Clark County Stormwater Manual

Book 1 – Applicability, BMP Selection, and Submittals

~~Adoption Final~~ Review Draft

~~November 24, 2015~~

~~The *Clark County Stormwater Manual: Book 1* –is adapted from the *Stormwater Management Manual for Western Washington*, (Ecology, 2014) Volumes I, II, III, and V, and the *Clark County Stormwater Manual 2009*.~~

The *Clark County Stormwater Manual: Book 1* –is updated from the *County Stormwater Manual 2015 errata version*.

Illustrations and drawings are courtesy Washington Department of Ecology or redrawn from Washington Department of Ecology, unless otherwise noted. Illustrations are simplified representations of stormwater facilities; they are not to scale and they require detailed engineering for use in design or construction. Design requirements in text take precedence over figures.

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Appendices

Introduction to Book 1

Book 1 of the *Clark County Stormwater Manual* contains regulatory requirements for applicability and selection of permanent and temporary stormwater controls that apply to new development, redevelopment, and construction sites.

Book 1 describes investigations and selection processes prerequisite to planning for site development and developing a stormwater site plan. It describes nine Minimum Requirements established by Washington Department of Ecology and implemented by Clark County, as well as numerous County requirements. Book 1 also lists submittal requirements for projects.

This book is both regulatory and technical. Use this book in conjunction with Book 2, which has specific requirements for engineering analyses and design of stormwater controls selected for the site.

BMP numbers used in this manual have been modified from those used in the *Stormwater Management Manual for Western Washington* (Ecology, ~~2014~~2019); however, the two often coincide.

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Chapter 1 Minimum Requirements, County Requirements and Submittals

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1.1 Introduction

1.1.1 Purpose

This chapter provides direction on identifying which Department of Ecology Minimum Requirements and Clark County requirements apply to a project. The chapter directs users to the appropriate book and chapter of this manual for meeting requirements. The chapter gives directions for submitting a Stormwater Site Plan to Clark County.

1.1.2 How to Use this Chapter

- Section 1.2 describes projects and activities that are exempt from Clark County Code (CCC) Chapter 40.386 and the *Clark County Stormwater Manual* (CCSM).
- Section 1.3 lists definitions related to the Minimum Requirements. These definitions are essential to understanding the Minimum Requirements.
- Section 1.4 defines thresholds for project type, area, and area of land-disturbance that determine which Minimum Requirements apply.
- Section 1.5 lists and describes the Minimum Requirements.
- Section 1.6 describes County technical requirements that apply to projects in addition to the Minimum Requirements.
- Section 1.7 describes how to submit a Stormwater Site Plan for a small project.
- Section 1.8 describes how to submit a Stormwater Site Plan to Clark County.
- Section 1.9 describes the types of administrative and legal submittals (e.g. easements) that may be required.

1.2 Exemptions

Some projects are exempt from the Minimum Requirements, County Requirements or this manual.

1.2.1 Total Exemptions from this Manual

Publicly-funded linear transportation projects may follow the minimum design requirements and BMPs of the 2014 version of the Washington Department of Transportation's *Highway Runoff Manual* (HRM), except use of the infeasibility criteria used for LID selection in the HRM (both the general criteria in Sections 4-5 and the BMP specific criteria in Section 5) is not allowed. Instead, LID infeasibility criteria in this manual must be used for LID selection.

1.2.2 Total Exemptions from the Minimum Requirements

The following activities are exempt from the Minimum Requirements of this manual. Other Clark County, state and federal requirements may apply.

- Forest practices regulated under Title 222 of the Washington Administrative Code (WAC), except Class IV General Forest Practices that are conversions from timberland to other uses.
- Commercial agricultural practices involving working the land for production. However, the conversion from timberland to agriculture and the construction of impervious surfaces are not exempt.
- Construction of agricultural buildings or other hard surfaces for the sole purpose of carrying out commercial agricultural activities; provided, that no stormwater is released from the site directly or indirectly to the County's stormwater conveyance system.
- Normal landscape maintenance activities and gardening, except as defined as a land disturbing activity per the definition in Appendix 1-A.
- Oil and gas field activities or operations, including construction of drilling sites, waste management pits, and access roads, as well as construction of transportation and treatment infrastructure such as pipelines, natural gas treatment plants, natural gas pipeline compressor stations, and crude oil pumping stations. Operators are encouraged to implement and maintain best management practices to minimize erosion and control sediment during and after construction activities to help ensure protection of surface water quality during storm events.
- The following pavement maintenance practices:
    - Pothole and square cut patching.
    - Overlaying existing asphalt or concrete pavement without expanding the area of coverage.
    - Shoulder grading.
    - Regrading/reshaping drainage systems.
    - Crack sealing.
    - Resurfacing with in-kind material without expanding the road prism.
    - Pavement preservation activities that do not expand the road prism.
    - Vegetation management.
- Pavement replaced as part of a Clark County Structural Stormwater Control project retrofitting existing stormwater facilities to comply with the NPDES phase I municipal stormwater permit.

1.2.2.1 Clarification of Pavement Maintenance Exemptions

The following pavement maintenance practices are not categorically exempt. They are considered redevelopment. The extent to which the Minimum Requirements applies is explained for each circumstance.

- Removing and replacing a paved surface to base course or lower, or repairing the pavement base: If impervious surfaces are not expanded, Minimum Requirements #1 – #5 apply.
- Extending the pavement edge without increasing the size of the road prism, or paving graveled shoulders: These are considered new impervious surfaces and are subject to the Minimum Requirements that are triggered when the thresholds identified for new or redevelopment projects are met.
- Resurfacing by upgrading from dirt to gravel, asphalt or concrete; upgrading from gravel to asphalt or concrete; or upgrading from a bituminous surface treatment ("chip seal") to asphalt or concrete: These are considered new impervious surfaces and are subject to the Minimum Requirements that are triggered when the thresholds identified for new or redevelopment projects are met.

1.2.3 Exemptions to Individual Minimum Requirements

- Drainage projects that are not new development or redevelopment and do not create new stormwater injection wells are exempt from Minimum Requirement #6, Runoff Treatment, and the Responsible Official may waive all or parts of Minimum Requirement #1, Preparation of a Stormwater Site Plan, if the project meets other applicable requirements of this manual.
- Underground utility projects that replace the ground surface with in-kind material or materials with similar runoff characteristics are subject only to Minimum Requirement #2, Construction Stormwater Pollution Prevention.
- New development and redevelopment that meet the criteria for a Flow Control-Exempt Surface Water (see Section 1.5.7.1) and all of the following criteria are exempt from Minimum Requirement #7, Flow Control:
    - Project meets the exemption requirements for discharges to one of the following water bodies:
        - Columbia River
        - Lake River
        - Lewis River, downstream of the confluence with Quartz Creek
        - East Fork Lewis River, downstream of the confluence with Big Tree Creek
        - Vancouver Lake
    - Runoff from the site is treated in accordance with the thresholds and requirements of Minimum Requirement #6, Runoff Treatment.

- The discharge structure is designed to avoid erosion during all storms up to the 100-year storm.
- If an existing discharge structure is used, then either:
  - The discharge structure and conveyance system leading to it must have adequate capacity to meet the requirements of Chapter 7 of Book 2; or
  - The project must detain runoff from the project site that exceeds the existing system's capacity.

- New development and redevelopment are exempt from Minimum Requirement #8, Wetlands Protection, provided that:
  - The project does not change the rate, volume, duration, or location of discharges to and from the project site (e.g. where existing impervious surface is replaced with other impervious surface having similar runoff-generating characteristics, or where pipe/ditch modifications do not change existing discharge characteristics), or
  - The project meets the land cover percentage requirements for full dispersion in accordance to this manual for flow control, or
  - The Responsible Official determines based on information in the Preliminary Stormwater Plan, or information submitted for wetland review per CCC 40.450, that the proposed project will not degrade wetland function.

1.2.4 Exemptions from County Requirements

Publicly-funded road-related development and drainage projects are exempt from Section 1.9, Administrative and Legal Requirements.

1.3 Definitions Related to the Minimum Requirements

Approved Continuous Flow Model – Where referenced in this document, this term applies to continuous simulation hydrologic models approved for use in Clark County by the Department of Ecology. ~~The Western Washington Hydrology Model (WWHM~~ 2012~~) and MGSFlood are the only two approved models for use in Clark County.~~ Ecology-approved models are listed in the Additional Resources pages for the on-line 2019 SWMMWW.

Bioretention – Engineered facilities that treat stormwater by passing it through a specified soil profile and either retain or detain the treated stormwater for flow attenuation.

Certified Erosion and Sediment Control Lead (CESCL) – means an individual who has current certification through an approved erosion and sediment control training program that meets the minimum training standards established by the Washington Department of Ecology (Ecology). A CESCL is knowledgeable in the principles and practices of erosion and sediment control. The CESCL must have the skills to assess site conditions and construction activities that could impact

the quality of stormwater and, the effectiveness of erosion and sediment control measures used to control the quality of stormwater discharges. Certification is obtained through an Ecology approved erosion and sediment control course. Course listings are provided online at Ecology's website.

Commercial Agriculture – means those activities conducted on lands defined in RCW 84.34.020(2) and activities involved in the production of crops or livestock for commercial trade. An activity ceases to be considered commercial agriculture when the area on which it is conducted is proposed for conversion to a nonagricultural use or has lain idle for more than five years, unless the idle land is registered in a federal or state soils conservation program, or unless the activity is maintenance of irrigation ditches, laterals, canals, or drainage ditches related to an existing and ongoing agricultural activity.

Converted Vegetation (areas) – The surfaces on a project site where native vegetation, pasture, scrub/shrub, or unmaintained non-native vegetation (e.g., Himalayan blackberry, scotch broom) are converted to lawn or landscaped areas, or where native vegetation is converted to pasture.

Effective Impervious Surface – Those impervious surfaces that are connected via sheet flow or discrete conveyance to a drainage system. Impervious surfaces are considered ineffective if: 1) the runoff is dispersed through use of BMP T5.30A or T5.30B; 2) residential roof runoff is infiltrated in accordance with Downspout Full Infiltration Systems in BMP T5.10A or BMP T5:10B; or 3) modeling with an approved continuous simulation hydrologic model indicate that the entire runoff file is infiltrated.

Erodible or Leachable Materials – Wastes, chemicals, or other substances that measurably alter the physical or chemical characteristics of runoff when exposed to rainfall. Examples include erodible soils that are stockpiled, uncovered process wastes, manure, fertilizers, oily substances, ashes, kiln dust, and garbage dumpster leakage.

Existing Hard Surface - Hard surfaces at a single family residence or duplex created before 2009 or hard surface areas greater than 5,000 square feet of impervious surface on a non-residential site created before 2000.

Hard Surface – An impervious surface, a permeable pavement, or a vegetated roof.

Highway – A main public road connecting towns and cities.

Impervious Surface – A non-vegetated surface area that either prevents or retards the entry of water into the soil mantle as under natural conditions prior to development. A non-vegetated surface area which causes water to run off the surface in greater quantities or at an increased rate of flow from the flow present under natural conditions prior to development. Common impervious surfaces include, but are not limited to, roof tops, walkways, patios, driveways, parking lots or storage areas, concrete or asphalt paving, gravel roads, packed earthen materials, and oiled, macadam or other surfaces which similarly impede the natural infiltration of stormwater. Open, uncovered retention/detention facilities shall not be considered as impervious surfaces for purposes of

determining whether the thresholds for application of Minimum Requirements are exceeded. Open, uncovered retention/detention facilities shall be considered impervious surfaces for purposes of runoff modeling.

Land Disturbing Activity – Any activity that results in a change in the existing soil cover (both vegetative and non-vegetative) and/or the existing soil topography. Land disturbing activities include, but are not limited to clearing, grading, filling, and excavation. Compaction that is associated with stabilization of structures and road construction shall also be considered a land disturbing activity. Vegetation maintenance practices, including landscape maintenance and gardening, are not considered land-disturbing activity. Stormwater facility maintenance is not considered land disturbing activity if conducted according to established standards and procedures.

Low Impact Development (LID) – A stormwater and land use management strategy that strives to mimic pre-disturbance hydrologic processes of infiltration, filtration, storage, evaporation and transpiration by emphasizing conservation, use of on-site natural features, site planning, and distributed stormwater management practices that are integrated into a project design.

LID Best Management Practices – Distributed stormwater management practices, integrated into a project design, that emphasize pre-disturbance hydrologic processes of infiltration, filtration, storage, evaporation, and transpiration. LID BMPs include, but are not limited to, bioretention/rain gardens, permeable pavements, roof downspout controls, dispersion, soil quality and depth, minimal excavation foundations, vegetated roofs, and water re-use.

LID Principles – Land use management strategies that emphasize conservation, use of on-site natural features, and site planning to minimize impervious surfaces, native vegetation loss, and stormwater runoff.

Maintenance – Repair and maintenance includes activities conducted on currently serviceable structures, facilities, and equipment that involves no expansion or use beyond that previously existing and results in no significant adverse hydrologic impact. It includes those usual activities taken to prevent a decline, lapse, or cessation in the use of structures and systems. Those usual activities may include replacement of dysfunctional facilities, including cases where environmental permits require replacing an existing structure with a different type structure, as long as the functioning characteristics of the original structure are not changed. One example is the replacement of a collapsed, fish blocking, round culvert with a new box culvert under the same span, or width, of roadway. In regard to stormwater facilities, maintenance includes assessment to ensure ongoing proper operation, removal of built up pollutants (i.e. sediments), replacement of failed or failing treatment media, and other actions taken to correct defects as identified in the maintenance standards in Book 4 of this manual. See also Pavement Maintenance exemptions in Section 1.2.2.

Native Vegetation – Vegetation comprised of plant species, other than noxious weeds, that are indigenous to the coastal region of the Pacific Northwest and which reasonably could have been expected to naturally occur on the site. Examples include trees such as Douglas Fir, western

hemlock, western red cedar, alder, big-leaf maple, and vine maple; shrubs such as willow, elderberry, salmonberry, and salal; and herbaceous plants such as sword fern, foam flower, and fireweed.

New Development – Land disturbing activities, including Class IV -general forest practices that are conversions from timber land to other uses; structural development, including construction or installation of a building or other structure; creation of hard surfaces; and subdivision, short subdivision and binding site plans, as defined and applied in Chapter 58.17 RCW. Projects meeting the definition of redevelopment shall not be considered new development.

On-site Stormwater Management BMPs – As used in this manual, a synonym for Low Impact Development BMPs.

Permeable Pavement – Pervious concrete, porous asphalt, permeable pavers or other forms of pervious or porous paving material intended to allow passage of water through the pavement section. It often includes an aggregate base that provides structural support and acts as a stormwater reservoir.

Pervious Surface – Any surface material that allows stormwater to infiltrate into the ground. Examples include lawn, landscape, pasture, native vegetation areas, and permeable pavements.

Pollution-generating Hard Surface (PGHS) – Those hard surfaces considered to be a significant source of pollutants in stormwater runoff. See the listing of surfaces under pollution-generating impervious surface.

Pollution-generating Impervious Surface (PGIS) – Those impervious surfaces considered to be a significant source of pollutants in stormwater runoff. Such surfaces include those which are subject to: vehicular use; industrial activities (as further defined in the glossary of this manual); storage of erodible or leachable materials, wastes, or chemicals, and which receive direct rainfall or the run-on or blow-in of rainfall; metal roofs unless they are coated with an inert, non-leachable material (e.g., baked-on enamel coating); or roofs that are subject to venting significant amounts of dusts, mists, or fumes from manufacturing, commercial, or other indoor activities.

Pollution-generating Pervious Surfaces (PGPS) – Any non-impervious surface subject to vehicular use, industrial activities (as further defined in the glossary of this manual); or storage of erodible or leachable materials, wastes, or chemicals, and that receive direct rainfall or run-on or blow-in of rainfall, use of pesticides and fertilizers, or loss of soil. Typical PGPS include permeable pavement subject to vehicular use, lawns, and landscaped areas including: golf courses, parks, cemeteries, and sports fields (natural and artificial turf).

Pre-developed Condition – The native vegetation and soils that existed at a site prior to the influence of Euro-American settlement. The pre-developed condition shall be assumed to be a forested land cover unless reasonable, historic information is provided that indicates the site was prairie prior to settlement.

Project Site – That portion of a property, properties, or right of way subject to land disturbing activities, new hard surfaces, or replaced hard surfaces.

Rain Garden – A non-engineered shallow landscaped depression, with compost-amended native soils and suitable plants. The depression is designed to pond and temporarily store stormwater runoff from adjacent areas, and to allow stormwater to pass through the amended soil profile.

Receiving Waters - Bodies of water or surface water systems to which surface runoff is discharged via a point source of stormwater or via sheet flow. Groundwater to which surface runoff is directed by infiltration.

Redevelopment – On a site that is already substantially developed (i.e., has 35% or more of existing hard surface coverage), the creation or addition of hard surfaces; the expansion of a building footprint or addition or replacement of a structure; structural development including construction, installation or expansion of a building or other structure; replacement of hard surface that is not part of a routine maintenance activity; and land disturbing activities.

Replaced Hard Surface – For structures, the removal and replacement of hard surfaces down to the foundation. For other hard surfaces, the removal down to bare soil or base course and replacement.

Replaced Impervious Surface – For structures, the removal and replacement of impervious surfaces down to the foundation. For other impervious surfaces, the removal down to bare soil or base course and replacement.

Site – The area defined by the legal boundaries of a parcel or parcels of land that is (are) subject to new development or redevelopment. For road projects, the length of the project site and the right-of-way boundaries define the site.

Source Control BMP – A structure or operation that is intended to prevent pollutants from coming into contact with stormwater through physical separation of areas or careful management of activities that are sources of pollutants. This manual separates source control BMPs into two types. Structural Source Control BMPs are physical, structural, or mechanical devices, or facilities that are intended to prevent pollutants from entering stormwater. Operational BMPs are non-structural practices that prevent or reduce pollutants from entering stormwater.

Threshold Discharge Area – An on-site area draining to a single natural discharge location or multiple natural discharge locations that combine within one-quarter mile downstream (as determined by the shortest flow path). The examples in Figure 1.1, below, illustrate this definition. The purpose of this definition is to clarify how the thresholds of this manual are applied to project sites with multiple discharge points.

