degradation is the breakdown of chemical compounds into simpler substances, usually less harmful than the original compound, as with the degradation of a persistent pesticide. Geological degradation is the wearing down by erosion. Water degradation is the lowering of water quality of a watercourse by an increase in the amount of pollutants.

**Dike**: An embankment to confine or control water, often built along the banks of a river to prevent overflow of lowlands; a levee.

**Directly Connected Impervious Areas (DCIA)**: Impervious surfaces that are directly connected to the storm drainage conveyance system. Directly connected means that there is no chance for infiltration or evapotranspiration before entering the conveyance system.

**Discharge**: The release of storm water or other substance from a conveyance system or storage container.
**Drainage:** Refers to the collection, conveyance, containment, and/or discharge of surface and storm water runoff.

**Dry Weather Screening (DWS):** The act of inspecting a storm drain system during dry weather to evaluate if there are any discharges to the system besides storm water.

**Erosion:** The wearing away of land surface by wind or water. Erosion control occurs naturally from weather or runoff but can be intensified by land-clearing practices related to farming, residential, or industrial development, road building, or timber cutting.

**Fill:** A deposit of earth material placed by artificial means.

**First Flush:** The delivery of a disproportionately large load of pollutants during the early part of storms due to the rapid runoff of accumulated pollutants.

**General Permit:** A permit issued under the NPDES program to cover a class or category of storm water discharges.

**Grading:** The cutting and/or filling of the land surface to a desired slope or elevation.

**Hazardous Waste:** By-products of society that can pose a substantial or potential hazard to human health or the environment when improperly managed. Possess at least one of four characteristics (flammable, corrosivity, reactivity, or toxicity), or appears on special Environmental Protection Agency (EPA) lists.

**Heavy Metals:** Metals of high specific gravity, present in municipal and industrial wastes that pose long-term environmental hazards. Such metals include cadmium, chromium, cobalt, copper, lead, mercury, nickel, and zinc.

**Illicit Connection:** Any physical connection to a publicly maintained storm water system allowing discharge of non-storm water which has not been permitted by the public entity responsible for the operation and maintenance of the system.

**Illicit Discharge:** Any direct or indirect non-storm water discharge to the storm water system, except discharges from firefighting activities and other discharges exempted in this ordinance.

**Illicit Discharge Detection and Elimination (IDDE):** A program that the County develops to identify and eliminate any illicit discharges they might have within their collection system.

**Impervious Surface:** A surface which prevents or retards the penetration of water into the ground including, but not limited to, roofs, sidewalks, patios, driveways, parking lots, concrete, and asphalt paving, gravel, compacted native surfaces and earthen materials, and oiled macadam, or other surfaces which similarly impede the natural infiltration of storm water.

**Individual Permit:** A permit issued under the NPDES program for a specific facility, whereby the unique characteristics of that facility may be addressed through the imposition of special conditions or requirements.

**Infiltration:** The downward movement of water from the surface to the subsoil. The infiltration capacity is expressed in terms of inches/hour.

**Ingress/Egress:** The points of access to and from a property.
**Inlet:** An entrance into a ditch, storm sewer, or other waterway.

**Low Impact Development (LID):** This term is used to describe means and methods that can be utilized to reduce the impact of development on the environment.

**Minimum Control Measure (MCM):** The EPA has identified six areas of focus for MS4s in developing a program to minimize the potential for pollutants to leave a jurisdiction and to enter the waters of the United States. The six areas of focus are called Minimum Control Measures (MCMs) and they include:

1. Public Education and Outreach;
2. Public Involvement;
3. Illicit Discharge Detection and Elimination;
4. Construction Site Storm Water Control;
5. Post Construction Storm Water Control; and
6. Pollution Prevention and Good Housekeeping.

**Municipal Separate Storm Sewer System (MS4):** A municipally owned and operated storm water collection system that may consist of any or all of the following: curb and gutter, drainage swales, piping, ditches, canals, detention basins, inlet boxes, or any other system used to convey storm water that discharges into canals, ditches, streams, rivers, or lakes not owned and operated by that municipality.

**Mulch:** A natural or artificial layer of plant residue or other materials covering the land surface which conserves moisture, holds soil in place, aids in establishing plant cover, and minimizes temperature fluctuations.

**National Pollutant Discharge Elimination System (NPDES):** EPA’s program to control the discharge of pollutants to waters of the United States.

**Non-point Source:** Pollution caused by diffuse sources (not a single location such as a pipe) such as agricultural or urban runoff.

**NPDES Permit:** An authorization, or license, or equivalent control document issued by EPA or an approved state agency to implement the requirements of the NPDES program.

**Off-site:** Any area lying upstream of the site that drains onto the site and any area lying downstream of the site to which the site drains.

**On-site:** The entire property that includes the property development.

**Outfall:** The point, location, or structure where wastewater or drainage discharges from a sewer pipe, ditch, or other conveyance to a receiving body of water.

**Point Source:** Any discernible, confined, and discrete conveyance including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged.

**Plat:** A map or representation of a subdivision showing the division of a tract or parcel of land into lots, blocks, streets, or other divisions and dedications.
Pollutant: Generally, any substance introduced into the environment that adversely affects the usefulness of a resource. Pollutants may include, but are not limited to: paints, varnishes and solvents; oil and other automotive fluids; non-hazardous liquid and solid wastes and yard wastes; refuse, rubbish, garbage, litter, or other discarded or abandoned objects and accumulations such that may cause or contribute to pollution floatables; pesticides, herbicides, and fertilizers; hazardous substances and wastes; sewage, fecal coliform and pathogens; dissolved and particulate metals; animal wastes; wastes and residues that result from construction a building or structure; and noxious or offensive matter of any kind.

Receiving Waters: Bodies of water or surface water systems receiving water from upstream constructed (or natural) systems.

Retention: The holding of runoff in a basin without release except by means of evaporation, infiltration, or emergency bypass.

Riparian: A relatively narrow strip of land that borders a stream or river.

Runon: Storm water surface flow or other surface flow which enters property other than that where it originated.

Runoff: That part of precipitation, snow melt, or irrigation water that runs off the land into streams or other surface water that can carry pollutants from the air and land into the receiving waters.

Sedimentation: The process of depositing soil particles, clays, sands, or other sediments that were picked up by runoff.

Sheet Flow: Runoff which flows over the ground surface as a thin, even layer, not concentrated in a channel.

Source Control: A practice or structural measure to prevent pollutants from entering storm water runoff or other environmental media.

Stabilization: The proper placing, grading and/or covering of soil, rock, or earth to ensure its resistance to erosion, sliding, or other movement.

Standard Operating Procedure (SOP): A written description of the standard method of performing a given task which can include a step-by-step description. SOPs are developed in an effort to bring consistency to a program and to clearly define the expectations of that program. They should be the basis of training programs for municipal employees.

Storm Drain: A slotted opening leading to an underground pipe or open ditch for carrying surface runoff.

Storm Water: Rainfall runoff, snow melt runoff, and drainage. It excludes infiltration.

Storm Water Management Plan (SWMP): A document which describes the BMPs and activities to be implemented by a person or business to identify sources of pollution or contamination at a site and the actions to eliminate or reduce pollutant discharges to storm water, storm water conveyance systems, and/or receiving waters.
**Storm Water Pollution Prevention Plan (SWPPP):** A document which describes the general plan for addressing storm water pollutants at a given site. The plan characterizes the nature of the potential pollutants, describes methods and concepts for controlling those pollutants and identifies those responsible for the plan.

**Swale:** An elongated depression in the land surface that is at least seasonally wet, is usually heavily vegetated, and is normally without flowing water. Swales direct storm water flows into drainage channels and allow some of the storm water to infiltrate into the ground surface.

**Total Maximum Daily Load (TMDL):** In this permit, it refers to a study that accomplishes the following:
1. Quantifies the amount of a pollutant in a stream;
2. Identifies the sources of the pollutant; and
3. Recommends regulatory or other actions that may need to be taken in order for the impaired water body to meet water quality standards.

**Total Suspended Solids (TSS):** An analytical measure of the amount of sediment suspended in water. TSS is typically comprised of larger sediment particles and does not include fine clays and silts that might be dissolved.

**Treatment Control BMP:** A BMP that is intended to remove pollutants from storm water.

**Underground Injection Wells (UIW):** A hole receiving storm water whose top dimension is narrower than the depth.

**Utah Pollutant Discharge Elimination System (UPDES):** The State of Utah’s program to control the discharge of pollutants to the water of the United States.

**Waters of the State:** Surface waters and ground waters within the boundaries of the State of Utah and subject to its jurisdiction.

**Waters of the United States:** Surface watercourses and water bodies as defined in 40 CFR § 122.2, including all natural waterways and definite channels and depressions in the earth that may carry water, even though such waterways may only carry water during rains and storms and may not carry storm water at and during all times and seasons.

**Wetlands:** An area that is regularly saturated by surface or ground water and subsequently characterized by a prevalence of vegetation that is adapted for life in saturated soil conditions. Examples include swamps, bogs, marshes, and estuaries.
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### BMP: Educational Materials

**APPLICATIONS**

- Manufacturing
- Material Handling
- Vehicle Maintenance
- Construction
- Commercial Activities
- Roadways
- Waste Containment
- Housekeeping Practices

### DESCRIPTION:

Educational Materials to present information to the public on storm water issues and water quality awareness is an integral part of any storm water education program. Providing storm water education by sending out information with bills, newsletters, or presented at city activities, in city offices, schools, and fair booths, exposes the message to a wide variety of people, if not city-wide. Topics can include Water conservation, proper lawn and garden care, and proper disposal of hazardous household wastes. Many educational materials can be used for city personnel, contractors as well as homeowners or businesses.

### APPROACH:

- Building a strong relationship with citizens is the most important step in getting storm water education city-wide.
- Educational materials can be tailored to all different age groups and technical background.
- Should make people aware of the potential impacts of hazardous household materials on water quality and inform residents of ways to properly store, handle, and dispose of the chemicals.
- Water usage in the home can easily be reduced by 15 to 20 percent—without major discomfort—by implementing a program to conserve water in the home.
- Lawn and garden activities can result in contamination of storm water through pesticide, soil, and fertilizer runoff. Proper landscape management, however, can effectively reduce water use and contaminant runoff and enhance the aesthetics of a property.
- More information and education materials can be found on the Summit County Stormwater webpage.

### LIMITATIONS:

- Not everyone will actually read or incorporate the information into their lives.
- Budgets need to have sufficient funds to obtain educational materials and their distribution.

### MAINTENANCE:

- Programs and educational materials can be re-used, but they must be presented on a continual basis.

### TARGETED POLLUTANTS

- Sediment
- Nutrients
- Heavy Metals
- Toxic Materials
- Oxygen Demanding Substances
- Oil & Grease
- Floatable Materials
- Bacteria & Viruses

### IMPLEMENTATION REQUIREMENTS

- Capital Costs
- O&M Costs
- Maintenance
- Training

- High Impact
- Medium Impact
- Low or Unknown Impact
**BMP: Classroom Education On Storm Water**

**APPLICATIONS**
- Manufacturing
- Material Handling
- Vehicle Maintenance
- Construction
- Commercial Activities
- Roadways
- Waste Containment
- Housekeeping Practices

**DESCRIPTION:**
Classroom education is an integral part of any storm water pollution outreach program. Providing storm water education through schools exposes the message not only to students but to their parents as well. Topics can include Water conservation, proper lawn and garden care, and proper disposal of hazardous household wastes.

**APPROACH:**
- Building a strong relationship with the school district is the most important step in getting storm water education into the schools.
- When developing an outreach message for children, choose the age ranges to target.
- Many additional classroom materials are available for use free of cost. Educational materials available for downloading from the Internet at [www.eugene-or.gov/469/teaching-tools](http://www.eugene-or.gov/469/teaching-tools).
- Should make students aware of the potential impacts of hazardous household materials on water quality and inform residents of ways to properly store, handle, and dispose of the chemicals.
- Water usage in the home can easily be reduced by 15 to 20 percent—without major discomfort—by implementing a program to conserve water in the home.
- Lawn and garden activities can result in contamination of storm water through pesticide, soil, and fertilizer runoff. Proper landscape management, however, can effectively reduce water use and contaminant runoff and enhance the aesthetics of a property.

**LIMITATIONS:**
- One of the limitations of classroom education is being able to incorporate storm water issues into the school curricula. With so many subjects to teach, environmental issues might be viewed as less important.

**MAINTENANCE:**
- Programs and educational materials can be re-used, but they must be presented on a continual basis.

**TARGETED POLLUTANTS**
- Sediment
- Nutrients
- Heavy Metals
- Toxic Materials
- Oxygen Demanding Substances
- Oil & Grease
- Floatable Materials
- Bacteria & Viruses

**IMPLEMENTATION REQUIREMENTS**
- High Impact
- Medium Impact
- Low or Unknown Impact

Students learn about storm water pollution (Source: City of Sacramento Storm Water Management Program, no date)
**APPLICATIONS**
- Manufacturing
- Material Handling
- Vehicle Maintenance
- Construction
- Commercial Activities
- Roadways
- Waste Containment
- Housekeeping Practices

**DESCRIPTION:**
The media can be strong allies to a storm water pollution prevention campaign in educating the public about storm water issues. Through the media, a program can educate targeted or mass audiences about problems and solutions, build support for remediation and retrofit projects, or generate awareness and interest in storm water management. Best of all, packaging a storm water message as a news story is virtually free!

**APPROACH:**
- **Newspapers and Magazines.** Newspapers are powerful vehicles for delivering educational information, policy analyses, public notices, and other messages. Many displays at watershed seminars proudly post newspaper articles on the projects being presented in recognition of the importance and impact of newspaper coverage.
- Newspapers can be accessed in several ways. Depending on the message or event, the appropriate format might be a news release, news advisory, query letter, letter to the editor, or (for urgent, timely information) a news conference.
- **Magazines.** Magazines, like newspapers, allow for greater length and analysis than television and provide the additional benefit of targeting specific audiences (e.g., landscapers, automobile mechanics, farmers, or recreationists).
- **Radio.** In spite of the popularity of video, radio remains a strong media contender due to its affordable production costs and creative possibilities. Further, commuters who drive to work spend much time in their vehicles.
- **Television.** Television is the primary source of news for the majority of the population, and local reporters are generally interested in covering environmental stories that pertain to their area.
- **Issues** will attract television coverage if they involve local people or issues, Focus on unique or unusual attributes, affect many people throughout a region, involve controversy or strong emotions.
- **Internet Message.** Increasingly, the Internet is becoming a powerful means of communication. It provides worldwide access to hundreds of thousands of sites containing millions of documents, chat rooms for special interest groups, and incredible database/mapping features.

**LIMITATIONS:**
- Working with the media is essentially free, but not always.
BMP: Employee Training

**DESCRIPTION:**
Employee training, like equipment maintenance, is a method by which to implement BMPs. Employee training should be used in conjunction with all other BMPs as part of the facility’s SWPPP.

The specific employee training aspects of each of the source controls are highlighted in the individual information sheets. The focus of this information sheet is more general, and includes the overall objectives and approach for assuring employee training in stormwater pollution prevention. Accordingly, the organization of this information sheet differs somewhat from the other information sheets in this chapter.

**OBJECTIVES:**
Employee training should be based on four objectives:
- Promote a clear identification and understanding of the problem, including activities with the potential to pollute stormwater;
- Identify solutions (BMPs);
- Promote employee ownership of the problems and the solutions; and
- Integrate employee feedback into training and BMP implementation.

**APPROACH:**
- Integrate training regarding stormwater quality management with existing training programs that may be required for other regulations.
- Employee training is a vital component of many of the individual source control BMPs included in this manual.

**TARGTED POLLUTANTS**
- Sediment
- Nutrients
- Heavy Metals
- Toxic Materials
- Oxygen Demanding Substances
- Oil & Grease
- Floatable Materials
- Bacteria & Viruses

**IMPLEMENTATION REQUIREMENTS**
- High Impact
- Medium Impact
- Low or Unknown Impact

**PROGRAM ELEMENTS**
- New Development
- Residential
- Commercial Activities
- Industrial Activities
- Municipal Facilities
- Illegal Discharges
SUMMIT COUNTY ENGINEERING

BMP: Community Hotlines

Summit County Community Hotline Number
435-336-3292

APPLICATIONS
- Manufacturing
- Material Handling
- Vehicle Maintenance
- Construction
- Commercial Activities
- Roadways
- Waste Containment
- Housekeeping Practices

DESCRIPTION:
Because regulators and authorities cannot monitor all water bodies at once, they sometimes rely on the public to keep them informed of water polluters. Community hotlines provide a means for concerned citizens and agencies to contact the appropriate authority when they see water quality problems.

APPROACH:
- Once a city has determined that they need a hotline, they should choose between a telephone or an e-mail hotline.
- A party or agency responsible for maintaining the hotline and responding to incoming complaints must first be identified. The responsible party could be a division of local government, a water quality board, a public utility, or an environmental agency.
- All distributed materials should include pollution hotline numbers and information.
- Curbs should have pumping systems, instead of drainage systems, for collecting spilled materials.
- Generally, an investigation team promptly responds to a hotline call and, in most cases, visits the problem site.
- If a responsible party can be identified, the team informs the party of the problem, offers alternatives for future disposal, and instructs the party to resolve the problem.

LIMITATIONS:
- The community’s ability to pay for it.
- The ability of the community to keep the hotline staffed.

MAINTENANCE:
- The most important part is the responsiveness of the hotline. If a citizen Reports an illegal dumping but no action is taken by the appropriate authority, that citizen could lose faith in the hotline and might not call back with future information.

TARGETED POLLUTANTS
- Sediment
- Nutrients
- Heavy Metals
- Toxic Materials
- Oxygen Demanding Substances
- Oil & Grease
- Floatable Materials
- Bacteria & Viruses

IMPLEMENTATION REQUIREMENTS
- Capital Costs
- O&M Costs
- Maintenance
- Training

- High
- Medium
- Low or Unknown Impact
BMP: Public Education/Participation

**Program Elements**
- New Development
- Residential
- Commercial Activities
- Industrial Activities
- Municipal Facilities
- Illegal Discharges

**Description:**
Public education/participation, like an ordinance or a piece of equipment, is not so much a best management practice as it is a method by which to implement BMPs. This information sheet highlights the importance of integrating elements of public education and participation into a municipality’s overall plan for stormwater quality management.

A public education and participation plan provides the municipality with a strategy for educating its employees, the public, and businesses about the importance of protecting stormwater from improperly used, stored, and disposed of pollutants. Municipal employees must be trained, especially those that work in departments not directly related to stormwater but whose actions affect stormwater. Residents must become aware that a variety of hazardous products are used in the home and that their improper use and disposal can pollute stormwater. Increased public awareness also facilitates public scrutiny of industrial and municipal activities and will likely increase public reporting of incidents.

**Approach:**
- Pattern a new program after the many established programs around the country.
- Implement public education/participation as a coordinated campaign in which each message is related to the last.
- Present a clear and consistent message and image to the public regarding how they contribute to stormwater pollution and what they can do to reduce it.
- Utilize multi-media to reach the full range of audiences.
- Translate messages into the foreign languages of the community to reach the full spectrum of your populace and to avoid misinterpretation of messages.
- Create an awareness and identification with the local watershed.
- Use everyday language in all public pieces. Use outside reviewers to highlight and reduce the use of technical terminology, acronyms, and jargon.
- Make sure all statements have a sound, up-to-date technical basis. Do not contribute to the spread of misinformation.
- Break complicated subjects into smaller more simple concepts. Present these concepts to the public in a metered and organized way to avoid “overloading” and confusing the audience.

**Limitations:**
None.

**Targeted Pollutants**
- Sediment
- Nutrients
- Heavy Metals
- Toxic Materials
- Oxygen Demanding Substances
- Oil & Grease
- Floatable Materials
- Bacteria & Viruses

**Implementation Requirements**
- Capital Costs
- O&M Costs
- Regulatory
- Training
- Staffing
- Administrative

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**DESCRIPTION:**
Citizens of the local community can volunteer to carry out various service projects. These projects allow citizens to become directly involved in improving the community.

**APPROACH:**
- Designate an individual or groups of individuals to schedule and organize the service projects, recruit volunteers, coordinate any trash disposal with the local solid waste authority, and assign staff for supervision of the projects.
- The first step for a municipally sponsored service program is to identify needed service projects.
- Advertise the program and let citizens know about service project opportunities. Projects can be advertised on bulletin boards, in a newsletter, on a website, etc.
- When volunteers are being used for service projects, municipalities must address the issue of liability. An attorney should be consulted to determine how liability should be handled and draft a waiver for volunteers to sign before participating.
- Service events are also effective at increasing public awareness of the need to better the community.

**LIMITATIONS:**
- Organization at the municipal level is a limitation to service project efforts. Some municipalities do not have the resources to designate staff to oversee a service project program and to supervise the projects.
- Limitations to an effective service group program are volunteer interest and commitment.

**MAINTENANCE:**
- Service project lists need to be updated continually.
**DESCRIPTION:**
Erosion control measures must be taken during a construction project. An Erosion Control Plan will be submitted and approved before work can begin on the project. An Erosion Control Plan describes what erosion control BMPs will be implemented, when and where, during the project.

**APPROACH:**
- Create a list of possible erosion control BMPs that could be implemented in any given project.
- Require submittal of erosion & sediment control plans for projects that are on 1 acre and larger sites.
- Develop a review checklist for plan review personnel.
- Provide the review checklist to contractors/developers so they know what is expected.
- Provide inspectors with a copy of the approved plans.

**LIMITATIONS:**
- Must be enforced to be affective.
- Sometimes site conditions are different than planned on and the plans have to be modified.
- The erosion control measures have to be maintained.
- The BMPs have to be installed early on in the project.
- The BMPs have to be removed at the end of the project.

**APPLIED TO:**
- Manufacturing
- Material Handling
- Vehicle Maintenance
- Construction
- Commercial Activities
- Roadways
- Waste Containment
- Housekeeping Practices

**TARGETED POLLUTANTS**
- Sediment
- Nutrients
- Heavy Metals
- Toxic Materials
- Oxygen Demanding Substances
- Oil & Grease
- Floatable Materials
- Bacteria & Viruses

**IMPLEMENTATION REQUIREMENTS**
- Capital Costs
- O&M Costs
- Maintenance
- Training

- High Impact
- Medium Impact
- Low or Unknown Impact
**BMP: Contractor Certification & Inspector Training**

**APPLICATIONS**
- Manufacturing
- Material Handling
- Vehicle Maintenance
- Construction
- Commercial Activities
- Roadways
- Waste Containment
- Housekeeping Practices

**DESCRIPTION:**
One of the most important factors determining whether or not erosion and sediment controls will be properly installed and maintained on a construction site is the knowledge and experience of the contractor. Many communities require certification for key on-site employees who are responsible for implementing the ESC plan. Several states have contractor certification programs. The State of Delaware requires that at least one person on any construction project be formally certified. The Delaware program requires certification for any foreman or superintendent who is in charge of onsite clearing and land-disturbing activities for sediment and runoff control associated with a construction project.

**APPROACH:**
- Training and certification will help to ensure that the plans are properly implemented and that best management practices are properly installed and maintained.
- Inspector training programs are appropriate for municipalities with limited funding and resources for ESC program implementation.
- Contractor certification can be accomplished through municipally sponsored training courses, or more informally, municipalities can hold mandatory pre-construction or pre-wintering meetings and conduct regular and final inspection visits to transfer information to contractors (Brown and Caraco, 1997).
- To implement an inspector training program, the governing agency would need to establish a certification course with periodic recertification, review reports submitted by private inspectors, conduct spot checks for accuracy, and institute fines or other penalties for noncompliance.
- Curb systems should be maintained through curb repair (patching and replacement).
- To minimize the amount of spilled material tracked outside of the area by personnel, grade within the curbing to direct the spilled materials to a down-slope side of the curbing, thus keeping the spilled materials away from personnel and equipment. Grading will also facilitate clean-up.

**LIMITATIONS:**
- Contractor certification and inspector training programs require a substantial amount of effort on the part of the municipality or regulatory agency.
- They need to develop curricula for training courses, dedicate staff to teach courses, and maintain a report review and site inspection staff to ensure that both contractors and inspectors are fulfilling their obligations and complying with the ESC program.

**TARGETED POLLUTANTS**
- Sediment
- Nutrients
- Heavy Metals
- Toxic Materials
- Oxygen Demanding Substances
- Oil & Grease
- Floatable Materials
- Bacteria & Viruses

**IMPLEMENTATION REQUIREMENTS**
- Capital Costs
- O&M Costs
- Maintenance
- Training

**IMPACT LEVELS**
- High Impact
- Medium Impact
- Low or Unknown Impact
DESCRIPTION:
Existing ordinances relating to storm water are reviewed for compliance. New ordinances are written to prohibit non-storm water discharges into the Municipal Separate Storm Sewer System (MS4), require proper erosion and sediment controls on construction sites, and require the implementation of post-construction runoff controls.

APPROACH:
- Review existing storm drain ordinances for consistency and compliance with state regulations and make improvements, if necessary. Ensure that no conflicts will occur with new ordinances that will be written and adopted.
- Write and adopt an ordinance that prohibits (to the extent allowable under State, Tribal, or local law) the discharge of non-storm water discharges into the MS4 with appropriate enforcement procedures and actions.
- Write and adopt an ordinance, with sanctions to ensure compliance, requiring the implementation of proper erosion and sediment controls, and controls for other wastes, on applicable construction sites.
- Write and adopt an ordinance requiring the implementation of post-construction runoff controls to the extent allowable under State, Tribal, or local law.
- Educate the public about the new ordinances.
- Enforce the new ordinances.

LIMITATIONS:
- Wording of ordinances is often difficult. It should be specific to serve the intended purpose, but not too specific to cause potential conflicts with other ordinances or situations.
- Once an ordinance is adopted, it can be difficult to modify ordinances to meet changing needs.
- Ordinances have to be enforced to be beneficial.
- Ordinances take time to change.
DESCRIPTION:
This BMP represents an important opportunity to reduce pollutants in stormwater runoff by using a comprehensive planning process to integrate water quality concerns into the development and redevelopment process. It is applicable to all types of land use and represents one of the most effective pollution prevention practices.

APPROACH:
The land use planning process need not be complex. A basic schematic model involves:

- Phase 1 - Goals: Determine clear-cut water quality goals.
- Phase 2 - Study: Identify planning area, gather pertinent data, and write a description of the planning area and its associated problems.
- Phase 3 - Analysis and Synthesis: Determine and prioritize the water quality needs as they relate to land use.
- Phase 4 - Recommendations: Future courses of action are developed to address the identified problems and needs determined previously.
- Phase 5 - Adoption: The recommendations are presented to a political body for acceptance and implementation.
- Phase 6 - Implementation: Recommendations adopted by the political body are implemented by the locality.

LIMITATIONS:
- Land use planning/management frequently addresses sensitive public issues. Restrictions on certain land uses for the purpose of mitigating stormwater pollution may be politically unacceptable.
- The use of land use controls and planning for water quality improvements may be limited by the lack of staff to enforce various aspects of local zoning and building codes.
- The planning process addresses many public needs and legal requirements which often are in conflict with one another. It is difficult but extremely important to integrate and balance these sometimes competing programs.

TARGETED POLLUTANTS
- Sediment
- Nutrients
- Heavy Metals
- Toxic Materials
- Oxygen Demanding Substances
- Oil & Grease
- Floatable Materials
- Bacteria & Viruses

IMPLEMENTATION REQUIREMENTS
- Capital Costs
- O&M Costs
- Regulatory
- Training
- Staffing
- Administrative

PROGRAM ELEMENTS
- New Development
- Residential
- Commercial Activities
- Industrial Activities
- Municipal Facilities
- Illegal Discharges
BMP: BMP Inspection and Maintenance

**APPLICATIONS**
- Manufacturing
- Material Handling
- Vehicle Maintenance
- Construction
- Commercial Activities
- Roadways
- Waste Containment
- Housekeeping Practices

**DESCRIPTION:**
Inspect and maintain all structural BMP’s (both existing and new) on a routine basis to remove pollutants from entering storm drain inlets. This includes the establishment of a schedule for inspections and maintenance.

**APPROACH:**
Regular maintenance of all structural BMP’s is necessary to ensure their proper functionality.
- Annual inspections.
- Prioritize maintenance to clean, maintain, and repair or replace structures in areas beginning with the highest pollutant loading.
- Clean structural BMP’s in high pollutant areas just before the wet season to remove sediments and debris accumulated during the summer and fall.
- Keep accurate logs of what structures were maintained and when they were maintained.
- Record the amount of waste collected.

**LIMITATIONS:**
- Cost
- Availability of trained staff

**TARGETED POLLUTANTS**
- Sediment
- Nutrients
- Heavy Metals
- Toxic Materials
- Oxygen Demand Substances
- Oil & Grease
- Floatable Materials
- Bacteria & Viruses

**IMPLEMENTATION REQUIREMENTS**
- High Impact
- Medium Impact
- Low or Unknown Impact

- Capital Costs
- O&M Costs
- Maintenance
- Staffing
- Training
- Administrative
BMP: Illegal Dumping Controls

**DESCRIPTION:**
Implement measures to detect, correct, and enforce against illegal dumping of pollutants on streets, into the storm drain system, and into creeks. Substances illegally dumped on streets, into the storm drain system, and into creeks includes paints, used oil and other automotive fluids, construction debris, chemicals, fresh concrete, leaves, grass clippings, and pet wastes. All of these wastes can cause storm water and receiving water quality problems as well as clog the storm drain system.

**APPROACH:**
One of the keys to success is increasing the general public’s awareness of the problem and to at least identify the incident, if not correct it. There are a number of ways of accomplishing this:
- Train municipal staff from all departments to recognize and report incidents.
- Deputize municipal staff who may come into contact with illegal dumping with the authority to write illegal dumping tickets for offenders caught in the act.
- Educate the public.
- Provide the public with a mechanism for reporting such as a hot line.

Establish system for tracking incidents which will identify:
- Illegal dumping “hot spots”,
- Types and quantities (in some cases) of wastes,
- Patterns in time of occurrence (time of day/night, month, or year),
- Mode of dumping (abandoned containers, “midnight dumping” from moving vehicles, direct dumping of materials, accident/spills), and
- Responsible parties.

A tracking system also helps manage the program by indicating trends, and identifying who, what, when, and where efforts should be concentrated.

**LIMITATIONS**
The elimination of illegal dumping is dependent on the availability, convenience, and cost of alternative means of disposal.

---

**TARGETED POLLUTANTS**
- Sediment
- Nutrients
- Heavy Metals
- Toxic Materials
- Oxygen Demanding Substances
- Oil & Grease
- Floatable Materials
- Bacteria & Viruses

**IMPLEMENTATION REQUIREMENTS**
- Capital Costs
- O&M Costs
- Regulatory
- Training
- Staffing
- Administrative
**OBJECTIVES**
- Housekeeping Practices
- Contain Waste
- Minimize Disturbed Areas
- Stabilize Disturbed Areas
- Protect Slopes/Channels
- Control Site Perimeter
- Control Internal Erosion

**DESCRIPTION:**
Create maps of existing storm water drain systems to facilitate spill cleanup and identify illicit connections.

**APPLICATION:**
- Use the map of the storm water drain system to track drainage paths and trace any contaminant problems to their source.
- In the event of a major spill, use the map of the storm water drain system to identify where the contaminants will flow to and cut off the flow before further contamination.

**INSTALLATION/APPLICATION CRITERIA:**
- Using GIS or other mapping programs, create accurate maps of the storm water drain system, including street names and pipe diameters.

**MAINTENANCE:**
- Annually review any development that has occurred and update the map of the storm drain system accordingly.

**TARGETED POLLUTANTS**
- Sediment
- Nutrients
- Toxic Materials
- Oil & Grease
- Floatable Materials
- Other Waste

- High Impact
- Medium Impact
- Low or Unknown Impact

**IMPLEMENTATION REQUIREMENTS**
- Capital Costs
- O&M Costs
- Maintenance
- Training

- High
- Medium
- Low
**BMP: Standard Operating Procedures**

**APPROACH:**
- Develop SOPs specific to tasks
- Follow SOPs each time a task needs to be completed
- Train new employees on SOPs

**LIMITATIONS:**
- SOPs can be tedious

**DESCRIPTION:**
Developing SOPs is an essential part of any stormwater program. SOPs provide information to perform tasks properly and consistently. SOPs also reduce time and mistakes when accomplishing tasks.

**TARGETED POLLUTANTS**
- Sediment
- Nutrients
- Heavy Metals
- Toxic Materials
- Oxygen Demanding Substances
- Oil & Grease
- Floatable Materials
- Bacteria & Viruses

**IMPLEMENTATION REQUIREMENTS**
- Capital Costs
- O&M Costs
- Maintenance
- Training

**IMPACTS:**
- High Impact
- Medium Impact
- Low or Unknown Impact
DESCRIPTION:
This practice requires changes in the regional growth planning process to contain sprawl development. Sprawl development is the expansion of low-density development into previously undeveloped land. The American Farmland Trust has estimated that the United States is losing about 50 acres an hour to suburban and exurban development (Longman, 1998). This sprawl development requires local governments to extend public services to new residential communities whose tax payments often do not cover the cost of providing those services. For example, in Prince William County, Virginia, officials have estimated that the costs of providing services to new residential homes exceeds what is brought in from taxes and other fees by $1,600 per home (Shear and Casey, 1996).

Infrastructure planning makes wise decisions to locate public services—water, sewer, roads, schools, and emergency services—in the suburban fringe and direct new growth into previously developed areas, discouraging Low-density development. Generally, this is done by drawing a boundary or envelope around a community, beyond which major public infrastructure investments are discouraged or not subsidized. Meanwhile, economic and other incentives are provided within the boundary to encourage growth in existing neighborhoods.

APPROACH:
- Sprawl development negatively impacts water quality in several ways. The most significant impact comes from the increase in impervious cover that is associated with sprawl growth. In addition to rooftop impervious area from new development, extension of road systems and additions of paved surface from driveways create an overall increase in imperviousness.
- Urban Growth Boundaries. This planning tool establishes a dividing line that defines where a growth limit is to occur and where agricultural or rural land is to be preserved. Often, an urban services area is included in this boundary that creates a zone where public services will not be extended.
- Infill/Community Redevelopment. This practice encourages new development in unused or underutilized land in existing urban areas. Communities may offer tax breaks or other economic incentives to developers to promote the redevelopment of properties that are vacant or damaged.

LIMITATIONS:
- Intense development of existing areas can create a new set of challenges for storm water program managers. Storm water management solutions are often more difficult and complex in ultra-urban areas than in suburban areas.
- Infrastructure planning is often done on a regional scale and requires a cooperative effort between all the communities within a given region in order to be successful.
**BMP: Housekeeping Practices**

**DESCRIPTION:**
Promote efficient and safe housekeeping practices (storage, use, and cleanup) when handling potentially harmful materials such as fertilizers, pesticides, cleaning solutions, paint products, automotive products, and swimming pool chemicals.

**APPROACH:**
- Pattern a new program after the many established programs from municipalities around the country. Integrate this best management practice as much as possible with existing programs at your municipality.
- This BMP has two key audiences: municipal employees and the general public.
- For the general public, municipalities should establish a public education program that provides information on such items as storm water pollution and beneficial effects of proper disposal on water quality; reading product labels; safer alternative products; safe storage, handling, and disposal of hazardous products; list of local agencies; and emergency phone numbers. The programs listed below have provided this information through brochures or booklets that are available at a variety of locations including municipal offices, household hazardous waste collection events or facilities, and public information fairs.

Municipal facilities should develop controls on the application of pesticides, herbicides, and fertilizers in public right-of-ways and at municipal facilities. Controls may include:
- List of approved pesticides and selected uses.
- Product and application information for users.
- Equipment use and maintenance procedures.
- Record keeping and public notice procedures.

**LIMITATIONS:**
There are no major limitations to this best management practice.
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Summit County BMP Manual
July 2017
Erosion and Sediment Controls
C2: Typical Residential Stormwater Pollution
Prevention Plan

C2-1
List of Temporary and Permanent Erosion/Sediment Controls

This list is not to be construed to be the limit of available BMPs, only as a partial list, and as examples which may be employed.

(2) Revegetation
(3) Mulching
(4) Geotextiles
(5) Surface Roughening
(6) Silt Fence
(7) Straw Bale Barrier
(8) Stabilized Construction Entrance
(9) Division Ditch/Dike
(10) Water Bar
(11) Storm Drain Inlet Protection
(12) Brush Barrier
(13) Gravel Check Dams
(14) Straw Bale Check Dams
(15) Slope Drains
(16) Open Chute Drains
(17) Rock Lined Ditches
(18) Grassed/Matted Swales
(19) Temporary Excavated Sediment Traps
(20) Equipment and Vehicle Wash Down Area
REVEGETATION

DEFINITION: Placement of seed material or sod over open area for temporary or permanent erosion control.

PURPOSE:
• Reduce velocity of storm water runoff.
• Reduce erosion by preventing rainfall directly hitting soil.

APPLICATION:
• All areas disturbed by construction activity, including cut and fill slopes.

LIMITATIONS:
• Revegetation on slopes steeper than 3:1 must utilize geotextiles to promote establishment of vegetative cover.

INSTALLATION:
Temporary Seeding
• Grade and shape the area to be seeded so that it will drain properly and accommodate seeding equipment.
• Loosen compacted soil by racking, or discing where hydraulic seeding will not be used, to provide for seed retention and germination.
• Apply seed and fertilization suitable for the area and season. The seed species and fertilization requirements must be developed by a professional or the local Soil Conservation Service Office.

Permanent Seeding
• Grade and shape the area to be seeded so that it will drain properly and accommodate seeding equipment. If slopes are steeper than 3:1, the use of hydraulic seeding equipment is encouraged.
• Loosen compacted soil by racking, or discing where hydraulic seeding will not be used, to provide for seed retention and germination.
• Spread at least 3 inches of topsoil, if required, before seeding. If topsoil is required, the subsoil should be serrated or disced to provide an interface.
• Apply seed and fertilization suitable for the area and season. The seed species and fertilization requirements must be developed by a professional or the local Soil Conservation Service Office.

MAINTENANCE:
• Inspect seeded areas after every rainfall event and at a minimum of monthly.
• Replace seed on any bare areas, or area showing signs of erosion as necessary.

MULCHING

DEFINITION: Placement of material such as straw, grass, wood-chips, wood-fibers or fabricated matting over open area.

PURPOSE:
• Reduce velocity of storm water runoff.
• Reduce erosion by preventing rainfall directly hitting soil.
• Facilitate plant growth by holding seeds and fertilizer in place, retaining moisture and providing insulation against extreme temperature.

APPLICATION:
• Any exposed area to remain untouched longer than 14 days and that will be exposed less than 60 days (seed areas to be exposed in excess of 60 days).
• Areas that have been seeded.
• Stockpiled soil material.

LIMITATIONS:
• Anchoring may be required to prevent migration of mulch material.
• Down-gradient control may be required to prevent mulch material being transported to storm water system.

INSTALLATION:
• Rough area to revive mulch to create depressions that mulch material can settle into.
Apply mulch to required thickness and anchor as necessary.

Recommended Application Rates:
Straw: 2-3 bales/1000 square feet (90-120 bales/acre)

Wood Fiber: 25-30 pounds/1000 square feet (1000-1500 pounds/acre)

Ensure material used is weed free and does not contain any constituent that will inhibit plant growth.

MAINTENANCE:
- Inspect mulched areas after every rainfall event and at a minimum of monthly.
- Replace mulch and any bare areas and re-anchor as necessary.
- Clean and replace down-gradient controls as necessary.

**Recommended Application Rates for Mulching.**

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<th>Material</th>
<th>Application</th>
<th>Depth</th>
<th>Comments</th>
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<tr>
<td>Gravel: Washed 3/4” to 1 ½”</td>
<td>9 cu yd/1000 sq ft</td>
<td>3 inches</td>
<td>Good for traffic areas. Good for short slopes.</td>
</tr>
<tr>
<td>Straw: Air-Dried, free of seeds and coarse material</td>
<td>2-3 bales/1000 sq ft</td>
<td>2 inches (Min.)</td>
<td>Subject to wind blowing. Tack down or keep moist.</td>
</tr>
<tr>
<td>Wood Fiber Cellulose: Free from growth inhibitors; dyed green</td>
<td>35 lb/1000 sq ft</td>
<td>1 inch (Min.)</td>
<td>For critical areas, double application rate; Limit to slopes &lt;3% and &lt; 150 feet</td>
</tr>
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</table>
GEOTEXTILES
DEFINITION: Matting or netting made biodegradable materials (such as Excelsior blanket, jute, wood fiber, straw, coconut, paper, or cotton) to reduce rainfall impact and surface erosion on disturbed soils.

PURPOSE:
• Reduce velocity of storm water runoff.
• Reduce erosion by preventing rainfall directly hitting soil.
• Facilitate plant growth by holding seeds, fertilizer, and mulch in place, retaining moisture and providing insulation against extreme temperature.
• Provide flexible roadway ditch lining to promote establishment of vegetative cover.

APPLICATION:
• Areas that have been seeded, fertilized and mulched with slopes that are steeper than 3:1.
• Stabilize vegetated roadway ditches while permanent vegetative cover becomes established.

LIMITATIONS:
• Effectiveness may be reduced drastically if the fabric is not properly selected, designed, or installed.
• Should not be placed on 1:1 slopes if they are to be covered with overlying material.
• Many synthetic geotextiles are sensitive to light and must be protected prior to installation.

INSTALLATION:
• Allow for an overlap of 4 inches on both sides of each roll and 36 inches at the ends of the roll.
• The fabric must extend beyond the edge of the exposed area at least 12 inches at the sides and 36 inches at the top and bottom.
• At the top of the area, bury the end of each roll in a trench at least 8 inches deep. The trench should then be backfilled and tamped.
• Staples should be driven perpendicularly into the slope face. Staples must be of 3/16" diameter (or heavier) steel wire. Allow for spacing of approximately 5 feet apart along the sides and center of each roll and not more than 12 inches apart along upper end of a roll or at the overlap of two rolls.
• The soil must be reasonably smooth. Fill and compact any rills and gullies. Remove any protruding rocks and other obstructions.
• Apply the individual rolls up and down the slope, from top to bottom--never along the contour.
• Make sure that the fabric makes uniform contact with the slope face underneath. No bridging of rills or gullies should be allowed.
MAINTENANCE:

- At a minimum, inspect geotextiles on a monthly basis, and after rain events greater than 0.5 inch of precipitation.
- Clean and replace down gradient controls as necessary.
SURFACE ROUGHENING

DEFINITION: Rough preparation of working areas leaving depressions and uneven surface.

PURPOSE: Depressions trap water and sediment reducing erosion and facilitating establishment of vegetative cover.

APPLICATION:
• Surface roughening is appropriate for all construction that will not be receiving impervious cover within 14 days and that will be exposed less than 60 days (seed areas to be open in excess of 60 days).

LIMITATIONS:
• Will not withstand heavy rainfall.
• Slopes steeper than 2:1 (50% ) should be benched.

CONSTRUCTION:
• Surface should be left in rough condition during initial earthwork activity.
• Surfaces that have become smoothed or compacted due to equipment traffic should be roughened by use of disks, spring harrows, teeth on front end loader, or similar, operating along the contour of the slope. Tracking (by crawler tractor driving up and down slope ) may also be used to provide depressions parallel to contours.
• Avoid compaction of soils during roughening as this inhibits plant growth and promotes storm water runoff. Limit tracked machinery to sandy soil.
• Seed or mulch areas to be exposed in excess of 60 days.
• Employ dust controls.

MAINTENANCE:
• Inspect following any storm event and at a minimum of weekly.
• If erosion in the form of rills (small waterways formed by runoff) is evident, perform machine roughening of area.
• For vegetated slopes reseed areas that are bare or have been reworked.
SILT FENCE

DEFINITION: A temporary sediment barrier consisting of filter fabric stretched across and secured to supporting posts and entrenched.

PURPOSE: To filter storm water runoff from up-gradient disturbed area and trap sediment on site.

APPLICATION:
- Perimeter Control: Place fence at down-gradient limits of disturbance.
- Sediment Barrier: Place fence at an offset distance from the toe of slope or soil stockpile required to contain anticipated sediment and storm water.
- Protection of Existing Waterways: Place fence at top of stream bank.
- Inlet Protection: Place fence surrounding catch basins.
- Sediment Removal: Place fence to capture sediment moving through roadway ditches.

LIMITATIONS:
- Recommended maximum drainage area of 0.5 acre per 100 feet of fence.
- Recommended maximum up-gradient slope length of 150 feet.
- Recommended maximum uphill grade of 2:1 (50%).
- Long-term ponding should not be allowed behind fence.

INSTALLATION:
- Place posts 6 foot on center along contour (or use preassembled unit) and drive 2 feet (min.) into ground. Excavate an anchor trench (8 inches wide and 8 inches deep) immediately up-gradient of posts.
- Secure wire mesh (14 gage min. with 6 inch openings) to up slope side of posts. Attach with heavy duty wire staples 1 inch long, tie wires or hog rings.
- Cut fabric to required width, unroll along length of barrier and drape over barrier. Secure fabric to, mesh with twine, staples, or similar, with trailing edge extending into anchor trench.
- Backfill trench over filter fabric to anchor.

MAINTENANCE:
- Inspect immediately after any rainfall and at least daily during prolonged rainfall.
- Look for runoff bypassing ends of barriers or undercutting fence (repair immediately).
- Repair or replace damaged areas of the fence and remove accumulated sediment.
- Re-anchor fence as necessary to prevent shortcutting.
- Remove accumulated sediment when it reaches ½ the height of the fence.
STRAW BALE BARRIER

DEFINITION: Temporary sediment barrier consisting of a row of entrenched and anchored straw bales.

PURPOSE: To filter storm water runoff from up gradient disturbed area and trap sediment on site.

APPLICATION:
- Perimeter Control: Place barrier at down gradient limits of disturbance.
- Sediment Barrier: Place barrier at an offset distance from the toe of slope or soil stockpile required to contain anticipated sediment and storm water.
- Protection of Existing waterways: Place barrier at top of stream bank.
- Velocity Dissipation: Reduce velocities in roadway ditches.

LIMITATIONS:
- Recommended maximum drainage area of 0.5 acre per 100 foot barrier.
- Recommended maximum up gradient slope length of 150 feet.
- Recommended maximum uphill grade of 2:1 (50% ).

INSTALLATION:
- Excavate a 4-inch minimum deep trench along contour line, i.e. parallel to slope, removing all grass and other material that may allow underflow.
- Place bales in trench with ends tightly abutting, fill any gaps by wedging loose straw into openings.
- Anchor each bale with 2 stakes driven flush with the top of the bale. Extend Stakes 18 inches (min.) into the ground.
- Backfill around bale and compact to prevent piping, backfill on uphill side to be built up 4-inches above original ground at the barrier.
- In roadway ditches, straw bales should not be placed in such a way as to direct water around sides. Riprap should be placed around straw bale edges.

MAINTENANCE:
- Inspect immediately after any rainfall and at least daily during prolonged rainfall.
- Look for runoff bypassing ends of barriers or undercutting barriers.
- Repair or replace damaged areas of the barrier and remove accumulated sediment.
- Realign bales as necessary to provide continuous barrier and fill gaps.
- Re-compact soil around barrier as necessary to prevent piping.
C1-12

STABILIZED CONSTRUCTION ENTRANCE

DEFINITION: A stabilized pad of crushed stone located where construction traffic enters or leaves the site from or to a paved surface.

PURPOSE: To reduce potential for vehicle tracking of sediment or flow of sediment onto a paved surface where it may runoff to a storm water collection system, waterway, or lake.

APPLICATION:
• At any point of ingress or egress at a construction site where adjacent traveled way is paved. Applies to all sites which require a Storm Water Pollution Prevention Permit and Erosion Control Permit.
• Any project having duration of 3 months or more must install filter fabric beneath the crushed stone to minimize sediment pumping into the crushed stone.

LIMITATIONS: Not listed.

INSTALLATION:
• Clear and grub area and grade to provide slope shown for driveway, or access/intersection.
  If adjacent to waterway, use a maximum slope of 2%.
• Compact subgrade and place filter fabric if required.
• Place coarse aggregate, 1 to 2 ½ inches size, to a minimum depth of 6 inches for commercial projects, and 4 inches for residential projects.

MAINTENANCE:
• Inspect daily for loss of gravel or sediment buildup.
• Inspect adjacent roadway for sediment deposit and clean by sweeping or shoveling.
• Repair entrance and replace gravel as required to maintain control in good working condition.
• Expand stabilized area as required to accommodate traffic, and off site street parking and prevent erosion at driveway.
STABILIZED CONSTRUCTION ENTRANCE

TYPICAL DESIGN LAYOUT
DIVERSION DITCH/DIKE

DEFINITION: A temporary sediment barrier and storm water conveyance consisting of an excavated channel and compacted earth ridge.

PURPOSE: To protect down-gradient areas from sedimentation and erosion by diverting runoff to a controlled discharge point.

APPLICATION:
- Construct along the top of construction slope to intercept up-gradient runoff.
- Construct along the toe of construction slope to divert sediment laden runoff.
- Construct along midpoint of construction slope to intercept runoff and channel to a controlled discharge point.
- Construct around base of soil stockpiles to capture sediment.
- Construct around perimeter of disturbed areas to capture sediment.

LIMITATIONS:
- Recommended maximum drainage of 5 acres.
- Recommended maximum side slopes of 2:1 (50%).
- Recommended maximum slope on channel of 1%.

INSTALLATION:
- Clear and grub area for ditch/dike construction.
- Excavate channel and place soil on down gradient side.
- Shape and machine compact excavated soil to form ditch/ridge.
- Place erosion protection (Riprap, mulch, appropriate geotextiles) at outlet.
- Stabilize channel and ridge as required with mulch, gravel or vegetative cover.

MAINTENANCE:
- Inspect immediately after any rainfall and at least daily during prolonged rainfall.
- Look for runoff breaching dike or eroding channel or side slopes.
- Check discharge point for erosion or bypassing of flows.
- Repair and stabilize as necessary.
- Inspect daily during vehicular or construction equipment activity on slope, check for and repair any traffic damage.
WATER BAR

DEFINITION: A constructed drainage feature that diverts water off unpaved roads or trails to a controlled discharge point.

PURPOSE: To prevent water from ponding and/or flowing on/or along an unpaved road or trail by diverting runoff to a controlled discharge point.

APPLICATION:
• Construct along roads/trails to intercept up-gradient runoff and prevent rills from forming on fill slopes.
• Construct in low areas where water ponding is likely to occur to divert water off of the road/trail surface.
• Construct where erosion problems are occurring due to uncontrolled runoff.

LIMITATIONS:
• Discharge point should be stable and not sensitive to increases in runoff.
• Unfiltered discharges should not be directed directly into natural waterways.
• Water bars must be appropriately sized for specific traffic types and levels of use.

INSTALLATION:
• Location and frequency should be based on road slopes, runoff patterns, and topography.
• Determine discharge point and appropriate discharge method (slope drain, vegetated swale, rip rapped chute, or storm drain).
• Excavate trough and/or construct berm with fill.
• Compact the fill material.
• Construct discharge point.
• Use straw bales, silt fencing, gravel check dams, excavated sediment traps, or existing vegetation to filter the discharge as necessary.

MAINTENANCE:
• Inspect immediately after any rainfall and at least daily during prolonged rainfall.
• Remove sediment as necessary.
• Inspect for runoff breaching water bar or eroding at/or below the discharge point.
• Repair vehicle ruts on the top of the berm and stabilize as necessary.
STORM DRAIN INLET PROTECTION

DEFINITION: Concrete block, filter cloth, and gravel filter placed over inlet to storm drain system.

PURPOSE: Reduce sediment discharge to storm drain system by filtering storm water flows and reducing flow velocities allowing deposition of sediment.

APPLICATION: Construct at storm drain inlets in paved or unpaved areas where up-gradient area is to be disturbed by construction activities.

LIMITATIONS:
- Recommended for maximum drainage of one acre.
- Excess flows may bypass the inlet requiring down gradient controls.
- Ponding will occur at inlet.

INSTALLATION:
- Place wire (with ½ inch openings) over the inlet extending 12-inches past inlet opening. Place filter fabric over mesh.
- Place concrete blocks around the inlet with openings facing outward. Stack blocks to minimum height of 12-inches and a maximum height of 24-inches.
- Place wire mesh around outside of blocks. Place gravel (3/4 inch to 3 inches) around blocks.

MAINTENANCE:
- Inspect inlet protection after every large storm event and at a minimum of once monthly.
- Remove sediment accumulated when it reaches 4-inches in depth.
- Replace filter fabric and clean or replace gravel if clogging is apparent.
REMOVE DRAIN GATE
INSERT SILTSACK™
REPLACE GRATE TO HOLD
SILTSACK IN POSITION
SILTSACK TRAPS SILT
REMOVE FILLED SILTSACK
(WITH FRONT-LOADER OR OTHER EQUIPMENT)
LIFT DUMP STRAPS
CLEAN AND REUSE OR
DISCARD AND REPLACE
SIZED TO FIT ANY SIZE OR SHAPE CATCH BASIN
ALL SEAMS DOUBLE STITCHED
PERMEABILITY—REGULAR FLOW SILTSACK ~40 GALLON/MIN/FT²
HIGH FLOW SILTSACK ~200 GALLON/MIN/FT²
UPS SHIPPABLE
STRAW BALE DROP-INLET BARRIER

DEFINITION: Straw Bale placed around inlet to storm drain system. Bale drop-inlets operate by intercepting and ponding sediment-laden runoff. Ponding the water reduces the velocity of the incoming flow and allows most of the suspended sediment to settle out. When the pond height reaches the top of the barrier, water flows over the bales and into the drop inlet.

PURPOSE: Reduce sediment discharge to storm drain system by some filtering of storm water flows and reducing flow velocities allowing deposition of sediment.

APPLICATION:
• Construct at storm drain inlets in unpaved areas where up-gradient area is to be disturbed by construction activities.
• Use at median drop-inlet boxes.

LIMITATIONS:
• Recommended for maximum drainage of one acre.
• Excess flows may bypass the inlet requiring down gradient controls.
• Ponding will occur at inlet.
• Do not use where ponding may stretch out onto adjacent roadway.

INSTALLATION:
• Excavate a trench around the perimeter of the drop inlet that is at least 6 inches deep by 1.5 times the width of the bale wide
• Place bales in the trench, making sure that they are butted tightly. Some bales may need to be shortened to fit the trench around the drop inlet. Two stakes must be driven through each bale approximately 8 inches from each end. The stakes must be driven a minimum of 18 inches into the ground.
• The bales must also be placed directly against the outside of the drop-inlet. This allows overtopping water to flow directly into the inlet instead of onto nearby soil causing scour.
• Place the excavated against the outside of the bales and compacted. The compacted soil should be no deeper than 4 inches against the bale.
• This method may be enhanced with the use of a silt catching/filtering sack placed inside the drop-inlet.

MAINTENANCE:
• Inspect inlet protection after every large storm event and at a minimum of once weekly.
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- Remove sediment accumulated when it reaches half the height of the bale.
- Replace bales which become damaged.
- Replace filter sack (if used) if clogging is apparent.
BRUSH BARRIER

DEFINITION: A vertical barrier constructed of tree trimmings, limbs, and brush obtained from the clearing operation. A filter cloth should be used over the brush barrier to maximize effectiveness.

PURPOSE: To trap sediment and filter construction runoff.

APPLICATION:
• Sediment Barrier: Place barrier at toe of slope or soil stockpile.
• Velocity Dissipation: Reduce velocities and trap sediment at culvert outlets and in roadway ditches.

LIMITATIONS:
• Adequate material for the barrier is available from the clearing operation.

INSTALLATION:
• Construct barrier with trimmings, limbs, and brush and perform necessary trimming.
• Construct small trench (8 inches wide and 8 inches deep) on front side of barrier.
• Cut filter cloth to proper size and place over brush.
• Bury the filter cloth to prevent undermining.
• Attach filter cloth to brush by stapling or other means.
• Brush barriers located below pipe culverts should be constructed prior to culvert installation.

MAINTENANCE:
• Inspect immediately after any rainfall and at least daily during prolonged rainfall.
• Look for runoff bypassing ends of barriers or undercutting barriers.
• Repair or replace damaged areas of the barrier and remove accumulated sediment.
• Re-compact soil around barrier as necessary to prevent piping.
GRAVEL CHECK DAMS

DEFINITION: Small temporary dam constructed across dry drainage path (i.e. not in live streams).

PURPOSE: To reduce erosion of drainage path by reducing velocity of flow and by trapping sediment and debris.

APPLICATION:
• Temporary drainage paths.
• Permanent drainage ways not yet stabilized.
• Existing drainage paths receiving increased flows due to construction.

LIMITATIONS:
• Maximum recommended drainage area is 10 acres.
• Maximum recommended height is 24".
• Do not use in running stream.

INSTALLATION:
• Prepare location of dam by removing any debris and rough grading any irregularities in channel bottom.
• Place rocks by hand or with appropriate machinery, do not dump.
• Construct dam with center lower to pass design flow.
• Construct 50% side slopes on dam.

MAINTENANCE:
• Inspect dams daily during prolonged rainfall, after each major rain event and at a minimum of once monthly.
• Remove any large debris and repair any damage to dam, channel, or side slopes.
• Remove accumulated sediment when it reaches one half the height of the dam.
GRAVEL CHECK DAMS

TYPICAL DESIGN LAYOUT

<table>
<thead>
<tr>
<th>Percent Grade (%)</th>
<th>Check Dam Spacing (Ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.0</td>
<td>60</td>
</tr>
<tr>
<td>6.0</td>
<td>50</td>
</tr>
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<td>7.0</td>
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<td>8.0</td>
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<tr>
<td>9.0</td>
<td>20</td>
</tr>
<tr>
<td>10.0</td>
<td>10</td>
</tr>
</tbody>
</table>
STRAW BALE CHECK DAMS

DEFINITION: Small temporary dam constructed across dry drainage path (i.e. not in live streams).

PURPOSE: To reduce erosion of drainage path by reducing velocity of flow and by trapping sediment and debris.

APPLICATION:
• Temporary drainage paths.
• Permanent drainage ways not yet stabilized.
• Existing drainage paths receiving increased flows due to construction.

LIMITATIONS:
• Maximum recommended drainage area is 10 acres.
• Sufficient numbers of bales are required to force runoff over the flow line.
• Does not use in ditches with slopes of 6% or more. For ditches with slopes over 6%, use rock check dams.
• Do not use where high flows are expected.
• Do not use directly in front of a culvert outlet.
• Do not use in running stream.

INSTALLATION:
• Prepare location of dam by removing any debris and rough grading any irregularities in channel bottom.
• Bales must be free of weeds declared noxious by the State of Utah, Department of Agriculture.
• Excavate a vertical trench perpendicular to the ditch flow line the length of the straw bale dam that is 6 inches deep, and 1.5 time the width of the bale.
• Place bales in the trench, making sure that they are tightly butted against each other, and the excavated trench on the downstream side.
• Place two stakes through each bale, approximately 8 inches from each end and drive at least 18 inches into the ground.
• Construct dam with center lower to pass design flow.
• Place and compact the excavated material in the remaining trench area on the upstream side. The compacted soil should be no more than 4 inches deep and extend upstream no more than 24 inches.
• Use downstream scour apron where required.

MAINTENANCE:
• Inspect dams daily during prolonged rainfall, after each major rain event and at a minimum...
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of once monthly.

• Remove any large debris and repair any damage to dam, channel, or side slopes.
• Remove accumulated sediment when it reaches one half the height of the dam.
STRAW HALE CHECK DAM
TYPICAL DESIGN LAYOUT

<table>
<thead>
<tr>
<th>EROSION (%)</th>
<th>CHECK DAM SPACING (FEET)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>200</td>
</tr>
<tr>
<td>2.0</td>
<td>100</td>
</tr>
<tr>
<td>3.0</td>
<td>80</td>
</tr>
<tr>
<td>4.0</td>
<td>60</td>
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<tr>
<td>5.0</td>
<td>40</td>
</tr>
<tr>
<td>6.0</td>
<td>34</td>
</tr>
</tbody>
</table>
SLOPE DRAIN

DEFINITION: A devise used to carry concentrated runoff from the top to the bottom of a slope.

PURPOSE:
• Convey runoff from offsite around a disturbed portion of the site.
• Drain saturated slopes that have the potential for soil slides.

APPLICATION:
• Use on cut or fill slopes before permanent storm water drainage structures have been installed.
• Use where diversion ditches or other diversion measures have been used to concentrate flows.
• Use on any slopes where concentrated runoff crossing the face of the slope may cause gullies, channel erosion, or saturation of slide-prone soils.
• Use as an outlet for a natural drainage way.

LIMITATIONS: Not suitable for drainage areas greater than 10 acres.

INSTALLATION:
• The slope drain design should handle the peak runoff for the 10-year 24-hour storm. Typical relationships between area and pipe diameter are shown below:

<table>
<thead>
<tr>
<th>Maximum Drainage Area (Acres)</th>
<th>Pipe Diameter (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.50</td>
<td>12</td>
</tr>
<tr>
<td>0.75</td>
<td>15</td>
</tr>
<tr>
<td>1.00</td>
<td>18</td>
</tr>
</tbody>
</table>

• Place slope drain on undisturbed or well-compacted soils.
• Place filter cloth under the inlet, extend it to 3 to 6 feet in front of the inlet, and key it in 6 to 8 inches on all sides to prevent erosion. A 6 to 8 inches metal toe plate may also be used for this purpose.
• Securely stake the drain pipe to the slope at intervals of 10 feet or less, using grommets.
• Make sure that all slope drain sections are securely fastened together and have watertight fittings.
• Extend the pipe beyond the toe of the slope and discharge at a non-erosive velocity into a stabilized area or to a sediment trap. Use riprap outlet protection if necessary.

MAINTENANCE:
• Inspect the slope drain regularly and after every storm. Check to see if water is bypassing the inlet or undercutting the inlet or pipe. If necessary, install head walls or sandbags to
• Prevent bypass flow.
• Check for erosion at the outlet point and check the pipe for breaks or clogs.
SLOPE DRAIN
TYPICAL DESIGN LAYOUT

NOTE:
WHERE APPLICABLE, USE A BUILT-INSLOPE FENCE PLUS EMBANKMENT FENCE TO
DECREASE SPEED OF THE WATER AND
FILTER THE RUNOFF.

PLAN VIEW
OPEN CHUTE DRAIN

DEFINITION: An excavated channel placed across disturbed slopes used to protect exposed slopes by intercepting runoff and directing it to a stabilized outlet or sediment-trapping devise.

PURPOSE: Convey runoff over disturbed soil without causing further erosion of the slope.

APPLICATION:
- Used on cut and fill slopes as a permanent or temporary storm water drainage structure.
- Used where diversion ditches or other diversion measures have been used to concentrate flows.

LIMITATIONS:
- Should be sized based on anticipated runoff, sediment loading and drainage area size.
- May require temporary slope drain until final grade is established and open chute drain is constructed.
- Recommended maximum slope of 2:1 (50%).
- Recommended minimum slope of 20:1(5%).

INSTALLATION:
- Detail design is required.
- Implementation of energy dissipaters at the outlet end to protect against scour.
- The elevation of the top of the lining of the inlet structure must not be higher than the lowest diversion dike(s) or other devices that direct flow to the chute.
- Design with adequate capacity to convey the 50-year, 6-hour storm.
- Compact some soil around the inlet to ensure that a good bond is attained at the interface of the structure and diversion dikes and to prevent piping failure. Place Rip Rap if required.

MAINTENANCE:
- Inspect after major storms. Look for piping failure at the interface of the inlet and adjoining diversion dike(s) or berm(s).
- Repair any damage promptly.
ROCK-LINED (RIP RAP) DITCHES

DEFINITION: A channel or ditch lined with rocks to prevent erosion. May be used as a temporary or permanent control.

PURPOSE: Convey runoff without causing erosion of a ditch or channel.

APPLICATION:
- Used in ditches or channels which may or may not have continuous flow.
- Used along roadways where the ditch or channel does not jeopardize the Clear Zone.

LIMITATIONS:
- Should be sized based on anticipated runoff, sediment loading and drainage area size.
- Recommended maximum slope of 2:1 (50%).
- Ditches or Channels having slopes greater than 8% must utilize geotextiles beneath the rock.
- Minimum Rock size shall be 6”. The gradation shall be determined by the detailed design.

INSTALLATION:
- Detail design is required.
- Implementation of energy dissipaters at the outlet end to protect against scour.
- Design temporary ditches with adequate capacity to convey the 50-year, 6-hour storm. Design permanent ditches per Summit County Standards.
- Excavate ditch or channel to the designed cross section and grade. The ditch or channel side slope may be no steeper than 2:1.
- Place geotextiles (if required) along the full width of the excavated ditch or channel. Be sure to overlap the material as required in the manufacturer’s guidelines.
- Place the rock by machine, or by hand as required.

MAINTENANCE:
- Inspect after major storms. Look for undermining failures.
- Repair any damage promptly.
GRASSED/MATTED SWALES

DEFINITION: A channel or ditch lined with vegetated mats to prevent erosion. May be used as a temporary or permanent control.

PURPOSE: Convey runoff without causing erosion of the ditch or channel.

APPLICATION:
- Used in ditches or channels which do not have continuous flow.
- Used along roadways where the ditch or channel is used to convey storm water.

LIMITATIONS:
- Should be sized based on anticipated runoff, sediment loading and drainage area size.
- Recommended maximum slope of 20:1 (5%).

INSTALLATION:
- Detail design is required.
- Implementation of energy dissipaters at the outlet end to protect against scour.
- Design temporary ditches with adequate capacity to convey the 50-year, 6-hour storm. Design permanent ditches per Summit County Standards.
- Excavate ditch or channel to the designed cross section and grade. The ditch or channel side slope may be no steeper than 3:1.
- Place matt along the full width of the excavated ditch or channel. Be sure to overlap the material if required in the manufacturer’s guidelines.

MAINTENANCE:
- Inspect after major storms. Look for undermining failures.
- Repair any damage promptly.
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TEMPORARY EXCAVATED SEDIMENT TRAP

DEFINITION: A small temporary containment area with gravel (Rip Rap) outlet.

PURPOSE:
• Reduce velocities and peak discharge of storm water runoff.
• Create temporary ponding to allow settlement and deposition of suspended solids.
• Protect down-gradient discharge point from sediment laden runoff and eroding velocities.

APPLICATION:
• Temporary control for runoff from disturbed areas of less than 3 acres.
• Temporary control for discharge from diversion dike, surface benching, or other temporary drainage measures.

LIMITATIONS:
• Should be sized based on anticipated runoff, sediment loading and drainage area size.
• May require silt fence at outlet for entrapment of very fine silts and clays.

INSTALLATION:
• Design basin for site specific location.
• Excavate basin or construct compacted berm containment.
• Construct outfall spillway with gravel (Rip Rap) apron.
• Provide downstream silt fence if necessary.
• Use straw bales in trap to reduce gullying.

MAINTENANCE:
• Inspect after each rainfall event and at a minimum of monthly.
• Repair any damage to berm, spillway or sidewalls.
• Remove accumulated sediment as it reaches 50% height of available storage.
• Check outlet for sediment/erosion of down-gradient area and remediate as necessary. Install silt fence if sedimentation downstream is apparent.
TEMPORARY EXCAVATED
SIDEMENT TRAP
TYPICAL DESIGN LAYOUT

PLAN VIEW

SECTION A-A
TEMPORARY EXCAVATED SEDIMENT TRAP
TYPICAL DESIGN LAYOUT

SECTION THROUGH SPILLWAY
EQUIPMENT AND VEHICLE WASH DOWN AREA

DEFINITION: A stabilized pad of crushed stone for general washing of equipment and construction vehicles.

PURPOSE: To reduce potential of sediment being tracked onto roads and streets by vehicles leaving a construction site and entering a storm water collection systems, or waterways.

APPLICATION:
• At any site where regular washing of vehicles and equipment must occur to reduce the potential of sediment being tracked onto roads and streets by vehicles leaving a construction site.
• May also be used as a filling point for water trucks limiting erosion caused by overflow or spillage of water.

LIMITATIONS:
• Cannot be utilizing for washing equipment or vehicles that may cause contamination of runoff such as fertilizer equipment or concrete equipment. Solely used to remove mud from vehicles leaving construction sites.
• A Sediment trap must be used in conjunction to control sediment runoff with wash water.

INSTALLATION:
• Clear and grub area and grade to provide maximum slope of 1%.
• Compact subgrade and place filter fabric if desired (required for wash areas which will remain in use for 3 months or more).
• Place coarse aggregate, 1 to 2 ½ inches in size, to a minimum depth of 8 inches.
• For small projects, install silt fence down gradient (see silt fence BMP information sheet).
• For large projects, install sediment basin down gradient (see excavated sediment trap BMP information sheet).

MAINTENANCE:
• Inspect daily for loss of gravel or sediment buildup.
• Inspect adjacent area for sediment deposit and install additional controls if necessary.
• Repair area and replace gravel as required to maintain control in good working condition.
• Expand stabilized area as required to accommodate activities.
• Maintain silt fence as outline in specific silt fence BMP information sheet.
• Maintain sediment trap as outline in specific sediment trap BMP information sheet.
EQUIPMENT AND VEHICLE WASH DOWN AREA
TYPICAL DESIGN LAYOUT
MATERIAL STORAGE

DEFINITION: Controlled storage of on-site materials.

PURPOSE: To limit potential for materials contaminating storm water runoff.

APPLICATION:
- Storage of hazardous, toxic, and all chemical substances.
- Any construction site with outside storage of materials.

LIMITATIONS:
- Does not prevent contamination due to mishandling of products.
- Spill Prevention and Response Plan still required.
- Only effective if materials are actively stored in a controlled location.

INSTALLATION:
- Designate a secured area with limited access as the storage location. Ensure no waterways or drainage paths are nearby.
- Construct compacted earthen berm or similar perimeter containment around storage location for impoundment in the case of spills.
- Ensure all on-site personnel utilize designated storage area. Do not store excessive amounts of material that will not be utilize on-site.
- For active use of materials away from the storage area ensure materials are not set directly on the ground and are covered when not in use. Protect storm drainage during use.

MAINTENANCE:
- Inspect daily and repair any damage to perimeter impoundment or security fencing.
- Check that materials are being correctly stored (i.e. standing upright, in labeled containers, tightly capped) and that no materials are being stored away from the designated location.
WASTE DISPOSAL

DEFINITION: Controlled storage and disposal of solid waste generated by construction activities.

PURPOSE: To prevent or reduce discharge of pollutants to storm water from improper disposal of solid waste.

APPLICATION: All construction sites.

LIMITATIONS: On-site personnel are responsible for correct disposal of waste.

INSTALLATION:
• Designate one or several waste collection areas with easy access for construction vehicles and personnel. Ensure no waterways or storm drainage inlets are located near the waste collection areas. Construct compacted earthen berm or similar perimeter containment around collection area for impoundment in the case of spills and to trap any windblown trash.
• Use water tight containers with covers which are to remain closed when not in use. Provide separate containers for different waste types where appropriate and label clearly.
• Ensure all on-site personnel are aware of and utilize designated waste collection area properly and for intended use only (e.g., all toxic, hazardous or recyclable materials shall be properly disposed of separately from general construction waste).
• Arrange for periodic pickup, transfer and disposal of collected waste at authorized disposal location. Include regular Porta-potty service in waste management activities.

MAINTENANCE:
• Discuss waste management procedures at progress meetings.
• Collect site trash daily and deposit in covered containers at designated collection area.
• Check containers for leakage or inadequate covers and replace as needed.
• Randomly check disposed materials for any unauthorized waste (e.g., toxic materials).
• During daily site inspections check that waste is not being incorrectly disposed of on-site (e.g., burial, burning, surface discharge, discharge to storm drain).
WASTE DISPOSAL

TYPICAL DESIGN LAYOUT
TYPICAL RESIDENTIAL STORM WATER POLLUTION PREVENTION PLAN
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Introduction
Summit County requires that proposed developments utilize nonstructural stormwater control BMPs to the maximum extent practicable in order to meet the required criteria for long-term runoff control. This appendix provides a list and description of appropriate nonstructural BMPs that a permit applicant could choose to utilize in their design. This list is not intended to be comprehensive, and alternative nonstructural controls may be selected subject to approval by Summit County. A nonstructural BMP checklist is included in this Appendix. This checklist is intended for planners, designers and/or developers to utilize during the site planning, design, and construction phases of all developments. Additional information and detailed examples of nonstructural controls and environmentally-sensitive design principles can be obtained online at:

- [http://www.cwp.org/better_site_design.htm](http://www.cwp.org/better_site_design.htm)
- [http://www.stormwatercenter.net/](http://www.stormwatercenter.net/)

**BMP 1: Preservation of Undisturbed Natural Areas**
This BMP involves formally designating appropriate undisturbed natural areas within the site as preservation areas. These areas must be specified in the maintenance covenant and recorded by the County in the land record to ensure they remain undeveloped in perpetuity. These areas must be clearly marked and remain undisturbed (i.e., no clearing, grubbing, or construction traffic) during construction. Areas that provide the greatest stormwater benefits through their preservation include:

- wetlands & meadows
- riparian buffers
- forested areas
- areas with high infiltration rates (e.g., hydrologic group A and B soils)
- groundwater recharge zones
- streams and natural drainageways

**BMP 2: Minimization of Disturbance**
This BMP involves using careful construction sequencing, well-designated limits of disturbance, and well-defined construction entrances/exits to minimize the total area of disturbance (e.g., excavation, grading, clearing, grubbing) and reduce soil compaction from construction traffic. Clearing and grading of forests and native vegetation at a site should be limited to the minimum amount needed to build lots, allow access, and provide fire protection. Site layouts and roadway patterns should be designed to conform with or “fit” the natural landforms and topography of a site. This helps to preserve the natural hydrology and drainageways on the site, as well as reduce the need for grading and disturbance of vegetation and soils.
BMP 3: Reduction of Impervious Cover
This BMP involves modifying the designs of permanent structures to reduce the overall area of impervious surfaces while still achieving development objectives. Specific modifications may include:

- reducing roadway lengths and widths to the minimum size needed to meet traffic and safety needs
- reducing building footprints (e.g., build up rather than out)
- reducing the parking footprint (build underground parking or multi-level parking decks; size a proportion of stalls for compact vehicles; use grass or alternative paving for overflow parking areas)
- reducing lot setbacks and frontages
- using fewer or alternative cul-de-sacs (e.g., install pervious vegetated islands in cul-de-sacs; reduce radius of cul-de-sacs; use alternatives such as T-shaped turnarounds)
- integrating porous areas such as landscaped islands, swales, filter strips, and bioretention areas into parking lot designs
- using alternative paving techniques (e.g., use loose gravel, coarse sand, wood or bark chips, or disconnected pavers for all or parts of driveways and walkways)
- using vegetated swales instead of curb and gutter to convey road runoff

BMP 4: Routing of Runoff to Pervious Areas/disconnection of Runoff
This BMP involves routing the runoff from impervious areas to pervious areas such as natural areas, buffers, lawns, landscaping, filter strips and vegetated channels. In this way, the runoff is “disconnected” from other impervious areas and paved collection/conveyance systems (e.g., curb and gutter) that do not allow for groundwater recharge or uptake of pollutants. Some of the methods for disconnecting impervious areas include:

- designing roof drains to flow to vegetated areas
- directing flow from paved areas such as driveways to stabilized vegetated areas
- breaking up flow directions from large paved surfaces and rooftops
- carefully locating and grading impervious areas and landscaped areas to achieve sheet flow runoff to the vegetated pervious areas
D-4

BMP 5: Pollution Prevention/Source Reduction
This BMP involves implementing measures to reduce or contain potential sources of contamination at a site. Specific measures include:

• controlling litter (providing adequate numbers of trash receptacles, emptying receptacles regularly, keeping dumpster lids closed, etc.)