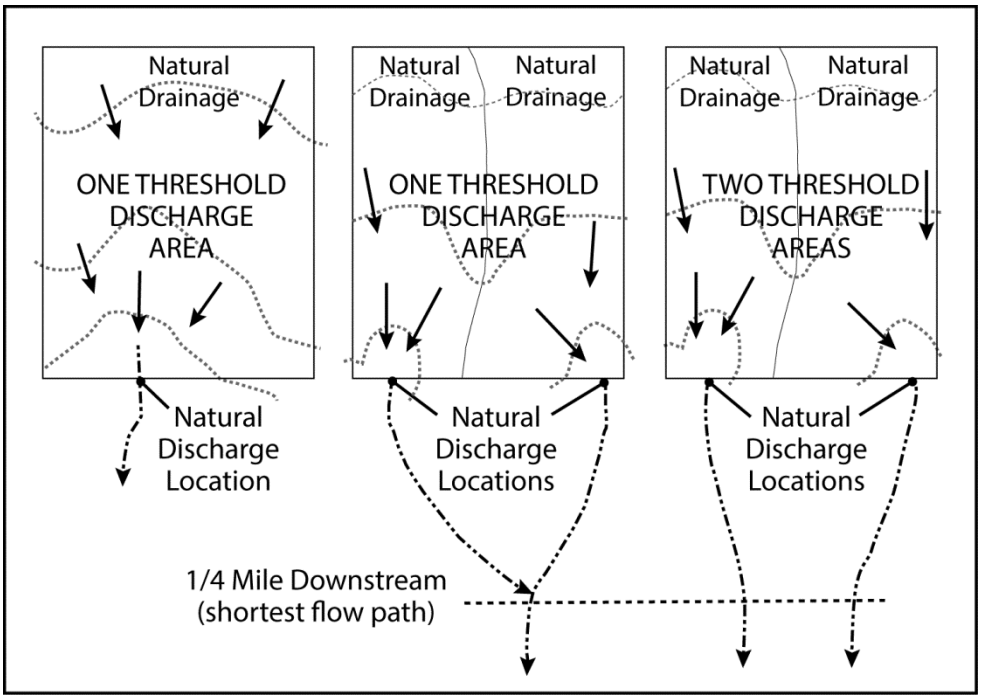

Figure 1.1: Threshold Discharge Area

(Source: modified from Department of Ecology)

1.4 Applicability of the Minimum Requirements

Clark County has other technical requirements and administrative and legal requirements that are not included in the Minimum Requirements. These are identified in Sections 1.6 and 1.9.

Clark County has nine Minimum Requirements for stormwater management. These Minimum Requirements are:

1. Preparation of Stormwater Site Plans
2. Construction Stormwater Pollution Prevention
3. Source Control of Pollution
4. Preservation of Natural Drainage Systems and Outfalls
5. On-site Stormwater Management (Low Impact Development)
6. Runoff Treatment
7. Flow Control
8. Wetlands Protection
9. Operation and Maintenance

Not all of the minimal requirements apply to every project. The applicability varies, depending on the project type, size, and location. To determine which requirements apply to a specific project, see Section 1.4.1 (for new development) or Section 1.4.2 (for redevelopment) and/or consult Figure 1.2 (for new development) and Figure 1.3 (for redevelopment).

Permit (Construction) Time Limit. All permits issued pursuant to the regulations contained in Chapter 40.385 or earlier stormwater code and the 2009 or earlier version of the Clark County Stormwater Manual expire on January 8, 2021, except if approved construction has begun on site before January 8, 2021. Beginning construction means, at a minimum, the site work associated with and directly related to the approved project has begun. For example: grading the project site to final grade, or the installation of utilities. Simply clearing the project site does not constitute the beginning of construction.

For purposes of applying the manual thresholds to a proposed single family residential subdivision (i.e., a plat or short plat project), assume 4,000 sq. ft. of hard surface (8,000 sq. ft. on lots of 5 acres or more) for each newly created lot, unless the project proponent has otherwise formally declared other values for each lot in the complete land division application.

Understanding the definitions in Section 1.3 is essential to correctly implementing the Minimum Requirements.

1.4.1 New Development

All new development shall comply with Minimum Requirement #2.

The following new development shall comply with Minimum Requirements #1 – #5 for the new and replaced hard surfaces and the land disturbed:

- Results in 2,000 square feet, or greater, of new, replaced, or new plus replaced hard surface area, or
- Has land disturbing activity of 7,000 square feet or greater.

The following new development shall comply with Minimum Requirements #1 – #9 for the new and replaced hard surfaces and the converted vegetation areas:

- Results in 5,000 square feet, or greater, of new plus replaced hard surface area, or
- Converts ¾ acres, or more, of vegetation to lawn, or landscaped areas, or
- Converts 1 acre or more of vegetation to stabilized soil on projects lacking an approved Final Engineering Plan, or
- Converts 2.5 acres, or more, of native vegetation to pasture.

1.4.2 Redevelopment

All redevelopment shall comply with Minimum Requirement #2.

The following redevelopment shall comply with Minimum Requirements #1 – #5 for the new and replaced hard surfaces and the land disturbed:

- Results in 2,000 square feet, or more, of new plus replaced hard surface area, or
- Has land disturbing activity of 7,000 square feet or greater.

The following redevelopment shall comply with Minimum Requirements #1 – #9 for the new hard surfaces and converted pervious areas:

- Adds 5,000 square feet or more of new hard surfaces or,
- Converts ¾ acres, or more, of vegetation to lawn, or landscaped areas, or
- Converts 1 acre or more of vegetation to stabilized soil on projects lacking an approved Final Engineering Plan, or
- Converts 2.5 acres, or more, of native vegetation to pasture.

Clark County may allow the Minimum Requirements to be met for an equivalent (flow and pollution characteristics) area within the same TDA ~~site~~. If the equivalent area is outside the TDA, or off site, the equivalent area must drains to the same receiving water and the guidance for equivalent facilities using in-basin transfers must be followed, as detailed in "I-D.6 Regional Facility Area Transfers" in the SWMMWW. For publicly-funded linear transportation projects, the equivalent area does not have to be within the project limits, but must drain to the same receiving water.

1.4.2.1 Additional Requirements for the Redevelopment Project Site

For road-related projects, runoff from the replaced and new hard surfaces (including pavement, shoulders, curbs, and sidewalks) and the converted vegetated areas shall meet Minimum Requirements #1 – #9 if the new hard surfaces total 5,000 square feet or more and total 50% or more of the existing hard surfaces within the project limits. The project limits shall be defined by the length of the project and the width of the right–of-way.

Other types of redevelopment projects shall comply with Minimum Requirements #1 – #9 for the new and replaced hard surfaces and the converted vegetated areas if the total of new plus replaced hard surfaces is 5,000 square feet or more, and the valuation of proposed improvements – including interior improvements – exceeds 50% of the assessed value of the existing project site improvements.

The Responsible Official may exempt or institute a stop-loss provision for redevelopment projects from compliance with Minimum Requirements #5, On-site Stormwater Management; Minimum Requirement #6, Runoff Treatment; Minimum Requirement #7, Flow Control; and/or Minimum Requirement #8, Wetlands Protection as applied to the replaced hard surfaces if Clark County has adopted a plan and a schedule that fulfills those requirements in regional facilities.

The Responsible Official may grant a variance/exception to the application of the flow control requirements to replaced impervious surfaces if such application imposes a severe and unexpected economic hardship. See CCC 40.386.

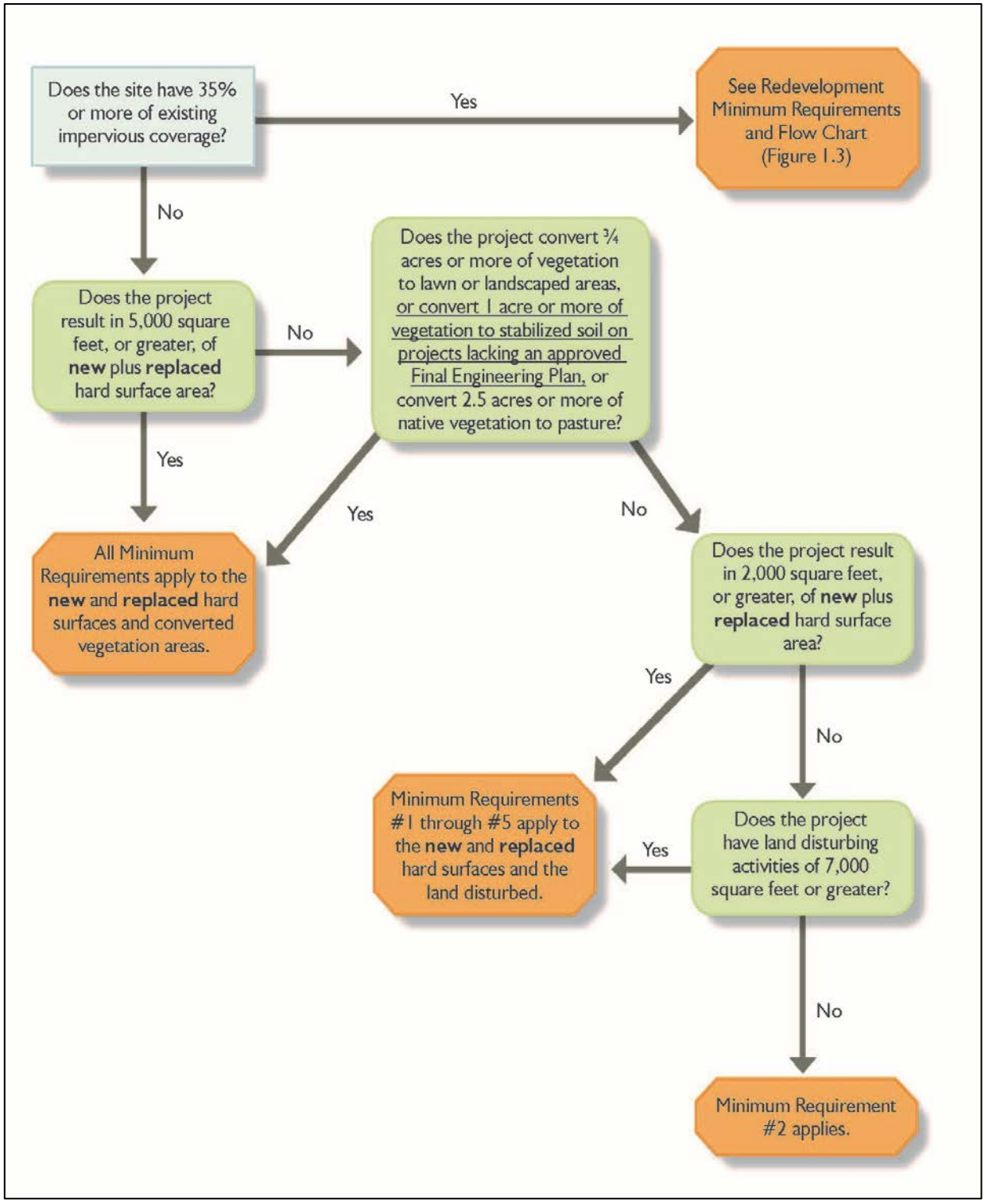

Figure 1.2: New Development Flow Chart

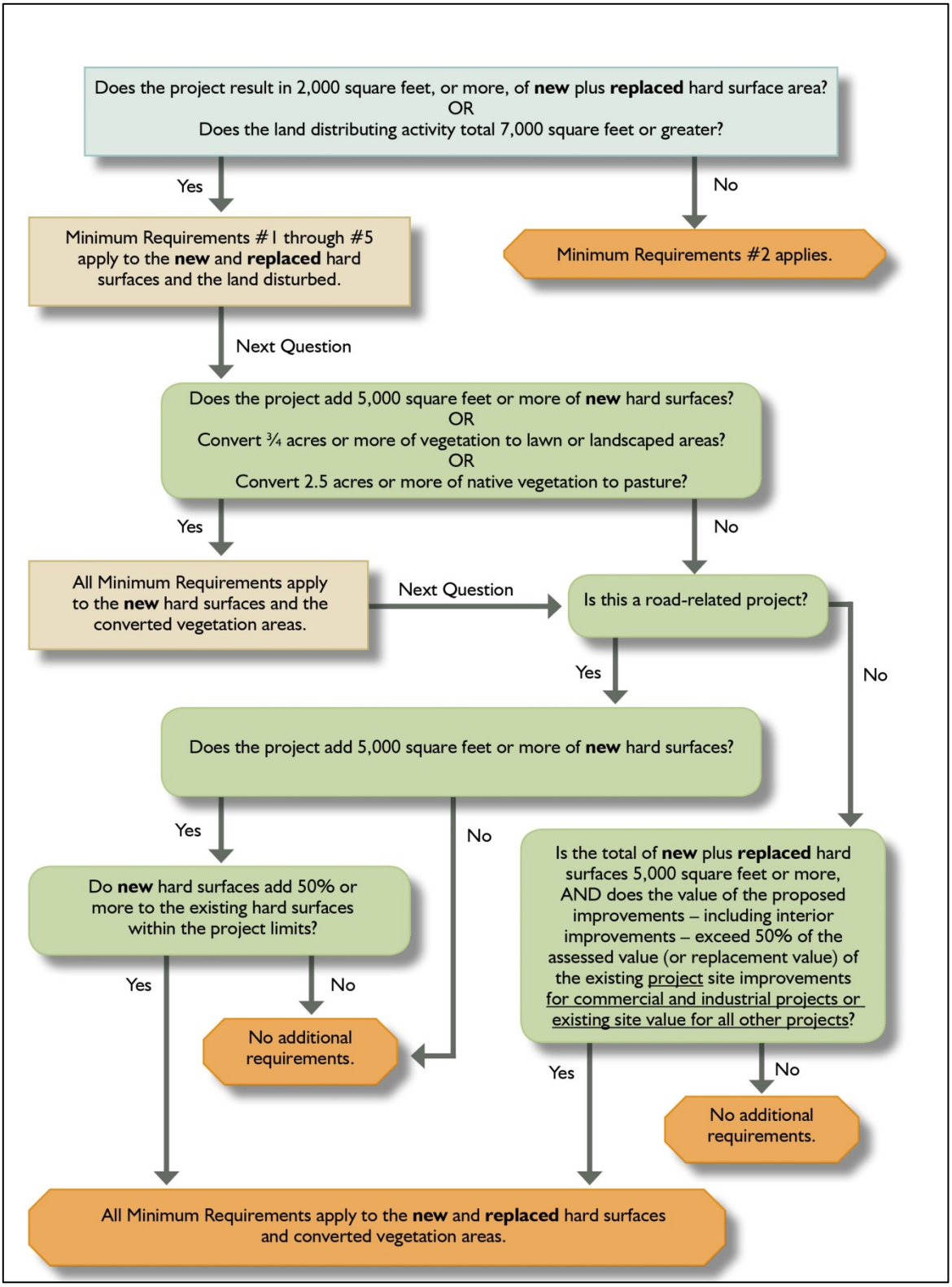

Figure 1.3: Redevelopment Flow Chart

1.4.3 How to Meet the Minimum Requirements

After determining which Minimum Requirements apply to a specific project, read the applicable Minimum Requirements in Section 1.5. Then refer to the list below to determine where to find out how to meet each one.

1: Preparation of Stormwater Site Plans

- Consult **Book 1, Section 1.8** of this manual to fulfill Minimum Requirement #1.
- For sites meeting the definition of a Small Project (see Section 1.7), consult **Book 1, Section 1.7** of this manual to confirm eligibility to use **Stormwater Site Plan Short Form**, in **Appendix 1-I** to fulfill Minimum Requirement #1.

2: Construction Stormwater Pollution Prevention

- Consult **Book 1, Chapter 6** of this manual to fulfill Minimum Requirement #2.

3: Source Control of Pollution

- Consult **Book 3, Source Control** of this manual to fulfill Minimum Requirement #3.

4: Preservation of Natural Drainage Systems and Outfalls

- Consult **Book 1, Section 1.5.4** and **Book 2, Chapter 7** to fulfill Minimum Requirement #4.

5: On-site Stormwater Management

- Consult **Book 1, Chapter 2** and **Book 2, Chapter 2** to fulfill Minimum Requirement #5.

6: Runoff Treatment

- Consult **Book 1, Chapter 3** and **Book 2 Chapters 3** and **4** to fulfill Minimum Requirement #6.

7: Flow Control

- Consult **Book 1, Chapter 4** and **Book 2, Chapters 5** and **6** to fulfill Minimum Requirement #7.

8: Wetlands Protection

- Consult **Book 1, Section 1.5.8** to fulfill Minimum Requirement #8.
- In addition, consult **CCC 40.450** for additional information relating to wetland protection in Clark County.

9: Operation and Maintenance

- Consult **Book 4, Operation and Maintenance** to fulfill Minimum Requirement #9.

1.5 Minimum Requirements

This section describes the Minimum Requirements for stormwater management at development and redevelopment sites. Consult Section 1.4 to determine which requirements apply to any given project and whether the Minimum Requirements apply to new surfaces, replaced surfaces, new and replaced surfaces, or converted vegetation areas.

1.5.1 Minimum Requirement #1: Preparation of Stormwater Site Plans

All projects meeting the thresholds in Section 1.4 shall prepare a Stormwater Site Plan for review by Clark County. Stormwater Site Plans shall use site-appropriate development principles to retain native vegetation and minimize impervious surfaces to the extent feasible. Stormwater Site Plans shall be prepared in accordance with Sections 1.7 and 1.8 of this book.

Stormwater Site Plans shall use appropriate development principles to retain native vegetation and minimize impervious surfaces to the extent feasible. See Preservation of Native Vegetation (BMP T5.40) and Better Site Design (BMP T5.41) in Book 2, Chapter 2 for more information.

1.5.2 Minimum Requirement #2: Construction Stormwater Pollution Prevention

1.5.2.1 Thresholds

All new development and redevelopment projects are responsible for preventing erosion and discharge of sediment and other pollutants into receiving waters.

Projects which result in 2,000 square feet or more of new plus replaced hard surface area, or which disturb 7,000 square feet or more of land must prepare and submit a Construction Stormwater Pollution Prevention Plan (SWPPP) as part of the Final Stormwater Plan.

Different methods of preparing a SWPPP are discussed in Sections 1.7 and 1.8 of this book.

Projects that result in less than 2,000 square feet of new plus replaced hard surface area or disturb less than 7,000 square feet of land are not required to prepare a Construction SWPPP, but must review the 13 Elements of Construction Stormwater Pollution Prevention and develop controls for each element that pertains to the project site.

The 13 Elements of Construction Stormwater Pollution Prevention are described in Chapter 6.

1.5.2.2 General Requirements

The SWPPP shall include a narrative and drawings. All BMPs shall be clearly referenced in the narrative and marked on the drawings. The SWPPP narrative shall include documentation to explain and justify the pollution prevention decisions made for the project. Each of the 13 elements must be considered and included in the Construction SWPPP unless site conditions render the element unnecessary and the exemption from that element is clearly justified in the narrative.

Clearing and grading activities for developments shall be permitted only if conducted pursuant to an approved site development plan (e.g., subdivision approval) that establishes permitted areas of clearing, grading, cutting, and filling. These permitted clearing and grading areas and any other areas required to preserve critical or sensitive areas, buffers, native growth protection easements, or tree retention areas shall be delineated on the site plans and the development site.

The SWPPP shall be implemented beginning with initial land disturbance and until final stabilization. Sediment and erosion control BMPs shall be consistent with the BMPs contained in Book 2, Chapter ~~8~~ 9 or the 2019 SWMMWW Volume II, Chapter 3.