• sweeping streets and paved areas rather than hosing them down or using pressurized washers

• reducing rainfall contact with potential pollution sources by installing roofs/canopies over gas station fueling areas, salt/sand piles, hazardous material storage areas, etc.

• providing secondary spill containment (e.g., berms) for hazardous liquid storage containers

• clearly marking storm drains “No Dumping- Drains to Live Stream”
Checklist for Nonstructural BMPs

Project name:

Site area (total acres):

Project location:
Contractor/builder information:
name:

address:

email:

phone/fax:

<table>
<thead>
<tr>
<th>Best Management Practices (BMPs)</th>
<th>Yes/ No</th>
<th>Comments (If applicable, describe actions taken or give explanation of no action)</th>
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<tr>
<td>Preservation of Undisturbed Natural Areas</td>
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<tr>
<td>Specification of natural areas in maintenance covenant.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preservation is recorded in the land record.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clear demarcation of undisturbed areas during construction.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimization of disturbance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction sequence reduces the amount of land disturbed at one time.</td>
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<td></td>
</tr>
<tr>
<td>Well-defined construction access points.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limited site clearing.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site layout and roadway patterns conform to topography.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduction of impervious cover</td>
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<td></td>
</tr>
<tr>
<td>Appropriate road sizing.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduced building footprint.</td>
<td></td>
<td></td>
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<tr>
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<td>Yes/No</td>
<td>Comments (If applicable, describe actions taken or give explanation of no action)</td>
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<tr>
<td><strong>Reduction of impervious cover (Cont.)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduced parking footprint.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduced lot setbacks and frontages.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alternative cul-de-sac design.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Integration of porous or infiltration areas (islands, swales etc.).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alternative paving.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of vegetated swales in place of curb and gutter.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Routing of runoff to pervious areas/Disconnection of runoff</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drains and runoff are directed to vegetated areas.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Runoff from large impervious surfaces (including pavement and rooftops) is broken into several flow paths.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design so that impervious areas direct runoff to vegetated areas.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pollution prevention/Source reduction</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Litter/trash control.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry sweep rather than washing or hosing off areas.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provide secondary spill containment for hazardous liquid if stored on- site.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stencil storm drains.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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GENERAL

A. Introduction

This appendix provides a list and description of appropriate structural BMPs that a permit applicant could select from to meet the stormwater treatment requirements described in Appendix A. This list is not intended to be comprehensive, and alternative structural controls may be selected subject to approval by Summit County. Additional information and detailed examples of long-term post-construction stormwater BMPs can be found online at:

http://cfpub.epa.gov/npdes/stormwater/menuofbmps/post.cfm
http://www.deq.state.id.us/water/stormwater_catalog/index.asp

All structural post-construction BMPs shall be inspected regularly (at least every six months or as otherwise noted) to determine maintenance needs.

For the purposes of meeting the water quality treatment requirements outlined in Appendix A, the sliding scale and TSS design removal rates shown in Tables 1 and 2 should be used. TSS removal rates for alternative structural controls will be determined by the applicant and approved by the County Engineer. Credible references justifying/documenting the removal rates used shall be submitted by the permit applicant.

For sites where newly-developed impervious areas lie within 50 feet of a live water body (perennial or intermittent stream, lake, pond, spring, or reservoir), the Table 1 sliding scale does not apply and the default 80% TSS removal standard must be met. The less-stringent removal efficiencies listed in Table 1 apply only to sites that refrain from creating new impervious cover near live water bodies.

B. Location of Structural BMPs

Structural BMPs should never be constructed in natural streams (perennial or intermittent) or wetlands. BMPs should be designed to only intercept and capture storm water runoff, not natural stream channel runoff.
Table 1.1  Sliding Scale for Required TSS Removal Efficiency (adapted from City of Boise.

| % of parcel area that is impervious | % TSS removal efficiency required  
<table>
<thead>
<tr>
<th></th>
<th></th>
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<tbody>
<tr>
<td>≤ 30%</td>
<td>40</td>
</tr>
<tr>
<td>35%</td>
<td>47</td>
</tr>
<tr>
<td>40%</td>
<td>53</td>
</tr>
<tr>
<td>45%</td>
<td>59</td>
</tr>
<tr>
<td>50%</td>
<td>62</td>
</tr>
<tr>
<td>55%</td>
<td>66</td>
</tr>
<tr>
<td>60%</td>
<td>68</td>
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<td>65%</td>
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<td>70%</td>
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<td>75%</td>
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<td>85%</td>
<td>77</td>
</tr>
<tr>
<td>90%</td>
<td>78</td>
</tr>
<tr>
<td>95%</td>
<td>79</td>
</tr>
<tr>
<td>100%</td>
<td>80</td>
</tr>
</tbody>
</table>

*a for sites where newly-developed impervious cover lies within 50 feet of a live water body, the values in Table 1 do not apply and instead a removal efficiency of 80% must be met, even if the total site imperviousness % is less than 100%.

Table 2.1  TSS Removal Rates for Selected BMPs (adapted from Schueler 1997, Winer 2000, & EPA 1993).

<table>
<thead>
<tr>
<th>BMP</th>
<th>Design Removal Rate (%)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Detention Ponds</td>
<td>15</td>
<td>Quantity control pond</td>
</tr>
<tr>
<td>Wet Detention Ponds</td>
<td>60</td>
<td>Quantity control pond</td>
</tr>
<tr>
<td>Dry Extended Detention Pond</td>
<td>45</td>
<td>Sediment forebay included</td>
</tr>
<tr>
<td>Wet Extended Detention Pond</td>
<td>80</td>
<td>Sediment forebay included</td>
</tr>
<tr>
<td>Evaporation Pond</td>
<td>100</td>
<td>Designed to evaporate or retain</td>
</tr>
<tr>
<td>Bioinfiltration Swale</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>Sand Filter</td>
<td>80</td>
<td>Pretreatment, includes Austin, underground, pocket, and Delaware designs</td>
</tr>
<tr>
<td>Organic Filter</td>
<td>80</td>
<td>Pretreatment, includes compost and peat/sand</td>
</tr>
<tr>
<td>Catch Basin Insert</td>
<td>25</td>
<td>Off-line only</td>
</tr>
<tr>
<td>Infiltration Facilities</td>
<td>95*</td>
<td>*removal rate only valid with adequate maintenance and pre-treatment</td>
</tr>
<tr>
<td>Sediment Trap</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Grass Buffer Strip</td>
<td>85</td>
<td>Minimum width of 10’</td>
</tr>
<tr>
<td>Oil/Water Separator</td>
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<td></td>
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</table>
BMP1: OIL/WATER SEPARATORS

A. Introduction

This section includes standards for oil/water separators to be installed to treat runoff from gas stations and parking lots. These systems can be used to intercept and remove contaminants from storm water runoff. They can also be used during redevelopment to retrofit an existing system in order to provide water quality treatment. Oil/water separators and catch basin inserts should not be used alone to treat storm water runoff but rather in combination with other BMPs to improve water quality.

B. Description

These structures are used to capture floatables, oil and grease, and sediment found in runoff. Two types of oil/water separators are discussed in this section: coalescing plate interceptor (CP) (Figure 1.1) and the conventional gravity separator, or API (Figure 1.2). The CP and API separators can function as pre-treatment systems if regularly maintained. A third system, the spill control (SC) separator should be considered for sites where there is a risk of leaks and small spills, such as gas station sand chemical storage areas. It is not considered a pre-treatment system.

C. Sizing

The contributing area to any individual oil/water separator should be limited to one acre of impervious cover. The maximum allowable velocity through the throat of the separator (0.5 fps) will also limit the size of the area served. Separators, boxes, or vaults are sized based on the contributing runoff area, sedimentation rates of particles, and maximum velocities through the throat of the separator.

Certain developments such as fuel farms or gas stations should consider properly sized facilities to capture floatables such as oil and grease. The American Petroleum Institute (API) standards related to oil rise rates and turbulence should be used to design these facilities.

D. Access

Provide access for inspection, proper maintenance, and monitoring activities, including clearance from structures to allow for equipment to clean out devices. Provide access to each compartment. If the length or width of any compartment exceeds 15’, an additional access point for each 15’ is required.
**E. Design Life**

The system shall be designed either to the manufacturer’s specifications or 50 years, whichever is greater.

All metal parts should be corrosion-resistant. Acceptable materials include parts made of aluminum and stainless steel, fiberglass, or plastic. Metal parts that come in contact with storm water runoff should not be painted because the paint tends to wear off.

Vault baffles should be made of concrete, stainless steel, fiberglass reinforced plastic, or other acceptable material and should be securely fastened to the vault. Apply the HS-20 traffic loading standard when locating the API and CP systems in parking lots.

**F. Maintenance**

Clean accumulated oil, grease, sediments and floating debris every two years, unless inspections show that more frequent maintenance is necessary. Oil/water separators should be inspected monthly to insure proper maintenance.
Figure 1.1. Coalescing Plate Oil/Water Separator.
Figure 1.2. Conventional Gravity Oil/Water Separator.
BMP2: CATCH BASIN INSERTS

A. Introduction

A catch basin insert is a device installed underneath a catch basin inlet that treats storm water through filtration, settling, absorption, adsorption, or a combination of these mechanisms.

A variety of catch basin inserts are commercially available from various different manufacturers. Summit County does not endorse any single product or manufacturer over any other; however, each selected product will be subject to review by the County and must be approved prior to installation.

Because they have limited capacity and limited sediment removal capabilities, catch basin inserts should NOT be used alone to treat storm water runoff but rather as pretreatment to another storm water management BMP or series of BMPs.

B. Installation

The insert must be fitted with oil-absorbent/adsorbent filter media. The filter must be changed monthly or when the filter media surface is covered with sediment. If the insert is installed in an existing catch basin, the insert shall be demonstrated to fit properly so that there is a positive seal around the grate to prevent low-flow bypass. If the insert is installed in a new or redevelopment project, it shall be installed according to the manufacturer’s recommendations. The insert should be installed in the catch basin after the site has been paved or stabilized (for new development) or after completion of construction (for a redevelopment site that is already paved).

C. Access

The catch basin insert shall be located in an easily-accessible area for maintenance activities. It should not placed in an area with continuous vehicle parking. Consequently, redevelopment projects may have to modify a parking stall in order to provide access to a catch basin insert.

D. Maintenance

Catch basin inserts shall be maintained at a frequency recommended by the manufacturer. Inspections should occur at least monthly during wet months and during periods of high runoff and once every 2 months during the remainder of the year. Full replacement or renewal of oil absorbent/adsorbent material shall be part of maintenance activities. In addition, the catch basin sump should be inspected for sediment accumulation. Filter media shall be disposed of in accordance with applicable regulations. In most cases, dewatered filter media may be disposed of...
as solid waste. To insure proper maintenance of the catch basin inserts inspections should occur monthly.
Figure 2.1.  Sample Detail of One Type of Catch Basin Insert (SNOT brand). Summit County does not endorse this brand over any other.
BMP3: INFILTRATION FACILITIES (GENERAL)

A. Introduction

This section contains requirements for facilities that manage storm water by subsurface disposal through infiltration. Requirements are included for seepage beds (infiltration trenches), infiltration basins, and infiltration swales. A seepage bed (Figure 3.1) receives runoff in a shallow excavated trench that has been backfilled with stone to form a below-grade reservoir. Seepage beds are typically located beneath landscaped or parking areas. A seepage bed can also be open to the surface and covered with landscaping rock. This type of system is referred to as an open trench. An infiltration basin (Figure 3.2) impounds water in a surface pond until it infiltrates the soil. Infiltration basins do not maintain a permanent pool between storm events and should drain within 48-72 hours after a design storm event. Infiltration swales (Figure 3.3) are vegetated channels designed to retain/detain, treat and infiltrate stormwater runoff.

B. Plan Submittal

For each infiltration facility, the applicant will be required to submit the general information listed in Section 3.A.1 of Appendix A as well as the following additional information:

- site characteristics that pertain to the proposed infiltration system (site evaluation information) soils report and geologic report with boring logs
- written opinion of site suitability by a hydrologist, geologist, soil scientist or engineer
- recommended design infiltration rate
- infiltration test data and results

C. Construction

Before the site is disturbed, the area selected for the infiltration system shall be secured to prevent heavy equipment from compacting the underlying soils. Runoff should be diverted away from the completed infiltration system during all phases of construction, until the site is completely stabilized. Excessive sediment loading during construction can severely impact the long-term performance of infiltration systems.
D. Setbacks and Separation Distances

- Infiltration facilities shall be located 100' from surface water supplies and tributaries used as drinking water and 50' from surface waters not used as drinking water, excluding drainage and irrigation water delivery systems.

- Infiltration facilities shall be located 100' from public and private drinking water wells.

- Infiltration facilities shall be located 5' from bedrock or basalt (vertical distance from bottom of facility to bedrock). Infiltration facilities must not be used on slopes $>20\%$.

E. Infiltration Rate

The infiltration rate shall be measured at a depth equal to the proposed bottom grade of the facility. Appropriate soil types are those that have an infiltration rate of 0.5”/hour or greater, as initially determined from NRCS Soil Textural Classification and subsequently confirmed by field geotechnical tests. Maximum soil percolation rates shall generally not exceed 8” per hour.

F. Maintenance

Systems should be inspected and cleaned during regular semi-annual inspections. This inspection schedule applies to all of the infiltration facilities unless otherwise noted. The maximum depth of sediment allowed should be stated in the O&M Plan with an estimate of impact on infiltration rate. Sediments shall be removed and disposed of properly.
BMP3.1: SEEPAGE BEDS

A. Limitations

Seepage beds are prohibited in the following situations:

- where hazardous or toxic materials greater than SARA Title III “reportable quantities” are stored or handled, including loading and unloading areas
- where there is existing soil and/or ground water contamination
- in fill material, where there is the possibility of creating an unstable grade and potential for movement at the interface between the fill and in-situ soils

Vadose zone characteristics and depth to water will determine where seepage beds will be prohibited. A final determination regarding the use of seepage beds is based on evaluating the natural, unaltered characteristics of the proposed location for the system. Table 3.1 illustrates how restrictions may be applied.

### Table 3.1. Restrictions for Seepage Beds.

<table>
<thead>
<tr>
<th>Depth to groundwater (below ground surface)</th>
<th>Vadose Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gravels, pebbly gravels, pebbles</td>
</tr>
<tr>
<td>&lt; 15 feet(^a)</td>
<td>seepage beds prohibited</td>
</tr>
<tr>
<td>15-30 feet</td>
<td>additional treatment required</td>
</tr>
<tr>
<td>31-100 feet</td>
<td>additional treatment required</td>
</tr>
<tr>
<td>&gt;100 feet</td>
<td>additional treatment required</td>
</tr>
</tbody>
</table>

\(\text{a}\) Assumes bottom of seepage bed is 5’ below ground surface.

\(\text{b}\) Assumes the separation distance between the bottom of the seepage bed and ground water is 10’.
B. Setbacks and Separation Distances

- Seepage beds must be separated a minimum of 10' from ground water (vertical distance from bottom of facility to seasonal high ground water level). A test boring shall be drilled to a sufficient depth to verify that a 10' separation distance between the proposed bottom of the facility and seasonal high ground water table is met. Each facility shall have one test boring, unless prior approval is obtained from Public Works.

- Seepage beds must be separated 10' from structures (foundations, septic systems, other seepage beds).

- Seepage beds must be separated 20' from basements.

- Seepage beds must be separated 10' from property boundaries.

C. Design

- Seepage beds should be designed to provide a direct method for removal of contaminants and sediments before direct discharge into the vadose zone. If the bed has a surface inlet, the system must be designed to capture sediment either through a grass buffer strip, biofiltration swale, or sediment trap. Depending on the expected site activities, a pretreatment system, such as an oil/water separator should also be considered.

- A vegetated buffer (20' minimum) is recommended for open trenches.

- A stone aggregate of clean, washed drain rock, 1.5-2" in diameter should be used. This size of aggregate will give a void ratio of 30-40%. Aggregate between .5-2.0" may be used but the void ratio must be certified.

- The bottom of the seepage bed shall be covered with a 6-12" layer of clean, washed sand that meets either specification: ASTM C-33 or ITD Standard 703.02, “Fine Aggregate for Concrete”.

- The seepage bed aggregate must be lined on the sides by an appropriate geotextile fabric. If the trench is a open trench, it should also be lined at the top and the top fabric layer should be located 1' below the surface to prevent surface sediment from passing through into the stone aggregate. Filter fabric can be placed on the bottom of the trench. Filter fabric should have a minimum weight of at least 4 oz./yd 2, a filtration rate of 0.08"/second, and an equivalent opening size of 30 for non-woven fabric.
• Seepage beds must have observation wells to determine how quickly the seepage bed drains after a storm. Wells shall be placed and every 2000 SF, with a minimum of 1 well/seepage bed. The observation well should be a perforated PVC pipe, 4-6" in diameter, extending to the bottom of the bed where it is connected to a foot plate. It should be capped and locked to prevent vandalism or tampering.

• If the seepage bed is located in a landscaped area, the bed should be constructed in one of the following ways: the bed should be covered with native soils and planted in grass, or if the seepage bed is an open trench, covered with stone aggregate and protected from sediment build-up with a vegetated buffer strip 20-25' wide on either side of the bed.

D. Operation and Maintenance

The system should be located so that it can be easily accessed by equipment necessary to maintain the pretreatment system and trench. The buffer and surface vegetation must be maintained by reseeding bare spots and mowing as frequently as needed to preserve aesthetics.

When ponding occurs at the surface or in the bed, corrective maintenance is required immediately. Ponding indicates the bed is clogged. Stripping off the top layer of soil, replacing the clogged filter fabric, and then replacing the top foot of aggregate or soil will correct the problem. Ponded water inside the trench (as visible from the observation well) after 24 hours or several days can indicate that the bottom of the trench is clogged. If this problem has occurred, then it is necessary to remove all of the layers and replace them.

E. Closure or Replacement

The owner is required to repair, replace, or reconstruct the infiltration system if it fails to operate as designed. A system fails to operate as designed when water is standing 24 hours or longer following the design storm. The maintenance and operation schedule for an infiltration system shall include such a provision. The owner is required to notify Summit County if the owner plans to close or replace the infiltration system. Additional studies may be required for all facilities depending on the land use of the site.
Figure 3.1. Seepage Bed.
BMP3.2 INFILTRATION BASIN

A. Applicability

An infiltration basin is suitable in residential and commercial developments. Infiltration basins should not be placed in locations where the basin could cause flooding to downstream properties or in natural drainages such that the basin would restrict inflows to the point of causing upstream flooding.

B. Sizing

In determining the size of the basin, the critical parameters are the storage capacity and the maximum rate of runoff released from the basin. In addition the basin size should be based on expected sediment accumulation and frequency of maintenance.

C. Forebay/Sediment Trap

A rock or an earthen berm shall be constructed with a minimum top width of 4' and side slopes no steeper than 3:1. The forebay/sediment trap shall have a treatment volume equal to 0.75 times the runoff from the mean annual storm (0.23”).

D. Construction Requirements

Infiltration basins shall be constructed in appropriate soil types. Infiltration basins should be excavated in a manner that will minimize disturbance and compaction of the basin. The basin bottom should be sloped to maximize infiltration. In addition, infiltration basins should not be constructed in highly erodible contributing areas, on slopes > 15%, or within fill soils. Inlet and outlet channels must be stabilized.

E. Separation Distance

The bottom of the infiltration basin should be separated by at least 3' vertically from the bedrock layer or seasonal high water table, as indicated by on-site geotechnical test results. Within the 3' separation distance, there must be at least a 2' layer of soil that conforms to infiltration rate requirements.

F. Pretreatment
Each infiltration basin shall have additional pretreatment. One of the following techniques can be used:

- construct grass channel
- construct grass filter strip
- install bottom sand layer
- install upper filter fabric with 6" sand layer
- use washed cobble rock as aggregate
- vegetate basin with deep-rooted turf
Figure 3.2. Infiltration Basin.
BMP3.3 INFILTRATION SWALE

A. Design

• Swale bottom slopes shall be between 1-4%.

• Curb cut pavement shall be installed at a maximum height of 6" above the swale if curb cuts will be used to introduce flow to the swale. Curb cuts shall be between 12-36" wide.

• A flow spreading device at the swale inlet shall be installed. Appropriate devices include shallow weirs, stilling basins, and perforated pipes. Provide a sediment clean-out area.

• Energy dissipation shall be provided at the inlet. Appropriate means are stilling basins and rip rap pads. If rip rap is used, it should be sized for the expected runoff velocity. A drainage window may be provided to direct the storm water runoff from events larger than the quantity design storm to the free draining material in the under drain. The top of the drainage window should be placed at an elevation above the water surface of the quantity design storm and should be located at the lower end of the swale.

• The swale side slopes shall be no more than 3:1.

• The swale bottom width shall be no greater than 8'.

• Swale shall be a maximum of 1.5' deep.

• The swale shall be grass-covered. Uniformly fine, close-growing, water-tolerant grasses should be used. Landscaping rock may also be used with an open trench.

• The swale under drain shall be constructed using clean 2" drain rock. The rock shall be wrapped in geotextile filter fabric, with a weight of greater than 4 ounces per square yard. The under drain will be a minimum depth of 12".

• A 6-12" layer of clean, washed sand that meets either specification: ASTM C-33 or ITD Standard 703.02, “Fine Aggregate for Concrete” shall be placed below the under drain.

B. Setbacks and Separation Distances

• Swale perimeter slope must be a minimum of 2' from the property line.

• There shall be at least 3’ of separation between the bottom of the swale or under drain and the seasonal high ground water table.
C. Landscaping

Vegetate swales uniformly with fine, close-growing, water-tolerant grasses that can withstand seasonally saturated soils. Swales shall not be used until the vegetation is established. The side slopes above the swale treatment area should be vegetated to prevent erosion. Additional grass or nonaggressive ground covers are appropriate.

Barrier shrubs, such as barberry, planted around the swale should be considered when there is a possibility that the public could damage the swale or hinder its function. Other plant materials are appropriate if recommended by a landscape professional.

Trees and shrubs should be planted high on the side slopes or above the water line elevation for the design storm. Avoid using bark, mulch, fertilizers, and pesticides in swale bottoms or sides. These materials tend to run off the planted area and into the swales reducing its treatment effectiveness. When storm water control and landscaping are integrated, the following standards apply:

- Up to 15% of the total area of the swale designated for storm water infiltration may be covered with ground cover plants other than grass.
- Up to 10% of the total area of the swale designated for storm water infiltration may be elevated above the bottom of the swale to allow the planting of trees and shrubs.

The decrease in swale area resulting from this action will be compensated for by infiltration of runoff that occurs during the storm. If trees and shrubs will be used, plant them on the top perimeter of swale side slopes. Minimize shading the vegetation in the swale treatment area. A spacing of at least 20' (6 meters) is appropriate for trees planted close to a swale. Avoid planting trees that would continuously shade the entire length of the swale. In addition, avoid using bark, mulch, fertilizers, and pesticides in these areas. These materials tend to run off the planted area and into the swale reducing its treatment effectiveness.

D. Pretreatment

To protect ground water from possible contamination, runoff cannot be infiltrated without proper pretreatment. Pretreatment shall be provided by a grass buffer strip, sediment forebay, biofiltration swale, oil/water separator, or sediment trap.
E. Operation and Maintenance

Grass should be mowed to maintain an average grass height between 3"-9", depending on site characteristics. Monthly mowing is needed from May through September to maintain grass vigor. Grass clippings should be removed from the swale and composted on site or disposed of properly off site.

Sediment deposition at the head of the swale should be removed if grass growth is being inhibited for more than 10% of the swale length or if the sediment is blocking the even spreading or entry of water to the rest of the swale. Annual sediment removal and spot reseeding should be anticipated.

The swale should be regraded to produce a flat bottom width then reseeded if flow channelization or erosion has occurred. Regrading should not be required every year.
Figure 3.3. Infiltration Swale.
BMP4: PONDS (GENERAL)

A. Definitions

A detention pond (water quantity) (Figure 4.1) is a pond designed to collect and temporarily hold surface and storm water runoff from a site and release it at a slower rate than it is collected. The water should drain within 24 hours. Detention ponds are traditionally used to mitigate downstream impacts and alleviate flooding problems.

An extended detention pond (water quality) (Figure 4.2) is a pond designed to treat and release surface and storm water runoff from a site. Extended detention ponds are designed to provide water quality treatment and may be used to provide peak flow attenuation. The water is held for at least 48-72 hours to allow for treatment of pollutants by settlement, nutrient absorption, and filtering by plant materials.

B. Requirements for All Ponds

• Design Life

The system should be designed for at least a 50-year life.

• Location

Ponds should not be constructed in natural streams or wetlands. Ponds should be located off-channel and should only hold storm water runoff, not natural runoff.

• Site Evaluation/Site Suitability

Sites should be evaluated for soils, depth to bedrock, and depth to water table. Requirements will depend on pond type. Ponds may be used at sites where a receiving body or structure can accept pond discharges. Ponds designed to meet on-site detention requirements shall not be located in regulatory flood plains. Also, ponds should not be used in areas where storm water has the potential to contain soluble metals, toxic organics, or where high sediment loads may occur.

• Design

The design of any detention pond requires consideration of several factors. Balancing the requirements is done by developing an inflow hydrograph, a depth-storage relationship, and a depth-outflow relationship. The inflow/storage/outflow relationships should be based on a storm duration that identifies a peak detention pond volume for the storm interval required. Refer to Appendix A, Section 3.B(6) for water quantity and quality design criteria.
The factors to be considered include:

- basin size
- minimum free board
- maximum allowable depth of temporary ponding
- recurrence interval of the storm being considered
- storm duration
- timing of the inflow
- allowable outflow rate
- the length of time water remains in the facility.

- Maximum Outflow Rate

The maximum outflow rate shall not be more than the pre-development rate of runoff for each storm return interval. The receiving system must be shown to be capable of accommodating the pre-development flow.

- Outlets

Outlet pipes shall be at least 12" in diameter. If riser pipes are used, they shall be 1 1/2 times the cross sectional area of the outfall pipe. Trash racks or anti-vortex devices shall be installed. All pipe joints are to be watertight. Anti-seep cutoff walls, 8" thick, or other seepage control methods are to be installed around outlet pipes. The channel immediately below the pond outfall shall be protected against erosion and shall transition to natural drainage conditions in the shortest distance possible.

- Dam Safety Requirements

If a pond is categorized as a dam by the State of Utah, the relevant sections of the Utah Code will apply. Contact the Utah Division of Water Rights for more information on dam safety requirements.

- Vegetative Buffers

Vegetative buffer strips shall be established around the perimeter of the pond for erosion control and additional sediment and nutrient removal. Buffer strips should include all areas between the normal pond water surface elevation to the top of the pond embankment.
• Side Slopes/Safety

Take all practical safety precautions. Side slopes should not exceed 4:1 (3:1, if the pond will normally remain dry).

• Soils

A soils investigation is required on all ponds. At a minimum, it shall include information along the centerline of the proposed dam in the emergency spillway location and the planned borrow area. It should include recommendations on cutoff trenches, compaction, and any other special design requirements.

• Freeboard and Emergency Spillway

All open surface facilities shall be designed with adequate freeboard above the maximum design water elevation. Emergency spillways are required on all ponds. The spillway shall be sized to safely pass the 100-year developed peak flow.

• Maintenance Access

Direct access to the pond bottom, inlet sedimentation area, and control structure is required. A right-of-way maintenance easement from a road to the pond (if not accessible from the public right-of-way), shall be provided.

• Inspection

Detention ponds should be inspected during regular semi-annual inspections to determine maintenance needs.
BMP4.1: DETENTION PONDS

A. Definition

Detention ponds are designed to detain a volume of water to attenuate peak flows. A wet pond has a permanent pool and provides temporary storage of storm water runoff. A dry detention pond does not maintain a permanent pool between storm events.

B. Applicability

Detention ponds are suitable in residential, commercial, and industrial sites.

C. Pond Geometry

The pond can be any shape provided that it has sufficient capacity to meet general design requirements.

D. Outlet Design

At the peak flow rate, pond volume shall be equal to the difference between pre and post-development storm volumes. The outlet structure shall be designed in accordance with the water quantity and quality requirements of Appendix A, Section 3.B(6). The outlet design shall incorporate a multi-stage riser that will allow water (above the permanent pool, in a wet pond) to be drained over 24 hours. The outlet shall be designed to mimic pre-development flow rates. The outlet structure shall be designed to prevent clogging and plugging.

E. Construction Requirements

Detention ponds shall be excavated in a manner that will minimize disturbance and compaction of the pond. Sediment measuring devices shall be installed at opposite ends of the bottom of the basin or sediment trap to measure sediment accumulation.

F. Sediment Storage

Ponds shall be designed to contain computed storage volume plus 15% of the computed storage volume to adequately accommodate sediment deposition.

G. Forebay/Sediment Trap

Each pond shall have a sediment forebay or equivalent upstream pretreatment. The forebay shall have a separate cell formed by an acceptable barrier. A fixed vertical sediment depth marker shall be installed in the forebay to measure sediment accumulation.
Minimum forebay size shall be equal to 15% of the water quality treatment volume. Optimal volume should be equal to 25% of the water quality treatment volume. Forebay volume shall be in addition to permanent pool volume, where applicable, and shall be separated from permanent pool, if possible. A weir flow structure or physical separation with pipes may be utilized. A rock or an earthen berm shall be constructed with a minimum top width of 4' and side slopes no steeper than 3:1 to provide separation from the permanent pool. A drainpipe should be included in the forebay to dewater the pool area for maintenance purposes.

**H. Inlet Protection**

The inlet shall be protected against erosion or scour. Riprap or other material may be required at the inlet to provide for energy dissipation.

**I. Stabilization**

Wet detention ponds shall be stabilized with vegetation to control dust and improve pond aesthetics. A landscaping plan for a pond and surrounding area should be prepared to indicate how aquatic and terrestrial areas will be vegetatively stabilized, established, and maintained. Whenever possible, wetland plants should be used in a pond design, either along the aquatic bench or within shallow areas of the pool.
Figure 4.1. Detention Pond.
BMP4.2: EXTENDED DETENTION PONDS

A. Definition

An extended detention pond is a constructed pond designed to detain a volume of water for a minimum time to allow for the settling of particles and associated pollutants. This type of pond can also be utilized for flood control by including additional temporary storage for peak flows. A wet extended detention pond incorporates both a permanent pool and extended detention. Dry extended detention ponds do not maintain a permanent pool between storm events.

B. Applicability

Ponds should not be used where storm water has the potential to contain soluble metals or toxic organics. In addition, ponds placed in areas where high sediment loads may occur, require frequent maintenance but still may be the most cost-effective treatment method. A wet extended detention pond is suitable in residential, commercial, and industrial sites. It is appropriate in areas where nutrient loadings are expected to be high. Dry extended detention ponds do not maintain a permanent pool between storm events.

C. Pond Geometry

The pond shall be designed to lengthen the flow path, thereby increasing detention time and limiting peak flow rates to pre-development rates. Shallow basins with large surface areas also provide better removal efficiencies than small deep basins. The pond geometry shall meet the following criteria:

- Permanent pool depth shall not exceed 12’ with an average depth between 4-6’.
- Length from inlet to outlet should be as far apart as possible.
- Length to width ratio should be approximately 3:1 and side slopes should be 4:1.

D. Sizing

Size the pool according to the design storm criteria in Appendix A, Section 3.B(6). The critical parameters in determining the size of the basin are the storage capacity and the maximum rate of runoff released from the basin. The design shall provide an average of 48-72 hours detention time. This design objective can be achieved by setting the maximum detention time for the greatest runoff volume at approximately 40 hours. The average detention time for very small storms should be at least 6 hours.
E. Forebay

Each pond shall have a sediment forebay or equivalent upstream pretreatment. The forebay shall have a separate cell formed by an acceptable barrier. A fixed vertical sediment depth marker shall be installed in the forebay to measure sediment accumulation.

Minimum forebay size shall be equal to 15% of the water quality treatment volume. Optimal volume should be equal to 25% of the water quality treatment volume. Forebay volume shall be in addition to permanent pool volume, where applicable, and shall be separated from permanent pool, if possible. A weir flow structure or physical separation with pipes may be utilized. A rock or earthen berm shall be constructed with a minimum top width of 4’ and side slopes no steeper than 3:1 to provide separation from the permanent pool. A drainpipe should be included in the forebay to dewater the pool area for maintenance purposes.

F. Outlet Design for a Wet Extended Detention Pond

The outlet shall be designed to pass a flow rate necessary for extended quantity attenuation. The outlet design shall incorporate a multi-stage riser that will allow water to be drained over a minimum of 48-72 hour period depending upon the design storm.

Ponds may be constructed with safety benches. The perimeter of all deep permanent pool areas (at least 4’ deep) shall be surrounded by two safety benches with a combined minimum width of 15’. The benches should be designed as follows:

- A safety bench that extends landward from the normal water level edge to the toe of the pond side slope. The maximum slope of the safety bench shall be 12%.
- An aquatic bench that extends from the normal shoreline and has a maximum depth of 18” below the normal pool water surface elevation. Pond slope between the top of the bank and bench shall not exceed 2:1.

G. Outlet Design for a Dry Extended Detention Pond

A perforated riser can be used to slowly release the water over a prolonged period. A cutoff collar should be considered for the outlet pipe to control seepage.

H. Construction Guidelines

Wet extended detention ponds should be excavated in a manner that will minimize disturbance and compaction of the pond. Sediment measuring gauges should be installed at opposite ends of the bottom of the basin to measure sediment accumulation.
I. Stabilization

A landscaping plan for a wet extended detention pond and its buffer shall be submitted to indicate how aquatic and terrestrial areas will be vegetatively stabilized and established. Whenever possible, wetland plants should be used in a pond design, either along the aquatic bench or within shallow areas of the pool. Bottom and banks of all dry extended detention ponds shall be stabilized with gravel, rock, vegetation, or other acceptable material to control dust and prevent erosion.
Figure 4.2. Extended Detention Pond.
BMP5: BIOFILTRATION SYSTEMS

A. Introduction and Purpose

This section includes requirements that apply to bio filtration swales (Figure 5.1) and grass buffer strips (Figure 5.2). These BMPs are pre-treatment systems that utilize plant materials for various physical and biological processes in the water quality treatment of runoff. These systems should not be used alone to treat storm water runoff. Rather, they should be used in combination with other structural and nonstructural BMPs to improve water quality.

B. Plan Submittal Requirements

The applicant will be required to provide a written report that includes the Plan Submittal Requirements and a Landscape Plan.

C. Sizing

Unless a bypass is included, the bio filter must be sized as both a treatment device and to pass the peak hydraulic flows. The depth of the storm water should not exceed the height of the grass.

D. Landscaping

Vegetate bio filters with fine, close-growing, water-tolerant grasses that can withstand seasonally saturated soils. Bio filters shall not be used to manage storm water until the vegetation is established. The side slopes of a bio filter should be vegetated to prevent erosion. Barrier shrubs, such as barberry, planted around the bio filter should be considered when there is a high potential for people to damage the bio filter or hinder the bio filter’s function. Other grasses or nonaggressive ground covers are appropriate if recommended by a landscape professional.

If trees will be planted near the bio filter, then minimize shading the vegetation in the bio filter treatment area. A spacing of at least 20’ (6 meters) is appropriate for trees planted close to a bio filter. Avoid planting trees that would continuously shade the entire length of the bio filter. In addition, avoid using bark, mulch, fertilizers, and pesticides in these areas. These materials tend to run off the planted area and into the bio filter reducing its treatment effectiveness.

E. Operation and Maintenance

Systems should be inspected during regular semi-annual inspections. This inspection schedule applies to all bio filtration systems unless otherwise noted.
Grass shall be mowed to maintain an average grass height between 3-9”, depending on the site situation. Monthly mowing is needed from May through September to maintain grass vigor. Grass clippings should be removed from the swale and composted on site or disposed of properly off site.

Sediment deposited at the head of the swale shall be removed if grass growth is being inhibited for more than 10% of the bio filter length or if the sediment is blocking the even spreading or entry of water to the rest of the facility. Annual sediment removal and spot reseeding should be anticipated.

If flow channelization or erosion has occurred, the facility shall be regraded, then reseeded as necessary.

Access for mowing equipment and maintenance shall be provided. Consideration should be given to providing wheel strips in the bottom of the swale if vehicular access (other than grass mowing equipment) is needed.
BMP5.1: BIOFILTRATION SWALES

A. Description

Bio filtration swales are storm water runoff systems which treat and then discharge storm water runoff to another system.

B. Design

• A hydraulic residence time for the storm water runoff of 9 minutes is required.
• Water velocity, as determined by Manning’s “n”, should not exceed 0.9 feet/second.
• The Manning’s “n” for grass shall be in the range between 0.02 and 0.024.
• Swales shall be sloped as necessary to obtain the desired design velocity and residence time.
• If flow is to be introduced to the swale via curb cuts, then curb cut pavement elevation shall be no higher than 6” above swale. Curb cuts should be between 12-36" wide.
• Install a flow spreading device at the swale inlet. Appropriate devices include shallow weirs, stilling basins, and perforated pipes. Provide a sediment clean-out area. A sediment catch basin or a larger pre-settling device would control sediments at the swale inlet and allow for easy maintenance.
• Provide for energy dissipation at the inlet. Appropriate means are stilling basins and rip rap pads.
• Swale using rip rap should be sized for the expected runoff velocity.
• Swale side slopes shall be no steeper than 3:1. Swale bottom width shall be no greater than 8’. The maximum depth of flow through the biofiltration swale shall be 3.0”.

C. Setbacks and Separation Distances

Perimeter slope of the swale must be a minimum of 2' from property line.
Figure 5.1. Biofiltration Swale.
BMP5.2: GRASS BUFFER STRIPS

A. Introduction

Grass buffer strips are used as a water quality pretreatment system for smaller sites.

B. Design

- The longest flow path from the area contributing sheet flow to the filter strip shall not exceed 150 feet.
- The lateral slope of the contributing drainage (parallel to the edge of pavement) shall be 2% or less.
- A hydraulic residence time of 9 minutes is required.
- A stepped series of flow spreaders installed at the head of the strip may be used to compensate for drainage areas having lateral slopes of up to 4%.
- The longitudinal slope of the contributing drainage area (parallel to the direction of flow entering the filter strip) shall be 5% or less.
- Grass buffer strips shall not be used when the contributing drainage areas has a longitudinal slopes steeper than 5% or energy dissipation and flow spreading should be provided up slope of the upper edge of the filter strip to achieve flow characteristics equivalent to those meeting the above criteria.
- The longitudinal slope of the strip (along the direction of flow) shall be between 1 - 20%. The lateral slope of the strip (parallel to the edge of pavement, perpendicular to the direction of flow) shall be less than 2 percent.
- The ground surface at the upper edge of the filter strip (adjacent to the contributing drainage area) shall be at least 1 inch lower than the edge of the impervious area contributing flows.
- Manning’s roughness coefficient (n) for flow depth calculations shall be 0.04.
- The maximum depth of flow through the filter strip for optimum water quality shall be 1.0 inch.
- The maximum allowable flow velocity for the water quality design flow (WQv) shall be 0.5 feet per second.
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- Runoff entering the filter strip must not be concentrated. If the contributing drainage area is not smoothly graded to prevent concentrated flowpaths, a flow spreader shall be installed at the edge of the pavement to uniformly distribute the flow along the entire width of the filter strip. At a minimum, a gravel flow spreader (gravel-filled trench) shall be placed between the impervious area contributing flows and the filter strip. The gravel flow spreader shall be a minimum of 6" deep and shall be 18" wide for every 50' of contributing flowpath. Where the ground surface is not level, the gravel spreader must be installed so that the bottom of the gravel trench is level.

- Energy dissipaters are needed in the filter strip if sudden slope drops occur, such as locations where flows in a filter strip pass over a rockery or retaining wall aligned perpendicular to the direction of flow. Adequate energy dissipation at the base of a drop section can be provided by a rip rap pad.

C. Landscaping

Trees and shrubs should not be located within a grass filter strip.

D. Maintenance

Inspections should occur semi-annually to determine maintenance needs. Access shall be provided at the upper edge of the filter strip to enable maintenance of the inflow spreader throughout the strip width and allow access for mowing equipment.
Figure 5.2. Grass Buffer Strip.

BMP6: SAND FILTERS
A. Introduction

Sand filters consist of self-contained beds of sand either underlain with underdrains or cells and baffles with inlets/outlets. Storm water runoff is filtered through the sand, and in some designs may be subject to biological uptake. The four most commonly used sand filter systems are the Austin Sand Filter, the Delaware Sand Filter, the Trench Filter, and the Pocket Sand Filter.

- Austin Sand Filter

The Austin sand filter (Figure 6.1), or surface sand filter, consists of a sedimentation chamber or pond followed by a surface sand filter with collector underdrains in a gravel bed. Filtered runoff is conveyed to a storm sewer or channel by gravity flow or pumping.

- Delaware Sand Filter

The Delaware sand filter (Figure 6.2), or perimeter system, consists of parallel sedimentation and sand filter trenches connected by a series of level weir notches to assure sheet flow onto the filter. Filtered runoff is conveyed to a storm sewer by gravity flow or pumping.

- Underground Sand Filter

The underground sand filter (Figure 6.3) is placed underground but maintains essentially the same components as the Austin sand filter. The filter consists of a 3 chamber vault. A 3’ deep wet sedimentation chamber is hydraulically connected by an underwater opening to provide pretreatment by trapping grit and floating organic material. The second chamber contains as 18-24” sand filter bed and an under drain system including inspection/cleanouts wells. A layer of plastic filter cloth with a gravel layer can be placed on top of the sand bed to act as a pre-planned failure plane which can be replaced when the filter surface becomes clogged. The third chamber collects the flow from the under drain system and directs flow to the downstream receiving drainage system.
• Pocket Sand Filter

The Pocket sand filter (Figure 6.4) is a simplified and low cost design suitable for smaller sites. Runoff is diverted within a catch basin. Pre-treatment is provided by a concrete flow spreader, a grass filter strip, and a plunge pool. The filter bed is a shallow basin and contains the sand filter layer. The surface of the filter bed may contain either a soil layer or grass cover crop.

B. Application and Limitations

Sand filters may be designed as trench systems to receive and treat parking lot runoff, and have been used to replace oil/water separators for pre-treatment. The storm water runoff is discharged or conveyed to another BMP for further treatment or disposal. Depending on soil types, sand filters may be designed as a stand-alone BMP to infiltrate all or a portion of treated runoff. Subsurface disposal restrictions will apply to this application.

The typical drainage area to be served by a sand filter should range from 0.5 to 10 acres. Depending on design, the contributing drainage area may be up to 50 acres.

C. Sizing

Sizing should be based on anticipated sediment accumulation and maintenance. Sand filters shall be sized using the following criteria:

• The sand filter shall be sized for water quality design storm requirements if it will be used as an off-line treatment facility.

• The maximum depth of water over the sand shall be 1'.

• Calculate the sand filter surface area using Darcy’s Law or the filtration rate.

• The sand filter shall be designed to completely drain in a 24 hours or less.

• The filtration rate shall be 2" per hour.

D. Pretreatment

Sand filters should be preceded by pretreatment to allow for the settling of coarse sediment that may clog the sand filter and reduce its effectiveness. Pretreatment systems that may be used are sedimentation basins, grass buffer strips, biofiltration swales, or catch basin inserts.
E. Design

The sand bed shall include a minimum of 18" of 0.02-0.04" diameter sand or ASTM C-33 sand. If infiltration into the underlying soil is not desired, the bottom of the system shall be lined with one of the following impermeable layers:

- a minimum 12" thick layer of clay
- a concrete liner with approved sealer or epoxy coating, at least 5", reinforced with steel wire mesh (use 6 gauge or larger wire and 6" x 6" smaller mesh, or a geomembrane layer).

The bed of the filter should be composed of gravel, measuring at least 4-6"; 2" drain rock may also be used.

When sand filters are designed as off-line BMPs, they should be sized for the water quality design storm and the storm water conveyance should be fitted with flow splitters or weirs to route runoff to the sand filter. Excess runoff bypasses the sand filter and continues to another BMP for water quantity control. The inlet structure should be designed to spread the flow uniformly across the surface of the filter; use flow spreaders, weirs, or multiple orifices.

F. Design Life

Final ownership of the system may affect the design, layout and materials used in a system. The designer should specify the materials for the system and at a minimum, the system should be designed for a 50-year life.

G. Setbacks and Separation Distances

When sand filters infiltrate to the subsurface, the following requirements apply:

- Sand filters must be a minimum of 100' from public and private wells.
- There shall be a 5' vertical separation distance between the infiltration surface and bedrock.
- There shall be a 100' separation distance from surface water supplies used as drinking water and a 50' separation distance from surface water supplies not used as drinking water.
- There shall be a minimum 3' vertical separation distance from the infiltration surface and the seasonal high ground water table.
H. Maintenance

- For the first few months after construction, the sand filters should be inspected after every storm. Thereafter the sand filters should be inspected semi-annually to determine maintenance needs.

- The sand filters should be raked periodically to remove surface sediment, trash, and debris.

- Sediments shall be disposed of in accordance with local, state, and federal regulations.

- The top layer of sand should be replaced annually, or more frequently when drawdown does not occur within 36 hours after the pre-settling basin has emptied.

- The water level in the filter chamber should be monitored on a quarterly basis and after large storms during the first year.

- The sedimentation chamber should be pumped out or extracted when the sediment depth reaches 12".

- Oil on the surface should be removed separately and recycled. The remaining material may be removed by a vacuum pump and disposed of according to local, state, and federal regulations.

I. Maintenance Access

- Unobstructed access shall be provided over the entire sand filter by either doors or removable panels.

- Access to the sand filter should be provided for maintenance, including inlet pipe and outlet structure.

- Ladder access is required when vault height exceeds 4'. Access openings should have round solid locking lids with ½" diameter allen head screw locks.
Figure 6.1.  Austin Sand Filter.
Figure 6.2. Delaware Sand Filter.
Figure 6.3. Underground Sand Filter.
Figure 6.4. Pocket Sand Filter.
CALCULATING PEAK DISCHARGE AND VOLUME

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This appendix describes methods for calculating pre- and post-development runoff volumes and peak discharge rates. These calculations should be performed in order to help select, size, and design stormwater BMPs to meet the peak flow rate, water quality, and groundwater recharge criteria described in Section 3.B.(6) of Appendix A. This Appendix provides steps for performing these calculations using the rational method, which is only applicable for sites 200 acres or less in size. For larger sites, areas with significant flood storage effects/features, highly complicated sites, or for BMP designs that require complete design hydrographs, calculations should be performed using the NRCS TR-55 method. A description of this method is not provided in this appendix; however, detailed TR-55 documentation and a free Windows-based download of the TR-55 program can be obtained on-line at:

http://www.wcc.nrcs.usda.gov/water/quality/hydro/

Hydrologic methods for determining runoff rate and volume other than the rational method or TR-55 may be acceptable, but the applicant must obtain prior approval from Summit County before beginning hydrologic studies and calculations using alternative methods.

**Calculating Peak Runoff**

Use the rational formula:

\[ Q_p = CiA \]

- \( Q_p \) = peak discharge (cfs)
- \( C \) = dimensionless runoff coefficient
- \( I \) = rainfall intensity (in./hr) for a duration equal to the time of concentration and for the recurrence interval chosen for design
- \( A \) = site area (acres)

1) **Calculate site area (A).** This can be determined from USGS topographic maps, site surveys, and other available information.

2) **Determine the runoff coefficient \( C \).** This value is obtained from the tables below, and is based on land use type(s) for developed areas, and soil hydrologic group/slope characteristics for undeveloped areas. For areas with mixed land uses, the area should be divided into subareas with similar characteristics \( (A_1, A_2, \text{ etc.}) \), and a weighted coefficient should be determined using the following formula:

\[ C = [(A_1 * C_1) + (A_2 * C_2) + ... + (C_n * A_n)]/A \]

where \( C_1, C_2, \text{ etc.} \) are the runoff coefficients for each individual subarea. Information on slope and land use can be obtained from USGS topographic maps, site surveys, air...
photos, and other available data. Summit County soil maps and hydrologic group information can be obtained from local Soil Conservation Districts, or on-line at:

http://soildatamart.nrcs.usda.gov/

Soil hydrologic group information can be obtained by selecting the “generate reports - water features” function at this website. The different soil hydrologic groups are defined as follows (definitions taken from USDA Technical Release-55 “Urban Hydrology for Small Watersheds, 1986):

**Group A:** These soils have low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sand or gravel and have a high rate of water transmission (greater than 0.30 in/hr).

**Group B:** These soils have moderate infiltration rates when thoroughly wetted and consist chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission (0.15-0.30 in/hr).

**Group C:** These soils have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine texture. These soils have a low rate of water transmission (0.05-0.15 in/hr).

**Group D:** These soils have high runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very low rate of water transmission (0-0.05 in/hr).
### Table F1. Recommended Rational Method “C” Coefficients for Developed Areas.

<table>
<thead>
<tr>
<th>Land Use Category</th>
<th>Runoff Coefficient “C”</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Business</strong></td>
<td></td>
</tr>
<tr>
<td>Central business areas</td>
<td>0.70-0.95</td>
</tr>
<tr>
<td>Neighborhood areas</td>
<td>0.50-0.70</td>
</tr>
<tr>
<td><strong>Residential</strong></td>
<td></td>
</tr>
<tr>
<td>Single-Family</td>
<td>0.35-0.45</td>
</tr>
<tr>
<td>Multi-family, detached</td>
<td>0.40-0.60</td>
</tr>
<tr>
<td>Multi-family, attached</td>
<td>0.60-0.75</td>
</tr>
<tr>
<td>Low Density - 0.5 acre lots or larger</td>
<td>0.25-0.40</td>
</tr>
<tr>
<td><strong>Industrial and Commercial</strong></td>
<td></td>
</tr>
<tr>
<td>Light areas</td>
<td>0.50-0.80</td>
</tr>
<tr>
<td>Heavy areas</td>
<td>0.60-0.90</td>
</tr>
<tr>
<td>Parks, cemeteries</td>
<td>0.10-0.25</td>
</tr>
<tr>
<td>Playgrounds</td>
<td>0.20-0.35</td>
</tr>
<tr>
<td>Railroad yard areas</td>
<td>0.20-0.40</td>
</tr>
<tr>
<td>Roofs</td>
<td>0.90-0.95</td>
</tr>
<tr>
<td>Streets, Drives, Walks (asphalt or concrete)</td>
<td>0.90-0.95</td>
</tr>
<tr>
<td>Streets, Drives, Walks (brick, gravel, or disconnected pavers)</td>
<td>0.70-0.85</td>
</tr>
</tbody>
</table>

### Table F2. Recommended Rational Method “C” Coefficients for Undeveloped/Pervious Areas.

<table>
<thead>
<tr>
<th>Slope</th>
<th>A soils</th>
<th>B soils</th>
<th>C soils</th>
<th>D soils</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat (0-2%)</td>
<td>0.04-0.09</td>
<td>0.07-0.12</td>
<td>0.11-0.16</td>
<td>0.15-0.20</td>
</tr>
<tr>
<td>Average (2-6%)</td>
<td>0.09-0.14</td>
<td>0.12-0.17</td>
<td>0.16-0.21</td>
<td>0.20-0.25</td>
</tr>
<tr>
<td>Steep (&gt;6%)</td>
<td>0.13-0.18</td>
<td>0.18-0.24</td>
<td>0.23-0.31</td>
<td>0.28-0.38</td>
</tr>
</tbody>
</table>

*Values should be selected from the high or low end of the given ranges based on the condition of ground cover/vegetation.*
3) **Calculate the time of concentration (T)** to use in determining the appropriate rainfall duration and intensity to use in the rational formula. T is the time required for water to travel the longest watercourse within the drainage area (i.e., the time for water to travel from the hydrologically most remote point of the basin to the location being analyzed). T can be determined graphically using Figure F1 or calculated using the FAA formula below. For small and/or highly impervious areas with very short times of concentration, the default minimum T value to be used for design purposes is 10 minutes.

\[ T = 1.8^* (1.1 - C) D^{0.5} / S^{1/3} \]

T = time of concentration (minutes)
C = dimensionless runoff coefficient (same as used in rational formula)
D = length (in feet) of longest watercourse
S = % slope of longest watercourse

The variables D and S can be determined from USGS topographic maps, site surveys, and other available information. Care should be taken to field-verify flow path information to ensure that any existing graded swales, ditches, gutters, or other constructed drainage systems that intercept the natural contours are accounted for when determining slope and flow length for the purposes of these calculations.

For small and/or highly impervious areas with very short times of concentration, the default minimum T value to be used for design purposes is 10 minutes.

Additional information and an automated T calculator can be found on-line at:

http://www.lmnoeng.com/Hydrology/TimeConc.htm

4) **Determine the average rainfall intensity (I)**. This value should be obtained for the recurrence interval of interest and a duration equal to the time of concentration T calculated in (3) above using the NOAA Atlas 14 intensity-duration-frequency (IDF) curve for an appropriate nearby climate station. Table F3 and Figure F2 provide IDF data for the Park City climate station; additional IDF curves and tables can be obtained online at:

http://hdsc.nws.noaa.gov/hdsc/pfds/sa/ut_pfds.html
5) **Calculate the peak discharge (Q_p).** For storm events with recurrence intervals more frequent than 25 years, use the following formula:

\[ Q_p = \phi \times (I) \times (A) \]

For storm events with recurrence intervals of 25 years or greater, the runoff coefficient should be adjusted by the factor \( C_f \) because infiltration and other abstractions have a proportionally smaller effect on runoff. Values for \( C_f \) are provided in Table F4. Once the \( C_f \) is determined, peak discharge is calculated using the following formula:

\[ Q_p = \phi \times (C_f) \times (I) \times (A) \]
Q_p should be calculated for both pre- and post-development land use conditions. In order to meet the peak flow rate criteria outlined in Appendix A, Section 3B(6), non-structural and structural BMPs should be designed to control the post-development rate Q_p to the pre-development rate. Non-structural methods that reduce the post-development runoff coefficient and lengthen the time of concentration (e.g., preservation of natural areas with type A or B soils, minimizing impervious areas, using vegetated swales instead of storm sewers, etc.) will be the most effective techniques to meet the peak flow rate criteria.

Table F4. Runoff Coefficient Adjustment Factors for Rational Method.

<table>
<thead>
<tr>
<th>Recurrence Interval (years)</th>
<th>Adjustment Factor C_f</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>1.1</td>
</tr>
<tr>
<td>50</td>
<td>1.2</td>
</tr>
<tr>
<td>100</td>
<td>1.25</td>
</tr>
</tbody>
</table>
Figure F1. Time of concentration curves based on the FAA (1965) method.

\[ T = \frac{1.8(1.1 - C)}{\sqrt{S}} \sqrt{D} \]
Figure F2.  NOAA Atlas 14 precipitation intensity-duration-frequency curves for station “Park City Radio, Utah” (Station #42-6648).
Calculating Water Quality Volume

To meet the water quality and groundwater recharge criteria outlined in Appendix A, Section 3B(6), the runoff volume associated with a storm event of 0.5" in 1 hour must be calculated for pre- and post-development conditions.

Use the rational formula:

\[ WQ_v = CitA \]

- \( WQ_v \) = water quality volume (ft\(^3\))
- \( C \) = dimensionless runoff coefficient
- \( I \) = rainfall intensity = 0.5"/hr = 0.042 ft/hr
- \( t \) = storm duration = 1 hour
- \( A \) = site area (ft\(^2\))

\[ WQ_v = C \times (0.042 \text{ ft/hr}) \times (1 \text{ hr}) \times A = (0.042 \text{ ft}) \times C \times A \]

Runoff coefficient \( C \) values for the water quality volume calculation should be selected using the same tables and guidelines described above in the section on calculating peak runoff.

Calculating Groundwater Recharge Volume

The criteria in Appendix A, Section 3B(6) require that the increase in surface runoff volume from the water quality storm (0.5" in 1 hour) is recharged into the ground rather than discharged off-site as surface runoff. This required groundwater recharge volume (GW\(_v\)) is calculated as:

\[ GW_v = WQ_v \text{ (post-development)} - WQ_v \text{ (pre-development)} \]

where \( WQ_v \) is calculated as described above in the section on calculating water quality volume.

Calculating TSS Removal Rate

Rather than requiring a calculation of the actual real-world TSS load for a site, the application of this standard has been simplified to estimate a site’s annual TSS load as 1.0 (i.e., 100%) as it enters the first BMP in the system. Therefore, in addition to performing the calculations below to demonstrate that adequate BMP performance efficiency has been provided, the permittee must also demonstrate compliance by showing that:

- The treatment BMPs have been designed/sized to treat the post-development water quality volume (WQ\(_v\)), calculated as described above; and,

- The BMPs are inspected regularly and maintained as needed to perform efficiently.
Information on maintenance needs for individual BMPs is included in Appendix E, and sample inspection forms are provided in Appendix G.

Steps to calculate the TSS removal rate:

1) From Table 1 in Appendix E, determine the required final TSS removal rate \( \bar{R} \) based on the percent of overall site area that is impervious. Use the definition for “impervious surface” provided in Appendix A Section 2. For sites where newly-developed impervious areas lie within 50 feet of a live water body (perennial or intermittent stream, lake, pond, spring, or reservoir), the Table 1 sliding scale does not apply and the default 80% TSS removal standard must be met.

2) If appropriate, divide the site into individual drainage areas. It is essential that the final TSS removal rate be calculated separately for each subarea. Isolated impervious areas (e.g., disconnected rooftops) that are serviced solely by their own BMPs, such as swales or seepage beds, should be considered as separate drainage areas. Each individual drainage area must meet the TSS removal rate for the entire site, as determined in step (1).

3) For each individual drainage area, list the storm water BMPs and their order in the engineered system, beginning with the first BMP collecting storm water from the site. For example, pretreatment and conveyance BMPs will typically precede the removal BMPs. Using the values from Appendix E Table 2, list the estimated TSS removal rate for each BMP in the treatment system.

4) Calculate the final TSS removal rate \( \bar{R} \) according to the following formula:

\[
R = (L_1 \times R_1) + (L_2 \times R_2) + (L_3 \times R_3) \ldots + (L_n \times R_n)
\]

- \( L_1 \) = initial TSS load = 1.0 (i.e. 100%)
- \( R_1 \) = fractional TSS removal rate for the first BMP in the system (e.g., if the removal rate listed in Appendix E Table 2 for BMP1 is 60%, the fractional rate \( R_1 \) is 0.60)
- \( L_2 \) = remaining TSS load after preceding BMP = \( L_1 \times (1 - R_1) \)
- \( R_2 \) = fractional TSS removal rate for the second BMP in the system
- \( L_3 \) = remaining TSS load after preceding BMP = \( L_2 \times (1 - R_2) \)
- \( R_3 \) = fractional TSS removal rate for the third BMP in the system
- \( L_n \) = remaining TSS load after preceding BMP = \( L_{n-1} \times (1 - R_{n-1}) \)
- \( R_n \) = fractional TSS removal rate of final (n\textsuperscript{th}) BMP in the system
As evident in the above formula, the TSS removal rates are not additive from one BMP to the next; instead, the estimated removal rates are applied consecutively as the TSS load passes through each BMP technology.

5) Check that the final removal rate for each drainage area is greater than or equal to 0.80 (80%) or the applicable sliding scale standard from Appendix E Table 1. If R is less than the standard for any of the drainage areas, the system should be redesigned in order to meet the standards.
APPENDIX G: SAMPLE INSPECTION FORMS
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SAMPLE INSPECTION FORM FOR TEMPORARY EROSION AND SEDIMENT CONTROLS

Name of Site

Inspector: ____________________________ Date: __________

Attendees: ____________________________________________

☐ Weekly Inspection   ☐ Before Rain Event   ☐ After Rain Event   ☐ Other

Controls: Silt Fence (SF)  Straw Bale Barrier (SBB)  Temporary Slope Drain (TSD)  Channel Liner (CL)  Stone Lined Ditch (SLD)
          Temporary Berm (TB)  Stone Check Dam (SCD)  Pipe Inlet Sediment Barrier (PISB)  Sediment Trap (ST)  Stone Spillway (SS)

<table>
<thead>
<tr>
<th>Station/Location</th>
<th>Notes:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

General Notes / Prioritization:

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
☐ Facility in Noncompliance
☐ Facility in Compliance

___________________________________________________

Signature(s)
## INSPECTION AND MAINTENANCE CHECKLIST FOR STRUCTURAL POST-CONSTRUCTION BMPs

**Summit County BMP1: Oil/Water Separators**

Date: ___________________________  Time: ___________________________  
Type of inspection (circle one):  Semi-Annual  Monthly  After major storm

**Site Name/Location:** ___________________________

**Inspector:** ___________________________

<table>
<thead>
<tr>
<th>Item Inspected: Separator Components (General)</th>
<th>Satisfactory yes/no</th>
<th>Type of Maintenance Needed if Unsatisfactory</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharge Quality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inlet Pipe</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outlet Pipe</td>
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<tr>
<td>Trash and Debris</td>
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<tr>
<td>Sediment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bypass Valve</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil Absorbent Pads</td>
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<td></td>
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</tr>
<tr>
<td><strong>Item Inspected: Vault Structure</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Ladder</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concrete (inspect when vault cleaned)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintenance hole</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inlet grates</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baffles</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Item Inspected: Coalescing Plates</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sediment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plates</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Item Inspected: Spill Control Separators</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tee Section</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### INSPECTION AND MAINTENANCE CHECKLIST FOR STRUCTURAL POST-CONSTRUCTION BMPs

**Summit County BMP2: Catch Basin Inserts**

<table>
<thead>
<tr>
<th>Date:</th>
<th>Time:</th>
<th>Type of inspection (circle one):</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Semi-Annual          Monthly    After major storm</td>
</tr>
</tbody>
</table>

**Site Name/Location:**

**Inspector:**

<table>
<thead>
<tr>
<th>Item Inspected: Catch Basin Insert Components</th>
<th>Satisfactory yes/no</th>
<th>Type of Maintenance Needed if Unsatisfactory</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filter Insert</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grate Seal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sump</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trash, debris, sediment, vegetation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pollution</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Access</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### INSPECTION AND MAINTENANCE CHECKLIST FOR STRUCTURAL POST-CONSTRUCTION BMPs

**Summit County BMP3.1: Seepage Beds (Infiltration Trench)**

Date: __________________________ Time: __________________________ Type of inspection (circle one):  
- Semi-Annual  
- Monthly  
- After major storm

Site Name/Location: __________________________ Inspector: __________________________

<table>
<thead>
<tr>
<th>Item Inspected: Seepage Bed</th>
<th>Satisfactory yes/no</th>
<th>Type of Maintenance Needed if Unsatisfactory</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain rock</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Filter fabric</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface Inlet (if present)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observation well</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ponding should not be present)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ponding should not be present)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface vegetation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trash, sediment, debris</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-treatment system (use additional checklist if appropriate, e.g. oil/water separator)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Pollution</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Vegetated buffer strip (if present)</td>
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</tbody>
</table>
# INSPECTION AND MAINTENANCE CHECKLIST FOR STRUCTURAL POST-CONSTRUCTION BMPs

Summit County BMP3.2: Infiltration Basin

<table>
<thead>
<tr>
<th>Date:</th>
<th>Time:</th>
<th>Type of inspection (circle one):</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Semi-Annual    Monthly    After major storm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Site Name/Location:</th>
</tr>
</thead>
</table>

Inspector:

<table>
<thead>
<tr>
<th>Item Inspected: Infiltration Basin</th>
<th>Satisfactory yes/no</th>
<th>Type of Maintenance Needed if Unsatisfactory</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet channel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inflow</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outlet channel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outfall</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forebay/sediment trap</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretreatment system (use additional checklist if appropriate)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trash, debris, sediment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface vegetation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency spillway (if present)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### INSPECTION AND MAINTENANCE CHECKLIST FOR STRUCTURAL POST-CONSTRUCTION BMPs

Summit County BMP3.3: Infiltration Swale

<table>
<thead>
<tr>
<th>Date:</th>
<th>Time:</th>
<th>Type of inspection (circle one):</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Semi-Annual  Monthly  After major storm</td>
</tr>
</tbody>
</table>

**Site Name/Location:**

**Inspector:**

<table>
<thead>
<tr>
<th>Item Inspected: Infiltration Swale</th>
<th>Satisfactory yes/no</th>
<th>Type of Maintenance Needed if Unsatisfactory</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflow</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inflow energy dissipation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(stilling basin, rip rap pad)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flow spreading device</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sediment clean-out area</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trash, debris, sediment</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## INSPECTION AND MAINTENANCE CHECKLIST FOR STRUCTURAL POST-CONSTRUCTION BMPs

Summit County BMP4: Ponds

Date: ___________________________ Time: ___________________________

**Type of inspection (circle one):**
- Semi-Annual
- Monthly
- After major storm

**Site Name/Location:** ___________________________

**Inspector:** ___________________________

<table>
<thead>
<tr>
<th>Item Inspected: Embankment and Spillways</th>
<th>Satisfactory Yes/No</th>
<th>Type of Maintenance Needed if Unsatisfactory</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetation and ground cover</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Erosion at inlets/outlets/side slopes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Animal/rodent burrows</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seeps or leaks in embankment or spillway</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cracking, bulging, or sliding of dam</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spillways clear of obstructions and debris</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Riser**

<table>
<thead>
<tr>
<th>Item Inspected: Riser</th>
<th>Satisfactory Yes/No</th>
<th>Type of Maintenance Needed if Unsatisfactory</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipe/concrete/ masonry condition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trash rack(s) free of debris (low flow &amp; weir)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orifice unobstructed by sediment/debris</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Condition of access structures (e.g., ladders)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excessive sediment accumulation inside riser</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Outflow**

<table>
<thead>
<tr>
<th>Item Inspected: Outflow</th>
<th>Satisfactory Yes/No</th>
<th>Type of Maintenance Needed if Unsatisfactory</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evidence of slope or bank erosion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Riprap condition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pipe &amp; endwall/headwall condition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pond (General)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>Sedimentation level in sediment forebay</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Undesirable vegetative growth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sedimentation level in pond</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evidence of pollution (oil, grease, etc.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trash/ yard waste</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graffiti</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public safety hazards</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noxious odors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noxious insects</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Inspection and Maintenance Checklist for Structural Post-Construction BMPs

Summit County BMP5: Biofiltration Systems

**Date:**

**Time:**

**Type of inspection (circle one):**
- Semi-Annual
- Monthly
- After major storm

**Site Name/Location:**

**Inspector:**

<table>
<thead>
<tr>
<th>Item Inspected: Biofiltration system components: Biofiltration swales and grass buffer strips</th>
<th>Satisfactory yes/no</th>
<th>Type of Maintenance Needed if Unsatisfactory</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharge Quality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetation height</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sediment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flow channelization/erosion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetation type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bare spots/need for reseeding</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flow spreading device</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintenance access</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noxious weeds</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pollution</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ponding</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trash/litter</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### INSPECTION AND MAINTENANCE CHECKLIST FOR STRUCTURAL POST-CONSTRUCTION

**BMPs**

Summit County BMP6: Sand Filters

<table>
<thead>
<tr>
<th>Date:</th>
<th>Time:</th>
<th>Type of inspection (circle one):</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Semi-Annual       Monthly    After major storm</td>
</tr>
</tbody>
</table>

**Site Name/Location:**

**Inspector:**

<table>
<thead>
<tr>
<th>Item Inspected: Sand Filter Components (General)</th>
<th>Satisfactory yes/no</th>
<th>Type of Maintenance Needed if Unsatisfactory</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharge Quality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inlet Pipe</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outlet Pipe</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trash and Debris</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sediment depth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bypass Valve</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Filter Bed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sedimentation Chamber/Pond (use additional checklist if appropriate)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infiltration rate/ponding after 36 hours</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil or other pollutants</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetation</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Rain Garden

Rain gardens are shallow bioretention areas with engineered or native soils. A variety of plants are used to increase infiltration and nutrient uptake including trees, shrubs, grasses, and other plants suitable for the climate. Rain gardens may be designed with various layers of soil, sand, and aggregate. They may also be designed with the existing soils at the site if the soils are expected to adequately infiltrate, support vegetation, and remove pollutants. They can be topped with a wood or rock mulch, any organic material, or other landscaping features. Performance is increased with high carbon soils. Sand and aggregate layers below the soil layers may provide filtration and storage. Rain gardens are usually well-received by the public for their aesthetic qualities.

Slopes leading to the garden bottom are gentle or steep based on site constraints, such as within urban areas. Ponding depths are typically between 1 to 18 inches. Underdrains and impermeable liners are necessary when subsurface concerns exist such as proximity to a structure, poorly infiltrating soils beneath the cross-section of the garden, or groundwater concerns. When a rain garden must be lined, its volume retention function is eliminated, pollutant removal effectiveness is diminished, and it functions primarily as a detention device; however, it still provides treatment through biofiltration. A bypass mechanism either within the rain garden or upstream of the rain garden should be considered for flood events.

<table>
<thead>
<tr>
<th>Pollutant Removal Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pollutant</td>
</tr>
<tr>
<td>Sediment</td>
</tr>
<tr>
<td>Nutrients</td>
</tr>
<tr>
<td>Metals</td>
</tr>
<tr>
<td>Bacteria</td>
</tr>
<tr>
<td>Oil/Grease</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Primary Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bioretention</td>
</tr>
<tr>
<td>Volume Retention</td>
</tr>
<tr>
<td>Biofiltration</td>
</tr>
</tbody>
</table>

### Design Criteria

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min. Value</th>
<th>Max. Value</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth to Historical High Groundwater</td>
<td>2 ft</td>
<td>No Maximum</td>
<td>-</td>
</tr>
<tr>
<td>Side Slopes</td>
<td>No Minimum</td>
<td>3H:1V</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>No Minimum</td>
<td>18 in.</td>
<td></td>
</tr>
<tr>
<td>----------------------</td>
<td>------------</td>
<td>--------</td>
<td>----------</td>
</tr>
<tr>
<td>Ponding Depth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drawdown Time</td>
<td>12 hrs</td>
<td>72 hrs</td>
<td></td>
</tr>
<tr>
<td>Design Infiltration Rate</td>
<td>0.25 in/hr</td>
<td>6 in/hr</td>
<td>Field testing required for final design. Infiltration rate should be low enough to allow biofiltration process to occur. During design, infiltration rate, drawdown time, and the soil matrix depth will be directly related</td>
</tr>
<tr>
<td>Freeboard</td>
<td>No Minimum</td>
<td>No Maximum</td>
<td>Freeboard per jurisdiction standards (ours?) . For public safety, consider requiring freeboard and a minimum 6 inch embankment when ponding depth is greater than 6 inches</td>
</tr>
</tbody>
</table>

**Calculation Methods**

Rain garden design is governed by the water quality volume. The general design steps are:

1. Calculate the water quality volume.
2. Determine the geometry of the rain garden.
3. Based on the rain garden geometry and the porosity of the soil layers, determine the ponding depth and soil matrix depth required to hold the water quality volume.
4. Calculate the drawdown time.
5. Calculate the water quality outlet elevation.

**Sample Calculations**

Refer to Calculation Methods in the Preface to Fact Sheets for discussion on the equations used.

A site has 1,500 sf of available open space at the downstream end of a parking lot. The parking lot and an adjacent pervious surface constitute one drainage area that is 0.75 ac in size. The total imperviousness of the drainage area is 0.80. The jurisdiction has a maximum drawdown time of 48 hours and uses a safety factor of 1.5 for water quality design.

**Given**

Contributing drainage area: 0.75 ac
Imperviousness: 0.80
90th percentile storm depth: 0.60 in
Design infiltration rate: 1.75 in/hr

**Determine**

The footprint and depth of a rain garden that can retain the water quality volume.
Calculations

Volumetric runoff coefficient, $R_V$ (See Sample Calculations)

$R_V = 0.91i - 0.0204$ (Reese method)

$R_V = 0.91(0.80) - 0.0204$

$R_V = 0.71$

Water quality volume, $WQV$ (See Developing the 90th Percentile Volume)

$WQV = R_VdA$

$WQV = (0.71)(0.60 \text{ in})(0.75 \text{ ac})(43,560 \text{ sf/ac}) / (12 \text{ in/ft})$

$WQV = 1,160 \text{ cf}$

Minimum footprint, $A_{min}$ (See Minimum footprint area)

$A_{min} = (12)(\text{Safety Factor})(WQV) / kt$

$A_{min} = (12)(1.50)(1,160 \text{ cf}) / (1.75 \text{ in/hr})(48 \text{ hrs})$

$A_{min} = 250 \text{ sf}$

The water quality volume will infiltrate into the existing soil in 48 hours if the rain garden bottom is 250 square feet. However, this does not mean that the rain garden bottom is required to be 250 square feet. A larger footprint with a faster drawdown time may be acceptable and reduce the depth required to retain the water quality volume.

A rain garden with a bottom footprint of 1,160 sf, a 12-inch ponding depth will retain the water quality volume. If a safety factor is desired, it should be accounted for by multiplying the water quality volume by the safety factor.

**Rain Garden Effectiveness**

Effective rain gardens provide an aesthetically pleasing method for retaining and treating storm water. Visiting rain gardens during rain events will reveal if the garden is draining properly. Rain gardens are performing properly if they are retaining their design volume and treating runoff. Creating and following through on maintenance guidelines are critical to ensuring that a rain garden remains functional.

There are many possible indications that a rain garden has failed or is near failure, such as: ponding beyond the design ponding depth during small storm events, drawdown time exceeds design drawdown time, larger than expected sediment buildup within or upstream of the rain garden, irregular settling of the rain garden bottom creating standing water, sloughing of side slopes, excessive and unmaintained vegetation, lack of vegetation, and no maintenance or no record of maintenance. Although this is not an all-inclusive list, being aware of these items will assist in determining what steps need to be taken to remediate a failing rain garden.
**Designer Checklist**

If the answer to these questions corresponds to a response box that is red, the BMP should either not be used or additional measures need to be taken to address the issue.

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does groundwater meet the minimum separation requirement?</td>
<td>🟥</td>
<td>🟥</td>
</tr>
<tr>
<td>Is there available right-of-way, property, or easement?</td>
<td>🟥</td>
<td>🟥</td>
</tr>
<tr>
<td>Is the design infiltration rate within acceptable rates?</td>
<td>🟥</td>
<td>🟥</td>
</tr>
<tr>
<td>Is contaminated groundwater present?</td>
<td>🟥</td>
<td>🟥</td>
</tr>
<tr>
<td>Is the drainage area to the rain garden less than 5 acres? (If no, consider an infiltration basin or subdividing to create smaller drainage areas.)</td>
<td>🟥</td>
<td>🟥</td>
</tr>
<tr>
<td>Do utility conflicts make installation of the rain garden technically infeasible?</td>
<td>🟥</td>
<td>🟥</td>
</tr>
<tr>
<td>Do geotechnical conditions exist that would compromise the stability of the rain garden or surrounding structures?</td>
<td>🟥</td>
<td>🟥</td>
</tr>
<tr>
<td>Does the rain garden provide storage for 100% of the water quality volume? (If no, it may still be appropriate to construct the rain garden if it is technically infeasible to capture 100% of the water quality volume.)</td>
<td>🟥</td>
<td>🟥</td>
</tr>
<tr>
<td>Does an overflow outlet structure or bypass mechanism exist?</td>
<td>🟥</td>
<td>🟥</td>
</tr>
</tbody>
</table>

**Vegetation**

Refer to Vegetation Guidance by BMP Type.