The applicant may comply with Minimum Requirement #2 at a site covered under the Construction Stormwater General Permit - National Pollutant Discharge Elimination System and State Waste Discharge Permit for Stormwater Discharges Associated with Construction Activity by fully implementing the permit- required SWPPP.

Seasonal Work Limitations

From October 1 through April 30, clearing, grading, and other soil disturbing activities shall only be permitted if shown to the satisfaction of Clark County that silt-laden runoff will be prevented from leaving the site through a combination of the following:

1. Site conditions including existing vegetative coverage, slope, soil type, and proximity to receiving waters.

2. Limitations on activities and the extent of disturbed areas.

3. Proposed erosion and sediment control measures.

The following activities are exempt from the seasonal clearing and grading limitations:

1. Routine maintenance and necessary repair of erosion and sediment control BMPs.

2. Routine maintenance of public facilities or existing utility structures that do not expose the soil or result in the removal of the vegetative cover to soil.

3. Activities where there is one hundred percent infiltration of surface water runoff within the site in approved and installed erosion and sediment control facilities.

4. Development projects in compliance with the state's Construction Stormwater General Permit.

1.5.3 Minimum Requirement #3: Source Control of Pollution

All known, available, and reasonable source control BMPs must be applied to all projects. Source control BMPs must be selected, designed, and maintained according to Book 3 of this manual.

1.5.4 Minimum Requirement #4: Preservation of Natural Drainage Systems and Outfalls

Natural drainage patterns shall be maintained, and discharges from the project site shall occur at the natural location, to the maximum extent practicable. The manner by which runoff is discharged from the project site must not cause a significant adverse impact to downstream receiving waters and down gradient properties. All outfalls require energy dissipation (see Book 2, Section 7.7).

1.5.5 Minimum Requirement #5: On-site Stormwater Management

Projects shall employ On-site Stormwater Management BMPs in accordance with the following project thresholds, standards, and lists to infiltrate, disperse, and retain stormwater runoff on-site to the maximum extent feasible without causing flooding or erosion impacts.

Projects qualifying as flow control exempt in accordance with Section 1.5.7 do not have to achieve the LID Performance Standard, nor consider bioretention, rain gardens, permeable pavement, or full dispersion if using List #1 or List #2. However, those projects must implement the following BMPs, if feasible:

- BMP T5.13, Post-Construction Soil Quality and Depth, in Chapter 2 and Book 2, Chapter 2; and
- BMPs T5.10A or BMP T5.10B, Downspout Full Infiltration; BMP T5.10C, Downspout Dispersion; or BMP T5.10D, Perforated Stub-out Connections, in Chapter 2 and Book 2, Chapter 2; and
- BMPs T5.11, Concentrated Flow Dispersion; or T5.12, Sheet Flow Dispersion, in Chapter 2 and Book 2, Chapter 2.

1.5.5.1 Project ~~Thresholds~~ Compliance Options

Projects triggering only Minimum Requirements #1 – #5 shall either:

1. Use On-site Stormwater Management BMPs from List #1 for all surfaces within each type of surface in List #1; or

2. Demonstrate compliance with the LID Performance Standard. Projects selecting this option cannot use Rain Gardens. They may choose to use Bioretention BMPs as described

in Chapter 2 and Book 2, Chapter 2 to achieve the LID Performance Standard. Projects selecting this option must implement BMP T5.13, Post-Construction Soil Quality and Depth, if feasible.

Projects triggering Minimum Requirements #1 – #9, must meet the requirements in Table 1.1.

Table 1.1: On-site Stormwater Management Requirements for Projects Triggering Minimum Requirements #1 – #9

Project Type and Location	Requirement
New development on any parcel inside the UGA, or new development outside the UGA on a parcel less than 5 acres.	Low Impact Development Performance Standard and BMP T5.13; or List #2 (applicant option).
New development outside the UGA on a parcel of 5 acres or larger.	Low Impact Development Performance Standard and BMP T5.13.
Redevelopment on any parcel inside the UGA, or redevelopment outside the UGA on a parcel less than 5 acres.	Low Impact Development Performance Standard and BMP T5.13; or List #2 (applicant option).
Redevelopment outside the UGA on a parcel of 5 acres or larger.	Low Impact Development Performance Standard and BMP T5.13.

NOTE: This table refers to the Urban Growth Area (UGA) as designated under the Growth Management Act (GMA) (Chapter 26.70A RCW) of the State of Washington. See Clark County Maps Online at http://gis.clark.wa.gov/mapsonline/ for the location of UGA boundaries.

On sites parcels greater than 5 acres outside the UGA where infiltration BMPs are infeasible or not capable of meeting the performance standard, the project must use list 2.

1.5.5.2 Low Impact Development Performance Standard

Stormwater discharges shall match developed discharge durations to pre-developed durations for the range of pre-developed discharge rates from 8% of the 2-year peak flow to 50% of the 2-year peak flow. Refer to Section 1.5.7.3, Standard Flow Control Requirement of Minimum Requirement #7, for information about the assignment of the pre-developed condition. Project sites that must also meet Minimum Requirement #7, Flow Control must match flow durations between 8% of the 2-year flow through the full 50-year flow.

1.5.5.3 List #1: On-site Stormwater Management BMPs for Projects Triggering Minimum Requirements #1 – #5

For each surface, consider the BMPs in the order listed for that type of surface. Use the first BMP that is considered feasible. No other On-site Stormwater Management BMP is necessary for that surface. Feasibility shall be determined by evaluation against:

1. Limitations and infeasibility criteria identified for each BMP in Chapter 2; and,

2. Competing Needs Criteria listed in Chapter 2.

List #1

Lawn and landscaped areas

- Post-Construction Soil Quality and Depth in accordance with BMP T5.13 in Book 2, Chapter 2 of this manual.

Roofs

1. Full Dispersion in accordance with BMP T5.30A or BMP T5.30B in Chapter 2 and Book 2, Chapter 2, or Downspout Full Infiltration Systems in accordance with BMP T5.10A or BMP T5.10B in Chapter 2 and Book 2, Chapter 2.

2. Rain Gardens in accordance with BMP T5.14A in Chapter 2 and Book 2, Chapter 5 of this manual, or Bioretention in accordance with BMP T5.14B Chapter 2 and Book 2, Chapter 2. A rain gardens or bioretention facility must have a minimum horizontally projected surface area below the overflow which is at least 5% of the total surface area draining to it.[1]

3. Downspout Dispersion Systems in accordance with BMP T5.10C in Chapter 2 and Book 2, Chapter 2.

4. Perforated Stub-out Connections in accordance with BMP T5.10D in Chapter 2 and Book 2, Chapter 2.

Other Hard Surfaces

1. Full Dispersion in accordance with BMP T5.30A or BMP T5.30B in Chapter 2 and Book 2, Chapter 2.

2. Permeable pavement[2] in accordance with BMP T5.15 in Chapter 2 and Book 2, Chapter 5 of this manual, or Rain Gardens in accordance with BMP T5.14 in Chapter 2 and Book 2, Chapter 2, or Bioretention in accordance with Chapter 2 and Book 2, Chapter 2.

3. Sheet Flow Dispersion in accordance with BMP T5.12, or Concentrated Flow Dispersion in accordance with BMP T5.11 in Chapter 2 and Book 2, Chapter 2.

[1] The minimum horizontally projected surface area requirement does not apply to projects meeting the LID Performance Standard.
[2] This is not a requirement to pave these surfaces. Where pavement is proposed, it must be permeable to the extent feasible unless full dispersion is employed.

1.5.5.4 List #2: On-site Stormwater Management BMPs for Projects Triggering Minimum Requirements #1 – #9

For each surface, consider the BMPs in the order listed for that type of surface. Use the first BMP that is considered feasible. No other On-site Stormwater Management BMP is necessary for that surface. Feasibility shall be determined by evaluation against:

1. Design criteria, limitations, and infeasibility criteria identified for each BMP in Chapter 2 and Book 2, Chapter 2; and

2. Competing Needs Criteria listed in Chapter 2.

List #2

Lawn and landscaped areas

- Post-Construction Soil Quality and Depth in accordance with BMP T5.13 in Chapter 2 and Book 2, Chapter 2.

Roofs

1. Full Dispersion in accordance with BMP T5.30A or BMP T5.30B in Chapter 2 and Book 2, Chapter 5 of this manual, or Downspout Full Infiltration Systems in accordance with BMP T5.10A or BMP 5.10B in Chapter 2 and Book 2, Chapter 2.

2. Bioretention in accordance with BMP T5.14B in Chapter 2 and Book 2, Chapter 2. Bioretention facilities must have a minimum horizontally projected surface area below the overflow which is at least 5% of the total surface area draining to it.[3]

3. Downspout Dispersion Systems in accordance with BMP T5.10C in Chapter 2 and Book 2, Chapter 2.

4. Perforated Stub-out Connections in accordance with BMP T5.10D in Chapter 2 and Book 2, Chapter 2.

Other Hard Surfaces

1. Full Dispersion in accordance with BMP T5.30A or BMP T5.30B in Chapter 2 and Book 2, Chapter 2.

2. Permeable pavement[4] in accordance with BMP T5.15 in Chapter 2 and Book 2, Chapter 2.

[3] The minimum horizontally projected surface area requirement does not apply to projects meeting the LID Performance Standard.
[4] This is not a requirement to pave these surfaces. Where pavement is proposed, it must be permeable to the extent feasible unless full dispersion is employed.

3. Bioretention BMPs (See Chapter 2 and Book 2, Chapter 2) that have a minimum horizontally projected surface area below the overflow which is at least 5% of the total surface area draining to it.

4. Sheet Flow Dispersion in accordance with BMP T5.12, or Concentrated Flow Dispersion in accordance with BMP T5.11 in Chapter 2 and Book 2, Chapter 2.

1.5.6 Minimum Requirement #6: Runoff Treatment

1.5.6.1 Thresholds

When assessing a project against the following thresholds, only consider those hard and pervious surfaces that are subject to this Minimum Requirement as determined in Section 1.4.

The following require construction of stormwater treatment facilities:

- Projects in which the total of pollution-generating hard surface (PGHS) is 5,000 square feet or more in a threshold discharge area of the project, or
- Projects in which the total of pollution-generating pervious surfaces (PGPS) – not including permeable pavements – is three-quarters (3/4) of an acre or more in a threshold discharge area, and from which there will be a surface discharge in a natural or man-made conveyance system from the site.

The following sites require phosphorus treatment stormwater treatment facilities:

- Projects located in the Lacamas watershed above the dam at the south end of Round Lake.

1.5.6.2 Treatment Facility Sizing

Size stormwater treatment facilities for the entire area that drains to them, even if some of those areas are not pollution-generating, or were not included in the project site threshold decisions (Section 1.4) or the treatment threshold decisions of this Minimum Requirement (Section 1.5.6.1).

Water Quality Design Storm Volume

The water quality design storm volume is the volume of runoff predicted from a 24-hour storm with a 6-month return frequency (a.k.a., 6-month, 24-hour storm). Wetpool facilities are sized based upon the volume of runoff predicted through use of the Natural Resource Conservation Service curve number equations in Appendix 2-A, for the 6-month, 24-hour storm. Alternatively, when using an approved continuous simulation hydrologic model, the water quality design storm volume shall be equal to the simulated daily volume that represents the upper limit of the range of daily volumes that accounts for 91% of the entire runoff volume over a multi-decade period of record.

Water Quality Design Flow Rate

Preceding Detention Facilities or when Detention Facilities are Not Required

The water quality design flow rate is the flow rate at or below which 91% of the runoff volume, as estimated by an approved continuous simulation hydrologic model, will be treated. Design criteria for treatment facilities are assigned to achieve the applicable performance goal (e.g. 80% TSS removal) at the water quality design flow rate. At a minimum, 91% of the total runoff volume, as estimated by an approved continuous flow model, must pass through the treatment facility(ies) at or below the approved hydraulic loading rate for the facility(ies).

Downstream of Detention Facilities

The water quality design flow rate is the full 2-year release rate from the detention facility.

1.5.6.3 Treatment Facility Selection, Design, and Maintenance

Stormwater treatment facilities shall be:

- Selected in accordance with the process identified in Chapter 3;
- Designed in accordance with the design criteria in Book 2, Chapters 3 and 4;
- Maintained in accordance with the maintenance schedules in Minimum Requirement #9 and Book 4 of this manual.

1.5.6.4 Additional Requirements

Direct discharge of untreated stormwater from pollution-generating hard surfaces to groundwater is prohibited, except for the discharge achieved by infiltration or dispersion of runoff through use of On-site Stormwater Management BMPs, in accordance with Chapter 2 and Book 2, Chapter 2; or by infiltration through soils meeting the soil suitability criteria in Book 2, Section 3.1.5.3.

1.5.7 Minimum Requirement #7: Flow Control

1.5.7.1 Applicability

The requirement below to provide flow control applies to projects that discharge stormwater directly, or indirectly through a conveyance system, into a surface waterbody.

Flow control is not required for projects that discharge directly to, or indirectly to, a waterbody listed in Section 1.2.3 subject to the following restrictions:

- Direct discharge to the exempt receiving water does not result in the diversion of drainage from any perennial stream classified as Types 1, 2, 3, or 4 in the State of Washington Interim Water Typing System, or Types "S", "F", or "Np" in the Permanent Water Typing System, or from any category I, II, or III wetland; and

- Flow splitting devices or drainage BMPs are applied to route natural runoff volumes from the project site to any downstream Type 5 stream (seasonal non-fish bearing) or category IV wetland:
    - Design of flow splitting devices or drainage BMPs will be based on continuous hydrologic modeling analysis. The design will assure that flows delivered to Type 5 stream reaches will approximate, but in no case exceed, existing condition durations ranging from 50% of the 2-year to the 50-year peak flow.
    - Flow splitting devices or drainage BMPs that deliver flow to category IV wetlands will also be designed using continuous hydrologic modeling to preserve pre-project wetland hydrologic conditions unless specifically waived or exempted by regulatory agencies with permitting jurisdiction; and
- The project site must be drained by a conveyance system that is comprised entirely of manmade conveyance elements (e.g., pipes, ditches, outfall protection, etc.) and extends to the ordinary high water line of the exempt receiving water; and
- The conveyance system between the project site and the exempt receiving water shall have sufficient hydraulic capacity to convey discharges from future build-out conditions (under current zoning) of the site, and the existing condition from non-project areas from which runoff is or will be collected; and
- Any erodible elements of the manmade conveyance system must be adequately stabilized to prevent erosion under the conditions noted above.

If the discharge is to a stream that leads to a wetland, or to a wetland that has an outflow to a stream, both this requirement and Minimum Requirement #8 apply. In these cases the point of compliance is at the wetland.

1.5.7.2 Thresholds

When assessing a project against the following thresholds, consider only those impervious, hard, and pervious surfaces that are subject to this Minimum Requirement as determined in Section 1.4.

The following circumstances require achievement of the standard flow control requirement for western Washington:

- Projects in which the total of effective impervious surfaces is 10,000 square feet or more in a threshold discharge area, or
- Projects that convert ¾ acres or more of vegetation to lawn or landscape, or convert 2.5 acres or more of native vegetation to pasture in a threshold discharge area, and from which there is a surface discharge in a natural or man-made conveyance system from the site, or
- Projects that through a combination of effective hard surfaces and converted vegetation areas cause a 0.10 cubic feet per second increase in the 100-year flow frequency from a threshold discharge area as estimated using an approved continuous flow model and one-hour time steps

(or a 0.15 cfs increase using 15-minute time steps). The 0.10 cfs (one-hour time steps) or 0.15 cfs (15-minute time steps) increase shall be a comparison of the post-project runoff to the existing condition runoff. For the purpose of applying this threshold, the existing condition is the pre-project land cover.

1.5.7.3 Standard Flow Control Requirement

Stormwater discharges shall match developed discharge durations to pre-developed durations for the range of pre-developed discharge rates from 50% of the 2-year peak flow up to the full 50-year peak flow. The pre-developed condition to be matched shall be a forested land cover unless one of the following conditions is met:

- Reasonable, historic information is provided that indicates the site was prairie prior to settlement (see Appendix 1-D). These areas are modeled as "pasture" in the approved continuous flow model.
- The drainage area of the immediate stream and all subsequent downstream basins has had at least 40% total impervious area since 1985[5]. In this case, the pre-developed condition to be matched shall be the existing land cover condition. Where basin-specific studies determine a stream channel to be unstable, even though the above criterion is met, the pre-developed condition assumption shall be the "historic" land cover condition, or a land cover condition commensurate with achieving a target flow regime identified by an approved basin study.
- The development site TDA drains to a reach of a stream where an Ecology approved basin plan has been developed that includes an alternative pre-development standard. See Appendix 1-B for these areas.

This standard requirement is waived for sites that will infiltrate all the runoff from hard surfaces and converted vegetation areas.

The Western Washington Hydrology Model provides ways to represent On-site Stormwater Management BMPs. Using those BMPs reduces the predicted runoff rates and volumes and thus also reduces the size of the required flow control facilities. See Book 2, Chapter 2 and Appendix 2-C for more on modeling On-site Stormwater Management BMPs in WWHM.

1.5.7.4 Flow Control Selection, Design and Maintenance

Flow control BMPs shall be

- Selected according to Chapter 4;
- Designed according to Book 2, Chapters 5 and 6;
- Maintained according to Book 4 of this manual.

[5] No areas in Clark County meet this criterion.

Stormwater shall be infiltrated to the maximum extent feasible under the design standards of this manual. Areas or watersheds where alternative flow control standards have been approved for use in Clark County can be found in Appendix 1-B.

1.5.8 Minimum Requirement #8: Wetlands Protection

1.5.8.1 Applicability

The requirements of this section apply to project TDAs proposing to discharge stormwater into a wetland, either directly or indirectly through a conveyance system. See Figure 1.4.

1.5.8.2 Thresholds

The thresholds identified in Minimum Requirement #6, Runoff Treatment and Minimum Requirement #7; Flow Control shall be applied to determine the applicability of Minimum Requirement #8 to discharges to wetlands.

Use the flow chart in Figure 1.4 to determine if Minimum Requirement #8 is applicable. ~~Fill out the checklist in Appendix 1-H and submit it with the Preliminary and Final Development Plan.~~ If Minimum Requirement #8 is applicable, meet the requirements in Section 1.5.8.3.

1.5.8.3 Standard Requirements for Protecting Wetlands from Stormwater Flows

If the standards in Minimum Requirement #8 are triggered, the hydrologic analysis shall use the existing (not pre-developed) land cover condition to determine the existing hydrologic conditions unless directed otherwise by a regulatory agency with jurisdiction.

Use an approved continuous flow model for estimating the increases or decreases in total flows (volume) into a wetland that can result from the development project. These total flows can be modeled for individual days or on a monthly basis. Compare the results from this modeling to the following two criteria.

Refer to Appendix H for the applicable Wetland Hydroperiod Method based on Figure 1.4.

Levels of Wetland Protection

The following levels of protection are further explained in Appendix 1-H.

General Protection

General Protection includes practices that protect wetlands of all types.

Protection From Pollutants

Protection from Pollutants includes measures to protect the wetland from pollutants in storm-water runoff. Measures of protection include Construction Stormwater BMPs, Source Control BMPs, LID practices and principles, and Runoff Treatment BMPs.

Wetland Hydroperiod Protection

Wetland Hydroperiod Protection includes measures to avoid excessive hydrologic alteration of existing wetlands from development. There are two methods within Wetland Hydroperiod Protection:

Method 1: Monitoring and Wetland Stage Modeling

This method requires data collection specific to the wetland, as well as continuous simulation modeling to demonstrate that the proposed project will not negatively alter the wet-land hydrology.

Method 2: Site Discharge Modeling

This method requires continuous simulation modeling of the runoff from the TDA to demonstrate that the changes in total discharge volume to the wetland will remain similar to the pre-development condition.

1.5.8.4 Additional Requirements

- Stormwater discharges to Category I or Category II wetlands, or to a wetland that contains habitat for threatened or endangered species, must be treated before discharged.
- Refer to ~~Guide Sheets 1 and 2 in~~ Appendix 1-H to determine if wetlands can serve as treatment or flow control facilities.
- Stormwater treatment and flow control facilities shall not be built within a natural vegetated buffer, except for:
    - Necessary conveyance systems as approved by the Responsible Official; or
    - As allowed in wetlands approved for hydrologic modification and/or treatment in accordance with Appendix 1-H of this book.
- ~~Protecting a wetland from pollutants generated by a development should include the following measures:~~
    - ~~Use effective erosion control at construction sites in the wetland's drainage catchment.~~
    - ~~Institute a program of source control BMPs and minimize the pollutants that will enter storm runoff that drains to the wetland.~~
    - ~~For wetlands the meet the criteria in Guide Sheet 1, provide a water quality control facility consisting of one or more treatment BMPs to treat runoff entering the wetland.~~

- ~~If the wetland is a Category I wetland because of special conditions (forested, bog, estuarine, Natural Heritage, costal lagoon), the facility should include a BMP with the most advanced ability to control nutrients.~~

~~Criterion 1~~

~~The total volume of water into a wetland during a single precipitation event shall not be more than 20% higher or lower than the pre-project volumes.~~

~~Modeling algorithm for Criterion 1~~

1. ~~Daily Volumes can be calculated for each day over 50 years for Pre- and Post-project scenarios. Volumes are to be calculated at the inflow to the wetland or the upslope edge where surface runoff, interflow, and groundwater are assumed to enter.~~

2. ~~Calculate the average of Daily Volume for each day for Pre- and Post-project scenarios. There will be 365 values for the Pre-project scenario and 365 for the Post-project.~~

~~Example calculation for each day in a year (e.g., April 1):~~

- ~~If you use 50 years of precipitation data, there will be 50 values for April 1. Calculate the average of the 50, April 1, Daily Volumes for Pre- and Post-project scenarios.~~
- ~~Compare the average Daily Volumes for Pre- versus Post-project scenarios for each day. The average Post-project Daily Volume for April 1 must be within +/- 20% of the Pre-project Daily Volume for April 1.~~

3. ~~Check compliance with the 20% criterion for each day of year. Criterion 1 is met/passed if none of the 365 post-project daily volumes varies by more than 20% from the pre-project daily volume for that day.~~

~~Criterion 2~~

- ~~The total volume of water into a wetland on a monthly basis shall not be more than 15% higher or lower than the pre-project volumes.~~

~~This needs to be calculated based on the average precipitation for each month of the year. This criterion is especially important for the summer months when a development may reduce the monthly flows rather than increase them because of reduced infiltration and recharging of groundwater.~~

~~Modeling algorithm for Criterion 2~~

1. ~~Monthly Volumes can be calculated for each calendar month over 50 years for Pre- and Post-project scenarios. Volumes are to be calculated at the inflow to the wetland or the upslope edge where surface runoff, interflow, and groundwater are assumed to enter.~~

2. ~~Calculate the average of Monthly Volume for each calendar month for Pre- and Post-project scenarios.~~

~~Example calculation for each calendar month in a year (e.g., April):~~

- ~~If you use 50 years of precipitation data, there will be 50 values for the month of April. Calculate the average of the 50, April, Monthly Volumes for Pre- and Post-project scenarios.~~
- ~~Compare the Monthly Volumes for Pre- versus Post-project scenarios. Post- project Monthly Volume for April must be within +/- 15% of the Pre- project Monthly Volume for April.~~

3. ~~Check compliance with the 15% criterion for each calendar month of year. Criterion 2 is met/passed if none of the post- project Monthly Volume varies by more than 15% from the pre- project Monthly Volume for every month.~~

- ~~Provide the results of both of these analyses in the Final Technical Information Report~~

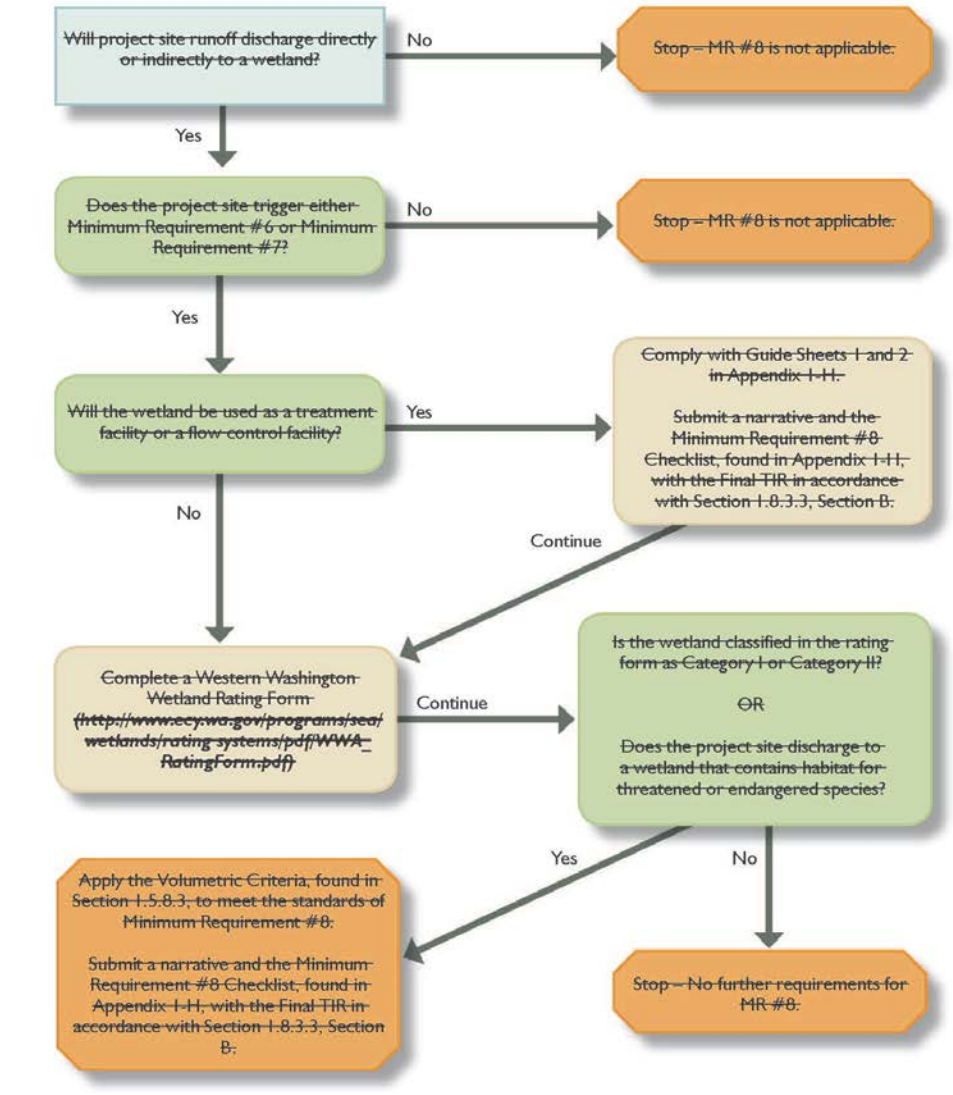

Figure I.4: Minimum Requirement #8 Flow Chart

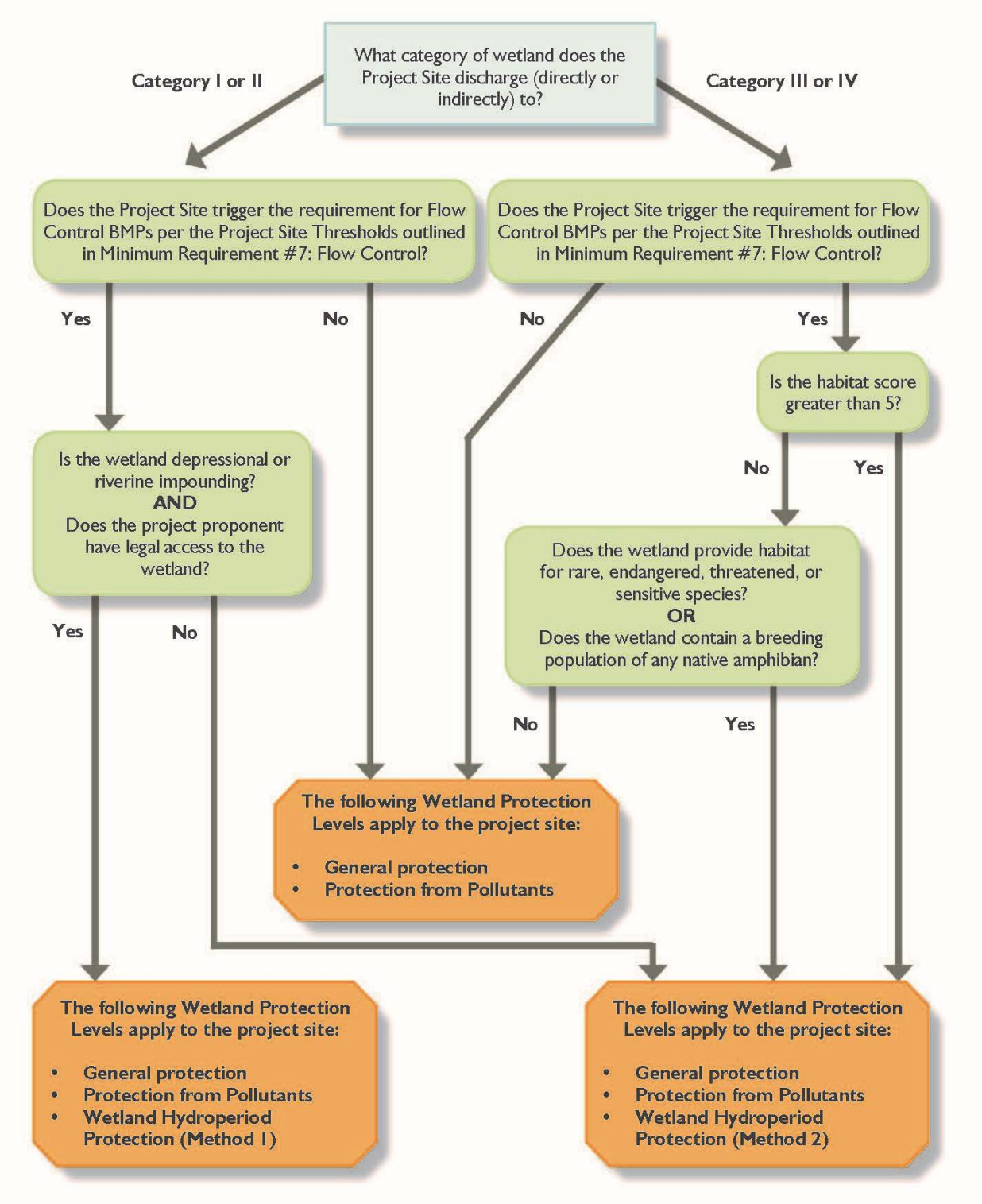

Figure 1.4: Minimum Requirement #8 Flow Chart

1.5.9 Minimum Requirement #9: Operation and Maintenance

A stormwater facility maintenance manual that includes the appropriate elements consistent with the provisions in Book 4 of this manual shall be submitted for proposed stormwater facilities and BMPs. The applicant shall identify the party (or parties) responsible for stormwater facility operation and maintenance. For privately owned facilities, a copy of the stormwater facility maintenance manual shall be retained on site or within reasonable access to the site and shall be transferred with the property to the new owner. For publicly owned facilities not maintained by the Clark County Public Works Department, a copy of the stormwater facility maintenance manual shall be retained in the appropriate department. A log of maintenance activity that indicates what maintenance activities were performed shall be kept and be available for inspection by Clark County.

1.6 Clark County Requirements

Clark County requirements in this section apply to all projects in addition to the Minimum Requirements described above.

1.6.1 Specifications

Stormwater facilities shall be constructed in accordance with the latest edition of the *Standard Specifications for Road, Bridge, and Municipal Construction* as prepared by the Washington Department of Transportation, with exception of Clark County standards as noted in the Clark County Standard Details referenced in Book 2 Introduction of this manual.

Signs placed on Clark Public Utilities utility poles must be no larger than 12" by 16".

1.6.2 Facility Signage and Markers

All stormwater facilities, including catch basins and manholes, capable of accepting stormwater shall be signed or marked as described below. Locations of medallions and signs shall be shown on the Final Development Plan (see Section 1.8.2.2).

Inlets must be marked with a permanently-affixed "Protect water – Only Rain in the Drain" medallion near the inlet.

Inlet medallions may be used in place of a bioretention sign for bioretention facilities in roads. The medallions must be placed at each facility inlet.

Figure 1.5: Stormwater Medallion (4" diameter)

Stormwater treatment and flow control facilities, including On-site Stormwater Management BMPs, must be marked with a sign specific to the type of facility, as shown in Figures 1.6 through 1.14, below. For fenced stormwater facilities, a sign must be placed at the entrance and on each side facing a road or sidewalk. For Permeable Pavement BMPs, place once sign every 200' at a minimum. Signs for facilities in right of way must adhere to sign placement requirements in CCC 40.350.

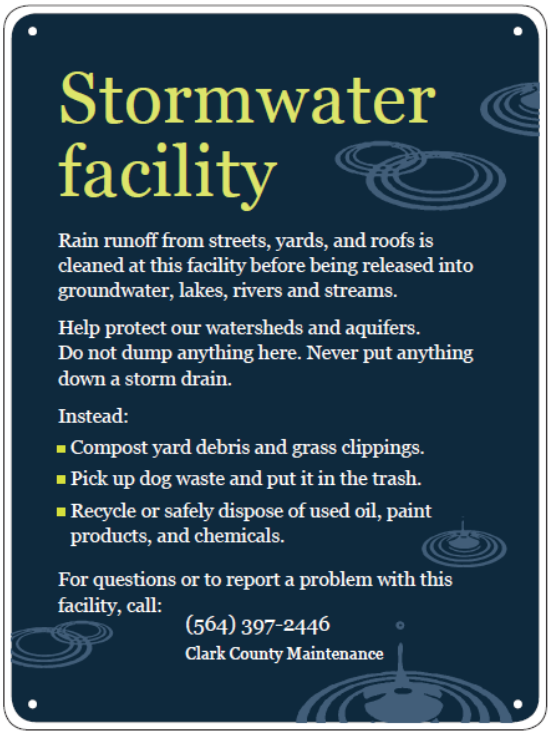

Figure 1.6: Standard Clark County Stormwater Sign ~~(18" x 24")~~ (12" x 16")

Figure 1.7: Standard Clark County Bioretention Sign ~~(18" x 24")~~ (12" x 16") Inlet medallions may be used in place of signs for facilities in roads.

Figure 1.8: Standard Clark County Rain Garden Sign ~~(18" x 24")~~ (12" x 16")

Figure 1.9: Standard Clark County Pervious Concrete Sign ~~(18" x 24")~~ (12" x 16")

Figure 1.10: Standard Clark County Porous Asphalt Sign ~~(18" x 24")~~ (12" x 16")

Figure 1.11: Standard Clark County Permeable Pavers Sign ~~(18" x 24")~~ (12" x 16")

Figure 1.12: Standard Clark County Native Plantings Sign ~~(18" x 24")~~ (12" x 16")

Figure 1.13: Standard Clark County Vegetated Roof Sign ~~(18" x 24")~~ (12" x 16")

Figure 1.14: Standard Clark County Vegetation Preservation Sign (9"x 11.75")

1.6.3 Off-site Drainage Impacts

If the Responsible Official determines based on information in the Preliminary Stormwater Plan (see Section 1.8.1) that the proposed project will adversely impact off-site drainage systems, then the applicant shall implement additional flow control or other measures to mitigate those adverse impacts. No new development, redevelopment, or drainage project shall be allowed to materially increase or concentrate stormwater runoff onto an adjacent property or block existing drainage from adjacent lots.

1.6.4 Erosion Control

1.6.4.1 General Standards

- All outfalls require energy dissipation (See Book 2, Section 7.7).
- Permanent infiltration BMPs shall not be used as temporary erosion control devices.
- Vehicles not performing a construction activity shall not be permitted off-street. Worker personal vehicles shall be parked on adjacent streets or other approved areas.

1.6.4.2 Underground Utility Construction

The construction of underground utility lines shall be subject to the following:

- BMPs shall be used to control erosion during and after construction.
- BMPs damaged during construction shall be replaced or repaired.

1.6.4.3 Signage

- Erosion control signage approved by the Responsible Official shall be installed at each point of entry on any development or redevelopment site subject to Minimum Requirement #2, as shown below.
- Removal of signage shall occur when either certificates of occupancy have been issued for seventy percent (70%) of the lots or there are less than ten (10) unoccupied lots remaining within the project site, whichever is later, or as determined by the Responsible Official.

Figure 1.15: Standard Clark County Erosion Control Sign (4' x 8')

1.6.5 On-going Maintenance

Maintenance of stormwater facilities shall be to the standards in Book 4 of this manual pursuant to CCC 13.26A.

1.6.6 Stormwater Facility Access

All stormwater facilities must allow for access by standard maintenance equipment and vehicles needed to remove sediment and maintain structures in accordance with the standards of this manual. Maintenance access must be provided using a minimum of a 10-foot wide roadway constructed using an all-weather surface or an alternative surface type approved by the county; the responsible office may waive this requirement where a road is not necessary for accessing the facility. Access criteria for specific BMPs are given in Book 2. All private stormwater facilities that are gated and locked are required to have a double locking system for inspection purposes. It is preferred to use a chain with a county lock and the private lock.