**Installation**

**Excavation**

Rain gardens, like other BMPs whose functionality is dependent on infiltration, will fail if proper care is not taken during excavation and construction. Excavators and heavy machinery should not be used within the rain garden area if infiltration is expected to occur through the rain garden bottom. Additional excavation beyond the rain garden’s footprint may be required depending on site conditions to provide soil stability or to be able to tie-in to the surrounding grade.

**Activities During Construction**

Avoid using heavy machinery within the rain garden footprint during construction as doing so will compact the soils and diminish their infiltrating capabilities. Light machinery and even walking within the rain garden’s footprint will also compromise infiltration. Compaction of native soils or backfill below the rain garden subsoils is acceptable if doing so does not prevent infiltration from occurring.
flows during construction

flows during construction should be diverted away from the rain garden to prevent construction site sediment from clogging soils. Scheduling installation of the rain garden shortly after excavation will minimize the impact of unnecessary storm water flows from entering the excavated area. The introduction of unwanted sediment can be prevented by placing fiber rolls or silt fences around the rain garden perimeter during construction.

additional guidance

- require certificates of compliance to verify that construction items meet specification requirements.
- follow landscaping guidance to ensure that vegetation establishes after installation.

installation costs

the following cost items are typically associated with rain garden construction

- excavation
- grading
- fine grading
- granular borrow fill
- landscaping and vegetation
- top layer
- engineered soil
- coarse sand
- crushed gravel
- open graded stone
- geotextile fabric
- outlet structure or upstream bypass structure (for larger storm events)
- observation wells
- curb and gutter
- impermeable liner (if needed)
- underdrain system (if needed)
- irrigation system (if needed)
**Maintenance**

Refer to Maintenance and Maintenance Costs in the Preface to Fact Sheets for general information related to maintenance of bioretention BMPs.

**Maintenance Activities**

<table>
<thead>
<tr>
<th>Inspection</th>
<th>Inspection/Maintenance Frequency</th>
<th>Maintenance Activity</th>
<th>Effort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspect for adequate vegetation coverage, and impaired or failing vegetation</td>
<td>Semiannual (Spring, Fall)</td>
<td>Reseed/replant barren spots, Notify the engineer if failing vegetation persists</td>
<td>Low</td>
</tr>
<tr>
<td>Inspect side slopes for erosion, rilling, and sloughing</td>
<td>Semiannual (Spring, Fall)</td>
<td>Regrade side slopes if soughing does not impact slope stability. Notify the engineer if sides slope stability has been compromised and is affecting the functionality of the basin</td>
<td>Low</td>
</tr>
<tr>
<td>Inspect for trash and debris within basin and at inlet and outlet structures</td>
<td>Semiannual (Spring, Fall) or as needed</td>
<td>Remove and dispose of trash and debris.</td>
<td>Low</td>
</tr>
<tr>
<td>Inspect for large deposits of sediment on basin bottom indicating soil clogging</td>
<td>Semiannual (Spring, Fall) or as needed</td>
<td>Remove and dispose of built up sediment when buildup causes reduction in size of basin or if buildup results in standing water. Notify the engineer in the case of standing water as it may indicate clogging within the basin’s soil layers</td>
<td>Low</td>
</tr>
<tr>
<td>Inspect for standing water within rain garden or within observation well</td>
<td>Semiannual (Spring, Fall) or as needed</td>
<td>Notify the engineer for further inspection</td>
<td>Medium</td>
</tr>
<tr>
<td>Inspect for failure of additional feature such as underdrains or irrigation systems</td>
<td>Semiannual (Spring, Fall) or as needed</td>
<td>Repair as needed</td>
<td>Medium</td>
</tr>
</tbody>
</table>
Rain Garden with Underdrain System

Not to scale

Notes:
- Impermeable liner around all sides and bottom of rain garden if groundwater concerns exist
- Dimensions shown may vary based on site conditions
- Consider forebay or other pretreatment

Rain Garden in Native or Engineered Soils

Not to scale

Notes:
- Consider forebay or other pretreatment
- Consider upstream bypass for large storm events
Bioretention cells are shallow bioretention areas with engineered soil. They typically differ from rain gardens by having a delineation such as a curb, wall, or other distinct boundary. Similar to a rain garden, a variety of plants are used to increase infiltration and nutrient uptake including trees, shrubs, grasses, and other plants suitable for the climate. They may be designed with native soils or various layers of soil, sand, and aggregate. They can be topped with a wood or rock mulch, any organic material, or other landscaping features. Performance is increased with high carbon soils. Sand and aggregate layers below the soil layers provide filtration and storage.

Ponding depths are usually between 1 to 18 inches. In areas with high foot traffic, it may be necessary to provide a safety bench of soil within the cell and a minimum side slope leading to the cell bottom. Underdrains and impermeable liners are necessary when subsurface concerns exist such as proximity to a structure, poorly infiltrating soils, or groundwater concerns. When a bioretention cell must be lined, its volume retention function is eliminated, its pollutant removal effectiveness is diminished, and it functions primarily as a detention device; however, it still provides treatment through biofiltration. A bypass mechanism either within the bioretention cell or upstream of the cell should be considered for flood events.

<table>
<thead>
<tr>
<th><strong>Design Criteria</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parameter</strong></td>
</tr>
<tr>
<td>Depth to Historical High Groundwater</td>
</tr>
<tr>
<td>Ponding Depth</td>
</tr>
<tr>
<td>Drawdown Time</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Pollutant Removal Effectiveness</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pollutant</strong></td>
</tr>
<tr>
<td>Sediment</td>
</tr>
<tr>
<td>Nutrients</td>
</tr>
<tr>
<td>Metals</td>
</tr>
<tr>
<td>Bacteria</td>
</tr>
<tr>
<td>Oil/Grease</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Primary Functions</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bioretention</td>
</tr>
<tr>
<td>Volume Retention</td>
</tr>
<tr>
<td>Biofiltration</td>
</tr>
</tbody>
</table>
**Calculation Methods**

Bioretention cell design is governed by the water quality volume. The general design steps are:

1. Calculate the water quality volume.
2. Determine the geometry of the bioretention cell.
3. Based on the bioretention cell geometry and the porosity of the soil layers, determine the ponding depth and soil matrix depth required to hold the water quality volume.
4. Calculate the drawdown time.
5. Calculate the water quality outlet elevation.

**Sample Calculations**

Refer to Calculation Methods in the Preface to Fact Sheets for discussion on the equations used.

A drainage area within a proposed roadway will be one-third of an acre with 90% imperviousness. It is proposed that three bioretention cells be placed within the drainage area creating three sub-drainage areas. Each sub-drainage area has the same imperviousness and ‘A’ soils are present.

**Given**

- Contributing drainage area: 0.11 ac
- Imperviousness: 0.90
- Storm depth: 0.50 in
- Design infiltration rate: 1.60 in/hr

**Determine**

The footprint and depth of the bioretention cells that can retain the water quality volume.

**Calculations**

Volumetric runoff coefficient, \( R_v \) (See Sample Calculations)
RV\-A = 0.84t^{1.302} (RV based on hydrologic soil group)

RV\-A = 0.84(0.90)^{1.302}

RV = 0.73

Water quality volume, WQV (See Developing the 90th Percentile Volume)

WQV = (0.73)(0.50 \text{ in}) (0.11 \text{ ac})(43,560 \text{ sf/ac}) / (12 \text{ in/ft})

WQV = 150 \text{ cf}

Minimum footprint, A_{\text{min}} (See Minimum footprint area)

A_{\text{min}} = (12)(1.50)(150 \text{ cf}) / (1.60 \text{ in/hr})(48 \text{ hrs})

A_{\text{min}} = 34 \text{ sf}

The water quality volume will infiltrate into the existing soil in 48 hours if the footprint area of all bioretention cells is 34 square feet. However, this does not mean that the bioretention cell footprint is required to be 34 square feet. A larger footprint with a faster drawdown time is acceptable and will reduce the depth required to retain the water quality volume.

If the bioretention cell were to require an engineered soil layer, the design below with a bottom footprint of 200 sf will retain the water quality volume. If a safety factor is desired, it should be accounted for by multiplying the water quality volume by the safety factor.

### Bioretention Cell Effectiveness

Effective bioretention cells provide an aesthetically pleasing method for retaining and treating storm water. Inspecting bioretention cells during rain events will reveal if the cell is draining properly. Bioretention cells are performing properly if they are retaining their design volume and treating runoff. Creating and following through on maintenance guidelines are critical to ensuring that a bioretention cell remains functional.
There are many possible indications that a bioretention cell has failed or is near failure, such as:
- ponding beyond the design ponding depth during small storm events,
- drawdown time exceeds design drawdown time, larger than expected sediment buildup within or upstream of the cell,
- excessive and unmaintained vegetation, lack of vegetation,
- obstructions at the inlet and outlet locations, and
- no maintenance or no record of maintenance. Although this is not an all-inclusive list, being aware of these items will assist in determining what steps need to be taken to remediate a failing bioretention cell.

**Designer Checklist**

If the answer to these questions corresponds to a response box that is red, the BMP should either not be used or additional measures need to be taken to address the issue.

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does groundwater meet the minimum separation requirement?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is there available right-of-way, property, or easement?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is the design infiltration rate within acceptable rates?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is contaminated groundwater present?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is the drainage area to the bioretention cell less than 5 acres? (If no, consider an infiltration basin or subdividing to create smaller drainage areas.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do utility conflicts make installation of the bioretention cell technically infeasible?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do geotechnical conditions exist that would compromise the stability of the bioretention cell or surrounding structures?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does the bioretention cell provide storage for 100% of the water quality volume? (If no, it may still be appropriate to construct the rain garden if it is technically infeasible to capture 100% of the water quality volume.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does an overflow outlet structure or bypass mechanism exist?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Vegetation**

Refer to Vegetation Guidance by BMP Type.

**Installation**

**Excavation**

Bioretention cells, like other BMPs whose functionality is dependent on infiltration, will fail if proper care is not taken during excavation and construction. Excavators and heavy machinery should not be used within the excavated area if infiltration is expected to occur through the bioretention cell bottom. Additional excavation beyond the footprint may be required depending on site conditions to provide soil stability or to be able to tie-in to the surrounding grade.
Activities During Construction

Avoid using heavy machinery within the bioretention cell footprint during construction as doing so will further compact the soils and diminish their infiltrating capabilities. Light machinery and even walking within the bioretention cell’s footprint will also compromise infiltration. Compaction of native soils or backfill below the bioretention cell subsoils is acceptable if doing so does not prevent infiltration from occurring.

Flows During Construction

Flows during construction should be diverted away from the bioretention cell to prevent construction site sediment from clogging soils. Scheduling installation of the bioretention cell shortly after excavation will minimize the impact of unnecessary storm water flows from entering the excavated area. The introduction of unwanted sediment can be prevented by placing fiber rolls or silt fences around the bioretention cell perimeter during construction.

Additional Guidance

- Require certificates of compliance to verify that construction items meet specification requirements.
- Follow landscaping guidance to ensure that vegetation establishes after installation.

Installation Costs

The following cost items are typically associated with bioretention cell construction.

- Excavation
- Landscaping and vegetation
- Top layer
- Engineered soil
- Coarse sand
- Crushed gravel
- Open graded stone
- Geotextile fabric
- Outlet structure or upstream bypass structure (for larger storm events)
- Observation wells
- Curb and gutter
- Impermeable liner (if needed)
- Underdrain system (if needed)
- Irrigation system (if needed)

**Maintenance**

Refer to Maintenance and Maintenance Costs in the Preface to Fact Sheets for general information related to maintenance of bioretention BMPs.

**Maintenance Activities**

<table>
<thead>
<tr>
<th>Inspection</th>
<th>Inspection/Maintenance Frequency</th>
<th>Maintenance Activity</th>
<th>Effort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspect for adequate vegetation coverage, and impaired or failing vegetation</td>
<td>Semiannual (Spring, Fall)</td>
<td>Reseed/replant barren spots, Notify the engineer if failing vegetation persists</td>
<td>Low</td>
</tr>
<tr>
<td>Inspect for trash and debris within basin and at inlet and outlet structures</td>
<td>Semiannual (Spring, Fall) or as needed</td>
<td>Remove and dispose of trash and debris.</td>
<td>Low</td>
</tr>
<tr>
<td>Inspect for standing water within bioretention cell or within observation well</td>
<td>Semiannual (Spring, Fall) or as needed</td>
<td>Notify the engineer for further inspection</td>
<td>Medium</td>
</tr>
<tr>
<td>Inspect for failure of additional feature such as underdrains or irrigation systems</td>
<td>Semiannual (Spring, Fall) or as needed</td>
<td>Repair as needed</td>
<td>Medium</td>
</tr>
</tbody>
</table>
Bioretention Cell in Native or Engineered Soils

Notes:
- Consider forebay or other pretreatment
- Consider upstream bypass for large storm events

Bioretention Cell with Underdrain System

Notes:
- Overflow elevation must be below elevation of inlet (curb cut, downspout, or other per site design)
- Dimensions shown may vary based on site conditions
- Consider forebay or other pretreatment
Bioswale

Bioswales are vegetated open channels designed to convey and treat storm water runoff. They are appropriate when it is desirable to convey flows away from structures or as an alternate conveyance method to pipes, concrete channels, or curbed gutters. Bioswales reduce peak flow rates, reduce flow velocities, filter storm water pollutants, and can also reduce runoff volume through infiltration.

The primary functions of bioswales are bioretention and treatment through biofiltration. Conveying runoff through bioswales allows the runoff to be filtered through two processes: bioretention through a native or engineered soil matrix and biofiltration through the above ground vegetation.

Although volume retention may be accomplished within the native soil or a subsoil matrix of engineered soil and gravel layers, retention is not its primary function. However, retention volumes may be determined by designing ponding areas within the swale or creating check dams. There is research to support the quantification of infiltration when runoff is simply conveyed through the swale (no ponding) but design parameters vary widely. Monitoring bioswales for volume reduction is the most reliable source for future estimates of expected reduction.

### Design Criteria

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min. Value</th>
<th>Max. Value</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>Based on hydraulic residence time</td>
<td>No Maximum</td>
<td>-</td>
</tr>
<tr>
<td>Longitudinal Slope</td>
<td>0.50%</td>
<td>5%</td>
<td>Underdrain recommended below minimum slope</td>
</tr>
<tr>
<td>Bottom Width</td>
<td>No minimum</td>
<td>No maximum</td>
<td>-</td>
</tr>
<tr>
<td>Side Slope</td>
<td>No minimum</td>
<td>3H:1V</td>
<td>Per jurisdiction requirements</td>
</tr>
<tr>
<td>Flow Velocity</td>
<td>No minimum</td>
<td>1.0 ft/s</td>
<td>Maximum permissible shear stress may also dictate maximum flow velocity</td>
</tr>
</tbody>
</table>

### Pollutant Removal Effectiveness

| Pollutant    | Effectiveness
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sediment</td>
<td>Medium</td>
</tr>
<tr>
<td>Nutrients</td>
<td>Medium</td>
</tr>
<tr>
<td>Metals</td>
<td>Medium</td>
</tr>
<tr>
<td>Bacteria</td>
<td>Medium</td>
</tr>
<tr>
<td>Oil/Grease</td>
<td>High</td>
</tr>
</tbody>
</table>

1 Removal effectiveness is increased for all pollutants as retention increases

### Primary Functions

<table>
<thead>
<tr>
<th>Function</th>
<th>Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bioretention</td>
<td>Yes</td>
</tr>
<tr>
<td>Volume Retention</td>
<td>Some</td>
</tr>
<tr>
<td>Biofiltration</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>No minimum</td>
</tr>
<tr>
<td>--------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Freeboard</td>
<td>No minimum</td>
</tr>
<tr>
<td>Vegetation Coverage</td>
<td>≥ 65%</td>
</tr>
<tr>
<td>Hydraulic Residence Time</td>
<td>5 min</td>
</tr>
</tbody>
</table>

**Calculation Methods**

Bioswale design is governed by the water quality flow. The general design steps are:

1. Calculate the water quality flow.
2. Determine the geometry of the bioswale’s cross-section.
3. Determine the flow depth.
4. Determine volume retention within bioswale, if any.
5. Check flow velocity and hydraulic residence time.

**Sample Calculations**

Refer to Calculation Methods in the Preface to Fact Sheets for discussion on the equations used.

During the planning phase of a city roadway project it has been decided to remove curbs and instead allow one acre of runoff to sheet flow into a 500 ft bioswale. There are 15 feet of available right-of-way between the edge of pavement and the project limits. A 4-foot sidewalk is also proposed to be within the right-of-way. The city has a requirement that there be no slopes greater than 6H:1V within five feet of the edge of pavement. The city’s storm water requirements state that the 2-yr, 6-hr intensity must be used in determining the water quality flow rate. Per city standards, 6 inches of freeboard will be required above the water quality flow depth.

**Given**

Contributing drainage area: 1.0 ac  
Imperviousness: 0.85  
90th percentile storm depth: 0.60 in  
2-yr, 6-hr storm intensity: 0.16 in/hr

**Design Goals**

Determine an acceptable swale bottom width and flow depth. Design a soil matrix and determine the volume of runoff that is expected to infiltrate into the bioswale.
Calculations

Volumetric runoff coefficient, \( R_v \) (See Sample Calculations)

\[
R_v = 1.14i - 0.371 \quad \text{(Granato method when } i \geq 0.55) \\
R_v = 1.14(0.85) - 0.371 \\
R_v = 0.60
\]

Water quality flow, \( WQF \)

\[
WQF = R_v i A \\
WQF = (0.60)(0.16 \text{ in/hr})(1.0 \text{ ac}) \\
WQF = 0.10 \text{ cfs}
\]

Flow depth, \( y_d \) (See Manning’s Equation)

The project team has decided that a 2-foot bottom width will be used for the bioswale. Per city standards, 6 inches of freeboard will be required above the water quality flow depth. Other design information for the bioswale includes:

- Longitudinal slope: 2.0%
- Side slopes: 3H:1V

Determine the flow depth during the design storm event by setting Manning’s equation equal to the WQF and solving the equation for the flow depth, \( y_d \). This calculation is made easier using a goal seek function within a spreadsheet.

\[
y_d = 1.8 \text{ in}
\]

Velocity, \( v \) (See Continuity Equation)

The city requires that flows remain below 1 ft/s to prevent scouring of the bioswale bottom. With the flow depth known, the continuity equation can be used to determine the flow velocity. The cross-sectional area is calculated to be 0.37 sf.

\[
v = Q/A \\
v = (0.10 \text{ cfs}) / (0.37 \text{ sf}) \\
v = 0.26 \text{ ft/s}
\]

Minimum swale length, \( L_{\text{min}} \)

The city also requires a 5-minute minimum hydraulic residence time to achieve the maximum desired biofiltration. Using the velocity, a minimum swale length can be determined.

\[
L_{\text{min}} = (0.26 \text{ ft/s})(300 \text{ s}) \\
L_{\text{min}} = 79 \text{ ft}
\]
Any portion of the runoff that enters the swale within 79 ft of the downstream end of the swale will not receive the optimal treatment.

With 6 inches of freeboard and a side slope of 3H:1V, the top width of the bioswale is 6.00 ft. With 15 feet of available right-of-way, 6 of which are available for the swale, at the planning level there is adequate space for the bioswale. If needed, the swale’s top width could be narrowed by decreasing the bottom width, which would also result in a deeper flow depth.

Water quality volume, WQV (See Developing the 90th Percentile Volume)

\[
WQV = (0.60)(0.60 \text{ in})(1.0 \text{ ac})(43,560 \text{ sf/ac}) / (12 \text{ in/ft})
\]

\[
WQV = 1,302 \text{ cf}
\]

Volume Reduction

The swale will also include check dams that are 6 inches high to increase the volume retention. With a longitudinal slope of 2%, a 6-inch check dam will create a triangular pool that is 25 ft long before overtopping the check dam. The volume retained behind the check dam is calculated with the bottom width, the check dam height, and the length of the check dam pool.

\[
V_{\text{check dam}} = (2 \text{ ft})(25 \text{ ft })(0.5 \text{ ft}) / 2
\]

\[
V_{\text{check dam}} = 12.50 \text{ cf}
\]

If the check dams are spaced every 50 feet, 10 check dams are possible, and the total volume retained by the check dams will be 125 cf.

Additional volume retention can be achieved in any ponding areas that are designed into the swale.

Although methodologies have been developed to determine volume retention within a bioswale, the current body of research varies widely and jurisdictions are encouraged to exercise engineering judgment (See Volume Reduction).

A conservative design for the soil matrix below the swale will allow for the maximum possible percentage of the water quality volume to be captured. For flood control purposes, zero infiltration may be assumed to prevent downstream piping from being undersized if the bioswale’s volume reduction is overestimated. Accounting for the ten check dams, the soil matrix below will provide storage for the remaining portion of the water quality volume (1,182 cf). Whether the full remaining volume is captured can be determined by monitoring the bioswale for volume retention.
Bioswale Effectiveness

Bioswales are effective when they can accomplish their design goals of conveying flows to a downstream receiving structure, BMP, or other receiving area. Flows through the swale should be relatively steady and uniform during a rain event unless retention areas and check dams are part of the swale design. Established vegetation with adequate coverage is an indication of a healthy bioswale along with minimal sediment and lack of invasive vegetation.

Designer Checklist

If the answer to these questions corresponds to a response box that is red, the BMP should either not be used or additional measures need to be taken to address the issue.

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>If longitudinal slope is less than minimum, can an underdrain be installed?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>If an underdrain is needed, is sufficient hydraulic head available for proper drainage?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Do flows result in a shear stress greater than the maximum permissible for selected vegetation?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Do utility conflicts make installation of the bioswale technically infeasible?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Will bioswale provide conveyance for larger storm events? (If yes, the geometry of the bioswale will need to accommodate the larger events)</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Is the bioswale providing pretreatment for a downstream BMP?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Is the bioswale connecting directly to the storm drain network? (If yes, the outlet structure elevation will need to be determined)</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

Vegetation

Refer to Vegetation Guidance by BMP Type.

Installation

Excavation

Bioswale construction is a relatively straightforward process of excavating the swale’s subsurface trench prior to backfilling with any underdrain system, open graded stone, engineered soil, and geotextile fabric. Additional excavation beyond the swale’s footprint may be required.
depending on site conditions to provide soil stability or to be able to tie-in to the surrounding grade.

**Activities During Construction**

Crews should avoid stepping within the trench except when necessary as doing so will compact the native soil that is expected to infiltrate runoff.

**Flows During Construction**

Flows during construction should be diverted away from the bioswale to prevent construction site sediment from clogging soils and to prevent erosion of the swale bed. Scheduling installation of the bioswale shortly after excavation will minimize the impact of unnecessary storm water flows from entering the excavated area. The introduction of unwanted sediment can be prevented by placing fiber rolls or silt fences around the bioswale perimeter during construction. Creating the upstream inlet or connection should be the last construction activity before flows are permitted to be conveyed as designed through the bioswale.

**Additional Guidance**

- Require certificates of compliance to verify that construction items meet specification requirements.
- Follow landscaping guidance to ensure that vegetation establishes after installation.

**Installation Costs**

The following cost items are typically associated with bioswale construction.

- Excavation
- Grading
- Fine grading
- Granular borrow fill
- Landscaping and vegetation
- Top layer
- Engineered soil
- Open graded stone
- Geotextile fabric
- Impermeable liner
- Outlet structure or upstream bypass structure (for larger storm events)
- Observation wells
- Underdrain system (if needed)
- Outlet protection such as riprap or other (if needed)

**Maintenance**

Refer to Maintenance and Maintenance Costs in the Preface to Fact Sheets for general information related to maintenance of bioretention BMPs.

**Maintenance Activities**

<table>
<thead>
<tr>
<th>Inspection</th>
<th>Inspection/Maintenance Frequency</th>
<th>Maintenance Activity</th>
<th>Effort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspect for adequate vegetation coverage, and impaired or failing vegetation</td>
<td>Semiannual (Spring, Fall)</td>
<td>Reseed/replant barren spots, Notify the engineer if failing vegetation persists</td>
<td>Low</td>
</tr>
<tr>
<td>Inspect side slopes for erosion, rilling and sloughing</td>
<td>Semiannual (Spring and Fall)</td>
<td>Regrade side slope if stability is not affected by sloughing. Notify engineer if stability is affecting basin functionality</td>
<td>Low</td>
</tr>
<tr>
<td>Inspect for trash and debris within basin and at inlet and outlet structures</td>
<td>Prior to mowing, at least semiannually</td>
<td>Remove and dispose of trash and debris.</td>
<td>Low</td>
</tr>
<tr>
<td>Inspect for standing water within bioswale or within observation well</td>
<td>Semiannual (Spring, Fall)</td>
<td>Notify the engineer for further inspection</td>
<td>Medium</td>
</tr>
<tr>
<td>Inspect vegetation height</td>
<td>As needed</td>
<td>Mow swale as needed</td>
<td>Low</td>
</tr>
</tbody>
</table>
Optional vegetated slope for pretreatment

Max side slope per jurisdiction (2H:1V max recommended)

2' minimum recommended

Underdrain observation well (optional)

12" to 24" engineered or native soil
Alternate configuration: 6" to 24" top soil above 6" to 12" sand

Geotextile fabric (optional)

Perforated underdrain pipe to outlet structure (optional)

12" x 12" open graded stone minimum of 3" on all sides of pipe (optional)

Notes:
- Engineered soil may improve filtration
- Underdrain recommended for longitudinal slopes < 1%
- Optional items shown for use of underdrain
- Dimensions shown may vary based on site conditions

Bioswales
Not to scale
Vegetated Strip

Vegetated strips are designed to receive and treat sheet flow from adjacent surfaces. This is accomplished by slowing runoff velocity to allow for pollutants and sediments to settle and by filtering out pollutants in the vegetation before entering the storm sewer system. Vegetated strips are best utilized for storm water treatment from roads, parking lots, and other impervious surfaces.

The primary functions of vegetated strips are bioretention and biofiltration. Volume Retention Some Bioretention within a vegetated strip occurs as runoff enters the soil and pollutants are removed through physical, chemical, and biological processes. Biofiltration Yes Similar biofiltration processes occur to provide treatment when runoff passes through the strip’s vegetation. Biofiltration is significantly reduced when vegetation coverage is less than 65%. In arid locations a gravel strip may be used as a substitute for the vegetated strip. The lack of vegetation will cause biofiltration and bioretention to be greatly reduced; however, the runoff velocity will still be decreased and allow for pollutants and sediments to settle out. Volume retention through infiltration will also occur as runoff enters the gravel’s void spaces.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min. Value</th>
<th>Max. Value</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length (direction of flow travel)</td>
<td>15ft</td>
<td>No Maximum</td>
<td></td>
</tr>
<tr>
<td>Longitudinal Slope</td>
<td>No minimum</td>
<td>4H:1V</td>
<td>Per jurisdiction requirements (?)</td>
</tr>
<tr>
<td>Flow Velocity</td>
<td>No minimum</td>
<td>1.0 ft/s</td>
<td>Maximum permissible shear stress may also dictate maximum flow velocity</td>
</tr>
<tr>
<td>Flow Depth</td>
<td>No minimum</td>
<td>2/3</td>
<td>Flow depths greater than vegetation height will bypass the biofiltration processes</td>
</tr>
</tbody>
</table>

Pollutant Removal Effectiveness

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Effectiveness¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sediment</td>
<td>High</td>
</tr>
<tr>
<td>Nutrients</td>
<td>Medium</td>
</tr>
<tr>
<td>Metals</td>
<td>Medium</td>
</tr>
<tr>
<td>Bacteria</td>
<td>High</td>
</tr>
<tr>
<td>Oil/Grease</td>
<td>High</td>
</tr>
</tbody>
</table>

¹Removal effectiveness is increased for all pollutants as retention increases.

Primary Functions

<table>
<thead>
<tr>
<th>Function</th>
<th>Yes/No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bioretention</td>
<td>Yes</td>
</tr>
<tr>
<td>Volume Retention</td>
<td>Some</td>
</tr>
<tr>
<td>Biofiltration</td>
<td>Yes</td>
</tr>
<tr>
<td>Freeboard</td>
<td>No minimum</td>
</tr>
<tr>
<td>---------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Vegetation Coverage</td>
<td>≥ 65%</td>
</tr>
</tbody>
</table>

**Calculation Methods**
Vegetated strip design is governed by the water quality flow. The general design steps are:
1. Calculate the water quality flow.
2. Determine the flow depth.
3. Check flow velocity.

**Sample Calculations**
Refer to Calculation Methods in the Preface to Fact Sheets for discussion on the equations used.
A roadway project is proposing to widen a road that is near a canal. Due to high groundwater and poor soils, retention on-site is not feasible. Treatment is still an option, however, and the design team has decided to establish vegetation within the twenty feet between the edge of pavement and the canal. The city’s storm water requirements state that the 2-yr, 2-hr intensity must be used in determining the water quality flow rate.

**Given**
Contributing drainage area: 0.25 ac
Imperviousness: 1.00
2-yr, 2-hr storm intensity: 0.318 in/hr

**Design Goals**
Determine that the flow depth will be less than 1 inch.

**Calculations**
Volumetric runoff coefficient, RV (See Sample Calculations)
\[ R_{V,A} = 0.84i^{1.302} \] (RV based on hydrologic soil group)
\[ R_V = 0.84(1.0)^{1.302} \]
\[ R_V = 0.84 \]
Water Quality Flow, WQF
\[ WQF = RViA \]
\[ WQF = (0.84)(0.318 \text{ in/hr})(0.25 \text{ ac}) \]
WQF = 0.067 cfs

There is available right-of-way for a 300-foot long strip that is 20 feet wide. The embankment side slope is 10H:1V which corresponds to a 10% longitudinal slope for the vegetated strip.

Flow depth, \( y_d \) (See Manning’s Equation)

Calculation of the flow depth is typically done using Manning’s equation setting the equation equal to the water quality flow and solving for the flow depth.

\[
y_d = \left( \frac{nQ}{1.49LS^{0.5}} \right)^{0.6}
\]

\[
y_d = \left( \frac{0.2(0.071 \text{ cfs})}{1.49(300 \text{ ft})(0.02)} \right)^{0.6}
\]

\( y_d = 0.04 \text{ in} \)

Velocity, \( v \) (See Continuity Equation)

The city requires that flows remain below 1 ft/s to prevent scouring of the strip bottom. With the flow depth known, the cross-sectional area is calculated to be 1.10 sf.

\[
v = \frac{Q}{A}
\]

\[
v = \frac{0.067 \text{ cfs}}{1.10 \text{ sf}}
\]

\( v = 0.06 \text{ ft/s} \)

Volume Reduction

Although methodologies have been developed to determine volume retention within a bioswale, the current body of research varies widely and jurisdictions are encouraged to exercise engineering judgment (See Volume Reduction).

**Vegetated Strip Effectiveness**

Vegetated strips are effective when they can accomplish their design goals of conveying sheet flow to the receiving area. Flows through the vegetated strip should be relatively steady and uniform during a rain event and should not create rilling or other visible signs of erosion. Established vegetation with adequate coverage is an indication of a healthy vegetated strip along with minimal sediment and lack of invasive vegetation.

**Designer Checklist**

If the answer to these questions corresponds to a response box that is red, the BMP should either not be used or additional measures need to be taken to address the issue.

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is the vegetated strip length greater than or equal to the minimum required length?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do flows result in a shear stress greater than the maximum permissible for selected vegetation?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Is the vegetated strip providing pretreatment for a downstream BMP?  

Is the slope in the direction of flow less than or equal to the jurisdiction’s standards?  

<table>
<thead>
<tr>
<th>Vegetation</th>
<th>Refer to Vegetation Guidance by BMP Type.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Installation</th>
<th>Vegetated strips can be installed as part of normal construction activities. An appropriate grass such as turf sod should be installed per specifications. If additional vegetation such as shrubs or bushes will be used within the strip, follow landscaping guidance to ensure that vegetation establishes after installation. To maximize infiltration performance, minimize use of heavy machinery.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Additional Guidance</th>
<th>Require certificates of compliance to verify that construction items meet specification requirements.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Installation Costs</th>
<th>The following cost items are typically associated with bioswale construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grading</td>
<td>Landscaping and vegetation</td>
</tr>
<tr>
<td>Topsoil</td>
<td>Engineered soil</td>
</tr>
<tr>
<td>Shoulder dressing</td>
<td>upstream of vegetated strip</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Maintenance</th>
<th>Refer to Maintenance and Maintenance Costs in the Preface to Fact Sheets for general information related to maintenance of bioretention BMPs.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Inspection</th>
<th>Inspection/Maintenance Frequency</th>
<th>Maintenance Activity</th>
<th>Effort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspect upstream end of vegetated strip for sediment buildup that may be impeding sheet flow</td>
<td>Semiannual (Spring, Fall) or as needed</td>
<td>Remove and dispose of sediment buildup</td>
<td>Low</td>
</tr>
<tr>
<td>Inspect grass length</td>
<td>As needed</td>
<td>Mow strip as needed</td>
<td>Low</td>
</tr>
<tr>
<td>Inspection Item</td>
<td>Frequency</td>
<td>Action</td>
<td>Risk Level</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------------</td>
<td>--------------------</td>
<td>---------------------------------------------------------------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Inspect side slopes for erosion, rilling and sloughing</td>
<td>Semiannual (Spring and Fall)</td>
<td>Regrade side slope if stability is not affected by sloughing. Notify engineer if stability is affecting basin functionality</td>
<td>Low</td>
</tr>
<tr>
<td>Inspect for adequate vegetative coverage, and impaired or failing vegetation</td>
<td>Semiannual (Spring, Fall) or as needed</td>
<td>Reseed/replant barren areas. Notify engineer if issue persists</td>
<td>Low</td>
</tr>
</tbody>
</table>

**Notes:**
- *Dimensions shown may vary based on site conditions*

---

**Vegetated Strips**

*Not to scale*
Tree Box Filter

Tree box filters are bioretention systems that are appropriate in urban drainage areas where space is limited. An underground concrete vault contains the soil matrix that provides bioretention and has a grated top where vegetation grows. Tree box filters are typically designed as flow-through devices, meaning that they do not retain storm water but rather allow flows to pass through them. However, a bottomless concrete vault will function as a bioretention system that provides infiltration into the native soils. Manufacturers have developed proprietary designs for tree box filters, but they may also be designed.

The primary functions of tree box filters are bioretention and treatment. Runoff from the contributing drainage area enters the tree box through an inlet where bioretention occurs. Storm water is treated by the physical, chemical, and biological processes that occur within the mulch, soil matrix, and plant roots.

**Design Criteria**

Refer to Design Criteria in the Preface to Fact Sheets for discussion of design criteria parameters. Tree box filters may be proprietary devices; follow manufacturer specifications to determine design criteria on a case-by-case basis.

### Design Criteria

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min. Value</th>
<th>Max. Value</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth to historical high groundwater</td>
<td>2 ft</td>
<td>No Maximum</td>
<td>May be less than 2 feet if tree box filter has impermeable bottom</td>
</tr>
<tr>
<td>Ponding Depth</td>
<td>No minimum</td>
<td>12 in</td>
<td>-</td>
</tr>
</tbody>
</table>

### Pollutant Removal Effectiveness

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sediment</td>
<td>High</td>
</tr>
<tr>
<td>Nutrients</td>
<td>Medium</td>
</tr>
<tr>
<td>Metals</td>
<td>Medium</td>
</tr>
<tr>
<td>Bacteria</td>
<td>High</td>
</tr>
<tr>
<td>Oil/Grease</td>
<td>High</td>
</tr>
</tbody>
</table>

### Primary Functions

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bioretention</td>
<td>Yes</td>
</tr>
<tr>
<td>Volume Retention</td>
<td>Varies¹</td>
</tr>
<tr>
<td>Biofiltration</td>
<td>Yes</td>
</tr>
</tbody>
</table>

¹ Volume retention may be achieved with a bottomless vault
Drawdown Times

- 12 hours
- 72 hours
- 24 to 48 hours preferred. Drawdown time may also depend on local mosquito abatement regulations (ours?)

Design Infiltration Rate

- 0.25 in/hr
- 6 in/hr
- Field testing required for final design. Infiltration rate should be low enough to allow biofiltration processes to occur. During design, infiltration rate, drawdown time, and the soil matrix depth will be directly related.

### Calculation Methods

Tree box filters are typically sized based on their water quality flow but may be sized for their water quality volume when being designed for retention. Both design approaches are dependent on the contributing drainage area and imperviousness. A larger contributing drainage area will require a larger tree box filter.

**Tree Box Filter Effectiveness**

Tree box filters are effective when they maintain their bioretention and biofiltration capabilities. Proper inspection and maintenance of tree box filters will ensure that the chemical and biological processes that treat runoff perform optimally. Qualified inspection crews are necessary to determine if soils and vegetation are healthy.

The tree box must be able to function hydraulically. Flows must be able to pass through the filter without backing up or maintenance will be required.

### Designer Checklist

If the answer to these questions corresponds to a response box that is red, the BMP should either not be used or additional measures need to be taken to address the issue.

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is there adequate space for a tree box filter?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Is there sufficient hydraulic head for tree box filter to connect to storm drain network?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>If retention is desired, will the design infiltration rate permit a reasonable drawdown time?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>If retention is desired, is depth to the historical high groundwater from the filter bottom greater than the jurisdiction’s minimum separation requirement?</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

### Vegetation

Refer to Vegetation Guidance by BMP Type.

### Maintenance

Refer to Maintenance and Maintenance Costs in the Preface to Fact Sheets for general information related to maintenance of bioretention BMPs.
Maintenance Activities

Proper maintenance of tree box filters will be per the manufacturer’s specifications, but it typically includes the following:

<table>
<thead>
<tr>
<th>Inspection</th>
<th>Inspection/Maintenance Frequency</th>
<th>Maintenance Activity</th>
<th>Effort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspect for trash and debris within tree box filter and at inlet and outlet structures</td>
<td>Semiannual (Spring, Fall) or as needed</td>
<td>Remove trash, debris and sediment</td>
<td>Low</td>
</tr>
<tr>
<td>Inspect performance</td>
<td>Semiannual (Spring and Fall)</td>
<td>Replenish media filter layer with new mulch</td>
<td>Medium</td>
</tr>
<tr>
<td>Inspect for invasive species</td>
<td>Semiannual (Spring and Fall)</td>
<td>Prune and weed filter box</td>
<td>Medium</td>
</tr>
</tbody>
</table>

**Tree Box Filters**

Not to scale
Green Roof

A green roof is a vegetated system that is designed to retain and treat rooftop runoff. The primary functions of green roofs are bioretention, volume retention, and filtration. Green roofs capture storm water within the pore space of the soil and vegetation and the moisture is then released through evapotranspiration.