1.6.7 Flood Plain Requirements

In addition to the requirements of Chapter 40.420 Flood Hazard Areas, any reduction of existing conveyance capacity, and any net loss of existing storage capacity for the one hundred (100) year storm, are prohibited in FEMA Special Flood Hazard Areas (SFHA). This prohibition also applies to all areas within the limits of the existing one hundred (100) year floodplain, as determined by hydrologic/hydraulic computations, for all streams and manmade channels.

1.7 Submittals for Small Projects

A Stormwater Site Plan is required for all new development and redevelopment projects that must comply with Minimum Requirement #1. The submittal requirements described in this section apply

to development and redevelopment projects ~~sites~~ that qualify as small projects. A small project is defined as a development or redevelopment project ~~site~~ that meets all of the following criteria:

1. Triggers Minimum Requirements #1 – #5.
2. Is less than one acre.
3. Does not construct a public road.
4. Does not require an Engineering Approval.

These are generally projects that:

- Are residential or other buildings that do not require an Engineering Approval from Clark County; and
- Replace or add between 2,000 and 4,999 square feet of impervious and hard surfaces; and/or
- Disturb between 7,000 square feet and one acre of land.

Applicants with qualifying small projects may use the Stormwater Site Plan Short Form located in Appendix 1-I to meet submittal requirements.

For detailed information about the applicability of Minimum Requirements to a specific project, see Section 1.4.

Applicants with qualifying small projects are not required to use the instructions in the remainder of this manual and should refer to Appendix 1-I for guidance and submittal requirements.

1.8 Submittals for Large and Engineered Projects

A Stormwater Site Plan is required for all new development and redevelopment projects that must comply with Minimum Requirement #1. The submittal requirements described in this section apply to projects that must meet Minimum Requirements #1 – #9 and to projects that must meet Minimum Requirements #1 – #5 and require an Engineering Approval from Clark County.

A Stormwater Site Plan is defined as the Preliminary Stormwater Plan, and its components; the Final Stormwater Plan, and its components; and the Construction Stormwater Pollution Prevention Plan. The Stormwater Site Plan must be approved by the Responsible Official before land-disturbing activity may begin.

The purpose of the submittal is to allow Clark County to determine whether the stormwater management plan proposed for the project will meet the requirements of CCC 40.386.

Plans and reports must be prepared by a licensed engineer in the state of Washington or another qualified professional as designated in this manual.

1.8.1 Preliminary Stormwater Plan

The Preliminary Stormwater Plan shall identify how stormwater runoff that originates on the site or flows through the site is currently controlled and how this will change with the proposed development or redevelopment project. The Preliminary Stormwater Plan shall be submitted with the land use application.

The goal of the Preliminary Stormwater Plan process is to develop and provide a preliminary stormwater report describing the design strategies that will be used to meet stormwater management requirements. A primary objective of the stormwater plan is to manage runoff created by the project to evaporate, transpire, and infiltrate stormwater, and to achieve the goal of mimicking the pre-development natural hydrologic conditions on the site.

The project engineer shall include a statement that all the required information is included in the Preliminary Stormwater Plan and that the proposed stormwater facilities are feasible. All plans, studies, and reports that are part of the Preliminary Stormwater Plan shall be ~~signed and dated~~ stamped by the professional civil engineer(s) (licensed in the state of Washington), or other qualified professional as designated in this manual, responsible for the preparation of the Preliminary Stormwater Plan and its components.

The Preliminary Stormwater Plan submittal shall consist of:

1) Existing Conditions Plan (Section 1.8.1.2)

2) Preliminary Development Plan (Section 1.8.1.3)

3) Off-site Areas Map (Section 1.8.1.4)

4) Preliminary Technical Information Report (TIR) (Section 1.8.1.5)

5) Soils Report (Section 1.8.3)

At the applicant's option, the applicant may submit a Final Stormwater Plan in accordance with the requirements of Section 1.8.2 in lieu of the Preliminary Stormwater Plan.

1.8.1.1 Modification of Content Requirements

The Responsible Official may waive in writing some or all of the content requirements in the Preliminary Stormwater Plan if:

- The project is included in an approved Stormwater Site Plan that meets the requirements of this manual; or

- The project is located in an area with an approved basin plan that makes some of the information irrelevant.

The waiver of some or all of the content requirements of the Preliminary Stormwater Plan does not relieve the applicant of the requirement to prepare a Final Stormwater Plan.

1.8.1.2 Existing Conditions Plan

The Existing Conditions Plan shall consist of 22-inch x 34-inch or 24-inch x 36-inch drawings; single family residence plans may be at 11-inch x 17-inch. Electronic submittals (in PDF) are encouraged. The Existing Conditions Plan shall include:

1. Existing property boundaries, easements, and rights-of-way.

2. Location of the 100-year floodplain and floodways and shoreline management areas on the site.

3. Existing contours with a 2-foot maximum contour interval, unless the Responsible Official determines a lesser interval is sufficient to show drainage patterns and basin boundaries. Contours with 10-foot or greater intervals are often sufficient for areas with slopes greater than 20%.

4. Natural drainage features on and adjacent to the site, including streams, wetlands, springs, and closed depressions.

5. Manmade drainage features on and adjacent to the site, including existing water quality or flow control BMPs and conveyance systems.

6. Areas of the site identified as geologic hazards as defined in CCC 40.430.

7. Existing on-site water wells, known agricultural drain tiles, structures, utilities, and septic tanks and drain fields.

8. Existing drainage flow routes for each threshold discharge area (TDA) to and from the site, including bypass flows.

9. Locations of existing hard surfaces.

10. Locations of existing pervious surfaces.

11. Existing areas of the site predominantly covered by native vegetation as defined in Appendix 1-A (e.g. native trees, shrubs, and herbaceous plants).

12. The delineated wetland boundary (for sites that discharge stormwater to a wetland, either directly or indirectly through a conveyance system, and that must meet Minimum Requirement #8, Wetlands Protection).

1.8.1.3 Preliminary Development Plan

The Preliminary Development Plan shall consist of 22-inch x 34-inch or 24-inch x 36-inch drawings; single family residence plans may be 11-inch x 17-inch. Electronic submittals (in PDF) are encouraged. The Preliminary Development Plan shall include:

1. Proposed property boundaries, easements, and rights-of-way.

2. Location of the 100-year floodplain and floodways and shoreline management area limits on the site.

3. Proposed contours with a 2-foot maximum contour interval, unless the Responsible Official determines a lesser interval is sufficient to show drainage patterns and basin boundaries.

4. Show the limits of the developed threshold discharge areas (TDAs). If the site will have more than one TDA, then label each one with a unique name. [Note: TDA names must be cross-referenced in the Technical Information Report, computer models, calculation sheets, and other pertinent submittals.]

5. Proposed drainage flow routes for each threshold discharge area (TDA) to and from the site, including bypass flows.

6. Locations of proposed hard surfaces.

7. Locations of proposed pervious surfaces. Locations of proposed structural source control BMPs in accordance with Minimum Requirement #3. Include BMP number and name from Book 3.

8. Locations of proposed points of discharge from the project site that preserve the natural drainage patterns and existing outfall locations in accordance with Minimum Requirement #4.

9. Areas of the project site where on-site stormwater management BMPs will be located in accordance with Minimum Requirement #5. This includes, but is not limited to, areas of retained native vegetation, location of retained or new trees to be used for surface reduction credit, and required flow paths and lengths of dispersion BMPs. Include BMP number and name from Book 2.

10. Approximate location and size of proposed runoff treatment and flow control facilities. Include BMP number and name from Book 2.

11. Include a conceptual grading plan that verifies the constructability of the proposed stormwater facilities.

12. The delineated on-site wetland boundary, and off-site wetland boundaries where stormwater is being discharged to a wetland, either directly or indirectly through a conveyance system.

13. Proposed detention/retention facilities, infiltration facilities, conveyances, discharges, and dispersion flow paths that intersect or are within 50 feet of a geologic hazard as defined in CCC 40.430.

The Responsible Official may require additional site or vicinity information before deeming an application "fully complete" if needed to determine the feasibility of the stormwater proposal.

1.8.1.4 Off-site Areas Map

The off-site areas map shall be an 8-1/2-inch x 11-inch or 11-inch x 17-inch map. Electronic submittals (in PDF) are encouraged. The map shall delineate the off-site areas contributing runoff to the site.

1.8.1.5 Preliminary Technical Information Report (TIR)

The preliminary TIR shall contain all technical information and analyses necessary to determine how applicable Minimum Requirements are being met and that the proposed stormwater facilities are feasible. The required contents of the preliminary TIR are identified below.

Section A – Project Overview

Section A.1: Site Information

Site information shall include:

- The location of the site, either with a parcel number, an address, or adjacent streets and distance to the nearest cross street.
- A description of the topography, natural drainage patterns, vegetative ground cover, and presence of critical areas, which include Critical Aquifer Recharge Areas (CCC 40.410), Flood Hazard Areas (CCC 40.420), Geologic Hazard Areas (CCC 40.430), Habitat Conservation Areas (CCC 40.440), Wetland Protection Areas (CCC 40.450) and Shoreline Master Program Areas (CCC 40.460). Critical areas that receive runoff from the site shall be described to a minimum of ¼ mile away from the site boundary.
- A description of existing on-site stormwater systems and their functions, including drainage patterns to and from adjacent properties. Identify the primary discharge point or points from the site, and the suitability of the use of these BMPs on the site.
- A general description of proposed site improvements, including the size of improvements and proposed methods of mitigating stormwater runoff quantity and quality impacts.

Section A.2 – Determination of Applicable Minimum Requirements

Based upon the preliminary site layout, determine whether Minimum Requirements #1 – #5 or #1 – #9 apply to the project. Include the following information in table format:

- The amount of existing hard surface.
- The amount of new hard surface.
- The amount of replaced hard surface.
- The amount of native vegetation converted to lawn or landscaping.
- The amount of native vegetation converted to pasture.
- The total amount of land-disturbing activity.
- If a redevelopment project, a cost basis.
- The amount of pollution generating hard surface (PGHS); this includes pollution-generating impervious surfaces (PGIS).
- The amount of pollution-generating pervious surfaces (PGPS).
- The total amount of pollution-generating surfaces.
- The total amount of non-pollution generating surfaces.

Provide a statement that confirms which Minimum Requirements apply to the development activity. Trace on the flowchart (Figure 1.2 or Figure 1.3) to show how applicable Minimum Requirements were determined.

For development or redevelopment where Minimum Requirements #1 – #9 must be met:

- Provide the amount of effective impervious area in each TDA, and document through an approved continuous flow model the increase in the 100-year flood frequency from pre-developed to developed conditions for each TDA.
- List the TDAs that must meet the runoff treatment requirements listed in Minimum Requirement #6.
- List the TDAs that must meet the flow control requirements listed in Minimum Requirement #7.
- List the TDAs that must meet the wetlands protection requirements listed in Minimum Requirement #8.

Section B – Minimum Requirements

This section shall discuss how each Minimum Requirement applicable to the project (as identified in Section A.2) will be met. Use the CCSM BMP number and name when discussing BMPs.

Minimum Requirement #1 – Preparation of Stormwater Site Plans

All projects meeting the thresholds in Section 1.4 shall submit a Stormwater Site Plan for review by Clark County. Stormwater Site Plans shall use site-appropriate development principles to retain native vegetation and minimize impervious surfaces to the extent feasible.

Minimum Requirement #3 – Source Control of Pollution

If the development activity includes any of the activities listed in Book 3, Appendix 3-A, identify the source control BMPs to be used with the land-disturbing activity. See Book 3 for source control BMPs.

Minimum Requirement #4 – Preservation of Natural Drainage Systems and Outfalls

Describe how natural drainage patterns are being maintained, and how discharges from the project site shall occur at the natural location, to the maximum extent practicable. The manner by which runoff is discharged from the project site must not cause a significant adverse impact to downstream receiving waters and down gradient properties. All outfalls require energy dissipation.

See Book2, Chapter 7 for more information on energy dissipation designs.

Minimum Requirement #5 – On-site Stormwater Management BMPs

Describe how on-site stormwater management BMPs, including LID BMPs, will be effectively implemented on the site, in accordance with this Minimum Requirement.

1. General
    - Describe the suitability of the site for the selected BMPs, including hydrologic soil groups, geologic media, infiltration rates, slopes, and groundwater elevations.
    - Summarize the pertinent results from geotechnical studies or other information used to complete the design of each on-site stormwater BMP.
    - Identify the design criteria in this manual for each on-site stormwater management BMP selected, and describe how the criteria will be met.
2. LID
    - Indicate whether a mandatory list is being used to select LID BMPs or if the LID Performance Standard will be met.
    - If using List #1 or List #2, provide written justification, including citation of site conditions identified in the soils report, for any on-site stormwater management BMPs that are determined to be infeasible for the project site. Complete the LID Feasibility Checklist (see Appendix 1-E), and include it in the TIR.
    - If meeting the LID Performance Standard, provide:

- Design details of all BMPs that are used to achieve the standard.
- A complete computer model report including input files and output files. Projects taking an impervious surface reduction credit for newly planted or retained trees must provide those calculations and show the locations of the trees on the preliminary development plan. Projects using full dispersion or full downspout infiltration BMPs must provide information to confirm conformance with design requirements that allow removal of the associated drainage areas from computer model input.

Minimum Requirement #6 – Runoff Treatment Analysis and Design

For land-disturbing activities where the thresholds within Minimum Requirement #6 (see Section 1.5.6) indicate that runoff treatment facilities are required:

- Document the level of treatment required (basic, enhanced, phosphorus, oil/water separation), based on procedures in Chapter 3.
- Identify the BMPs used in the design, and list the reference or design manual used to design them.
- Include an analysis of initial construction costs and long-term maintenance costs.
- Show the approximate location and size of proposed runoff treatment facilities on the preliminary development plan.

Minimum Requirement #7 – Flow Control Analysis and Design

For land-disturbing activities where the thresholds within Minimum Requirement #7 indicate that flow control facilities are required:

- Summarize the site's suitability for infiltration, including tested infiltration rates, logs of soil borings, and other information provided in the Soils Report.
- If infiltration is infeasible for flow control, provide the following additional information:
    - Identify the areas where flow control credits can be obtained for dispersion, LID, or other measures, in accordance with the requirements in Chapter 2, Book 2, Chapter 2, and the guidance in Appendix 2-C.
    - Provide the approximate sizing and location of flow control facilities for each TDA, per Chapter 4.
    - Identify the criteria (and their sources) used to complete the analyses, including pre-developed and post-developed land use characteristics.
    - For sites considered to be historic prairie, submit a project site report prepared by a wetland scientist or horticulturist experienced in identifying soils, plant, and other evidence associated with historic prairies that demonstrates the existence of historic prairie on the project site. Areas within Clark County that were historically

prairie are identified in Appendix 1-D. Historic prairie areas include Bear Prairie, Fourth Plain, Mill Plain, and Lacamas Prairie, among others. The map may be used only as an indicator of historic prairie, not for specific prairie boundaries.

- Complete a hydrologic analysis for historic and developed site conditions, in accordance with the requirements of CCC 40.386 and Book 2, Chapter 1, using an approved continuous flow model. Compute historic and developed flow durations for all TDAs. Provide an output table from the approved continuous flow model.
- Include and reference all hydrologic computations, equations, graphs, and any other aids necessary to clearly show the methodology and results.
- Include all maps, exhibits, graphics, and references used to determine pre-developed and developed site hydrology.

Minimum Requirement #8 – Wetlands Protection

For projects with stormwater discharges to a wetland, either directly or indirectly through a conveyance system, the preliminary TIR shall describe the analysis performed per Section 1.5.8 and the wetland protection measures to be implemented in accordance with Minimum Requirement #8. Complete and submit the Wetlands Checklist in Appendix 1-H.

Minimum Requirement #9 – Operation and Maintenance

Provide information on who will own, operate, and maintain the stormwater facilities, including LID BMPs that are considered in the design of treatment and flow control facilities meeting Minimum Requirements #5, #6 or #7.

Appendices

Map Submittals

The following maps shall be included with the TIR. All maps shall contain a scale and north arrow.

- **Vicinity Map**: All vicinity maps shall clearly show the project site.
- **Soils Map**: This map shall show soils mapped by the Natural Resources Conservation Service (NRCS) within the contributing area that drains to the site itself. Soils maps may be obtained from the following sources:
    - Updated version of the Soil Survey of Clark County, Washington, originally published in 1972, and updated by the NRCS.
    - Geographic information system (GIS) maps of soils from Clark County GIS.
    - Washington soil survey data as available on the NRCS website (http://websoilsurvey.nrcs.usda.gov).

- If the maps do not appear to accurately represent the soils for the site, the applicant's geologist or geotechnical engineer is responsible for verifying the actual soils for the site.

- Other Maps

The following additional maps shall be required in the situations noted:

- Critical Aquifer Recharge Areas. If the site lies within a Category I or II critical aquifer recharge area (CARA), a map is required showing the extent of these areas in relation to the site. See CCC 40.410 for CARA regulations.
- Floodplains. If a floodplain mapped by the Federal Emergency Management Agency (FEMA) exists on or adjacent to the site, a map showing the floodplain is required. See CCC 40.420 for Flood Hazard Areas regulations.
- Shoreline Management Area. If the site contains or is adjacent to a water body regulated under the Washington Shorelines Management Act, a map showing the boundary of the shoreline management area in relation to the site is required. See CCC 40.460 for Shoreline Management Area regulations.
- The 1996 flood aerial photograph from Clark County MapsOnline if the GIS depth to water map shows groundwater depth is less than 20 feet.

Other Submittals

1. Soils Report: See Section 1.8.3.

1.8.2 Final Stormwater Plan

In accordance with Minimum Requirement #1, the Final Stormwater Plan provides final engineering design and construction drawings for the stormwater aspects of a proposed new development or redevelopment project. The Final Stormwater Plan shall be submitted and approved by the Responsible Official before construction of the development can begin.

All plans, studies, and reports that are part of the Final Stormwater Plan shall be signed and dated by the professional civil engineer(s) (registered in the state of Washington), or other qualified professional as designated in this manual, responsible for the preparation of the Final Stormwater Plan and its components.

The goal of the Final Stormwater Plan submittal is to allow the Responsible Official to review the following:

1. Any easements, covenants, or agreements necessary to permit construction and maintenance, including for each on-site stormwater management BMP.

2. Design details, figures, and maintenance instructions for each post construction Stormwater Management BMP. These documents must be suitable to serve as a recordable document that can be attached to a declaration of covenant and grant of easement associated with each lot.

3. Final engineering plans that provide sufficient detail to allow construction of the stormwater facilities. These plans shall be stamped, signed, and dated by the engineer(s), registered in the state of Washington, responsible for hydrologic, hydraulic, geotechnical, structural and general civil engineering design and by the project engineer responsible for the preparation of the Final Stormwater Plan. The final engineering plan shall show all utilities to ensure that conflicts between proposed utility lines do not exist.

4. The approved Preliminary Stormwater Plan, with an explanation of any differences between the design concepts included in the preliminary and Final Stormwater Plans. If a Final Stormwater Plan differs from the approved Preliminary Stormwater Plan in a manner that, in the opinion of the Responsible Official, raises significant water quality or quantity control issues, it shall require another SEPA determination (if subject to the State Environmental Policy Act [SEPA]) and a post-decision review, in accordance with CCC Section 40.520.060.

5. A final development plan (which may be a part of the final engineering plans or a separate plan). See the requirements identified below.

6. A plan sheet showing the entire stormwater drainage system on a single sheet to facilitate mapping assets in the GIS and Construction Inspection. Each BMP must be identified using the BMP number from Book 2.

7. A final technical information report (TIR). See the requirements identified below.

8. For a subdivision, short plat, or development project on which individual sites or pads will be sold or built under different responsibility, an individual stormwater lot plan is required for each lot or pad. This plan must show the details of all stormwater facilities planned for the site to meet requirements pertaining to and for each specific lot. The project applicant will need to complete all required forms and participate in all required meetings (including on-site inspections) to ensure that lot plans meet stormwater requirements. The plan shall be to a scale that is readable as determined by the Responsible Official. [Note: subsequent construction on the lot(s) will require conformance to the submitted stormwater lot plan.]

The Final Stormwater Plan shall consist of:

1. Final Development Plan (Section 1.8.2.2)

2. Final Technical Information Report (TIR) (Section 1.8.2.3)

3. Soils Report (Section 1.8.3)

4. Administrative and Legal Submittals (Section 1.9)

1.8.2.1 Modification of Content Requirements

The Responsible Official may waive in writing some or all of the content requirements in the Final Stormwater Plan if:

- The project is included in an approved Stormwater Site Plan that meets the requirements of this manual; or
- The project is located in an area with an approved basin plan that makes some of the information irrelevant.

1.8.2.2 Final Development Plan

The Final Development Plan shall be consistent with the Preliminary Development Plan and may be combined with the final engineering plans. In addition to the information required in the Preliminary Development Plan, the final plan requires the following information:

1. Threshold discharge area (TDA) delineations, and hard surface and pervious area delineations and area by TDA.

2. The acreage of pollution-generating pervious surfaces (PGPS) and pollution-generating hard surfaces (PGHS) used in the hydraulic/hydrologic calculations both on-site and off-site that contribute surface runoff.

3. Directions and lengths of overland, pipe, and channel flow.

4. Outfall points from each TDA and overflow routes for the 100-year storm.

5. Onsite conveyance systems, including pipes, catch basins, channels, ditches, swales, and culverts.

6. Energy dissipation designs for all outfalls.

7. Primary flow path arrows for drainage under developed conditions, with the calculated flow rates. Cross-reference the flow rates to the hydrological model output file used to calculate the flow rates.

8. The site's Point of Compliance (POC).

9. Locations of required signs and markers.

10. Catchment areas for each Stormwater Treatment and Flow Control BMP.

11. The Responsible Official may require additional site or vicinity information if needed to determine the feasibility of the stormwater proposal.

1.8.2.3 Final Technical Information Report (TIR)

The final TIR shall be a comprehensive report, supplemental to the final engineering plans, that contains all technical information and analyses necessary to complete final engineering plans based on sound engineering practices and appropriate geotechnical, hydrologic, hydraulic, and water quality design.

The final TIR shall be stamped, signed, and dated by the professional engineer(s), registered in the state of Washington, responsible for hydrologic, hydraulic, geotechnical, structural and general civil engineering design.

The required contents of the final TIR, which is part of the Final Stormwater Plan, are identified below.

Section A – Project Overview

Provide the information from the preliminary TIR, with the following additional elements:

1. Reference the conceptual design proposed in the Preliminary Stormwater Plan, and identify revisions contained within the final engineering plans.

Section B – Minimum Requirements

Provide the information from Section B of the preliminary TIR, revised as necessary for the final design. Confirm the applicable Minimum Requirements identified in the preliminary TIR. For land-disturbing activities where Minimum Requirements #1 – #9 must be met, provide the required information listed in Section B of the preliminary TIR, revised to reflect the final design.

Minimum Requirement #2 – Construction Stormwater Pollution Prevention

All projects are required to comply with Minimum Requirement #2. Provide a statement declaring that a Construction Stormwater Pollution Prevention Plan meeting the requirements of Minimum Requirement #2 will be submitted, with the Erosion Control Inspection fee.

Minimum Requirement #3 – Source Control

See the preliminary TIR requirements.

Minimum Requirement #4 – Preservation of Natural Drainage Systems and Outfalls

See the preliminary TIR requirements.

Minimum Requirement #5 – On-site Stormwater Management BMPs

Provide the information from the preliminary TIR, with the following additional elements:

1. Reference the conceptual design proposed in the Preliminary Stormwater Plan, and identify revisions contained within the final engineering plans.

2. For Post-Construction Soil Quality and Depth, provide details on the method used to meet the criteria given in the Design Installation and Specifications section of BMP T5.13 in Book 2, Chapter 2.

3. For Full Dispersion, Provide an analysis that demonstrates standards are met for BMP T5.30A or BMP T5.30B.

4. For bioretention systems and rain gardens, as well as any stormwater system that includes or requires plantings in or over the proposed stormwater system, provide the following:

    a. The proposed soil matrix for the facility.

    b. The planting plan, listing proposed plant types, sizes and locations. Planting plan shall include proposed grading (1-foot contours) and stormwater system layout to ensure minimal conflict between plantings and stormwater system.

    c. Detail drawings, including the following:

        - If an underdrain is used, show drain rock, pipe, and filter fabric specifications.
        - All stormwater piping associated with the facility, including manholes, catch basin, pipe materials, sizes, slopes, and invert elevations.
        - Width, length, side slopes, and maximum design water depth for all facilities.
        - Irrigation system, if installed.
        - Designs for any retaining walls proposed. Structural walls shall meet County building permit requirements.

5. For porous pavements, provide supporting design calculations showing adequate infiltration rates to accommodate flows from all impervious surfaces directed onto any porous pavement. Reference standard details used in the design.

6. For reversed slope sidewalks, provide details on the planting plan for areas receiving water from reversed slope sidewalks.

7. Tree retention and planting.

8. Preserving native vegetation.

9. Rainwater harvesting if used as a flow reduction BMP.

10. Vegetated roof if used as a flow reduction BMP

Minimum Requirement #6 – Runoff Treatment Analysis and Design

For land-disturbing activities where the thresholds within Minimum Requirement #6 indicate that runoff treatment facilities are required, provide the information from the preliminary TIR, with the following additional elements:

1. Reference the conceptual runoff treatment design proposed in the Preliminary Stormwater Plan.

2. Identify revisions to the conceptual runoff treatment design contained in the Preliminary Stormwater Plan.

3. Complete a detailed analysis and design of all proposed runoff treatment system elements, in accordance with Book 2, Chapters 3 and 4. Reference runoff treatment system elements to labeled points shown on the site location map or final development plan.

4. Include and reference all computations, equations, charts, nomographs, detail drawings, and other tabular or graphic aids used to design water quality system elements in the technical appendix.

5. Summarize the results of the runoff treatment design and describe how the proposed design meets the requirements of CCC 40.386 and this manual.

Treatment System Plan

1. Provide an illustrative sketch of the treatment facilities and appurtenances.

2. The sketch shall correspond with the final engineering plans. Alternatively, a final site grading plan that incorporates the above information may be included as an attachment to the Final Stormwater Plan.

3. Provide electronic copies of the drawings used for analysis, measurement, and design inputs for the hydrologic analysis submitted with the final drawing in Portable Document Format (PDF) format.

Minimum Requirement #7 – Flow Control

For land-disturbing activities where the thresholds within Minimum Requirement #7 indicate that flow control facilities are required:

1. Identify revisions to the conceptual design proposed in the Preliminary Stormwater Plan.

2. Identify initial conditions, including stream base flows, beginning water surface elevations, hydraulic or energy grade lines, initial groundwater elevations, beginning storage volumes,

and other data or assumptions used to complete the analyses of initial conditions. Reference the sources of information.

3. Describe any assumptions used to complete the analysis, including flow credits through the use of on-site stormwater BMPs or LID measures.

4. Complete a detailed hydrologic analysis for existing and developed site conditions, in accordance with the requirements of Book 2, Chapter 1, using an approved continuous flow model. Compute pre-developed and developed flow durations for all sub-basins. Provide an output table from the model, including the following:

    a. Flow rates for the 2-, 10-, and 100-year return periods for pre-developed and developed conditions.

    b. A table listing the pass/fail rates for each flow level where duration statistics were calculated.

    c. A graph showing the flow rate on the y axis and percent time exceeding on the x axis for pre-developed conditions and post-developed mitigated conditions, from 50 percent of the 2-year flow rate through the 50-year flow rate.

    d. Written justification for any manual changes to model parameters (e.g. changes to LSUR, SLSUR, NSUR, etc. for the PERLND or IMPERLND parameters in WWHM).

5. Provide a hydraulic analysis of pipes and/or channels that lead to and/or from the outlet structure. The analysis should confirm the capacity of pipes and channels to convey the peak flow rates for the 2-, 10-, 50-, and 100-year return period flow rate with the water surface elevation of the pond at the elevation for those return period flow rates.

6. Submit electronic copies of the approved continuous flow model project files to allow reviewers to run the model and confirm the model results.

7. Include and reference all hydrologic and hydraulic computations, equations, rating curves, stage/storage/discharge tables, graphs, and any other aids necessary to clearly show the methodology and results.

8. Include all maps, exhibits, graphics, and references used to determine pre-development and developed site hydrology.

Flow Control System Plan

1. Provide an illustrative sketch of the flow control facilities and appurtenances.

2. Show basic measurements necessary to confirm storage volumes.

3. Show all orifice, weir, and flow restrictor dimensions and elevations.

4. The sketch shall correspond with final engineering plans. Alternatively, a final site grading plan that incorporates the above information may be included as an attachment to the Final Stormwater Plan.

5. Provide electronic copies of the drawings used for analysis, measurement, and design inputs for the hydrologic analysis submitted with the final drawing in Portable Document Format (PDF) format.

Minimum Requirement #8 – Wetlands Protection

For projects that discharge stormwater to a wetland, either directly or indirectly through a conveyance system, the TIR shall describe wetland protection measures to be implemented in accordance with Minimum Requirement #8. The narrative shall describe the analysis performed (See Section 1.5.8) to define the measures that will maintain the hydrologic conditions and hydrophytic vegetation.

Minimum Requirement #9 – Operation and Maintenance

Provide information on who will own, operate, and maintain the permanent stormwater facilities.

Submit an operation and maintenance manual that includes O&M procedures for each stormwater control or treatment facility that will be privately maintained.

The manual shall be written in an orderly and concise format that clearly describes the design and operation of the facility. The manual shall also provide an outline of required maintenance tasks, with recommended frequencies at which each task should be performed. The manual shall contain or reference procedures from Book 4, *Stormwater Facility Operations and Maintenance.*

For private facilities in residential subdivions, provide an estimate of the average annual operation and maintenance cost for facilities owned by an HOA. This will give the HOA a basis for collecting revenue to maintain the facility in accordance with Clark County's NPDES permit requirements.

Include a planting maintenance plan to ensure that plantings survive the two-year applicant maintenance period.

See Section 1.9 for details on legal documents such as covenants and plat information.

Section C – Conveyance Systems Analysis and Design

1. Reference the conceptual drainage design proposed in the Preliminary Stormwater Plan.

2. Identify revisions to the conceptual drainage design contained in the Preliminary Stormwater Plan.

3. Include and reference in the technical appendix all computations, equations, charts, nomographs, detail drawings, and other tabular or graphic aids used to design conveyance system elements.

4. Identify and discuss initial conditions, including water surface elevations, hydraulic or energy grade lines, beginning storage elevations, and other data or assumptions used to complete the analyses of initial conditions. Reference the sources of information.

5. Describe any assumptions used to complete the analyses.

6. Complete a detailed hydraulic analysis of all proposed collection and conveyance system elements, including flow splitters, outfall structures, and outlet protection in accordance with Book 2, Chapter 7, Conveyance Design.

7. Compute and tabulate the following:

    a. Identify design flows and velocities and conveyance element capacities for all conveyance elements within the development.

    b. Identify the 10-year recurrence interval stage for detention facility outfalls (See Book 2, Chapter 7). Provide stage-frequency documentation from an approved continuous flow model.

    c. Compute existing 100-year floodplain elevations and lateral limits for all channels, and verify no net loss of conveyance or storage capacity from development.

    d. Verify the capacity of each conveyance system element to convey design flow and discharge at non-erosive velocities. Verify the capacity of the on-site conveyance system to convey design flows that result from ultimate build-out of upstream areas.

8. Reference conveyance system elements to labeled points shown on the site location map or development plan.

9. Include and reference all hydraulic computations, equations, pipe flow tables, flow profile computations, charts, nomographs, detail drawings, and other tabular or graphic aids used to design and confirm the performance of conveyance systems.

10. Summarize the results of system analyses, and describe how the proposed design meets the requirements of this manual.

Section D Additional Requirements

Section D.1 – Off-site Analysis

If applicable, provide the results of an off-site analysis prepared in accordance with Chapter 5.

Off-site analysis is required when a project that must meet Minimum Requirements #1 – #9 meets any of the following criteria:

- Adds 35,000 square feet or more of new pervious surface.
- Constructs or modifies a drainage pipe or ditch that is 12 inches or more in size/depth or that receives runoff from a drainage pipe or ditch that is 12 inches or more in size/depth.
- Contains or lies adjacent to a landslide, steep slope, or erosion hazard area.
- Is not exempt from Minimum Requirement #8.
- The project changes the rate, volume, duration, or location of discharges to and from the project site.

Section D.2 - Closed Depression Analysis

If applicable, provide the results of a closed depression analysis prepared in accordance with Book 2, Chapter 1.

Section D.3 – Other Permits

Construction of roads and stormwater facilities may require additional permits from other agencies. These permits may contain requirements that affect the design of the stormwater system. This section lists the titles of other possible required permits, the agencies that require the permits, and the permit requirements, if known, that may affect the Final Stormwater Plan. Approved permits that are critical to the feasibility of the stormwater facility design shall be included in this section.

1. Onsite sewage disposal: Clark County Public Health or Washington Department of Health
2. Developer/local agency agreement: Washington State Department of Transportation (WSDOT) (connection license)
3. Temporary exceedance of State Surface Water Quality Standards – Turbidity Mixing Zone: Washington Department of Ecology (WAC 173-201A)
4. An Ecology general construction stormwater permit for projects that disturb over an acre
5. An Ecology general stormwater permit for industrial activities
6. Hydraulic project approval: Washington Department of Fish and Wildlife (WDFW)
7. Dam safety permit: Ecology
8. Section 10, 404, and 103 permits: U.S. Army Corps of Engineers
9. Surface mining reclamation permits: Washington Department of Natural Resources

10. Clark County critical aquifer recharge area (CARA) permit: CCC 40.410
11. Clark County floodplain permit: CCC 40.420
12. Clark County geohazard permit: CCC 40.430
13. Clark County habitat permit: CCC 40.440
14. Clark County wetland permit: CCC 40.450
15. Clark County shoreline management permit: CCC 40.460
16. Underground injection control (UIC) well registration: Ecology (Clark County requires registration through the Washington State Department of Ecology for all UICs)

Section D.4—Approval Conditions Summary

List each preliminary approval condition related to stormwater control, wetlands, floodplains, and other water-related issues, and describe how the final design addresses or conforms to each condition.

Section D.5 – Special Reports and Studies

Where site-specific characteristics, such as steep slopes, wetlands, and sites located in floodplains or wellhead protection areas, present difficult drainage and water quality design problems, the Responsible Official may require additional information or the preparation of special reports and studies that further address the specific site characteristics, describe the potential for impacts associated with the development, and demonstrate the proposed measures to mitigate impacts. Special reports shall be prepared by professionals with expertise in the particular area of analysis, who shall date, sign, stamp, and otherwise certify the report. Subjects of special reports may include, but are not be limited to:

1. Geotechnical
2. Wetlands
3. Floodplains and floodways
4. Groundwater
5. Structural design
6. Fluvial geomorphology (erosion and deposition).

All special reports and studies shall be included in the technical appendix.

Appendices

Map Submittals

See the preliminary TIR requirements.

Technical Data

All TIRs shall contain a technical appendix that includes all computations completed in the preparation of the TIR, together with copies of referenced data, charts, graphs, nomographs, hydrographs, stage-storage discharge tables, maps, exhibits, and all other information required to clearly describe the stormwater flow control and runoff treatment design for the proposed development activity. The format of the technical appendix shall follow as closely as possible the section format of the TIR and shall be adequately cross-referenced to ensure that the design may be easily followed, checked, and verified. The technical appendix shall also contain all special reports and studies.

1.8.3 Soils Report

For projects subject to engineering review triggering Minimum Requirements #1 – #5 or Minimum Requirements #1 – #9, a soils report is required. This report must be prepared by a certified soil scientist, professional engineer, geologist, hydrogeologist or engineering geologist registered in the State of Washington or suitably trained persons working under the supervision of the above professionals or, for projects meeting Minimum Requirements #1 – #5, the report may be prepared by a licensed on-site sewage designer.

The report must include information gathered in the soil assessments and characterization studies described in Chapters 2 and 4, and include the information presented below.

The requirements for this report differ, depending upon which Minimum Requirements are triggered. For sites triggering Minimum Requirements #1 – #5, the following is required.

- The report shall identify:
    - Underlying soils on the site utilizing soil surveys, soil test pits, soil borings, or soil grain analyses (see http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm for soil survey information).
    - The results of infiltration testing using a Clark County approved method (see Chapter 4) to assess infiltration capability and the feasibility of rain gardens, bioretention, and permeable pavement, if applicable. Grain size analyses may substitute for infiltration tests.
    - Submit justification for the number of infiltration tests conducted and the correction factors used per Chapters 2 and 4, if applicable.

- The results of testing for an hydraulic restriction layer (groundwater, soil layer with less than 0.3 in/hr Ksat, bedrock, etc.) under possible sites for a rain garden, bioretention facility, or permeable pavement.

For sites triggering Minimum Requirements #1 – #9, include the above information, plus the following additional items:

- Soil stratigraphy shall be assessed for low permeability layers, highly permeable sand/gravel layers, depth to groundwater, and other soil structure variability necessary to assess subsurface flow patterns. Soil characterization for each soil unit (soil strata with the same texture, color, density, compaction, consolidation and permeability) shall include:
    - Grain size distribution
    - Textural class
    - Percent clay content
    - Cation exchange capacity
    - Color/mottling
    - Variations and nature of stratification
- Site characterization information as described in Chapter 4.
- The results of infiltration testing to assess infiltration capability and the feasibility of bioretention, and permeable pavement. Use Clark County approved soil testing methods (see Section 4.3.1.3). Grain size analyses may substitute for infiltration tests on sites underlain by unconsolidated sediment.
- The results of testing for an hydraulic restriction layer (groundwater, soil layer with less than 0.3 in/hr Ksat, bedrock, etc.) under possible sites for a bioretention facility, or permeable pavement.
- Results from the groundwater assessment as described in Section 2.3.1.5.