Green roofs can be classified as either extensive or intensive systems. Extensive systems are those in which the soil media is up to 6 inches in depth and support smaller grasses and other vegetative species that do not have deep root systems. Intensive systems are those that support root systems greater than 6 inches such as those from trees and bushes.

The design of green roofs should be done with the coordination of qualified landscaping, structural, and maintenance teams. Vegetation selection and the proper maintenance of vegetation are critical items in the overall performance and functionality of the green roof. The integrity of the roof structure must also be accounted for as large volumes of plants, soils, water, and the weight of the green roof structure will create additional loads on the building.

### Design Criteria

Refer to Design Criteria in the Preface to Fact Sheets for discussion of design criteria parameters.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Extensive</th>
<th>Intensive</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drawdown Time</td>
<td>12 hours</td>
<td>12 hours</td>
<td>-</td>
</tr>
<tr>
<td>Grow Media Depth</td>
<td>&lt; 6 in</td>
<td>6 + in</td>
<td>-</td>
</tr>
</tbody>
</table>

### Pollutant Removal Effectiveness

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Effectiveness&lt;sup&gt;1&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sediment</td>
<td>High</td>
</tr>
<tr>
<td>Nutrients</td>
<td>Medium&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>Metals</td>
<td>High</td>
</tr>
<tr>
<td>Bacteria</td>
<td>High</td>
</tr>
<tr>
<td>Oil/Grease</td>
<td>-</td>
</tr>
</tbody>
</table>

<sup>1</sup> Removal effectiveness is increased for all pollutants as retention increases

<sup>2</sup> Use of organic matter to establish vegetation may increase nutrient leaching

### Primary Functions

<table>
<thead>
<tr>
<th>Function</th>
<th>Extensive</th>
<th>Intensive</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bioretention</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Volume Retention</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biofiltration</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetation</td>
<td>Low growing, low water-use vegetation such as sedum, herbs, grasses, perennials</td>
<td>More complex gardens including the species listed for extensive green roofs, but also incorporating trees and shrubs</td>
<td>-</td>
</tr>
<tr>
<td>----------------------------</td>
<td>---------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
<td>---</td>
</tr>
<tr>
<td>Load</td>
<td>12-54 lb/sf</td>
<td>72 + lb/sf</td>
<td>-</td>
</tr>
<tr>
<td>Roof Slope</td>
<td>5:1 maximum</td>
<td>5:1 maximum</td>
<td>-</td>
</tr>
<tr>
<td>Access</td>
<td>Required for maintenance</td>
<td>Required for maintenance</td>
<td>-</td>
</tr>
<tr>
<td>Irrigation</td>
<td>Simple irrigation. Only needed during droughts and plant establishment if well designed</td>
<td>Complex irrigation</td>
<td>-</td>
</tr>
<tr>
<td>Drainage</td>
<td>Simple drainage system</td>
<td>Complex drainage system</td>
<td>-</td>
</tr>
</tbody>
</table>

**Calculation Methods**

Green roof design is governed by the water quality volume; however, special consideration must also be given to vegetation selection and proper installation with the assistance of a landscape architect or other qualified person. Special consideration must also be given to the structural design of the roof, with the assistance of a structural engineer. Neither of those considerations are considered in this discussion of calculation methods. For the purposes of determining if the green roof retains the water quality volume, the general design steps are:

1. Calculate the water quality volume.
2. Determine the porosity of the engineered soil used within the green roof and the retention volume within the soil.
3. Determine the required footprint to retain the water quality volume.

**Sample Calculations**

Refer to Calculation Methods in the Preface to Fact Sheets for discussion on the equations used.

An extensive green roof system will be designed for a new building with a roof that is 0.37 acres. The entire roof will drain to the green roof. It was decided that an extensive green roof system with a 6-inch soil matrix will be used. Determine the footprint that will be needed to capture the water quality volume.

**Given**

- Roof area: 0.37 ac
- 85th percentile storm depth: 0.60 in
- Porosity of engineered soil: 0.25

**Determine**

Determine the footprint of the green roof.
Calculations

The footprint can be determined through iterative calculations. After iterative calculations, it was found that a footprint of 3,405 square feet will capture the water quality volume.

Pervious area (green roof footprint): 3,405 sf (0.078 ac)

Imperviousness of rooftop: 0.79

Volumetric runoff coefficient, \( R_v \) (See Sample Calculations)

\[
R_v = 0.91i - 0.0204 \quad \text{(Reese method)}
\]

\[
R_v = 0.91(0.79) - 0.0204
\]

\[
R_v = 0.70
\]

Water quality volume, WQV (See Developing the 90th Percentile Volume)

\[
WQV = (0.70)(0.60 \text{ in})(16,117 \text{ sf}) / (12 \text{ in/ft})
\]

WQV = 562 cf

Determine the equivalent storage depth of the engineered soil.

\[
d_{\text{equivalent}} = (0.6 \text{ in})(0.25)
\]

\[
d_{\text{equivalent}} = 1.5 \text{ in}
\]

Determine the required footprint of the green roof to capture the water quality volume.

\[
\text{Footprint} = \frac{WQV}{d_{\text{equivalent}}}
\]

Footprint = 562 cf / (1.5 in)(12 in/ft)

Footprint = 4,496 sf

Green Roof Effectiveness

Green roofs provide an aesthetically pleasing method for retaining and treating storm water runoff. Healthy plants and soils are indications that the green roof is performing as expected. Excessive drainage through the soil layer may be an indication that the soils and vegetation are not retaining runoff; consequently, the evaporation and transpiration processes are not occurring. Qualified horticulturists and/or green roof contractors should be involved in determining the health and effectiveness of the green roof.
**Designer Checklist**

If the answer to these questions corresponds to a response box that is red, the BMP should either not be used or additional measures need to be taken to address the issue.

<table>
<thead>
<tr>
<th>Has a landscape architect been involved in the vegetation selection?</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Has a structural engineer been involved in the green roof design?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Are maintenance crews trained and aware of maintenance responsibilities?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Does the green roof provide storage for 100% of the water quality volume? (If no, it may still be appropriate to construct the green roof if it is technically infeasible to capture 100% of the water quality volume)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Will the green roof partially cover or fully cover the roof?</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Will the green roof be extensive or intensive?</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Vegetation**

Refer to Vegetation Guidance by BMP Type.

**Installation**

Green roof installation should be done with proper oversight from qualified environmental or green roof specialists. Any requirements related to working on rooftops should be followed. During construction, vegetation and the growth media should be protected from erosion until vegetation has been established.

**Additional Guidance**

- Require certificates of compliance to verify that construction items meet specification requirements.

**Installation Costs**

The following cost items are typically associated with rain garden construction.

- Vegetation and landscaping expertise
- Horticulturist expertise
- Structural expertise

**Maintenance**

Refer to Maintenance and Maintenance Costs in the Preface to Fact Sheets for general information related to maintenance of green roofs.
## Maintenance Activities

<table>
<thead>
<tr>
<th>Inspection</th>
<th>Inspection/Maintenance Frequency</th>
<th>Maintenance Activity</th>
<th>Effort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspect weed growth</td>
<td>2-4 weeks during growing season</td>
<td>Remove weeds before they flower</td>
<td>High</td>
</tr>
<tr>
<td>Inspect fertilization</td>
<td>Annually</td>
<td>Apply fertilizer in accordance with manufacturer recommendations. Avoid hottest/driest parts of the year</td>
<td>Medium</td>
</tr>
<tr>
<td>Inspect water retention</td>
<td>Semiannual (Spring and Fall) or as needed</td>
<td>If natural precipitation is not adequate for vegetation, water plants</td>
<td>High</td>
</tr>
</tbody>
</table>

**Notes:**
- Dimensions shown may vary based on site conditions

---

**Green Roof**

Not to scale
Pervious Surfaces

Pervious surfaces such as permeable pavement, concrete pavers, pervious concrete, modular open pavers, and other types of pervious surfaces provide structural support for light vehicle or pedestrian traffic while also providing open space for storm water infiltration.

The primary function of pervious surfaces is volume retention, but some filtration is possible depending on the type of paver and subsurface selected. A modular open paver that, when installed, provides a certain percentage of pervious area in the form of grass, will allow for filtration processes to occur. Another source of filtration is the choker layer directly beneath the pervious surface.

The subsections beneath the pervious surface are typically a choker layer composed of small gravel and a storage layer of larger rock beneath. Underdrains may be required if existing soils do not adequately infiltrate.

Design Criteria

Refer to Design Criteria in the Preface to Fact Sheets for discussion of design criteria parameters.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min. Value</th>
<th>Max. Value</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain Time</td>
<td>12 hours</td>
<td>72 hours</td>
<td>-</td>
</tr>
<tr>
<td>Design Infiltration Rate</td>
<td>0.25 in/hr</td>
<td>6 in/hr</td>
<td>Field testing required for final design</td>
</tr>
<tr>
<td>Depth to Historical High Groundwater</td>
<td>2 ft</td>
<td>No maximum</td>
<td>-</td>
</tr>
</tbody>
</table>

Pollutant Removal Effectiveness

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Effectiveness¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sediment</td>
<td>High</td>
</tr>
<tr>
<td>Nutrients</td>
<td>High</td>
</tr>
<tr>
<td>Metals</td>
<td>High</td>
</tr>
<tr>
<td>Bacteria</td>
<td>High</td>
</tr>
<tr>
<td>Oil/Grease</td>
<td>High</td>
</tr>
</tbody>
</table>

¹ Removal effectiveness is increased for all pollutants as retention increases

Primary Functions

<table>
<thead>
<tr>
<th>Function</th>
<th>Yes¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bioretention</td>
<td></td>
</tr>
<tr>
<td>Volume Retention</td>
<td>Yes</td>
</tr>
<tr>
<td>Biofiltration</td>
<td>Some</td>
</tr>
</tbody>
</table>

¹ Bioretention occurs in the subsurface and not within the pervious surface
**Calculation Methods**

Pervious surface design is governed by the water quality volume. The general design steps are:

1. Calculate the water quality volume.
2. Determine the required thickness of the subsection layers given their porosity and the footprint of the pervious surface area.

**Sample Calculations**

Refer to Calculation Methods in the Preface to Fact Sheets for discussion on the equations used.

A development in the planning phase will have a 0.90-acre parking lot. It is proposed that the parking lot be graded so that runoff is conveyed towards stalls that will be constructed with permeable asphalt.

**Given**

Contributing drainage area: 0.90 ac  
Imperviousness: 0.95  
85th percentile storm event: 0.53 in  
Design infiltration rate: 0.5 in/hr

**Design Goals**

Determine an acceptable area size and depth of the permeable asphalt section.

**Calculations**

Volumetric runoff coefficient, \( R_V \) (See Sample Calculations)

\[
R_V = 1.14i - 0.371 \quad \text{(Granato method when } i \geq 0.55) \\
R_V = 1.14(0.95) - 0.371 \\
R_V = 0.71
\]

Water quality volume, WQV (See Developing the 90th Percentile Volume)

\[
WQV = (0.71)(0.53 \text{ in})(0.90 \text{ ac})(43,560 \text{ sf/ac}) / (12 \text{ in/ft}) \\
WQV = 1,230 \text{ cf}
\]

A permeable asphalt area that is 15 ft x 140 ft (2,100 sf) with the following properties will retain the water quality volume and will have an acceptable drawdown time. See Storage volume within a media with a known porosity for guidance on determining storage within soils.
Drawdown time, $t$

$t = \text{Equivalent storage depth} / \text{Design infiltration rate}$

Weighted porosity, $n_W = 0.37$

Equivalent storage depth $= (20 \text{ in})(0.37)$

Equivalent storage depth $= 7.2 \text{ in}$

$t = (7.2 \text{ in}) / (0.5 \text{ in/hr})$

$t = 14.40 \text{ hrs}$

**Pervious Surface Effectiveness**

Pervious surfaces are effective when runoff from the design storm depth can enter the porous spaces of the pervious surface and successfully infiltrate into the native soil or drain through an underdrain system. Visual inspection of the pervious surface can reveal reasons for failure: for example, sediment-laden sheet flows that are conveyed to the pervious surface, or a down drain might be introducing organic material. Both scenarios are likely to contribute to clogging within the porous spaces of the pervious surface or within the sublayers.

**Designer Checklist**

If the answer to these questions corresponds to a response box that is red, the BMP should either not be used or additional measures need to be taken to address the issue.

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Will an underdrain system be required?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>If an underdrain is needed, is there sufficient head for the underdrain system to drain?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Has the proposed pervious surface performed successfully in similar climate conditions?</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
Installation

Excavation

Pervious surfaces will fail if proper care is not taken during excavation and construction. Excavators and heavy machinery should not be used if infiltration is expected to occur through the underlying soils beneath the pervious surface’s subsection.

Activities During Construction

Avoid using heavy machinery on the revealed soil during construction. Crews should avoid unnecessarily walking on the underlying soils when possible. Compaction of native soils or backfill below the pervious surface subsoils is acceptable if doing so does not prevent infiltration from occurring.

Flows During Construction

Flows during construction should be diverted away from the exposed underlying soil to prevent erosion. Scheduling installation of the pervious surface within a short time span after excavation will minimize the impact of unnecessary storm water flows from entering the excavated area. The introduction of unwanted sediment and storm water flows can be prevented by placing fiber rolls or silt fences around the excavated perimeter during construction.

Additional Guidance

- Require certificates of compliance to verify that construction items meet specification requirements.

Installation Costs

The following cost items are typically associated with construction of pervious surfaces.

- Excavation
- Grading
- Fine grading
- Pervious surface
- Top layer
- Engineered soil
- Choker layer
- Open graded stone
- Geotextile fabric
- Impermeable liner
- Observation wells (if needed)
- Underdrain system (if needed)

**Maintenance**

Refer to Maintenance and Maintenance Costs in the Preface to Fact Sheets for general information related to maintenance of pervious surfaces.

**Maintenance Activities**

<table>
<thead>
<tr>
<th>Inspection</th>
<th>Inspection/Maintenance Frequency</th>
<th>Maintenance Activity</th>
<th>Effort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspect for sediment accumulation</td>
<td>Semiannual (Spring, Fall)</td>
<td>Use vacuum sweeper followed by pressure washing</td>
<td>Medium</td>
</tr>
<tr>
<td>Inspect for weed growth</td>
<td>Semiannual (Spring, Fall)</td>
<td>Remove weeds</td>
<td>Low</td>
</tr>
<tr>
<td>Inspect for standing water on surface or within observation well (if used)</td>
<td>Semiannual (Spring and Fall)</td>
<td>Notify engineer for further inspection</td>
<td>Low</td>
</tr>
<tr>
<td>Inspect surface for deterioration</td>
<td>Annual</td>
<td>Notify engineer for further inspection</td>
<td>Low</td>
</tr>
<tr>
<td>Inspect exfiltration and drainage performance</td>
<td>As needed, at least annually</td>
<td>Notify engineer for further inspection</td>
<td>Medium</td>
</tr>
</tbody>
</table>

Notes:
- Optional items shown for use of underdrain
- Dimensions shown may vary based on site conditions

**Pervious Surfaces**

Not to scale
Infiltration Basin

Infiltration basins are shallow depressions that use existing soils to retain and provide treatment for storm water runoff. Infiltration basins function by capturing and infiltrating runoff over a specified drawdown time.

The primary functions of infiltration basins are bioretention, volume retention, and filtration. The existing soils remove pollutants through physical, chemical, and biological processes before the storm water reaches the groundwater. Filtration occurs as runoff interacts with grass and other vegetation within the basin and as runoff infiltrates through the soil.

Infiltration basins are typically designed for larger drainage areas where it may be impractical for a BMP such as a bioretention area that requires more maintenance of specialized vegetation over a larger area.

Pretreatment of runoff may take place in a forebay that will allow for particulate settling. Forebays are typically sized for a percentage of the water quality volume; typically ranging from 10% to 25%.

Design Criteria

Refer to Design Criteria in the Preface to Fact Sheets for discussion of design criteria parameters.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min. Value</th>
<th>Max. Value</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Quality Volume</td>
<td>0.1 ac-ft (4356 cf)</td>
<td>No maximum</td>
<td>-</td>
</tr>
<tr>
<td>Freeboard</td>
<td>1 ft</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Overflow Spillway Length</td>
<td>3 ft spillway length</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Invert Slope</td>
<td>0% (flat basin bottom)</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Interior Side Slope</td>
<td>No minimum</td>
<td>3H:1V</td>
<td>-</td>
</tr>
</tbody>
</table>

Pollutant Removal Effectiveness

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sediment</td>
<td>High</td>
</tr>
<tr>
<td>Nutrients</td>
<td>High</td>
</tr>
<tr>
<td>Metals</td>
<td>High</td>
</tr>
<tr>
<td>Bacteria</td>
<td>High</td>
</tr>
<tr>
<td>Oil/Grease</td>
<td>High</td>
</tr>
</tbody>
</table>

Primary Functions

<table>
<thead>
<tr>
<th>Function</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bioretention</td>
<td></td>
</tr>
<tr>
<td>Volume Retention</td>
<td></td>
</tr>
<tr>
<td>Biofiltration</td>
<td></td>
</tr>
<tr>
<td>Drawdown Time</td>
<td>24 hours</td>
</tr>
<tr>
<td>---------------</td>
<td>----------</td>
</tr>
<tr>
<td>Design Infiltration Rate</td>
<td>0.25 in/hr</td>
</tr>
<tr>
<td>Depth to Historical High Groundwater</td>
<td>2 ft</td>
</tr>
</tbody>
</table>

Calculation Methods

Infiltration basin design is governed by the water quality volume. The general design steps are:

1. Calculate the water quality volume.
2. Determine the geometry of the infiltration basin.
3. Based on the basin geometry, determine the ponding depth required to hold the water quality volume.
4. Calculate the drawdown time.

Calculate the water quality outlet elevation.

Sample Calculations

Refer to Calculation Methods in the Preface to Fact Sheets for discussion on the equations used.

A 13.50-acre highway development routes all of its storm water to a single infiltration basin. A safety factor of 1.50 is required for infiltration design within the jurisdiction. Adjacent soils are ‘A’ and are part of the drainage area.

Given

Contributing drainage area: 13.50 ac

Imperviousness: 0.65

90th percentile storm depth: 0.55 in

Soil infiltration rate: 1.35 in/hr

Design Goals

Determine the bottom footprint of the infiltration basin and the elevation of the water quality outlet above the basin bottom.

Calculations

Volumetric runoff coefficient, $R_v$ (See Sample Calculations)

$$R_{v,A} = 0.844^{0.302} \text{ (} R_v \text{ based on hydrologic soil group)}$$
RV = 0.84(0.65)^{1.302}

Water quality volume, WQV (See Developing the 90th Percentile Volume)

\[
WQV = (0.48)(0.55 \text{ in})(13.50 \text{ ac})(43,560 \text{ sf/ac}) / (12 \text{ in/ft})
\]

WQV = 12,921 cf

Minimum footprint, \(A_{\text{min}}\) (See Minimum footprint area)

\[
A_{\text{min}} = (12)(1.50)(12,921 \text{ cf}) / (1.35 \text{ in/hr})(48 \text{ hrs})
\]

\[
A_{\text{min}} = 3,589 \text{ sf}
\]

The water quality volume will infiltrate into the existing soil in 48 hours if the infiltration basin bottom is 4,276 square feet. However, this does not mean that the infiltration basin bottom is limited to 4,276 square feet.

Water quality elevation, \(E_{\text{wq}}\)

The elevation of a water quality outlet above the basin bottom is determined by assuming that infiltration occurs only through the bottom of the basin and not through the sides.

\[
E_{\text{wq}} = \frac{WQV}{A_{\text{min}}}
\]

\[
E_{\text{wq}} = \frac{12,921 \text{ cf}}{3,589 \text{ sf}}
\]

\[
E_{\text{wq}} = 3.60 \text{ ft}
\]

**Infiltration Basin Effectiveness**

Effective infiltration basins take advantage of open spaces for retaining and treating storm water. Established vegetation with adequate coverage is an indication of a healthy infiltration basin along with minimal sediment and lack of invasive vegetation. Side slopes should be stable and show little to no signs of erosion or rilling. Slope sloughing is an indication that geotechnical remediation is needed.

During the design storm event, infiltration basins should, at most, pond up to the water quality outlet. After the rain event, runoff within the basin should infiltrate through the bottom soils within the design drawdown time.

**Designer Checklist**

If the answer to these questions corresponds to a response box that is red, the BMP should either not be used or additional measures need to be taken to address the issue.

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does groundwater meet the jurisdiction’s minimum separation requirement?</td>
<td>☐</td>
</tr>
<tr>
<td>Is there available right-of-way, property, or easement for the infiltration basin?</td>
<td>☐</td>
</tr>
</tbody>
</table>
Is contaminated groundwater present at the infiltration basin location?  

Is the water quality volume above the 4,356 cf threshold  

Does the infiltration basin provide storage for 100% of the water quality volume? (If no, it may still be appropriate to construct the infiltration basin if it is technically infeasible to capture 100% of the water quality volume)  

Do utility conflicts make installation of the infiltration basin technically infeasible?  

Do geotechnical condition exist that compromise the stability of the infiltration basin or surrounding structures?  

Does an overflow outlet structure or bypass mechanism exist?  

Is a fence required?  

Vegetation

Refer to Vegetation Guidance by BMP Type.

Installation

Excavation

Installation of infiltration basins is a relatively straightforward process of excavation and grading; however, the basin will fail if proper care is not taken during construction. Excavators and heavy machinery should not be used within the basin area to avoid soil compaction.

Activities During Construction

Avoid using heavy machinery within the infiltration basin footprint during construction as doing so will compact the soils and diminish their infiltrating capabilities. Installation of an outlet structure may require machinery.

Flows During Construction

Flows during construction should be diverted away from the infiltration basin to prevent construction site sediment from clogging soils. Seeding or laying turf sod should occur within a short time span after excavation to minimize the impact of unnecessary storm water flows from entering the basin area. The introduction of unwanted sediment can be prevented by placing fiber rolls or silt fences around the basin perimeter during construction.

Additional Guidance

• Require certificates of compliance to verify that construction items meet specification requirements.

• Follow landscaping guidance to ensure that vegetation establishes after installation.
**Installation Costs**

The following cost items are typically associated with infiltration basin construction.

- Excavation
- Grading
- Outlet structure or upstream bypass structure (for larger storm events)
- Forebay and associated items: outlet protection, forebay wall, and connection between forebay and main bay.

**Maintenance**

Refer to Maintenance and Maintenance Costs in the Preface to Fact Sheets for general information related to maintenance of infiltration BMPs.

**Maintenance Activities**

<table>
<thead>
<tr>
<th>Inspection</th>
<th>Inspection/Maintenance Frequency</th>
<th>Maintenance Activity</th>
<th>Effort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspect for trash and debris at inlet and outlet structures</td>
<td>Semiannual (Spring, Fall) or as needed</td>
<td>Remove and dispose of trash and debris</td>
<td>Low</td>
</tr>
<tr>
<td>Inspect grass length</td>
<td>As needed</td>
<td>Mow basin grass</td>
<td>Low</td>
</tr>
<tr>
<td>Inspect pre-treatment diversion structures for sediment build-up</td>
<td>Semiannual (Spring and Fall)</td>
<td>Remove and dispose of sediment buildup</td>
<td>Low</td>
</tr>
<tr>
<td>Inspect topsoil for sediment build-up</td>
<td>Semiannual (Spring, Fall) or as needed</td>
<td>Notify engineer for further inspection</td>
<td>Low</td>
</tr>
<tr>
<td>Inspect for standing water above trench or within observation well (if used)</td>
<td>Semiannual (Spring, Fall)</td>
<td>Notify engineer for further inspection</td>
<td>Low</td>
</tr>
</tbody>
</table>
Notes:
- Dimensions shown may vary based on site conditions.
- Forebay connection type to main bay will vary: outlet pipe, gabion wall, notched concrete wall, and others are acceptable.
- Consider upstream bypass for large storm events.

**Infiltration Basin**

Not to scale
Infiltration Trench

Infiltration trenches are linear excavations that are backfilled with a combination of gravel, open graded stone, and sand layers that provide storage within the pore space of the specified layers. Although typically linear, infiltration trenches can be any shape provided that the footprint and depth are sized to retain the water quality volume.

The primary function of infiltration trenches is volume retention. The trench is designed such that the water quality volume is retained and stored within the gravel and sand layers. Depending on the design of the trench, pollutant removal occurs via filtration as runoff passes through an initial pea gravel layer and ultimately through the bottom sand layer. A geotextile fabric is also recommended along the sidewalls of the trench and under the pea gravel layer.

**Design Criteria**

Refer to Design Criteria in the Preface to Fact Sheets for discussion of design criteria parameters.

<table>
<thead>
<tr>
<th>Design Criteria</th>
<th>Min. Value</th>
<th>Max. Value</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth of Trench</td>
<td>2 ft</td>
<td>No maximum</td>
<td>Maximum depth determined by jurisdiction</td>
</tr>
<tr>
<td>Longitudinal Trench Slope</td>
<td>0%</td>
<td>1%</td>
<td>-</td>
</tr>
<tr>
<td>Width</td>
<td>2 ft</td>
<td>No maximum</td>
<td>-</td>
</tr>
<tr>
<td>Drawdown Time</td>
<td>12 hours</td>
<td>72 hours</td>
<td>Field testing required for final design</td>
</tr>
<tr>
<td>Design Infiltration Rate</td>
<td>0.25 in/hr</td>
<td>6 in/hr</td>
<td>-</td>
</tr>
<tr>
<td>Depth to Historical High Groundwater</td>
<td>2 ft</td>
<td>No maximum</td>
<td>-</td>
</tr>
</tbody>
</table>

**Pollutant Removal Effectiveness**

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sediment</td>
<td>High</td>
</tr>
<tr>
<td>Nutrients</td>
<td>High</td>
</tr>
<tr>
<td>Metals</td>
<td>High</td>
</tr>
<tr>
<td>Bacteria</td>
<td>High</td>
</tr>
<tr>
<td>Oil/Grease</td>
<td>High</td>
</tr>
</tbody>
</table>

*Bioretention occurs in subsurface and not within the trench*
Calculation Methods

Infiltration trench design is governed by the water quality volume. The general design steps are:

1. Calculate the water quality volume.
2. Determine the trench footprint.
3. Based on the trench geometry, porosity of the trench layers, and ponding depth (if any), determine the trench depth.
4. Calculate the drawdown time.

Sample Calculations

Refer to Calculation Methods in the Preface to Fact Sheets for discussion on the equations used.

A proposed park will have a concrete plaza that is 0.40 acres. Runoff from the plaza will flow towards a pervious area. To meet the jurisdiction’s retention requirement, the design team proposes to install an infiltration trench adjacent to the plaza.

Given

Contributing drainage area: 0.40 ac
Imperviousness: 1.00
90th percentile storm depth: 0.70 in

Design Goals

Determine that the geometry of an infiltration trench that will retain the water quality volume.

Calculations

Volumetric runoff coefficient, $R_V$ (See Sample Calculations)

$R_V = 0.91i - 0.0204$ (Reese method)

$R_V = 0.91(1.0) - 0.0204$

$R_V = 0.89$

Water quality volume, $WQV$ (See Developing the 90th Percentile Volume)

$WQV = (0.89)(0.70 \text{ in})(0.40 \text{ ac})(43,560 \text{ sf/ac}) / (12 \text{ in/ft})$

$WQV = 904 \text{ cf}$

There are 100 linear feet adjacent to the plaza that are available for the infiltration trench. Based on the grading at the trench, ponding above the trench will not occur. A trench that is 4.5 ft wide with the following properties will be able to retain the water quality volume. See Storage volume within a media with a known porosity for guidance on determining storage within soils.
The equivalent storage depth of the water quality volume within the 4,500-sf infiltration trench is:

\[ d = \frac{911.2 \text{ cf}}{4,500 \text{ sf}} \]

\[ d = 2 \text{ ft} \]

\[ d = 24 \text{ in} \]

Drawdown time, \( t \)

The infiltration rate of the surrounding soils is 1.5 in/hr.

\[ t = \text{Equivalent storage depth} / \text{infiltration rate} \]

\[ t = \frac{24 \text{ in}}{1.5 \text{ in/hr}} \]

\[ t = 16 \text{ hrs} \]

**Infiltration Trench Effectiveness**

Effective infiltration trenches take advantage of limited or narrow spaces where bioretention areas or infiltration basins are impractical. Visible sediment buildup on the top layer of the trench could be an indication that clogging is present within the trench or that runoff is simply passing over the trench and not being captured. Although some vegetation intrusion or organic debris is likely not a concern, proper grooming and maintenance will contribute to a trench’s extended life-span.

During the design storm event, runoff should be conveyed toward and enter the trench per the design plans. Recent new construction, regrading, or resurfacing within the contributing drainage area should be noted as it may impact flow paths or the introduction of new pollutants.

**Designer Checklist**

If the answer to these questions corresponds to a response box that is red, the BMP should either not be used or additional measures need to be taken to address the issue.
<table>
<thead>
<tr>
<th>Does groundwater meet the jurisdiction’s minimum separation requirement?</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is the infiltration rate of the existing soils within acceptable rates?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Is contaminated groundwater present at the infiltration basin location?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Do utility conflicts make installation of the infiltration basin technically infeasible?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Do geotechnical condition exist that compromise the stability of the infiltration basin or surrounding structures?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Does the infiltration basin provide storage for 100% of the water quality volume? (If no, it may still be appropriate to construct the infiltration basin if it is technically infeasible to capture 100% of the water quality volume)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Does an overflow outlet structure or bypass mechanism exist?</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

**Vegetation**

Vegetation is not typical for an infiltration trench.

**Installation**

**Excavation**

Excavation for infiltration trenches is typically linear but alternate geometries are possible. During excavation, light machinery should be used to avoid excessive compaction.

**Activities During Construction**

Avoid using heavy machinery within the infiltration trench footprint during construction as doing so will compact the soils and diminish their infiltrating capabilities.

**Flows During Construction**

Flows during construction should be diverted away from the infiltration trench to prevent construction site sediment from clogging soils. The introduction of unwanted sediment can be prevented by placing fiber rolls or silt fences around the trench perimeter during construction.

**Additional Guidance**

- Require certificates of compliance to verify that construction items meet specification requirements.

**Installation Costs**

The following cost items are typically associated with infiltration trench construction.

- Excavation
- Landscaping and vegetation
- Pea gravel
- Open graded stone
- Sand layer
- Geotextile separator

**Maintenance**

Refer to Maintenance and Maintenance Costs in the Preface to Fact Sheets for general information related to maintenance of infiltration BMPs.

**Maintenance Activities**

<table>
<thead>
<tr>
<th>Inspection</th>
<th>Inspection/Maintenance Frequency</th>
<th>Maintenance Activity</th>
<th>Effort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspect for trash and debris at inlet and outlet structures</td>
<td>Semiannual (Spring, Fall) or as needed</td>
<td>Remove and dispose of trash and debris</td>
<td>Low</td>
</tr>
<tr>
<td>Inspect grass length</td>
<td>As needed</td>
<td>Mow basin grass</td>
<td>Low</td>
</tr>
<tr>
<td>Inspect pre-treatment diversion structures for sediment build-up</td>
<td>Semiannual (Spring and Fall)</td>
<td>Remove and dispose of sediment buildup</td>
<td>Low</td>
</tr>
<tr>
<td>Inspect tree growth near trench</td>
<td>Semiannual (Spring, Fall)</td>
<td>Remove trees in vicinity of the trench</td>
<td>Low</td>
</tr>
<tr>
<td>Inspect for standing water above trench or within observation well (if used)</td>
<td>Semiannual (Spring, Fall)</td>
<td>Notify engineer for further inspection</td>
<td>Low</td>
</tr>
</tbody>
</table>
Overflow berm or curb as needed

Pea gravel

Perforated pipe observation well (optional)

Vegetated strip pretreatment as needed

Geotextile fabric

Open graded stone

3” - 12” Sand layer

Minimum distance from trench bottom to water table per jurisdiction

Notes:
- Dimensions shown may vary based on site conditions

Infiltration Trench
Not to scale
Dry Well

Dry wells are underground storage areas that are sized to retain the water quality volume and infiltrate runoff into the existing soils.

The primary functions of dry wells are bioretention and volume retention. Bioretention does not occur within the dry well but occurs in the native soils immediately surrounding the dry well.

Dry wells contribute to aquifer recharge and as such classify as a subclass of Underground Injection Control (UIC) Class V wells. Refer to the DWQ website on storm water drainage wells (link below) for more information relating to the UIC Program.


**Design Criteria**

Refer to Design Criteria in the Preface to Fact Sheets for discussion of design criteria parameters.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min. Value</th>
<th>Max. Value</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth to Historical High Groundwater</td>
<td>2 ft</td>
<td>No maximum</td>
<td></td>
</tr>
<tr>
<td>Drawdown Time</td>
<td>12 hours</td>
<td>72 hours</td>
<td></td>
</tr>
<tr>
<td>Building Setback</td>
<td>10 ft</td>
<td>No maximum</td>
<td></td>
</tr>
<tr>
<td>Design Infiltration Rate</td>
<td>0.25 in/hr</td>
<td>6 in/hr</td>
<td>Field testing required for final design</td>
</tr>
</tbody>
</table>

**Pollutant Removal Effectiveness**

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sediment</td>
<td>High</td>
</tr>
<tr>
<td>Nutrients</td>
<td>High</td>
</tr>
<tr>
<td>Metals</td>
<td>High</td>
</tr>
<tr>
<td>Bacteria</td>
<td>High</td>
</tr>
<tr>
<td>Oil/Grease</td>
<td>High</td>
</tr>
</tbody>
</table>

**Primary Functions**

<table>
<thead>
<tr>
<th>Function</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bioretention</td>
<td>Yes</td>
</tr>
<tr>
<td>Volume Retention</td>
<td>Yes</td>
</tr>
<tr>
<td>Biofiltration</td>
<td>No</td>
</tr>
</tbody>
</table>
Calculation Methods

Dry well design is governed by the water quality volume. The general design steps are:

1. Calculate the water quality volume.
2. Determine the dry well geometry.
3. Determine the drawdown time.

Sample Calculations

Refer to Calculation Methods in the Preface to Fact Sheets for discussion on the equations used.

A drywell is proposed at the downstream end of a swale that is being proposed adjacent to a new road.

Given

Contributing drainage area: 0.72 ac
Imperviousness: 0.40
90th percentile storm depth: 0.59 in
Infiltration rate of surrounding soil: 3 in/hr

Design Goals

Determine the dry well geometry required to hold the water quality volume.

Calculations

Volumetric runoff coefficient, RV (See Sample Calculations)

\[ R_V = 0.225i + 0.05 \] (Granato method when \( i < 0.55 \))

\[ R_V = 0.225(0.40) + 0.05 \]

\[ R_V = 0.14 \]

Water quality volume, WQV (See Developing the 90th Percentile Volume)

\[ WQV = (0.14)(0.59 \text{ in})(0.72 \text{ ac})(43,560 \text{ sf/ac}) / (12 \text{ in/ft}) \]

\[ WQV = 220 \text{ cf} \]

A dry well that has a 6 ft radius and is 8 ft deep will hold 226 cf.

For a conservative estimate at the planning stage, the dry well’s drawdown time is based on the infiltration rate of the surrounding soil and ignores the effects of the pressure head within the dry well. A more detailed determination of the drawdown should be done for final design.

Drawdown time, \( t \)
t = Dry well depth / infiltration rate
\[ t = \frac{(8 \text{ ft})(12 \text{ in/ft})}{3 \text{ in/hr}} \]
\[ t = 32 \text{ hrs} \]

**Dry Well Effectiveness**

Effective dry wells optimize infiltrating soils within limited space to retain storm water runoff while not introducing stability concerns to nearby development or structures. The design storm volume within a functioning dry well will drawdown within the design time and leave no standing water inside of the well. Pretreatment should be provided prior to entering the dry well and the pretreatment method should be determined based on the expected pollutants. Entry to the dry well should be unobstructed and free of debris that will restrict flows from entering.

**Designer Checklist**

If the answer to these questions corresponds to a response box that is red, the BMP should either not be used or additional measures need to be taken to address the issue.

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does groundwater meet the jurisdiction’s minimum separation requirement?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is the infiltration rate of the existing soils within acceptable rates?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is contaminated groundwater present at the dry well location?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do utility conflicts make installation of the infiltration dry well technically infeasible?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do geotechnical condition exist that compromise the stability of the infiltration dry well or surrounding structures?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is pretreatment provided upstream of or within the dry well</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Installation**

**Excavation**

Excavate area in which dry well will be placed.

**Activities During Construction**

Take proper safety measures to cover the excavated dry well area before putting the dry well in place. If the dry well is designed to infiltrate through the well bottom, place and level gravel within the excavation to provide a foundation for the well structure.

**Flows During Construction**

Flows during construction can enter the dry well if the grated manhole lid contains a filtering material.
**Additional Guidance**

- Require certificates of compliance to verify that construction items meet specification requirements.
- Obtain a permit through the UIC Program

**Installation Costs**

The following cost items are typically associated with dry well construction.

- Excavation
- Dry well
- Permit application fees for Class V Injection Wells
- Gravel-filled annular space surrounding dry well
- Pretreatment upstream of dry well
- Overflow connection to downstream system
- Gravel foundation (optional)

**Maintenance**

Refer to Maintenance and Maintenance Costs in the Preface to Fact Sheets for general information related to maintenance of dry wells.

**Maintenance Activities**

<table>
<thead>
<tr>
<th>Inspection</th>
<th>Inspection/Maintenance Frequency</th>
<th>Maintenance Activity</th>
<th>Effort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspect water depth</td>
<td>Initially after every major storm, then annually</td>
<td>Remove and dispose of built up sediment when build up causes reduction in detention capacity. Notify the engineer.</td>
<td>Medium</td>
</tr>
<tr>
<td>Inspect inlet for obstructions</td>
<td>Semiannual (Spring and Fall) or as needed</td>
<td>Remove obstructions</td>
<td>Low</td>
</tr>
<tr>
<td>Inspect structural elements</td>
<td>As determined by jurisdiction</td>
<td>Repair or reconstruct deficient structural components</td>
<td>Medium</td>
</tr>
</tbody>
</table>
Dry Well

Not to scale
Underground Infiltration Galleries

Source: StormTech

Underground storage devices are proprietary alternatives to above ground storage when space at the project site is limited. They may be sized for the 90th percentile volume similar to how they are sized for flood control volumes. When underground storage is used for water quality, its primary functions are bioretention as runoff infiltrates into the underlying soil and volume retention. They are constrained by subsurface conditions such as depth to the historical high groundwater, soil infiltration rates, and other site-specific constraints that prevent infiltration. Designing underground storage devices is done with the assistance of the device manufacturer.

Pretreatment for underground systems will vary. Pretreatment removes sediment that will potentially clog elements of the underground system such as geotextile fabrics or bedding layers. If the manufacturer does not include a pretreatment system as part of the device, it may be necessary to design a separate pretreatment system such as a settling basin upstream before entering the underground system.

Underground systems are typically modular and allow for configurations that range from large areas such as would be needed underneath a parking lot to linear installations like within a park strip or underneath a bioswale.

**Design Criteria**

Underground storage devices are proprietary devices; follow manufacturer specifications to determine design criteria on a case-by-case basis.

**Calculation Methods**

Underground storage device design is governed by the water quality volume (when sizing for the water quality event). It is not uncommon for manufacturers to provide sizing tools based on the desired storage volume. The general design steps are:

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sediment</td>
<td>High</td>
</tr>
<tr>
<td>Nutrients</td>
<td>High</td>
</tr>
<tr>
<td>Metals</td>
<td>High</td>
</tr>
<tr>
<td>Bacteria</td>
<td>High</td>
</tr>
<tr>
<td>Oil/Grease</td>
<td>High</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Primary Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bioretention</td>
</tr>
<tr>
<td>Volume Retention</td>
</tr>
<tr>
<td>Biofiltration</td>
</tr>
</tbody>
</table>
1. Calculate the water quality volume.

2. Determine manufacturer’s recommendations given the water quality volume and other site conditions.

**Underground Infiltration Effectiveness**

With regular maintenance and inspection, it can be determined if the underground system is performing as expected. As part of the design process, determine how the system will be inspected. Possible inspection methods include the use of observation wells or structural vaults at tie-in locations with the site’s storm drain network. Inspect for any soil displacement or movement at the perimeter of the system and any depressions above the system.

**Designer Checklist**

If the answer to these questions corresponds to a response box that is red, the BMP should either not be used or additional measures need to be taken to address the issue.

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does groundwater meet the minimum separation requirement?</td>
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<td></td>
</tr>
<tr>
<td>Is the infiltration rate of the existing soils within acceptable rates?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is contaminated groundwater present?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do utility conflicts make installation of the device technically infeasible?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do geotechnical conditions exist that would compromise the stability of the device or surrounding structures?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is pretreatment provided upstream of or within the underground storage device?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is the soil bearing capacity of the underlying soil sufficient for the system?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Will the underground system support the expected loads above it?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Installation**

**Excavation**

Excavate the footprint of the underground system.

**Activities During Construction**

Avoid using heavy machinery within the excavated footprint during construction as doing so will compact the soils and diminish their infiltrating capabilities. Avoid using heavy machinery on top of the underground system as well. Follow all installation guidelines from the manufacturer.

**Flows During Construction**
Flows during construction should be diverted away from the excavated area to prevent construction site sediment from clogging soils.

**Additional Guidance**

- Follow all manufacturer’s requirements.

**Installation Costs**

The following cost items are typically associated with installation of underground storage systems.

- Excavation
- Geotextile fabric
- Underground storage devices
- Aggregate (bedding, overlay, other as needed)
- Observation wells
- Pretreatment upstream of system (if not provided)

**Maintenance**

Underground systems are typically designed with accessible pretreatment areas such as a manhole. Refer to manufacturer’s guidelines.

**Maintenance Activities**

Typical maintenance activity includes removal of sediment or debris within the pretreatment area. High pressure washing of geotextile fabrics or replacement of filter fabrics may also be needed. Refer to manufacturer’s guidelines for specific activities and frequency of inspections.

**Manufacturers**

The following table of manufacturers is for reference only and does not constitute an endorsement.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Device Type(s)</th>
<th>URL</th>
</tr>
</thead>
<tbody>
<tr>
<td>StormTech</td>
<td>Chambers</td>
<td><a href="http://www.stormtech.com/">http://www.stormtech.com/</a></td>
</tr>
<tr>
<td>ACF Environmental</td>
<td>Chambers, R Tanks</td>
<td><a href="https://www.acfenvironmental.com">https://www.acfenvironmental.com</a></td>
</tr>
<tr>
<td>ConTech</td>
<td>Chambers</td>
<td><a href="https://www.conteches.com">https://www.conteches.com</a></td>
</tr>
</tbody>
</table>
Notes:
- Configurations will vary
- Impermeable liner around underground system if groundwater concerns exist
- If impermeable liner is used, provide outlet to prevent standing water

Underground Infiltration Gallery

Not to scale
Harvest and Reuse

Pollutant Removal Effectiveness:

Pollutant removal will vary based on the ultimate use of the harvested runoff.

<table>
<thead>
<tr>
<th>Primary Functions</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bioretention</td>
<td>Varies</td>
</tr>
<tr>
<td>Volume Retention</td>
<td>Yes</td>
</tr>
<tr>
<td>Biofiltration</td>
<td>Varies</td>
</tr>
</tbody>
</table>

Harvest and reuse refers to any type of runoff collection system that captures rainfall, stores it temporarily, and reuses it for irrigation, landscaping, or other non-potable uses. Harvest and reuse systems inherently retain the volume of runoff that it captures. Depending on the subsequent use after being captured, they also provide bioretention and filtration to the released runoff.

Harvest and reuse systems may be used in lieu of directly connecting rooftop drains to storm sewer systems; where downdrains discharge to impervious surfaces and the opportunity for irrigation or landscaping exists; as part of a home owner’s irrigation plan; or for any other non-potable purpose where storm water is determined to be acceptable such as vehicle or machinery washing.

As of 2010, Utah’s legislative code 73-3-1.5 requires that if more than 100 gallons of rainwater (13.4 cf) are captured, it must be registered through the Utah Division of Water Rights (https://waterrights.utah.gov/forms/rainwater.asp). The code also limits the total capture to 2,500 gallons (334.2 cubic feet). See the code for additional requirements.

Design Criteria

Design criteria for harvest and reuse devices or systems will vary widely. The governing principles of harvest and reuse are based on the system’s function and capacity. For example, a rain barrel that provides occasional irrigation to a flower bed should be appropriately sized for the 90th percentile volume and be able to release the volume within an appropriate time that does not flood out the flower bed. A larger harvest and reuse system, such as an underground detention vault or above ground pond will be required to meet geotechnical or structural design criteria. The applications of harvest and reuse systems are endless; specific design criteria should be determined on a case-by-case basis with site-specific consideration.
**Calculation Methods**

Harvest and reuse systems are governed by the water quality volume. The general design steps are:

1. Calculate the water quality volume.
2. Size device for the water quality volume.

**Sample Calculations**

Refer to Calculation Methods in the Preface to Fact Sheets for discussion on the equations used.

A commercial development will have two buildings with roofs that are 2,500 square feet each. Rain barrels that will release to flower beds will be included as part of the design. Each roof is considered one drainage area.

**Given**

Contributing drainage area: 2,500 sf

Contributing drainage area: 0.057 ac

Imperviousness: 1.00

90th percentile storm depth: 0.60 in

**Design Goals**

Capture all runoff from the 90th percentile storm within rain barrels.

**Calculations**

Volumetric runoff coefficient, $R_v$ (See Sample Calculations)

$$R_v = 0.91i - 0.0204 \text{ (Reese method)}$$

$$R_v = 0.91(1.0) - 0.0204$$

$$R_v = 0.89$$

Water quality volume, $WQV$ (See Developing the 90th Percentile Volume)

$$WQV = (0.89)(0.60 \text{ in})(0.057 \text{ ac})(43,560 \text{ sf/ac}) / (12 \text{ in/ft})$$

$$WQV = 111 \text{ cf}$$

$$WQV = 832 \text{ gallons}$$

If 55-gallon rain barrels are used, 15 rain barrels will be needed for each roof and the capture will need to be registered with the Division of Water Rights.

**Harvest and Reuse Effectiveness**
The effectiveness of a harvest and reuse system is dependent on its use. Detention devices should be free of standing water to prevent stagnation and vector concerns. Systems that provide irrigation or that are part of landscaping features should be inspected regularly to ensure proper performance.

**Designer Checklist**

If the answer to these questions corresponds to a response box that is red, the BMP should either not be used or additional measures need to be taken to address the issue.

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Will stagnation of runoff be prevented by frequent release of the harvested runoff?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Does quantity of harvested runoff require registration with the Division of Water Rights?</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

**Installation**

Installation of harvest and reuse systems will vary depending on its use. Rain barrels can simply be connected to a down drain. More complicated systems require additional coordination.

Depending on the quantity of runoff being harvested, it will be necessary to register the detention device with the Division of Water Rights.

**Installation Costs**

The following cost items are typically associated with harvest and reuse systems.

- Detention device
- Upstream connection to detention device
- Other items will be dependent on site-specific use

**Maintenance**

Refer to Maintenance and Maintenance Costs in the Preface to Fact Sheets for general information related to maintenance of harvest and reuse systems.

**Maintenance Activities**

<table>
<thead>
<tr>
<th>Inspection/Maintenance Activity</th>
<th>Frequency</th>
<th>Maintenance Activity</th>
<th>Effort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspect for mosquitos</td>
<td>Semiannual (Spring and Fall)</td>
<td>Implement larvicide or other remediation</td>
<td>Low</td>
</tr>
<tr>
<td>Inspect harvesting device for leaking</td>
<td>Semiannual (Spring and Fall)</td>
<td>Replace harvesting device</td>
<td>Low</td>
</tr>
<tr>
<td>Inspect condition of system components</td>
<td>Semiannual (Spring and Fall)</td>
<td>Replace or repair components</td>
<td>Medium</td>
</tr>
</tbody>
</table>
Notes:
- Configurations and applications may vary

Harvest and Reuse
Not to scale
EXHIBIT A

{Include this EXHIBIT with this agreement document to be recorded. The text below that does not apply will need to be deleted along with this instruction text.}

{For properties that are not a part of a residential or commercial subdivision, provide the parcel number and a legal description for the property.}

Replace this text with the parcel #
Replace this text with the legal description

OR

{For properties that are a LOT in a commercial subdivision, provide the LOT and parcel number and refer to the newly recorded subdivision by the title it is recorded by in the Salt Lake County Recorder’s Office.}

Replace this text with the parcel #
Replace this text with the LOT #
Replace this text with the plat title and the township and range as it is recorded on the plat

OR

{For properties that are a private residential subdivision, refer to the newly recorded subdivision by the title it is recorded by in the Salt Lake County Recorder’s Office.}

All parcels of
Replace this text with the plat title and township and range as it is recorded on the plat.
EXHIBIT B

Long-Term Stormwater Management Plan

for:

Insert Development Name
Address
City, State, Zip Code
PURPOSE AND RESPONSIBILITY

As required by the Clean Water Act and resultant local regulations, including Summit County Municipal Separate Storm Sewer Systems (MS4) Permit, those who develop land are required to build and maintain systems to minimize litter and contaminants in stormwater runoff that pollute waters of the State.

This Long-Term Stormwater Management Plan (LTSWMP) describes the systems, operations and the minimum standard operating procedures (SOPs) necessary to manage pollutants originating from or generated on this property. Any activities or site operations at this property that contaminate water entering the City’s stormwater system and generate loose litter must be prohibited, unless SOPs are written to manage those activities or operations, and amended into this LTSWMP.

The NAME OF RIVER River is impaired but does not have a TMDL. The LTSWMP is aimed at addressing these impairments in addition to all other pollutants that can be generated by this property.

CONTENTS

SECTION 1: SITE DESCRIPTION, USE AND IMPACT
SECTION 2: TRAINING
SECTION 3: RECORDKEEPING
SECTION 4 APPENDICES
SECTION 1: SITE DESCRIPTION, USE AND IMPACT

The site infrastructure at our site is limited at controlling and containing pollutants and our operations if managed improperly can contaminate the environment. This LTSWMP includes standard operations procedures (SOPs) that are intended to compensate for the pollution containment limitations of our site infrastructure and direct our maintenance operations to responsibly manage our grounds.

Instructions:

— The purpose of this section is to help the Operator understand that the property can impact water quality and why it is important to maintain the property according to this LTSWMP.
— Describe site infrastructure, structural controls and any low impact development designs (LIDs) necessary to control and contain pollutants. Identify the limitations of the infrastructure at controlling and containing pollutants. It is important the Operator, staff, service contractors and anyone else involved in onsite operations and activities understand the unique exposures, operations and infrastructure which impact the storm drain systems.
— Describe both business operations and maintenance activities that generate pollutants.
— Briefly identify the need for SOP that are necessary to compensate for the limitations of the site infrastructure and operations. Create SOPs to manage the site functions, and maintenance operations. Include the SOPs in Appendix B.
— Refer to the LTSWMP example provided as a separate download to create the site descriptions required in this Section.
— Generally most sites will have the following infrastructure listed in this Section, however, the designer is expected to add or remove descriptions to accurately represent the unique site infrastructure needing controls.

Parking, Sidewalk and flatwork

[Describe the impervious infrastructure and how its presence and maintenance practices can impact water quality. When paved surfaces are designed to include LID infrastructure, describe the water quality benefits. Incorporating LID infrastructure can reduce the level of controls necessary for SOPs. Identify the necessary SOPs and include them in Appendix B]

[The following text is suggested for your convenience. If used the property owner and design agent are expected modify the suggested text to represent the sites unique infrastructure, operations and conditions]

Any sediment, leaves, debris, spilt fluids or other waste that collects on our parking lots and sidewalks will be carried by runoff to our storm drain inlets. This waste material will settle in our storm drain system increasing maintenance cost and solid and dissolved waste in our runoff can pass through our system ultimately polluting NAME OF RIVER River.

Maintenance involves regular sweeping, but it can also involve pavement washing to remove stains, slick spots and improve appearance when necessary. Use our Pavement Maintenance and the Pavement Washing SOPs to manage pollutants that collect on our pavements.

Landscaping

Summit County Long-Term Stormwater Management Plan 2019
[Describe the vegetation and/or xeriscape infrastructure and how its presence and maintenance practices impacts water quality. When the landscape design includes LID infrastructure, describe the water quality benefits. Incorporating LID designs into landscape infrastructure can reduce the level of controls necessary for SOPs. Identify the necessary SOPs and include them in Appendix B]

[The following text is suggested for your convenience. If used the property owner and design agent are expected modify the suggested text to represent the sites unique infrastructure and conditions]

Our landscape operations can result in grass clippings, sticks, branches, dirt, mulch, fertilizers, pesticides and other pollutants to fall or be left on our paved areas. This waste material will settle in our storm drain system increasing maintenance cost and solid and dissolved waste in our runoff can pass through our storm drain system ultimately polluting NAME OF RIVER. The primary pollutant impairing the X River is organic material so it is vital that our paved areas with direct connection to the City storm drain systems remain clean of landscape debris. Use our Landscape Maintenance SOP to prevent this potential pollution source from affecting the NAME OF RIVER.

Storm Drain System

[Describe the stormwater system including surface, impoundment, conveyance system and structural water quality infrastructure and how its presence and maintenance practices impacts water quality. Incorporating LID designs and structural water quality devices into stormwater infrastructure can reduce the level of controls necessary for SOPs. Identify the necessary SOPs and include them in Appendix B]

[The following text is suggested for your convenience. If used the property owner and design agent are expected modify the suggested text to represent the sites unique infrastructure and conditions]

The storm drain inlets direct all runoff to a detention pond and though a stormwater treatment unit NAME AND Describe TREATMENT UNIT that is designed to capture floating material and heavier sediment particles, but does not trap suspended or dissolved pollutants. This device is susceptible to bypass and scour during large storm events and the dissolved pollutants will pass through and harm the NAME OF RIVER. Also our stormwater treatment system holds water that can breed mosquitoes. It is important to regularly maintain this system to protect the NAME OF RIVER and prevent mosquito breeding. Use our Storm Drain Maintenance SOP manage our storm drain system responsibly.

Waste Management

[Describe the waste management system infrastructure and how its presence and maintenance practices impacts water quality. When the waste control design includes LID infrastructure, describe the water quality benefits. Incorporating LID into waste control infrastructure can reduce the level of controls necessary for the SOP. Identify the necessary SOPs and include them in Appendix B]

[The following text is suggested for your convenience. If used the property owner and design agent are expected modify the suggested text to represent the sites unique infrastructure and conditions]
Our 6-yard dumpster and trash receptacles with lids are intended to prevent precipitation exposure minimizing liquids that can leak to pavements and from haul trucks. Lids will also prevent the light weight trash carried off by wind. Good waste management systems, if managed improperly, can become the source of the very pollution that they were intended to control. Use our Waste Management SOP to control and manage the solid waste we generate.

**Utility System**
[Describe the utility infrastructure and how its presence and maintenance practices impacts water quality. Incorporating LID into the building utility infrastructure can reduce the level of controls necessary for SOPs. Identify the necessary SOPs and include them in Appendix B]
[The following text is suggested for your convenience. If used the property owner and design agent are expected modify the suggested text to represent the sites unique infrastructure and conditions]

Our roof top utility system is exposed to our roof drains which drain to our pavements. This heating and air conditioner unit contains oils and other chemicals that can harm the NAME OF RIVER if allowed to drain off our property. Liquids and other waste generated by maintenance of this system can be appropriately managed by our Spill Containment and Cleanup SOP.

**Snow and Ice Removal Management**
[Describe the snow and ice operations and how it can impact water quality. Incorporating LID designs can reduce the level of controls necessary for SOPs necessary to manage this operation. Identify the necessary SOPs and include them in Appendix B]
[The following text is suggested for your convenience. If used the property owner and design agent are expected modify the suggested text to represent the sites unique infrastructure and conditions]

Salt is a necessary pollutant and is vital to ensuring a safe parking and pedestrian walkways. However, the snow removal operations if improperly managed will increase our salt impact to our own vegetation and local water resources. Use our Snow and Ice Removal SOP to minimize our salt impact.

**Equipment / Outside Storage**
[Describe any outside storage facilities or operations and how it can impact water quality. Incorporating LID designs can reduce the level of controls necessary to manage impacts caused by outside storage and related functions. Identify the necessary SOPs and include them in Appendix B]

**Add infrastructure or operations that are unique to this site**
[Describe any other site infrastructure or operations unique to this property which impacts water quality. Identify the necessary SOPs and include them in Appendix B]
Low Impact Development BMP Selection

[Describe the selection process from the Summit County LID Guidance and how BMP presence and maintenance practices impact water quality. Incorporating LID into the building utility infrastructure can reduce the level of controls necessary for SOPs. Identify the pollutant removed from the selected BMP and provide the technical support. Include SOP/BMP documents in Appendix B]

[The following text is suggested for your convenience. If used the property owner and design agent are expected modify the suggested text to represent the site's unique infrastructure and conditions]

We have incorporated a rain garden as a BMP to hold and filter the 80th percentile rains for our property. Stormwater from pavement may contain pollutants that are harmful to NAME OF RIVER if allowed to drain off our property. The rain garden is highly effective at removing sediment, and oil/grease before being allowed to percolate into the native soils. See appendix B for supporting documentation.
SECTION 2: TRAINING

Ensure that all employees and maintenance contractors know and understand the SOPs specifically written to manage and maintain the property. Maintenance contractors must use the stronger of their Company and the LT SWMP SOPs. File all training records in Appendix C.

SECTION 3: RECORDKEEPING

Maintain records of operation and maintenance activities in accordance with SOPs. Mail a copy of the record to Summit County Stormwater Division annually.
SECTION 4: APPENDICES

**Instructions:**
- Include all drawings, details, SOPs and other supporting information referenced in Sections 1.
- Ensure the LTSWMP is updated with any as-built plans, details and SOP changes prior to releasing the project, and NOI.

Appendix A- Site Drawings and Details
Appendix B- SOPs
Appendix C- Recordkeeping Documents
APPENDIX A – SITE DRAWINGS AND DETAILS

[Insert Site Drawings and Details following the blue text]
APPENDIX B – SOPs

[Insert SOPs following this page and delete the blue instruction text]

The following are suggested SOPs that should be adequate for most typical developments. If used the property owner and design agent are expected to evaluate applicability and modify the suggested text to the site’s unique infrastructure, its limitations and operations. The City also encourages the use of existing company SOPs modified and geared for this site and operations.

The SOPs are expected to include the following components.

1. Provide instruction that directs workers to operate and maintain the property that will prevent, control and contain debris, liquids and other pollutants from leaving the property.
2. Provide instruction that directs workers to dispose of the waste generated by maintenance functions at licensed facilities or means consistent with MS4 regulations.
3. Provide instruction that directs the property owner for maintenance frequency and to adjust maintenance frequency based on inspections and observation.
4. Provide instruction that directs the property owner to document the effectiveness of the SOP and overall site LTSWMP at controlling and containing pollutants on the property.
Pavement Maintenance Operations

General:
These SOPs are not expected to cover all necessary procedure actions. Operators are allowed to adapt SOPs to unique site conditions in good judgment when it is necessary for safety, and the proper, and effective containment of pollutants. However, any changes of routine operations must be amended in these SOPs.

1. Purpose and Selection:
   a) Reduce stormwater pollution by sweeping and removing pollutants that will be carried to City stormwater systems during stormwater runoff or by non stormwater runoff.
   b) The sweeper is intended for removing material that collect on pavements by use and the natural degradation of pavements, i.e. material that collect, drop from vehicles and the natural erosion and breaking up of pavements.

2. Regular Procedure:
   a) Remain aware of debris and sweep minor debris is needed by hand.
   b) Generally sweeping machinery should be used during autumn when leaf fall is heavy and early spring after winter thaw. Sometimes sweeping machinery will be necessary when accumulations are spread over a large area of the pavement.
   c) Manage outside activities that leave waste or drain pollutants to our pavements. This involves outside functions including but not limited to: Yard sales, yard storage, fund raisers, etc. Do not allow car wash fund raiser or other activities that allow detergents or other pollutants to be wash into storm drain systems.

4. Disposal Procedure:
   a) Service contractor dispose at licensed facilities
   b) Dispose of hand collected material in dumpster

5. Training:
   a) Annually and at hire
Landscape Maintenance Operations

General:
This SOP is not expected to cover all necessary procedure actions. Operators are allowed to adapt SOPs to unique site conditions in good judgment when it is necessary for safety, and the proper, and effective containment of pollutants. However, any changes of routine operations must be amended in this SOP.

Rule: Prevent any solids, liquids or any light weight material from being carried away from the construction or maintenance envelop by wind or water.

1. Application:
   a) This SOP should provide sufficient direction for many of the general landscaping operations, e.g., fertilizer and pesticide applications, mowing, weeding, tree trimming, digging, sprinkler repairs, varying landscape cover management, etc.

2. Maintenance Procedure:
   a) Grooming
      • Lawn Mowing – Immediately following operation sweep or blow clippings onto vegetated ground.
      • Fertilizer Operation – Prevent overspray. Sweep or blow fertilizer onto vegetated ground immediately following operation.
      • Pesticide Operations – Prevent overspray, use spot treatment, sweep or blow dry pesticide onto vegetated ground immediately following operation.
   b) Remove or contain all erodible or loose material prior forecast wind and precipitation events, before any non-stormwater will pass through and over the project site and at end of work period. Light weight debris and landscape materials can require immediately attention when wind expected.
   c) Landscape project materials and waste can usually be contained or controlled by operational best management practices.
      • Operational; including but not limited to:
         ➢ Strategic staging of materials eliminating exposure, such as not staging on pavement
         ➢ Avoiding multiple day staging of landscaping backfill and spoil on pavements
         ➢ Haul off spoil as generated or daily
         ➢ Scheduling work when weather forecast are clear.
   d) Cleanup:
      • Use dry cleanup methods, e.g. square nose shovel and broom and it is usually sufficient when no more material can be swept onto the square nosed shovel.
      • Power blowing tools
3. Waste Disposal:
   a) Dispose of waste according to General Waste Management SOP, unless superseded by specific SOPs for the operation.

4. Equipment:
   a) Tools sufficient for proper containment of pollutants and cleanup.
   b) Push broom and square blade shovel should be a minimum.

5. Training:
   a) Annually and at hire
   b) Landscape Service Contractors must have equal or better SOPs.
Waste Management Operations

General:
This SOP is not expected to cover all necessary procedure actions. Operators are allowed to adapt SOPs to unique site conditions in good judgment when it is necessary for safety, and the proper, and effective containment of pollutants. However, any changes of routine operations must be amended in this SOP.

1. Application:
   a) This SOP is intended for all Staff, intended for the proper disposal of common everyday waste.

2. Waste Collection Devices (Exposed units):
   a) The site contains 2 types of waste management containers.
      • 6yd dumpster with lid
      • Receptacles with lids

3. Waste Disposal Restrictions for all waste Scheduled for the Trans-Jordan Landfill:
   a) Generally most waste generated at this property, and waste from spill and clean up operations can be disposed in our dumpsters under the conditions listed in this SOP. Unless other disposal requirements are specifically identified by the product SDS or otherwise specified in other SOPs.
   b) Know the facility disposal requirements and restrictions. It should not be assumed that all waste disposed in collection devices will be disposed at the NAME OF LANDFILL.
   c) Review NAME OF LANDFILL regulations for additional restrictions and understand what waste is prohibited in the NAME OF LANDFILL. Ensure the SDS and NAME OF LANDFILL Landfill regulations are not contradictory.

   Generally the waste prohibited by the NAME OF LANDFILL is:
   ➢ Liquid:
      • paint
      • pesticides/fertilizers
      • oil (all types)
      • antifreeze
      • batteries
      • liquid chemicals
      • etc.
      (Generally, all the above hazardous waste when involved in minor spill cleanup operations can be disposed in covered dumpsters and our waste
bays, if the liquid is contained in absorbent material, e.g. sand, dirt, loose absorbent, pads, booms etc., and transformed or dried such that it will not drip. This is not intended for whole sale disposal of out dated or spent liquid hazardous waste. When disposal of out dated or spent liquid is needed or for questions of how to dispose of other waste, contact the NAME OF HEALTH DEPARTMENT Health Department (ABRIVIATION) for instructions and locations, PHONE NUMBER).

4. Waste Disposal Required for NAME OF LANDFILL or other:
   a) Generally for waste not accepted by the NAME OF LANDFILL.
   b) Follow SDS for disposal requirements. Review NAME OF LANDFILL regulations for additional restrictions and understand what waste is prohibited in the NAME OF LANDFILL. Ensure the SDS and NAME OF LANDFILL regulations are not contradictory
      General rules are:
      • Get approval prior to delivery.
      • Transport waste in secure leak proof containers that are clearly labeled.
   c) Lookup and follow disposal procedures for disposal of waste at other EPA approved sites, the NAME OF LANDFILL # is a good resource, PHONE #

5. General Staff Maintenance Practices:
   a) Prevent dumpsters and receptacles from becoming a pollution source by:
      1. Closing lids
      2. Reposition tipped receptacles upright.
      3. Report full or leaking and unsecured dumpsters and receptacles to the company provider or repair it in house. Determine source liquids and prevent it.
      4. Report any eminent pollutant hazard related to dumpsters and receptacles to the owner.

6. Training:
   a) Annually and at hire
Storm Drain Maintenance Operations

General:
These SOPs are not expected to cover all necessary procedure actions. Operators are allowed to adapt SOPs to unique site conditions in good judgment when it is necessary for safety, and the proper, and effective containment of pollutants. However, any changes of routine operations must be amended in these SOPs.

1. Procedure:
   a) Inspect for need:
      1. Schedule cleaning for boxes and pipe that contain 2” or more of sediment and debris.
      2. Remove debris by vacuum NAME OF LANDFILL operated machinery.
      3. When accumulations are mostly floating debris this material can be removed with a net.
      4. Inspect standing water for mosquito larvae and contact the NAME OF MOSQUITO ABATEMENT DISTRICT when necessary.

2. Disposal Procedure:
   a) Dispose of waste collected by machinery at regulated facilities.
   b) Floating materials and floating absorbent materials may be disposed in dumpster when dried out. Dry dirt and slurry may also be disposed in the dumpster.
   c) Disposal of hazardous waste
      1. Dispose of hazardous waste at regulated disposal facilities, see Waste Management and Spill Control SOP
   d) Disposal of waste collected from sanitary sewer device at regulated facilities.

3. Training:
   a) Annually and at hire
Pavement Washing Operations

General:
These SOPs are not expected to cover all necessary procedure actions. Operators are allowed to adapt SOPs to unique site conditions in good judgment when it is necessary for safety, and the proper, and effective containment of pollutants. However, any changes of routine operations must be amended in these SOPs.

1. Procedure:
   a) Prevent waste fluids and any detergents if used from entering storm drain system. The following methods are acceptable for this operation.
      • Dam the inlet using a boom material that seals itself to the pavement and pick up the wastewater with shop-vacuum or absorbent materials.
      • Collect wastewater with shop-vacuum simultaneous with the washing operation.
      • Collect wastewater with vacuum truck or trailer simultaneous with the washing operation.
   b) This procedure must not be used to clean the initial spills. First apply the Spill Containment and cleanup SOP.

2. Disposal Procedure:
   a) Small volumes can usually be drained to the local sanitary sewer. Contact the NAME OF SEWER DISTRICT.
   b) Large volumes must be disposed at regulated facilities.

2. Pavement Cleaning Frequency:
   a) There is no regular pavement washing regimen. Pavement washing is determined by conditions that warrant it, including but not limited to: prevention of slick or other hazardous conditions or restore acceptable appearance of pavements.

3. Training:
   a) Annually and at hire
Snow and Ice Removal Management

General:
This SOP is not expected to cover all necessary procedure actions. Operators are allowed to adapt SOPs to unique site conditions in good judgment when it is necessary for safety, and the proper, and effective containment of pollutants. However, any changes of routine operations must be amended in this SOP.

1. Application:
   a) Parking and sidewalk winter management operations.

2. De-Icing Procedure:
   a) Do not store or allow salt or equivalent to be stored on outside paved surfaces.
   b) Minimize salt use by varying salt amounts relative to hazard potential.
   c) Sweep excessive piles left by the spreader.
   d) Watch forecast and adjust salt amounts when warm ups are expected the same day.

3. Training:
   a) Annually and at hire.
   b) Require snow and ice service contractors to follow the stronger this SOP and their company SOPs.
General Construction Maintenance

General:
This SOP is not expected to cover all necessary procedure actions. Operators are allowed to adapt SOPs to unique site conditions in good judgment when it is necessary for safety, and the proper, and effective containment of pollutants. However, any changes of routine operations must be amended in this SOP.

Rule: Prevent any solids, *liquids or any light weight material from being carried away from the construction or maintenance envelop by wind or water.
*liquids - including culinary water and irrigation water that are polluted with material that will damage the environment.

1. Application:
   a) This SOP should provide sufficient direction for many of the general operations, e.g., building maintenance, curb/sidewalk/flatwork, overlay/patching, landscape renovations, misc. maintenance/repairs, etc.

2. Construction Procedure:
   a) Remove or contain all erodible or loose material prior forecast wind and precipitation events or before non-stormwater will pass through the project site. For light weight debris maintenance can require immediately attention for wind events and many times daily maintenance or as needed for precipitation or non-stormwater events.
   b) Project materials and waste can be contained or controlled by operational or structural best management practices.

   • Operational; including but not limited to:
     ➢ Strategic staging of materials eliminating exposure, such as not staging on pavement
     ➢ Avoiding multiple day staging of backfill and spoil
     ➢ Haul off spoil as generated or daily
     ➢ Schedule work during clear forecast

   • Structural; including but not limited to:
     ➢ Inlet protection, e.g. wattles, filter fabric, drop inlet bags, boards, planks
     ➢ Gutter dams, e.g. wattles, sandbags, dirt dams
     ➢ Boundary containment, e.g. wattles, silt fence
     ➢ Dust control, e.g. water hose,
     ➢ Waste control, e.g. construction solid or liquid waste containment, dumpster, receptacles
c) Inspection often to insure the structural best management practices are in good operating condition and at least prior to the workday end. Promptly repair damaged best management practices achieving effective containment.

d) Cleanup:
   • Use dry cleanup methods, e.g. square nose shove and broom.
   • Wet methods are allowed if wastewater is prevented from entering the stormwater system, e.g. wet/dry vacuum, disposal to our landscaped areas.

e) Cleanup Standard:
   • When a broom and a square nosed shovel cannot pick any appreciable amount of material.

3. Waste Disposal:
   a) Dispose of waste according to General Waste Management SOP, unless superseded by specific SOPs for the operation.
   b) Never discharge waste material to storm drains

4. Equipment:
   a) Tools sufficient for proper containment of pollutants and cleanup.
   b) Push broom and square blade shovel should be a minimum.

5. Training:
   b) Annually and at hire.
Spill Control

General:

This SOP is not expected to cover all necessary procedure actions. Operators are allowed to adapt SOPs to unique site conditions in good judgment when it is necessary for safety, and the proper, and effective containment of pollutants. However, any changes of routine operations must be amended in this SOP.

1. Rational:
   a) All properties are susceptible to spills whether it is a result of operations or by customers. Insufficient response, inadequate containment materials and improper spill cleanup methods will result in pollutants in our waterways. Once the pollutants reach our storm drain system, or even the detention pond, they are difficult and expensive to remove.

2. Containment Procedure:
   a) Priority is to dam and contain flowing spills.
   b) Use spill kits booms if available or use any material available; including but not limited to, nearby sand, dirt, landscaping materials, etc.
   c) Hazardous or unknown waste material spills
      1. Critical Emergency constitutes large quantities of flowing uncontained liquid that will affect areas with people or reach storm drain systems. Generally burst or tipped tanks. Call HAZMAT, DWQ, NAME OF HEALTH DEPARTMENT, City.
      2. Minor Emergency constitutes a spill that has reached a storm drain but is no longer flowing. Call NAME OF HEALTH DEPARTMENT, City
      3. Spills that are contained on the surface and do not meet the criteria for Critical and minor emergencies may be managed by the responsible implementation of this SOP.
   4. Contact Numbers:
      HAZMAT - 911
      DWQ – 801-231-1769, 801-536-4123
      NAME OF HEALTH DEPARTMENT – PHONE NUMBER
      City – PHONE NUMBER

3. Cleanup Procedure:
   a) NEVER WASH SPILLS TO THE STORM DRAIN SYSTEMS.
   b) Clean per SDS requirements but generally most spills can be cleaned up according to the following:
      • Absorb liquid spills with spill kit absorbent material, sand or dirt until liquid is sufficiently converted to solid material.
• Remove immediately using dry cleanup methods, e.g. broom and shovel, or vacuum operations.
• Cleanup with water and detergents may also be necessary depending on the spilled material. However, the waste from this operation must be vacuumed or effectively picked up by dry methods. See Pavement Washing SOP.
• Repeat process when residue material remains.

4. DISPOSAL:
   a) Follow SDS requirements but usually most spills can be disposed per the following b. & c.
   b) Generally most spills absorbed into solid forms can be disposed to the dumpster and receptacles. Follow Waste Management SOP.
   c) Generally Liquid waste from surface cleansing processes may be disposed to the sanitary sewer system after the following conditions have been met:
      • Dry cleanup methods have been used to remove the bulk of the spill and disposed per the Waste Management SOP.
      • The liquid waste amounts are small and diluted with water. This is intended for spill cleanup waste only and never for the disposal of unused or spent liquids.

5. Documentation:
   a) Document all spills in Appendix C.

6. SDS sheets:
   a) SDS Manual is filed in break room.

7. Materials:
   a) Generally sand or dirt will work for most clean up operations and for containment. However, it is the responsibility of the owner to select the absorbent materials and cleanup methods that are required by the SDS Manuals for chemicals used by the company.

8. Training:
   a) Annually and at hire.
APPENDIX C – PLAN RECORDKEEPING DOCUMENTS

[Insert PLAN Recordkeeping forms following this page]
## MAINTENANCE/INSPECTION SCHEDULE

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Site Infrastructure</th>
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<tr>
<td>Replace text with the infrastructure / system that must be maintained: repeat</td>
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Inspection Frequency Key:  A=annual, Q=Quarterly, M=monthly, W=weekly, S=following appreciable storm event, U=Unique infrastructure specific (specify)

### RECORD INSPECTIONS IN THE MAINTENANCE LOG

Inspection Means: Either; Traditional walk through, Awareness/Observation, and during regular maintenance operations while noting efficiencies/inefficiencies/concerns found, etc.
## MAINTENANCE LOG

<table>
<thead>
<tr>
<th>Date</th>
<th>Maintenance Performed/Spill Events. Perform Maintenance per SOPs</th>
<th>Observation Notes, including but not limited to: Inspection results, Observations, System Performance (effectiveness/inefficiencies), SOP Usefulness, Concerns, Necessary Changes…</th>
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### Annual Summary of LTSWMP effectiveness, inefficiencies, problems, necessary changes etc.