1.8.4 Construction Stormwater Pollution Prevention Plan (SWPPP)

The Construction SWPPP is a required component of the Stormwater Site Plan and must be approved by the Responsible Official prior to land-disturbing activity.

The Construction SWPPP shall be submitted to the Responsible Official at the applicant's discretion at any time between submittal of the Final Stormwater Plan and 10 working days prior to the pre-construction conference.

Chapter 6 describes requirements for preparation of the Construction SWPPP. Those projects that will disturb less than one acre of land may use the Abbreviated Construction SWPPP in Appendix 1-J in lieu of the instructions in Chapter 6.

The Construction SWPPP shall be prepared by a licensed engineer in the state of Washington or, if preparation of the SWPPP does not require the practice of engineering, by a person who holds a valid Certified Erosion and Sediment Control Lead (CESCL) certification.

~~*Clark County recommends applicants prepare and submit the Construction SWPPP as part of the Final Stormwater Plan submittal for Final Engineering Review.*~~

~~*If the Construction SWPPP is not received as part of the Final Stormwater Plan submittal for Final Engineering Review, the Final Engineering Approval will be conditioned on review and approval of the Construction SWPPP before land-disturbing activity will be permitted.*~~

1.8.5 Stormwater Plan Revisions

If the applicant must make changes or revisions to the Final Stormwater Plan after approval, the proposed revisions shall be submitted to Clark County for review and approval. The submittal shall include the following:

1. Substitute pages from the originally approved Final Stormwater Plan, and identify the proposed changes.

2. Revised drawings, showing any structural changes.

3. Any other supporting information that explains and supports the reason for the change.

All revisions shall be stamped, signed, and dated by the professional engineer(s), registered in the state of Washington, responsible for hydrologic, hydraulic, geotechnical, structural and general civil engineering design.

1.8.6 Record Drawings

Record drawings which completely and accurately represent the project site as constructed shall be provided to the Responsible Official prior to:

1. The issuance of building permits for single-family/duplex residential subdivisions;

2. Provisional acceptance of stormwater facilities to be owned by the county; and

3. The issuance of occupancy permits for development subject to site plan review <u>or building permits for residences with Stormwater Treatment and Flow Control BMPs</u>.

The record drawings shall include corrected engineering plans for the stormwater facilities, showing constructed dimensions and elevations. In addition, revisions to the Final Stormwater Plan shall be submitted with the record drawings where changes during construction significantly alter the calculations and assumptions contained in the plan.

All record drawings shall be submitted on Mylar (or acceptable media per Community Development) and clearly reproducible. The record drawing submittal shall be stamped, signed and dated by an engineer licensed in the state of Washington.

Record drawings shall also be submitted on computer disk in the following approved file formats: Portable Document Format (.pdf), derived directly from the electronic design software (scans of paper as-builts may be accepted on a case-by-case basis).

Record drawings shall clearly indicate the ownership of any stormwater facilities and who is responsible for the maintenance of each component.

1.9 Administrative and Legal Requirements

All project proponents are required to submit administrative and legal documents as described in this section when applicable to the project.

1.9.1 Documentation of Ownership and Maintenance Responsibilities

1.9.1.1 Authority of Applicant; Obligations of Developer

Each project applicant (Applicant) must submit documentation demonstrating the legal authority to bind the owner and developer of the subject property, and their successors in interest with respect to the subject property (all of which are referred to as Developer), to comply with the requirements and conditions of this manual. The Developer must comply with the requirements, conditions, and any other obligations of this manual.

1.9.1.2 Required Documents

The Applicant shall obtain approval by the Responsible Official of the documented allocation of long-term ownership and maintenance responsibility for stormwater facilities as part of county approval of the Final Stormwater Plan. There are up to five separate documents that describe stormwater facility ownership and maintenance responsibility. These are (1) the final engineering plan; (2) the approved subdivision plat or site plan; (3) the developer covenant to Clark County; (4) the subdivision covenants, conditions and restrictions (CC&R's); and (5) any deed necessary to convey ownership of an easement across property or the property itself. The persons responsible for stormwater facility ownership and maintenance must be clearly identified in each document, and each other document must be consistent with the approved final engineering plan and record drawings.

The Final Stormwater Plan must clearly indicate the owner of and persons responsible for ongoing maintenance of each element of the project stormwater facilities. Plats must include notes specifying the owner and the person or entity responsible for long-term maintenance of every component of the stormwater facilities, including components in easements.

See Appendix 1-G for developer covenant example forms.

1.9.2 County Ownership of Stormwater Facilities

County ownership of stormwater facilities is required for all such facilities located within a ~~public~~ Clark County right-of-way or on a legal tract conveyed to the county.

Clark County will accept ownership only of stormwater treatment and flow control facilities, including low impact development BMPs, that are built as part of single-family residential subdivisions or facilities that include elements of the county storm sewer system that convey stormwater through an easement granted to Clark County.

Applicants must follow county policy for conveyance of open space, critical areas, undevelopable remnant lands, and stormwater tracts in Appendix 1-K.

Permeable pavement, bioretention facilities and enclosed underground systems including UIC regulated structures in residential subdivisions may be placed in ~~public~~ Clark County right-of-way subject to the standards of Chapter 40.350 CCC. Except as provided below in this paragraph, all other stormwater treatment and flow control facilities that serve residential subdivisions and short plats must be located on separate lots or tracts. Clark County recommends that these tracts meet minimum zoning lot size requirements. Stormwater conveyance systems that are not on-site stormwater management facilities, treatment facilities or flow control facilities may be placed on easements.

1.9.2.1 County Stormwater Facility Acceptance Process

For stormwater facilities that will be owned by the county, the county will provisionally accept ownership upon (1) approval of the record drawings; (2) approval of a facility inspection; and (3) receipt of a workmanship and materials and maintenance bond (or other secure method) in the amount of 10 percent (10%) of the construction cost (as prepared by the project engineer) acceptable to the Responsible Official. Provisional acceptance of the facilities does not relieve the Developer from any obligation to undertake any remedial measures to correct deficiencies in the design, construction, maintenance, or operation of the facilities.

No sooner than 18 months after the provisional acceptance of the facilities, the Applicant or Developer shall notify the Responsible Official that the facilities are eligible for final acceptance. The Developer shall continue to maintain the facilities until the county inspects and subsequently accepts the facilities.

The county may accept new stormwater facilities for single family residential development that are constructed under a preliminary plat approval that meets all of the following conditions:

1. Improvements in residential plats have been completed for at least 80 percent of the lots, unless this requirement is waived by the county.

2. All stormwater facilities have been tested as required by this manual, inspected, and have been approved by Clark County, and have been in satisfactory operation for at least 2 years.

3. All stormwater facilities reconstructed or repaired during the maintenance period have been approved by Clark County. For facilities that required modification, the Responsible Official may require extension of the maintenance period for an additional 1-2 years.

4. The stormwater facilities, as designed and constructed, conform to the provisions of this manual and to Chapters 13.26A and 40.386 of the Clark County Code.

5. All easements, lots and tracts required under this manual that the county must own or have access across in order to operate, inspect, maintain and repair stormwater facilities have been conveyed to Clark County, and all required conveyances have been recorded with the Clark County Auditor.

6. The Applicant or Developer has provided to Clark County a complete and accurate set of reproducible Mylar as-built (record) drawings from black and white reproductions may be produced without losing information and detail.

7. The Applicant or Developer has provided to Clark County a complete and accurate set of the as-built (record) drawings on computer disk in the following approved file format: Portable Document Format (.pdf) derived directly from the electronic design software (scans of paper as-builts may be accepted on a case-by-case basis).

1.9.2.2 Warranty Period for Maintenance of Stormwater Facilities

For stormwater facilities that will be conveyed to the county, for a period of at least two (2) years following the provisional acceptance of stormwater facilities, or thereafter until the facilities are finally accepted by the county, the Developer shall operate, inspect, maintain, repair, redesign, and reconstruct the facilities as necessary to ensure that they meet this manual's standards. Elements of facility construction that are most likely to cause problems which may extend the warranty period beyond two years include marginal soil conditions for the facility design; unusual, complex or experimental design elements; unusual maintenance requirements; and potential for failing walls, slopes, or discharge points. This obligation shall extend to remedying any damage caused to the facilities by accident, acts of nature, other builders or third parties during the warranty period. The required maintenance shall be performed according to the *Clark County Stormwater Manual* pursuant to Chapter 13.26A CCC.

1. During the warranty period, the Developer shall be responsible for and shall complete prior to acceptance all remedial work to correct deficiencies, including design deficiencies. Required remedial work to correct design, maintenance and construction deficiencies shall be completed by the Developer prior to final acceptance and may result in the extension of the maintenance period.

2. Following final acceptance for county ownership, the county shall maintain stormwater facilities.

1.9.3 Private Ownership and Maintenance Responsibility for Stormwater Facilities

If the county does not accept ownership of stormwater facilities, the Applicant shall ensure the assumption of ongoing responsibilities for stormwater facilities according to 1.9.3.1 through 1.9.3.5, below. Prior to county approval of the Final Stormwater Plan, the Responsible Official shall certify that the Developer has established procedures to satisfy each of the following obligations regarding ongoing maintenance of stormwater facilities.

1.9.3.1 Initial Responsibility

The Developer shall be responsible to maintain the stormwater facilities for two years following the recording of a final plat. During this period, the Developer shall operate, inspect, maintain, repair, redesign, and reconstruct the facilities as necessary to ensure that they meet this manual's standards.

1.9.3.2 Stormwater Covenant

The Applicant for a residential subdivision, single family residence or other building project having stormwater treatment and flow control BMPs, or a site plan review shall submit a "Covenant Running With the Land" (Stormwater Covenant) to Clark County that specifies the responsibility for stormwater facility maintenance, and the Responsible Official shall review and approve the Stormwater Covenant, after which it shall be recorded with the Clark County Auditor. The template for the Stormwater Covenant can be found in Appendix 1-G.

The purposes of the Stormwater Covenant shall be to ensure that all privately owned stormwater facilities are inspected and maintained in compliance with this manual, Chapter 13.26A CCC, and Title 32 CCC.

Pursuant to the Stormwater Covenant, the property owner(s) and all successors, heirs and assigns shall agree to maintain all private facilities and shall grant Clark County irrevocable rights routinely to access and inspect the facilities, and to perform maintenance and repair in an emergency or when required to meet County obligations under its Phase I NPDES Municipal Stormwater Permit, Chapter 13.26A CCC and Title 32 CCC.

If the parties responsible for long-term maintenance fail to maintain their facilities to standards of this manual, the county shall issue a written notice specifying required actions to be taken in order to bring the facilities into compliance. If these actions are not performed in a timely manner, the county shall take enforcement action against parties responsible for the maintenance in accordance with Title 32 CCC. The county shall be entitled to recover its costs associated with repairs or maintenance in accordance with Title 32 CCC.

1.9.3.3 Plat Note

All final plats shall include a note specifying the party(ies) responsible for long-term maintenance of stormwater facilities. Plats must include notes specifying the stormwater facility owner and the person or entity responsible for long-term maintenance of every component of the stormwater facilities, including components in easements.

1.9.3.4 Residential Subdivision

Prior to submitting the final plat for recording, the Applicant shall create a homeowners' association as a legal entity. The documents that create the homeowners' association, or accompanying bylaws, shall, at a minimum, include the following:

a. Members of the homeowners' association shall be jointly and severally responsible for maintenance of stormwater facilities.

b. The homeowners' association shall have the power and duty to assess fees in the amounts necessary to maintain stormwater facilities, and the members shall be liable for assessed fees.

c. The homeowners' association shall be responsible for payment of financial penalties or reimbursements if the county has conducted repairs or other maintenance activities because of hazardous conditions or to bring stormwater facilities into compliance with maintenance standards.

d. When recording the final plat, the Applicant shall record the Stormwater Covenant against the plat, and also against each lot within the subdivision or short division. See Appendix 1-G for an example covenant.

e. When recording the final plat, the Applicant shall record every deed necessary to convey to the homeowners' association the ownership of or easements over the platted property on which stormwater facilities are located.

f. The operation and maintenance manual prepared by the project engineer in accordance with this manual shall be recorded as part of the subdivision CC&R's.

g. The operation and maintenance manual prepared by the project engineer in accordance with this manual, or pertinent section(s) thereof as approved by the Responsible Official, shall be recorded against each lot that is proposed in the Final Stormwater Plan to contain ~~a Rain Garden BMP,~~ a Bioretention BMP, or a Permeable Pavement BMP.

1.9.3.5 Other Land Use

If the project is other than a residential subdivision, the Applicant and Developer shall comply with manual Section 1.9.3.2, and if applicable, Section 1.9.1.2. The Applicant shall describe in the Final Stormwater Plan, the person or entity that will own and maintain the stormwater facilities, shall convey the interest in real property that will enable that person or entity to maintain the facilities as require, and shall ensure that maintenance activities will be financed.

1.9.4 Easement Standards

1.9.4.1 Stormwater Facilities

Publicly Owned Systems

The property owner shall by plat or deed convey to Clark County an easement for access, inspection, maintenance, repair, and reconstruction of each stormwater facility within the site that will be maintained by the county, including streams (natural drainage ways), if used. The minimum widths of easements must allow for access by standard maintenance equipment vehicles to all areas within the stormwater facilities in accordance with the standards of this manual. Maintenance access must be provided using an all-weather surface or an alternative surface type approved by the county.

Privately Owned Systems

The property owner shall convey to Clark County an easement for access, inspection, maintenance, repair and ability to control discharges to the county storm sewer system, on each stormwater conveyance system within the development site that will be privately owned and maintained, including streams (natural drainage ways), if used. The minimum widths of easements must allow for access by standard maintenance equipment vehicles to all areas within the stormwater facilities in accordance with the standards of this manual.

1.9.4.2 Conveyance Systems

Publicly Owned Systems

Minimum easement widths for conveyance systems shall be at least as wide as indicated in Table 1.2, although the Responsible Official may require increased widths when necessary to ensure adequate area for equipment access and maintenance.

Table 1.2: Easement Widths for Publicly Owned Conveyance Systems

Easement Widths for Publicly Owned Conveyance Systems	
Pipe Diameter	**Easement Width**
<= 36 inches	20 feet

> 36 inches	20 feet plus the pipe's inside diameter
Open conveyances	Top width of channel plus 15 feet on one side and at least 2 feet to property line
Each pipe shall be located with its center line no closer than one-quarter the easement width from an abutting property line.	

Privately Owned Systems

Minimum easement widths shall be at least as wide as indicated in Table 1.2, except under the following conditions:

- For pipes used for rear and side lot drainage collection systems, where the inside diameter of the pipes is less than or equal to 12 inches and the pipes are less than or equal to 5 feet deep at the invert, the easement shall be 10 feet or equal to the lot setback if the pipe is located within the setback.to a minimum of 5 feet.
- No buildings, structures, hard surfaces, or vegetation that would prevent access are permitted within pipe drainage easements.

1.9.4.3 Full Dispersion and Preserving Native Vegetation BMPs

For land divisions and site plans, the preserved area(s) for BMP T5.30A Full Dispersion and BMP T5.40 Preserving Native Vegetation shall be placed in a separate tract or protected through recorded easements for individual lots. For individual residences or other building projects on existing lots, the dispersion area must be included in a covenant running with the land to preserve it.

1.9.5 Deeds and Easements

The following deeds and easements shall be used, as appropriate, to convey property or rights necessary for ownership and maintenance of stormwater facilities:

- Statutory Warranty Deed: Conveys ownership of real property.
- Stormwater Easement:
    - Conveys to Clark County the rights to access across the easement to inspect, maintain, construct, repair, reconstruct, and enforce maintenance standards for any part of a stormwater facility on a specified property. A stormwater easement must be conveyed to Clark County by plat or by deed.
    - Conveys to the private entity responsible for ownership, operation, inspection, maintenance and repair of a private stormwater facility the rights to access across the easement for location, construction, reconstruction, operation, inspection, maintenance and repair for any part of a stormwater facility on a specified property. A stormwater easement must be conveyed to a homeowner's association

or other private entity that is responsible long-term maintenance of the facilities by deed.

1.9.6 Performance Security

In lieu of completing required stormwater facilities within a preliminary plat prior to recording, the Applicant may, with the approval of the Responsible Official, post a performance bond or other security acceptable to the Responsible Official in the amount of one hundred fifty percent (150%) of the estimated cost (prepared by the project engineer), as approved by the Responsible Official, of completing construction of the facilities per the approved stormwater plan.

The estimated construction cost shall be calculated to include all stormwater facilities to be constructed under the approved stormwater plan. Costs shall reflect all labor, materials and other costs associated with constructing the stormwater facilities. The costs shall be documented using the most current version of the County's Cost Breakdown Sheet maintained by the County Engineer.

After the Responsible Official determines that all stormwater facilities are constructed in compliance with the approved stormwater plan, that they are performing as designed, and that the maintenance bonding requirements of this manual are met, the performance bond or security shall be released. Other than as allowed under CCC 40.260.175, no building permits shall be issued until the stormwater facilities are completed and provisionally accepted.

New development, redevelopment and drainage projects undertaken by governmental agencies are exempt from posting a performance bond or security.

1.9.7 Maintenance Security

In order to ensure adequate funding is available so that the Applicant will satisfy financial obligations of manual Section 1.9.2.2, the Applicant shall post a materials and maintenance bond or other security acceptable to the Responsible Official, in the amount of ten percent (10%) of the estimated costs (prepared by the project engineer), as approved by the Responsible Official. The bond or other security shall be maintained throughout the two- (2-) year initial maintenance period for stormwater facilities and until final acceptance by Clark County.

1.9.8 Late-Comers Agreement

The following costs associated with stormwater facilities may be recoverable through latecomer's agreements (Chapter 35.91 RCW):

1. The costs to over-size facilities on the site above their existing capacity or the capacity required for the proposed new development;

2. A proportionate share of the total cost of off-site facilities; and

3. Compliance with the provisions of RCW 35.91.010 *et seq*.

1.9.9 Regional Stormwater Facilities

Clark County encourages the use of regional stormwater facilities.

1.9.9.1 Conditions of Use

If regional stormwater facilities are used to meet some or all of the requirements of this manual, the following conditions shall be met:

1. Stormwater runoff shall be transported from a project site to a regional stormwater facility through a pipe or manmade open channel conveyance system.

2. The facility must have sufficient capacity to meet the Minimum Requirements specified in this manual at the time of each connection.

3. If mandatory LID BMPs are not planned and installed where feasible in the area draining to the regional facility, the facility must meet the LID Performance Standard in Minimum Requirement #5.