*You may create your own form that provides this same information or request a word copy of this document.*
**Annual SOP Training Log per Section 2**

<table>
<thead>
<tr>
<th>SOP</th>
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*You may create your own form that provides this same information or request a word copy of this document.*
Appendix D
ORDINANCE NO. 381-A

AN ORDINANCE CONCERNING STORM WATER POLLUTION PREVENTION AND EROSION CONTROL FOR DEVELOPMENT AND RESIDENTIAL CONSTRUCTION PROJECTS.

WHEREAS, Summit County has adopted the Snyderville Basin Development Code, the Eastern Summit County Development Code, Ordinance 181-D, and Ordinance 315-B all of which address excavation, placement of fill, grading and or removal of vegetation; and,

WHEREAS, Summit County Storm Water Management Plan requires that more stringent Storm Water Pollution Prevention measures are to be adopted during the implementation period of the Plan; and,

WHEREAS, Storm water pollution prevention and erosion control are only generally addressed in Summit County’s Codes or Ordinances; and,

WHEREAS, The United States Environmental Protection Agency and The State of Utah Division of Water Quality have rules, regulations and laws which only address Storm Water Pollution and Erosion Control for construction sites having disturbed areas of (1) acre or more; and

WHEREAS, The State of Utah Division of Water Quality is concerned about various waterways and lakes which have been determined to be impaired; and,

WHEREAS, The State of Utah Division of Water Quality has limited staff to review, inspect or enforce Storm Water Discharge Permits issued by the Division; and,

WHEREAS, The Summit County Engineering Division has been charged with the review, inspection and enforcement of construction activities of projects which require a permit under the Codes and Ordinances adopted by the County;

BE IT ORDAINED BY THE BOARD OF COUNTY COMMISSIONERS OF SUMMIT COUNTY, STATE OF UTAH, AS FOLLOWS:

Section 1. Requirements for Storm Water Pollution Prevention Permit and Erosion Control Permit. (SWP3 and ECP)

1) It shall be unlawful and punishable as a Class C Misdemeanor provided for any person, firm, public utility, public agency, or corporation, to make, enlarge or change any excavation, re-grade existing contours, place fill or strip vegetation without complying with the provisions of this ordinance and obtaining a Storm Water Pollution Prevention Plan (SWP3) and Erosion Control Plan (ECP) Permit as provided for herein. It shall also be unlawful for any person hiring or directing
another person, firm, or corporation to perform the work without obtaining a SWP3 and ECP Permit.

2) It shall be unlawful and punishable as provided to change or expand the excavation, regrading of existing contours, placement of fill or stripping of vegetation without first requesting a modification of the SWP3 and ECP Permit issued for the work.

3) A SWP3 and ECP Permit shall be required for any project which requires a permit under any other Ordinance, Development Code or Building Permit issued by Summit County.

4) A SWP3 and ECP Permit shall be required for Commercial and Industrial uses occupying a site of 1 acre or more, and which are found to be discharging sediment off site, into a waterway, or tracking onto a road or street.

Section 2. Emergency Conditions

Emergency excavations, grading, or placement of fill may be made without a permit if the reason for the excavation or grading or placement fill is to prevent loss of life or damage to property which appears to be imminent if the action is delayed by waiting to secure said permits. In such emergency situations, those making the excavation, grading or placement of fill MUST contact the County Engineer’s Office at the earliest possible time, but in no case later than the first working day following the emergency work in order to secure a formal permit. None of the provisions of this ordinance are waived for emergency situations except for the prior permit requirement.

Section 3. Applications

Applications shall be made by the owner of the property on which the work is being done. In the case of work within a public right-of-way, by the firm, public utility, public agency or corporation actually doing the work, or in the case of work within a private road or private road right-of-way, by the owner of the road or association responsible for the maintenance of the road. Applications for all permits shall be made to the County Engineer’s Office as provided, and state the purpose therefor, the person, firm, public utility, or corporation doing the actual work and the name of the person, firm, public utility, or corporation for whom or by which the work is being done and shall contain an agreement that the applicant will comply with all ordinance and laws of Summit County, the State of Utah, and the Federal Government relating to the work to be done. The application shall also provide for an agreement that the applicant shall indemnify the County for any loss, liability, or damage that may result from or because of the making, placement, existence, or manner of guarding or constructing any such excavation. The application shall be accompanied by a Storm Water Pollution Prevention and Erosion Control Plan (SWP3 and ECP). Said plan shall have a drawing of the location of the intended excavation, grading, filling or stripping of vegetation, the pertinent dimensions thereof. The SWP3 and ECP plan shall employ Best Management Practice (BMP’s) and shall contain the layout, typical sections and details of the erosion control and sediment control measures to be used in the plan.
Section 4. Permits

1) All permits issued pursuant to this ordinance shall be valid for a period not to exceed the Development Permit, “Grading” Permit or “Excavation” Permit issued in conjunction with the SWP3 and ECP Permit. A copy of the permit issued shall be available on site at all times when work is under way.

2) Excavations, grading, or filling of sites which are one (1) acre or more, are required by State and Federal regulations to file a “Notice of Intent” with the Utah Division of Water Quality, Storm Water Permits Section (http://waterquality.utah.gov/updes/stormwater.htm). A copy of the Notice of Intent shall be submitted with the Application as provided herein.

Section 5. Exemptions

The following activities are exempt from the requirements of this ordinance:

1) Actions by a public agency or utility, the County or other governmental agency to remove or alleviate an emergency condition, restore utility service, or reopen a public thoroughfare to traffic; or

2) Actions by any person when the County determines, and documents in writing, that the actions are necessary to remove or alleviate an emergency condition, restore utility service, or reopen a public thoroughfare to traffic;

3) Landscape maintenance activities on fully developed property.

4) Bona fide agricultural and farming operations which constitute the principle use of any parcel or tract of ground located in the County and which meet the requirements of the zoning for that portion of the County in which the operation is located.

Section 6. Fees

A review fee and inspection fee, in the current amount as set by resolution of the Board of County Commissioners, shall accompany each application for a permit. Fees must accompany the application.

Section 7. Completion Bond

Applicants shall file a completion bond with the County Engineer in the amount as set by resolution of the Board of County Commissioners at the time the permit is approved. This may be cash, a letter of credit from an FDIC Insured Financial Institution, or a corporate surety bond. The bond shall be valid until one year after all work shown in the permit is completed to guarantee that the conditions of the permit together with any restorative works is completed properly. The bond will be released only upon recommendation of the County Engineer.
Section 8. Supervision and Inspection

1) The County Engineer shall from time to time inspect or cause to be inspected, all work done pursuant to permits to insure the enforcement of the provisions of this title. Notification shall be given to the County Engineer at least 24 hours prior to the commencement of any work and within 24 hours after implementing the SWP3 and ECP. The Completion Bond shall not be released without an inspection made to determine satisfaction of all applicable provisions of this ordinance.

2) For construction sites whose area of disturbance is one (1) acre or more, the applicant shall retain qualified personnel to inspect the sediment control measures, a) at least once each two and after a storm event which precipitated 0.5 inches of water or more within 24 hours. The inspector shall prepare written reports of each inspection and make recommendations for correcting any sediment control measure (BMP) found not performing as intended. A copy of each inspection shall be kept on site until such time as the disturbed area has been permanently stabilized. A copy of the report shall also be submitted the office of the County Engineer.

The applicant shall implement all recommendations of the inspector, or the County Engineer to correct any sediment control measure (BMP) found not performing as intended.

Section 9. Appeals

An applicant for a SWP3 and ECP whose application has been denied or approved with conditions, may appeal the denied or imposed conditions to the Board of Adjustment. A notice of appeal must be filed with the office of the County Engineer within 10 days of the denial or imposition of conditions of the permit. The notice of appeal shall contain the following information:

(1) An application containing the applicants name, address and daytime telephone number,

(2) A statement describing the basis for the appeal; and

(3) The relief sought by the applicant.

The appeal shall be scheduled on the next available Board of Adjustment meeting.

Section 10. Failure to Comply

In the event of failure on the part of any person, firm, public utility, or corporation to comply fully with the provisions of this ordinance, law enforcement authorities of Summit County are authorized to:

(1) Initiate criminal action by citation or information under Section 10 of this ordinance and/or proceed to forfeit bond, or
(2) Proceed to forfeit bond; or

(3) Install or repair such erosion control and sediment control measures as required to restore the SWP3 and ECP; or

(4) Give written notice to such person, firm, public utility, or corporation to restore such BMP’s as required to restore or implement the SWP3 and ECP. Such notice may be served either by personal service or by mailing the notice to the person, firm, public utility, or corporation by certified mail and posting a copy thereof on such installation for a period for 10 days. If the SWP3 and ECP is not implemented or restored within 10 days after the notice is complete, said authorities may implement the SWP3 and ECP the same at the expense of the person, firm, or corporation and recover costs and expenses, and also the sum of $100.00 for each day the SWP3 and ECP were not in effective operation after notice was complete, in an action for that purpose; or,

(5) If such person, firm, public utility, or corporation refuses to implement a SWP3 and ECP, said authorities may bring an action to abate the same as a nuisance, and if judgement is recovered by said authorities, there shall also be recovered, in addition to having the same abated, the cost of action and the sum of $100.00 for every day such nuisance remained after notice was given for its implementation in the manner provided in Subsection (2) of this Section. (UCA 27-12-135).

Section 11. **Penalty**

Any person who violates the provisions of this ordinance is guilty of a Class “C” Misdemeanor, punishable by a fine not to exceed seven hundred and fifty dollars ($750.00), or a jail term of up to ninety (90) days, or by both such fine and jail term.

Violators of this ordinance are also subject to any penalties that may be imposed by the State of Utah, or the Federal Government, under the Clean Water Act.

In addition to any criminal fines and/or penalties which may be assessed for a violation of this ordinance, Summit County shall have the right to issue a Stop Work Order on the entire construction site, and/or install or maintain appropriate erosion control and sediment control measures on any site which is required to have such measures in the event that construction activity is commenced or continued without such measures having been installed or required by this ordinance. Summit County shall have the right to have such measures installed and maintained by County Personnel or to have hire a private contractor to perform such work at the expense of the permittee, property owner, developer or contractor responsible for such measures. The County may assess said expenses against the bond posted by the permittee.

It is unlawful for any person, firm, public utility, public agency, or corporation to continue any further work on the construction site after a Stop Work Order has been issued. A violation of a Stop Work Order is punishable as a Class C Misdemeanor.

Summit County may also pursue civil remedies for a violation of this ordinance.
Section 12. Specific Requirements

Specific standards and requirements for the enforcement of this ordinance are attached as Appendix “A” which are made a part of this ordinance by reference.

Section 13. Repeal of Ordinance No. 381

Summit County Ordinance 381 are hereby repealed.

Section 14. Severability

Should any section, paragraph, sentence, clause, or phase of this ordinance be declared unconstitutional or invalid for any reason, the remainder of said ordinance shall not be affected thereby.

Section 15. Effective Date

This ordinance shall become effective after publication of such in accordance with applicable State Law.

PASSED AND ADOPTED by the Board of County Commissioners of Summit County, Utah, this ____ day of ____________, 2004.

SUMMIT COUNTY BOARD COMMISSIONERS

KEN WOOLSTENHULME, CHAIR

BOB RICHER

SHAUNA KERR

ATTEST:

SUE FOLLETT
Summit County Clerk

APPROVED AS TO FORM:

Deputy Summit County Attorney
COMMISSIONER VOTED:

WOOLSTENHULME  (AYE OR NAY)
RICHER  (AYE OR NAY)
KERR  (AYE OR NAY)
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Section 1. General

The purpose of this ordinance is to prevent the discharge of sediment and other construction related pollution from construction sites by storm water runoff. Construction sites are a major source of pollution to waterways and storm drain systems located within Summit County and the surrounding area. Storm Water runoff carries sediment from construction sites into nearby water ways, lakes, canals, irrigation systems and storm drain systems. The sediment clogs storm drain systems, pollutes the water in the streams and lakes and damages wildlife habitat and water quality. The same potential for polluting waterways, lakes, canals, irrigation systems, and storm drain systems can occur from commercial or industrial operations. Existing and future commercial and industrial operations which are allowing sediments to be discharged from the operation site, or allowing sediments to be tracked onto public or private roads and streets must also comply with the provisions of this ordinance.

A second purpose of this ordinance is to minimize long-term changes in storm water runoff quantity and quality associated with development. Land development projects and associated increases in impervious cover alter the hydrologic response of local watersheds and can increase stormwater runoff rates and volumes, flooding, stream channel erosion, and sediment transport and deposition. Other potential hydrologic alterations include reduced infiltration rates and lower in-stream base flow levels. These hydrologic changes adversely affect local fishery resources and aquatic habitat, and are often accompanied by increased pollutant loadings. This ordinance is intended to minimize these adverse effects by requiring
developments to incorporate permanent, post-construction Best Management Practices (BMPs) that treat storm water runoff quantity and quality and maximize on-site infiltration of runoff to promote groundwater recharge.

This Appendix shall establish guidelines for the preparation of the SWP3/ECP, which will include both temporary and permanent BMPs to control erosion and prevent polluted runoff both during and after construction.

Section 2. Definitions

For the purpose of this ordinance and appendix, the definitions listed hereunder shall be construed as specified in this section.

APPLICANT- Any person or entity which files or is required to file an application for a SWP3 and ECP.

APPLICATION- The form and supporting information filed with Summit County for review and approval of a SWP3 and ECP.

APPROVAL- The proposed plan conforms to this ordinance and appendix in the opinion of the County Engineer.
BEST MANAGEMENT PRACTICES (BMPs)- Schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of waters of the state. BMPs also include treatment requirements, operating procedures, and practices to control site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

COMMENCEMENT OF CONSTRUCTION- The initial disturbance of soils associated with clearing, grading or excavating activities or other construction activities.

CONTROL MEASURE- Any Best Management Practice or other method used to prevent or reduce the discharge of pollutants.

CIVIL ENGINEER- A professional engineer registered in the State of Utah to practice in the field of civil works.

CWA- Clear Water Act or the Federal Water Pollution Control Act.

DEVELOPMENT OR DEVELOPMENT ACTIVITY- Any of the following activities requiring a permit pursuant to the Codes and Ordinances of Summit County.

A. Construction, clearing, filling, excavating, grading, paving, dredging, mining, drilling or otherwise significantly disturbing the soil of a site.
B. Building, installing, enlarging, replacing or substantially restoring a structure, impervious surface, and the long-term stockpiling of materials.

C. Construction, elimination or alteration of a driveway onto a public road.

DISCHARGE OF STORM WATER ASSOCIATED WITH CONSTRUCTION ACTIVITY- Storm Water “point source” discharges from areas where soil disturbing activities (e.g. clearing, grading, or excavating, etc.), construction material or equipment activities (e.g. fill piles, concrete truck washout, fueling, etc.), or other industrial storm water directly related to the construction process (e.g. concrete or asphalt batch plants, etc.) are located.

DISTURBANCE- To alter the physical location, natural appearance, existing vegetation of the land by clearing, grubbing, grading, excavating, filling, building or other construction activity.

EPA- The United State Environmental Protection Agency.

EROSION- is the wearing away of the ground surface as a result of the movement of wind, water or ice.
EXCAVATION- Is the mechanical removal of earth material.

EXISTING GRADE- Is the grade prior to grading.

FILL- Is a deposit of earth material placed by artificial means.

FINAL STABILIZATION- All soil disturbing activities at the site have been completed, and that a uniform (e.g. evenly distributed, without large bare areas) perennial vegetative cover with a density of 70% of the native background vegetative cover for the area has been established on all unpaved areas and areas not covered by permanent structures, or equivalent permanent stabilization measures (such as the use of rip rap, gabions, or geotextiles) have been employed. In some parts of the County, background native vegetation will cover less than 100% of the ground (e.g. arid areas). Establishing at least 70% of the natural cover of native vegetation meets the vegetative cover criteria for final stabilization. For example, if the native vegetation covers 50% of the ground, 70% of 50% would require 35% cover for final stabilization.

FINISHED GRADE- The final grade of size which conforms to the approved plan.

GAS STATION- A permanent commercial or private facility that involves transferring fuel into mobile vehicles or equipment.
GEOTECHNICAL ENGINEER- See “soils engineer.”

GRADE- The vertical location of the ground surface.

GRADING- Any excavating or filling or combination thereof.

IMPERVIOUS SURFACE - Any surface which prevents or retards the penetration of water into the ground, including, but not limited to, paved streets, graveled or paved areas such as driveways, parking areas, packed earth material, oiled macadam or other treated surfaces, sidewalks, walkways, roof surfaces, patios and formal planters.

MAXIMUM EXTENT PRACTICABLE- A level of effort to be undertaken where technical feasibility and financial cost to be incurred are appropriate for the probable negative impacts to water quality to be minimized. Implementation of a storm water management practice is considered practicable unless one or both of the following apply:

A. The practice is not technically feasible for the proposed use and physical characteristics of the site; or
B. The cost of implementing the practice would outweigh the benefits of maintaining water quality. Costs are considered to outweigh benefits only if they exceed $0.50 per square foot of the lot or land on which the development takes place.

NATURAL LANDSCAPE- The cover and topography of land before any man-made change, or, in areas where there have been man-made modifications, that state of the area and topography of land as of the date of adoption of this Article.

PERMIT- A Summit County Storm Water Pollution Prevention Permit and Erosion Control Permit.

PERMITTEE- The recipient of a Summit County Storm Water Pollution Prevention Permit and Erosion Control Permit.

PERSON- Any individual, corporation, partnership, association, company or body politic, including any agency of the State of Utah and the United States Government.

PLAN- A Storm Water Pollution Prevention Plan and Erosion Control Plan.

POINT SOURCE- Any discernable, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, collection system, from which pollutants are or may be discharged. This
term does not include return flows from irrigated agriculture or agricultural storm water runoff.

PROFESSIONAL INSPECTION- The inspection required by this ordinance to be performed by the civil engineer, soils engineer, hydrologist, or engineering geologist. Such inspections include that performed by persons supervised by such engineers, hydrologists or geologists and shall be sufficient to form an opinion relating to the conduct of the work.

ROUGH GRADE- The stage at which the grade approximately conforms to the approved plan.

RUNOFF COEFFICIENT- The fraction of total rainfall that will appear at a conveyance as runoff:

SITE- Any lot or parcel of land or contiguous combination thereof, under the same ownership, where grading is performed or permitted.

SLOPE- An inclined ground surface the inclination of which is expressed as a ration of horizontal distance to vertical distance.

SOIL- Naturally occurring superficial deposits overlying bedrock.
SOILS ENGINEER (GEOTECHNICAL ENGINEER)- An engineer experienced and knowledgeable in the practice of soils engineering (geotechnical) engineering.

SOILS ENGINEERING (GEOTECHNICAL ENGINEERING)- The application of the principles of soils mechanics in the investigation, evaluation and design of civil works involving the use of earth materials and the inspection or testing of the construction thereof.

STORM WATER- Storm water runoff, snow melt runoff, and surface runoff and drainage.

STORM WATER DISCHARGE ASSOCIATED WITH INDUSTRIAL ACTIVITY- Existing Commercial or Industrial operations whose operation may allow sediment, mud or debris to flow from the site or is tracked onto adjacent public or private roads by vehicles leaving the site.

SWP3- Storm water pollution prevention plan, referring to the plan required in the permit.

UNSTABILIZED- Areas of land which are disrupted or whose natural landscape has been changed due to excavation, grading grubbing and clearing, or other construction activity and which has not been finally stabilized.
Section 3. Storm Water Pollution Prevention Plan and Erosion Control Plan (SWP3 and ECP)

A. The Storm Water Pollution Prevention Plan and Erosion Control Plan shall contain the following:

(1) General Information including:
   • a brief narrative description of the project
   • legal description of site
   • copies of relevant permits, easements, rights-of-way, and discharge permission agreements
   • copies of maintenance easement(s) and covenant(s)
   • total area of parcel/site
   • area of expected disturbance by clearing, grading, excavation, filling, or other activities
   • contact information for the applicant/permittee

(2) A Site Plan Map or maps that show:
   • existing topography and proposed grades (2' contour interval or greater if needed for readability)
   • existing drainage courses and impoundments (wet or dry)
   • existing wetlands on or adjacent to the site
   • existing soil and vegetation cover types
• environmentally sensitive features
• boundary of the 100-year flood plain (if applicable)
• receiving water body(ies) or, if far offsite, distance to and name(s) of receiving water body (ies)
• boundaries of individual drainage areas within the site and discharge point locations (per-and post-development, if different)
• location of construction activities
• extent/limits of clearing and grading
• existing and proposed utility locations
• location and finished elevations of proposed permanent structures including buildings, roads, and parking areas
• location of existing on-site or adjacent storm drain systems and canals
• landscaping plan, including any proposed irrigation system
• location of temporary and permanent stormwater runoff and erosion control BMPs

(3) Technical Information including:
• results of any soil or geologic tests/borings
• construction sequence and schedule for implementation of temporary erosion and sediment control measures
• area of new impervious surfaces and total post-development impervious area
• grades of all impervious surfaces
• hydrologic and hydraulic design calculations for the pre-development and post-development conditions for the design storms specified in this ordinance (see Appendix F for additional details)
• design drawings (plan and profile), construction details, grades, elevations, and supporting engineering calculations (as applicable) for individual permanent stormwater BMPs and proposed drainage systems (see Appendix E for details)
• a description of how the SWP3 and ECP use non-structural controls to the maximum extent practicable for long-term treatment of stormwater runoff, and justification for any use of large-scale structural surface runoff controls (use form provided in Appendix D).

B. The proposed measures and controls described in the SWP3 and ECP shall be designed to meet the following goals and criteria.

(1) The proposed measure and controls shall be designed to prevent or minimize, to the maximum extent practical, the discharge of sediment, debris and other construction-related pollutants from the construction site by storm water runoff.

(2) The proposed measures and controls shall be designed to prevent or minimize, to the maximum extent practicable, the deposit, discharge, tracking by
construction vehicles or other vehicles leaving the construction site, or dropping of mud, sediment, debris or other potential pollutants onto public or private roads and streets. Any such discharge shall be cleaned up and removed prior to the end of the work shift in which the deposit occurred, or prior to sunset whichever comes first.

(3) The proposed measures and controls shall consist of the Best Management Practices (BMPs) available at the time that the plan is submitted. BMPs may include, but shall not be limited to, temporary silt or sediment fences, sediment traps and detention ponds, gravel construction (drain rock) entrances and wash down pads to reduce or eliminate off site tracking, straw bale sediment carriers, establishment of temporary and permanent vegetative cover, use straw mulch as a temporary ground cover, erosion control blankets, temporary interceptor dikes and swales, storm drain inlet protection, check dams, surface drains, pipe slope drains, level riprap pads for culvert outlet protection, reinforced soil retaining systems and gabions.

(4) Existing vegetation should be preserved wherever possible and disturbed portions of the site shall be stabilized. Stabilization practices may include, but not be limited to temporary seeding, permanent seeding, mulching, geotextiles, sod stabilization, vegetative buffer strips, protection of trees, preservation of nature vegetation, and other appropriate measures. Use of impervious surfaces
for stabilization shall be avoided. Except as provided below, stabilization measures shall be initiated as soon as possible in disturbed portions of the site where construction activities have temporarily or permanently ceased, but in no case more than 10 working days after the construction activity in that portion of the site has temporarily or permanently ceased.

(a) Where the initiation of stabilization measures by the 10th day after construction activity temporarily or permanently ceases is precluded by deep snow or frozen ground conditions, stabilization measures shall be initiated as soon as practicable.

(b) Where construction activity on a portion of the site is temporarily ceased, and earth disturbing will resume within 15 working days, temporary stabilization measures need not be initiated on that portion of the site.

(5) Measures shall be employed to minimize the risk of discharge of construction-related pollutants (such as paint, thinners, solvents, fuels and oils) from the construction site. Such measures may include implementation of storage practices to minimize exposure of the material to storm water as well as spill prevention and response.
(6) The SWP3 and ECP shall include long-term, post-construction runoff control measures that meet the following performance criteria:

(a) Peak Flow Rate Criteria. The flow rate of runoff from the proposed land development shall not exceed the pre-development runoff rate. Pre- and post- development rates shall be checked for the 10 and 100-year storm events. Structural controls such as detention or extended detention ponds shall include spillways that are adequate to transport the entire peak runoff of the 100-year storm event. The 10-year storm event shall be used for sizing underground storm water conveyance systems, i.e., pipe sections between catch basins and storm drainage manholes. Surface conveyance systems such as canals, drainage channels/ditches/swales, curb and gutters, and culverts shall be designed to safely pass the 100-year storm event. Design storms and runoff values shall be calculated using the methods described in Appendix F.

(b) Flood Control Criteria. Development activities that result in new releases of surface water from the development that inundate, erode, deposit sediment or otherwise damage downstream property, real or personal, shall not be allowed. Releases of runoff to downstream property that, prior to the proposed development, would not have received any runoff, will require that the downstream property owner provides an
easement and consent that shall be written in the land record, and that Summit County grants approval. When releases of runoff are directed into an irrigation canal or ditch, written permission will be required from the canal company president for acceptance of storm water into a canal unless otherwise covered by a flood control agreement. The canal company may also stipulate how the storm drain will enter the canal and any erosion protection needed. Entrance into the smaller private ditches will require the approval of the relevant water right holder and owner of the property upon which the ditch is located. If there is a question as to whether or not the ditch can carry the additional storm water, a capacity evaluation shall be submitted for the ditch in question.

©) Water Quality Criteria. Surface and subsurface (i.e. infiltration) storm water BMPs shall be implemented and maintained such that they provide water quality treatment for (i.e., infiltrate or capture and treat) the runoff volume (WQv) associated with a storm event of 0.5 inch in 1 hour under post-development site conditions. Storm water BMPs shall be designed to remove a proportion of the average annual load of Total Suspended Solids (TSS), according to the sliding scale shown in Appendix E. The required removal rate is based on the percentage of impervious cover under post-development site conditions, and BMPs must be applied to all impervious areas in such a manner that the overall weighted average TSS removal rate
(from one or more BMPs) equals or exceeds the required removal efficiency level. BMPs will also be implemented to remove floatibles from storm water runoff prior to discharge of the water from the development site.

(d) Groundwater Recharge Criteria. Annual groundwater recharge rates shall be maintained by promoting infiltration through the use of non-structural and structural methods. At a minimum, annual recharge from the post development site shall mimic the annual recharge from pre-development site conditions. Specifically, BMPs shall be implemented to ensure that the increase in surface runoff volume from the 1-hour, 0.5" storm event relative to pre-development conditions (i.e., the post-development WQv minus the pre-development WQv) is recharged into the groundwater rather than discharged off-site as surface runoff. Infiltration facilities must be situated in areas with suitable soils and adequate depths to groundwater (see Appendix E for detailed suitability information). Adequate pretreatment must be provided for runoff from pollution “hot spots” prior to recharging such runoff into the ground. Pollution “hot spots” include:

- road salt storage facilities
- parking lots that receive road salt applications
• vehicle salvage yards and recycling facilities
• vehicle service and maintenance facilities
• vehicle and equipment cleaning facilities, including carwashes
• fleet storage areas
• industrial sites
• marinas (service and maintenance)
• outdoor liquid container storage
• outdoor loading/unloading facilities
• public works storage areas
• facilities that generate or store hazardous materials
• commercial container nurseries
• permanent, temporary, and mobile fueling operations

(e) Water Quality Criteria for Gas Stations. Because the paved portions of gas stations are sources of harmful pollutants such as oil, gas, grease, metals, and other organic compounds, new gas station developments shall be required to install oil/water separators approved by the County Engineer to treat runoff from all impervious surfaces. Examples of appropriate oil/water separator devices are provided in Appendix E. Oil/water separators shall be installed off-line, upstream of any additional water quality BMPs and detention basins, and as close to the source of oil-generating activity as possible. Separators shall be sized to the water
quality design storm (WQv; 1-hour 0.5” storm) and shall be inspected monthly and maintained as needed. During larger storm events, excess flows should be safely directed away from the separator to another BMP.
In addition to installing oil/water separators, gas stations must also install controls to meet all other treatment criteria listed above. Oil-water separators should not be used alone to treat storm water runoff, but rather as pretreatment to another storm water BMP or series of BMPs.

Section 4. Temporary and Permanent Erosion and Sediment Control/Stormwater Treatment Methods

Refer to Appendix B, C, D, and E for examples of temporary and permanent erosion and sediment control/stormwater treatment measures. The permittee may use those controls which may apply to his/her site, or may use other BMPs, and erosion and sediment control measures provided they are approved by the County Engineer. However, when selecting long-term (post-construction) stormwater treatment methods, the applicant must demonstrate that they have employed non-structural controls (e.g., reduction in paved area, disconnection of rooftop runoff, source control/pollution prevention, etc.) to the maximum extent practicable rather than relying solely on structural controls such as detention ponds. A more detailed list of non-structural control measures is provided in Appendix D. Non-structural controls are the preferred treatment method because they limit the increase in volume and rate of runoff associated with development, help preserve groundwater recharge, and limit pollutants at their source. Large-
scale structural surface runoff controls (e.g., large detention ponds) will only be permitted when the applicant demonstrates to the satisfaction of Summit County that it is not feasible to meet the storm water quantity and quality requirements through the use of non-structural and subsurface techniques alone. The worksheet included in Appendix D should be filled out by the applicant to demonstrate the use of non-structural techniques. If BMPs other than those shown in Appendix B, D or E are used, the permittee must demonstrate to the satisfaction of the County Engineer that the alternative controls will successfully meet the requirements listed in Section 3 above. Summit County may require more than the minimum control requirements specified if hydrologic, geologic, or topographic conditions warrant or if unique flooding, stream channel erosion, or water quality problems exist downstream from a proposed project.

Section 5. Proper Operation and Maintenance

A. The permittee shall install the erosion and sediment control measures required by the approved SWP3 and ECP before commencing any construction activities on the site to which the plans apply, or at such time as indicated on the plan. The permittee shall contact County Engineer’s Office to schedule an inspection of the installed measures prior to commencing other construction activities.

B. The permittee shall maintain such measures on the site in good condition until the disturbed areas have been finally stabilized and the measures are no longer necessary to prevent or minimize, to the maximum extent practicable, the discharge of sediment,
debris and other pollutants from the site by storm water runoff or vehicular tracking. The erosion control measures shall be properly installed and maintained in accordance with the manufacturers specifications and good engineering practices. Once the temporary erosion control measures have been deemed no longer necessary, or once the site is finally stabilized, the controls shall be removed from the site in a timely manner.

C. Maintenance Covenants

(1) Establishment of Covenant. Maintenance of all long-term stormwater management facilities, including non-structural practices such as natural area conservation and buffer establishment, shall be ensured through the creation of a formal maintenance covenant that must be approved by Summit County and recorded into the land record prior to final plan approval. As part of the covenant, the location of each permanent structure will be added to the county’s storm water map and a schedule shall be developed for when and how often maintenance will occur to ensure proper function of the stormwater management facility. The covenant shall also include plans for periodic inspections to ensure proper performance of the facility between scheduled cleanouts. The property owner listed on the land record is responsible for performing these periodic inspections and keeping written records of the inspections and any maintenance activities performed. Sample inspection forms are provided in Appendix G. These written records shall be retained for a minimum of three years from the date of the
inspection or maintenance activity. A copy of these written records shall be sent to Summit County within one week of the inspection.

(2) Maintenance and Inspection Plan Requirements. All permanent stormwater management facilities must undergo, at the minimum, semi-annual inspections in the fall and in the spring to document maintenance and repair needs and ensure compliance with the requirements of this ordinance and accomplishment of its purposes. These needs may include; removal of silt, litter, and other debris from all catch basins, inlets and drainage pipes, grass cutting and vegetation removal, necessary replacement of landscape vegetation, and removal and replacement of contaminated filter media. Specific maintenance needs for individual long-term BMPs are provided in Appendix E and sample inspection forms are provided in Appendix G. Following each inspection, a copy of the completed inspection form shall be sent to Summit County within one week of the inspection. Any maintenance needs found must be addressed in a timely manner.

(3) Failure to Maintain Practices. If a responsible party fails or refuses to meet the requirements of the maintenance covenant, Summit County, after reasonable notice, may correct a violation of the design standards or maintenance needs by performing all necessary work to place the facility in proper working condition. In the event that the stormwater management facility becomes a danger to public safety or public health, Summit County shall notify the party responsible for
maintenance of the stormwater management facility in writing. Upon receipt of that notice, the responsible person shall have 30 days to implement maintenance and repair of the facility in an approved manner. After proper notice, Summit County may assess the owner(s) of the facility for the cost of repair work; and the cost of the work shall be a lien on the property.

Section 6. Inspection and Entry

A. The permittee shall allow authorized employees and representatives of Summit County, State of Utah Division of Water Quality, and the Environmental Protection Agency (EPA), to enter the site to which the permit applies at any time during or after construction and to inspect the erosion and sediment control and permanent stormwater treatment measures installed and maintained by the permittee. The permittee shall allow inspection of any other construction activity pertaining to the conditions of the permit. This right of entry shall be formalized in a Maintenance and Inspection Easement that must be approved by Summit County and recorded into the land record such that the easement remains binding on all subsequent land owners.

B. Inspections During Construction

(1) For construction sites greater than 1 acre, qualified personnel (provided by the permittee) shall inspect disturbed areas of the construction site that have not been finally stabilized, areas used for storage of materials that are exposed to
precipitation, areas with structural control measures, and locations where vehicles enter or exit the site at least once every seven (7) calendar days and within 24 hours of the end of a storm that is 0.5 inches or greater. Where sites have been temporarily stabilized, such inspection shall be conducted at least once every month.

(2) Disturbed areas and areas used for storage of materials that are exposed to precipitation shall be inspected for evidence of, or the potential for, pollutants entering the drainage system. Erosion and sediment control measures identified in the plan shall be observed to ensure that they are operating correctly. Where discharge locations or points are accessible, they shall be inspected to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters. Locations where vehicles enter or exit the site shall be inspected for evidence of offsite sediment tracking.

(3) Based on the results of the inspection, the pollution prevention, erosion and sediment control, and stormwater runoff control measures identified in the SWP3 and ECP shall be revised as appropriate as soon as practical after such inspection. Such modifications shall provide for timely implementation of any changes to the plan within seven (7) calendar days following the inspection. Such modifications may include maintenance of existing controls, adjustments in the locations of
controls, or addition of new controls to ensure that the ECP/SWP3 is meeting its goals and criteria.

(4) An inspection report summarizing the scope of the inspection, name(s) and qualifications of personnel making the inspection, the date(s) of the inspection, major observations relating to the implementation of the storm water pollution prevention plan, and actions taken in accordance with Section 6B(3) above, shall be made and retained as part of the SWP3/ECP Plan for at least three years from the date that the site is finally stabilized (see Appendix G for sample inspection forms). During construction, the reports shall be maintained onsite along with a copy of the SWP3/ECP Plan. The construction inspection reports shall identify any incidents of non-compliance. Where a report does not identify any incidents of non-compliance, the report shall contain a certification that the facility is in compliance with the storm water pollution prevention plan and this permit. The report shall be signed by the permittee or their duly authorized representative and the inspector.
Section 7. Revocation or Suspension of SWP3 and ECP

A. A SWP3 and ECP may be revoked or suspended by the County Engineer or designee upon the occurrence of any of the following:

(1) Failure of the permittee to comply with the plan or any portion thereof, or any condition of the permit; or

(2) Failure of the permittee to comply with any provision of this ordinance, or any other applicable law, ordinance, rule or regulation; or

(3) A determination by the County Engineer that the erosion and sediment control measures implemented by the permittee pursuant to the plan are inadequate to prevent or minimize, to the maximum extent practicable, the discharge of sediment, debris or other pollutants from the construction site by storm water runoff or vehicular tracking.

B. Summit County shall mail permittee written notice of non compliance or personally serve notice to the person responsible for maintaining the erosion control and sediment control measures, before revoking or suspending a permit. The notice shall state the nature and location of the non compliance and shall specify what action is required for the permittee to avoid revocation or suspension of the permit, which in the absence of
exceptional circumstances shall not be less than 5 working days or more than 10 working
days. The notice shall be sent by certified mail to the address listed for the permittee on
the application.

C. For the purposes of this ordinance, exceptional circumstances include, but are not
limited to, situations which involves risk of injury to persons, damage to storm drain
facilities, or damage to other property. Summit County may take any action deemed
necessary to alleviate any such exceptional circumstances defined above and may bill the
permittee, property owner, developer or contractor responsible for creating eh
exceptional circumstances for the cost of alleviating said circumstance.

D. A stop work order on all construction activity on the site may be issued upon the
revocation or suspension of a permit. No construction activity may be commenced or
continued on any site for which a permit has been revoked or suspended and a stop work
order issued until the permit has been reinstated or reissued.

E. A SWP3 and ECP may be reinstated or reissued upon review and approval of a
written description of he permittee’s proposed actions to bring the erosion control and
sediment control measures into compliance with all provisions of this ordinance, or
submission, review and approval of a revised SWP3 and ECP.
Section 8. Compliance with Federal and State Law

Nothing contained in this ordinance is intended to relieve any person or entity from any obligation to comply with applicable federal and/or state laws and any other regulations pertaining to clean water and/or storm water runoff and erosion control.
APPENDIX B: PERIMETER CONTROL EXEMPTIONS
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<td>PURPOSE</td>
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DEFINITION: Certain construction sites may be exempt from installing silt fence or other temporary perimeter controls if the site meets certain criteria.

PURPOSE: Exemptions for silt fence or other perimeter controls are for construction sites where such controls may be ineffectual, excessive, and/or detrimental to nearby water resources and other natural resources.

APPLICATION: All exemptions must be approved by the Summit County Engineer and must meet the following criteria:

1. Total disturbance is less than 1 acre.
2. A 50 foot wide vegetated buffer exists down gradient from the disturbed portion(s) of the site.
3. A 100 foot wide vegetated buffer exists down gradient between the disturbed portions(s) of the site and any live stream or existing drainage way.
4. The site and vegetated buffer have less than 5% slope (slope must be documented).
5. The vegetated buffer has at least 70% ground cover.