4. If stormwater facilities are required for project sites draining to the facility, the facility design must specify the design requirements to meet each Minimum Requirement of this manual.

5. The Developer shall pay the owner of the regional facility reasonable compensation for the use of the regional facility.

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Chapter 2 On-Site Stormwater Management

Chapter Contents

Chapter Figures

Chapter Tables

2.1 Introduction

2.1.1 Purpose

This chapter presents methods, criteria, and details for analysis and selection of On-site Stormwater Management BMPs as specified in Minimum Requirement #5.

The primary purpose of On-site Stormwater Management BMPs is to reduce the disruption of the natural site hydrology for vegetated sites and partially restore natural hydrology on development sites lacking natural vegetation. Clark County requires projects to use these BMPs to comply with Minimum Requirement #5. These BMPs can also contribute to compliance with Minimum Requirements #6 and #7.

The Low Impact Development Technical Guidance Manual for Puget Sound (Puget Sound Partnership, 2013) is an excellent source of information about LID site planning and BMPs. The requirements in this manual take precedence where conflicts may occur.

Most On-site Stormwater Management BMPs are intended primarily to reduce runoff volume and flow rates and secondarily to provide some level of stormwater treatment benefits.

2.1.2 How to Use this Chapter

- Section 2.2 describes how to determine which LID BMPs the site designer must consider.
- Section 2.3 describes how to assess the soil and infiltration capacity of the site for LID BMPs.
- Section 2.4 describes competing needs.
- Section 2.5 describes selection and infeasibility criteria for On-site Stormwater Management BMPs.

2.1.3 Minimum Requirements

Projects shall employ On-site Stormwater Management BMPs in accordance with the project thresholds, standards, and lists in Section 1.5.5 to infiltrate, disperse, and retain stormwater runoff on-site to the maximum extent feasible without causing flooding or erosion impacts. The full text of Minimum Requirement #5 is contained in Section 1.5.5.

Clark County accepts the use of Full Dispersion BMP T5.30A and BMP T5.30B as meeting Minimum Requirements #6 and #7. Bioretention and Permeable Pavements may be capable of meeting treatment and flow control requirements for their tributary drainage areas depending upon site conditions and sizing. Full dispersion can also be applied to meet Minimum Requirement #8.

Minimum Requirements #6 and #7 are described in Sections 1.5.6 and 1.5.7.

2.2 BMP Selection Process

The following process is required for selecting and planning for LID BMPs and demonstrating compliance with Minimum Requirement #5:

1. Use site design principles to retain native vegetation and minimize impervious surfaces to the extent feasible, including using site design BMPs and vegetation retention BMPs, per Minimum Requirement #1.

2. Determine applicable BMPs per Section 2.2.

3. Perform the Soils Assessment per Section 2.3.

4. Evaluate the feasibility of required BMPs using information in Sections 2.4 and 2.5.

5. Refer to BMP Information Sheets in Book 2, Chapter 2 to design selected BMPs.

Projects subject to Minimum Requirement #5 must consider LID BMPs from one of three tables based on the thresholds and criteria in Minimum Requirement #5. Each table lists the required LID BMPs and the order of use to meet Minimum Requirement #5.

Use Figure 2.1 to determine which LID table the project site designer is required to use. If the flowchart in Figure 2.1 requires:

- The use of BMPs from List #1, then use Table 2.1 to find out which LID BMPs the site designer must consider. Follow instructions in the table.
- The use of BMPs from List #2, then use Table 2.2 to find out which LID BMPs the site designer must consider. Follow instructions in the table.
- If the project drains to a flow exempt water body, then use Table 2.3 to find out which LID BMPs the site designer must consider.
- Meet the LID Performance Standard, then select any combination of LID and traditional flow control and treatment BMPs that achieve the performance objective in accordance with Minimum Requirement #5 and apply BMP T5.13 Post-Construction Soil Quality and Depth.

Clark County accepts and encourages the use of other on-site stormwater management BMPs that are not listed in the selection process for required BMPs. These BMPs are described in Sections 2.5.6 and 2.5.7, and include Better Site Design (BMP T5.41), Tree Retention and Tree Planting (BMP T5.16), and others.

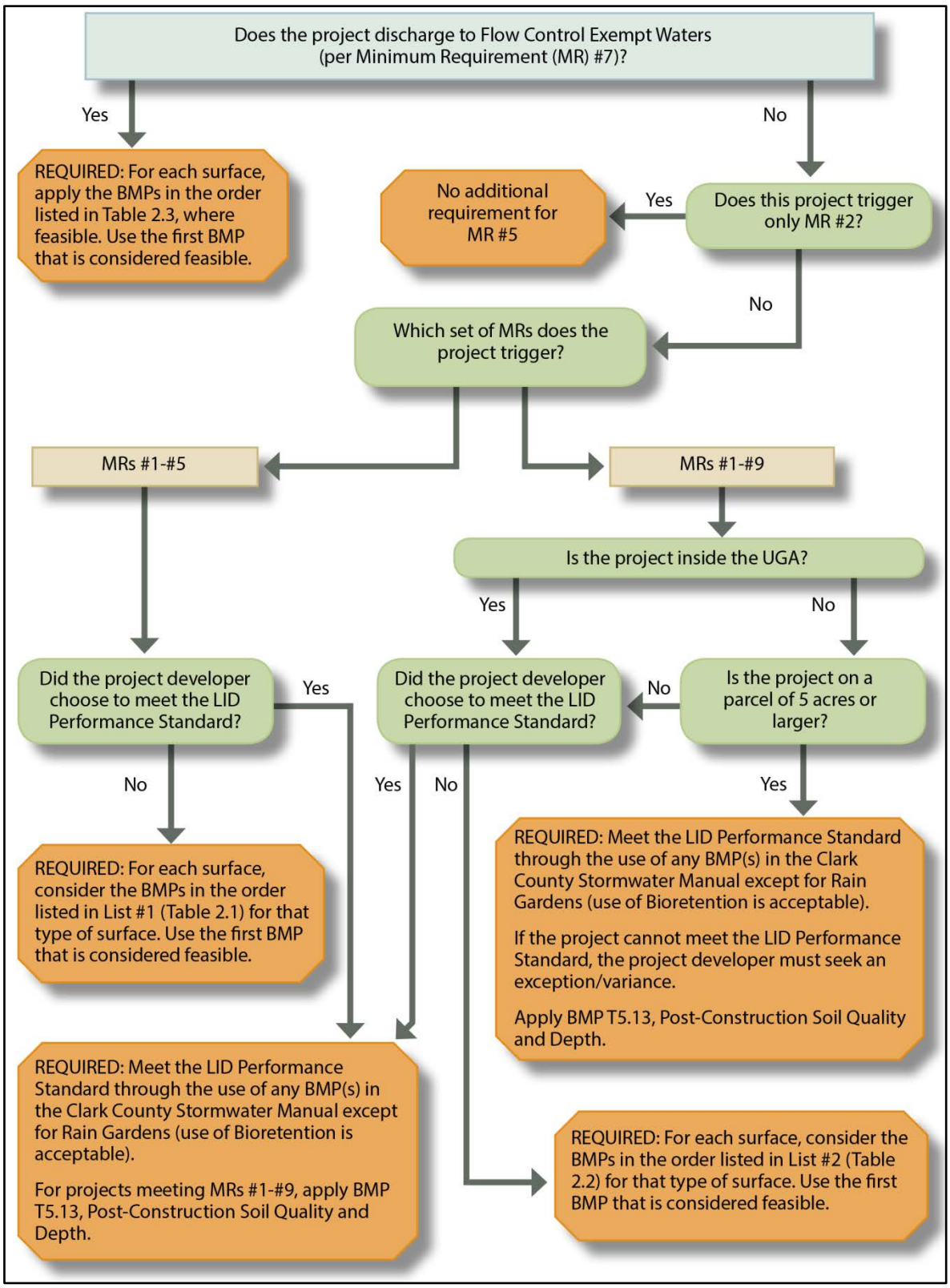

Figure 2.1: Flow Chart for Determining LID Minimum Requirement #5 Requirements

Table 2.1: Required Table of LID BMPs for Projects Subject only to Minimum Requirements #1 – #5

This table is equivalent to List #1 in Minimum Requirement #5.				
For each surface, consider BMPs in the sequence indicated for that type of surface. If a sequence number appears on more than one BMP for a surface, then the BMPs labeled with that sequence number may be considered in any order before moving on to the next number in the sequence. Use the first BMP that is considered feasible. No other On-site Stormwater Management BMP is necessary for that surface.				
BMP #	**BMP Name**	**Lawn and Landscape Areas**	**Roofs**	**Other Hard Surfaces**
T5.13	Post-Construction Soil Quality and Depth	1		
T5.30A/B	Full Dispersion		1	1
T5.10A/T5.10B	Downspout Full Infiltration		1	
T5.15	Permeable Pavement			2
T5.14A	Rain Garden		2	2
T5.14B	Bioretention		2	2
T5.10C	Downspout Dispersion		3	
T5.10D	Perforated Stub-out Connections		4	
T5.12	Sheet Flow Dispersion			3
T5.11	Concentrated Flow Dispersion			3

Table 2.2: Required Table of LID BMPs for Projects Subject to Minimum Requirements #1 – #9 that discharge to a water body that is not flow control exempt per Minimum Requirement #7

This table is equivalent to List #2 in Minimum Requirement #5.

For each surface, consider BMPs in the sequence indicated for that type of surface. If a sequence number appears on more than one BMP for a surface, then the BMPs labeled with that sequence number may be considered in any order before moving on to the next number in the sequence.

Use the first BMP that is considered feasible. No other On-site Stormwater Management BMP is necessary for that surface.

BMP #	BMP Name	Lawn and Landscape Areas	Roofs	Other Hard Surfaces
T5.13	Post-Construction Soil Quality and Depth	1		
T5.30A/B	Full Dispersion		1	1
T5.10A/T5.10B	Downspout Full Infiltration		1	
T5.15	Permeable Pavement			2
T5.14B	Bioretention		2	3
T5.10C	Downspout Dispersion		3	
T5.10D	Perforated Stub-out Connections		4	
T5.12	Sheet Flow Dispersion			4
T5.11	Concentrated Flow Dispersion			4

Table 2.3: Required Table of LID BMPs for Projects that discharge to a flow control exempt water body per Minimum Requirement #7

Implement the following BMPs where feasible.				
For each surface, consider BMPs in the sequence indicated for that type of surface. If a sequence number appears on more than one BMP for a surface, then the BMPs labeled with that sequence number may be considered in any order before moving on to the next number in the sequence. Use the first BMP that is considered feasible. No other On-site Stormwater Management BMP is necessary for that surface.				
BMP #	**BMP Name**	**Lawn and Landscape Areas**	**Roofs**	**Other Hard Surfaces**
T5.13	Post-Construction Soil Quality and Depth	1		
T5.10A/T5.10B	Downspout Full Infiltration		1	
T5.10C	Downspout Dispersion		2	
T5.10D	Perforated Stub-out Connections		3	
T5.12	Sheet Flow Dispersion			1
T5.11	Concentrated Flow Dispersion			1

2.3 Soils Assessment for Engineered Stormwater Plans

Low impact development requires soil and possibly groundwater analysis to determine infiltration rates and soil storage capacity. These analyses are needed for three primary reasons:

1. LID emphasizes storage and infiltration of stormwater in smaller-scale facilities distributed throughout the site.

2. On sites with mixed soil types, areas with permeable soils should be preserved and utilized for infiltration, and impervious areas should be located over less permeable soils.

3. Determining feasibility of LID BMPs.

Soil and subsurface characterization relies to a large extent on infiltration testing and soil testing. The type and number of these tests for site assessments is variable and specific to the site and site design; however some general guidelines are appropriate. Test locations should consider site features such as topography, mapped soil type, hydrologic characteristics and other site features.

A soil and infiltration capacity assessment is necessary to complete the preliminary Stormwater Site Plan once the layout and location of LID stormwater BMPs has been determined. If traditional infiltration BMPs will be used on the site, see requirements in Chapter 4 in addition to this chapter.

The site designer must provide sufficient information to confirm the feasibility of the proposed BMPs to meet Minimum Requirement #5. Information should also be gathered to provide a basis for estimating the facilities' contribution to meeting Minimum Requirements #6 and #7, where applicable.

Document the results of the Soils Assessment in the Soils Report described in Section 1.8.3. For projects qualifying to use the Stormwater Site Plan Short Form, follow the instructions in the in Appendix 1-I to document the results.

2.3.1 Qualified Professionals

Soil and subsurface characterization shall be conducted by a certified soil scientist, professional engineer, geologist, hydrogeologist or engineering geologist registered in the State of Washington or suitably trained persons working under the supervision of the above professionals. For projects meeting Minimum Requirements #1 – #5, a licensed on-site sewage designer can be used to complete the soil description (Section 2.3.1.2) and to conduct infiltration tests (Section 2.3.1.4) where necessary.

2.3.2 Soil Description

Perform the following to describe the underlying soils on the site:

- Soil test pits
- Soil borings
- Soil grain size analysis

Provide boring logs and other detailed information to characterize the soil profile. Provide a review of existing geotechnical and geological information from published geology maps, Natural Resource Conservation Service soil surveys, and past geotechnical information. Identify the appropriate hydrologic soil group, and provide a summary of seasonal groundwater elevation information and topsoil depth.

Where downspout infiltration systems are proposed, the soils description must demonstrate that soils suitable for infiltration are present on the site. Prepare at least one soils log at the location of each downspout infiltration system, a minimum of 4 feet in depth from the proposed grade and at least 1 foot below the expected bottom elevation of the infiltration trench or drywell. Identify the NRCS series of the soil, the hydrologic soil group per Appendix 2-A, and the USDA textural class of the soil horizon through the depth of the log. Note any evidence of high groundwater level, such as mottling.

Applicants proposing to meet Minimum Requirement #5 solely with one of the following listed BMPs are not required to complete the remaining aspects of the Soils Assessment described in Sections 2.3.~~1.~~3 through 2.3.~~1.~~5:

BMP T5.30A/B, Full Dispersion.

BMP T5.10A/B, Roof Downspout Full Infiltration.

BMP T5.10C, Downspout Dispersion.

BMP T5.10D, Perforated Stub-out Connection.

2.3.3 Soil Stratigraphy

For projects subject to Minimum Requirements #1 – #9, the soils report should include a description of the soil stratigraphy and groundwater elevations at the site.

Soil stratigraphy must be assessed for low permeability layers, highly permeable sand/gravel layers, depth to groundwater, and other soil structure variability necessary to assess subsurface flow patterns. Soil characterization for each soil unit (soil strata with the same texture, color, density, compaction, consolidation and permeability) should include:

- Grain size distribution
- Textural class
- Percent clay content
- Cation exchange capacity
- Color/mottling
- Variations and nature of stratification

2.3.4 Infiltration Rate (Coefficient of Permeability)

Determine the measured infiltration rate for subgrade soil profile (existing soils) beneath areas proposed to have bioretention, rain gardens and permeable pavement. Conduct infiltration tests using one of the methods in Section 4.3.1.3. Conduct tests in locations and at adequate frequency capable of producing a soil profile characterization that fully represents the infiltration capability where the LID infiltration BMPs are proposed.

Prepare detailed logs for each test pit or test hole and a map showing the location of the test pits or test holes. Logs must include, at a minimum: depth of pit or hole, soil descriptions, depth to water, and presence of stratification. Logs must substantiate whether stratification does or does not exist. The qualified professional may consider additional methods of analysis to substantiate the presence of stratification that may influence the design or successful operation of the facility.

Projects Subject Only to Minimum Requirements #1 – #5 and Not Meeting LID Performance Standard

Perform an infiltration test at each rain garden location to determine if the minimum measured coefficient of permeability of 0.3 in/hr is exceeded.

For proposed permeable pavement locations, perform an infiltration test for every 5,000 sq. ft. of permeable pavement.

The depth and number of infiltration tests and soil samples should be increased if, in the judgment of the qualified professional, conditions are highly variable and such increases are necessary to accurately estimate the performance of the infiltration system. The professional can also consider a reduction in the extent of infiltration testing if, in their judgment, information exists confirming that the site is unconsolidated sediment with high infiltration rates, and there is one foot of separation from the bottom of the base course for permeable pavement to groundwater and site soils are found to be homogeneous and consistent.

In high water table sites, the subsurface exploration sampling need not be conducted lower than two feet below the groundwater table. For all proposed locations of LID infiltration BMPs, determine whether the location has at least one foot minimum clearance to the seasonal high groundwater or other hydraulic restriction layer.

Projects Subject to Minimum Requirements #1 – #9 or Meeting LID Performance Standard

Bioretention

For proposed bioretention locations, infiltration tests shall be conducted as follows:

- On a single, smaller commercial property where one bioretention facility is proposed, one test must be performed at the proposed bioretention location. Tests at more than one site could reveal the advantages of one location over another.
- On larger commercial sites, a test per Section 4.3.1.3 must be performed every 5,000 square feet of PGIS.
- On residential developments where the proposed bioretention facility will receive runoff from one or two lots and less than ¼ acre of impervious surface, conduct one infiltration test at the proposed bioretention location.
- For bioretention facilities proposed to receive runoff from more than two lots or greater than ¼ acre of impervious surface, an infiltration test is required at each potential bioretention site.
- Long, narrow bioretention facilities or bioretention swales, such as one following the road right-of-way, should have a test location at least every 200 lineal feet, and within each length of road with significant differences in subsurface characteristics.
- The qualified professional can exercise discretion concerning the need for and extent of infiltration rate testing:

- The depth and number of infiltration tests should be increased if, in the judgment of the qualified professional, conditions are highly variable and such increases are necessary to accurately estimate the performance of the infiltration system.
- The depth and number of infiltration tests can be decreased, if in the judgement of the qualified professional, information exists confirming that the site is unconsolidated coarse gravel with high infiltration rates, and there is one foot or three foot minimum separation to groundwater from the bottom of a bioretention installation depending upon drainage area size (per BMP T5.14B Infeasibility Criteria; See Section 2.5.4.3).

After conducting an infiltration test, test sites should be over-excavated three feet below the projected infiltration facility's bottom elevation to determine if there are restrictive layers or groundwater. Observations through a winter season can also be used to assist in identifying a seasonal groundwater restriction.

Correction Factors

Correction factors are applicable to projects subject to Minimum Requirements #1 – #9 and to projects that must or choose to demonstrate compliance with the LID Performance Standard of Minimum Requirement #5. Note that this is separate design issue from the assignment of a correction factor to the overlying, designed bioretention soil mix. See the bioretention design section in Book 2, Chapter 2 for information on those correction factors. Correction factors are shown in Table 2.4.

Table 2.4: Correction Factors to Infiltration Rate for Bioretention

This table gives correction factors for coefficient of permeability values to estimate the design (long-term) infiltration rates of subgrade soils underlying Bioretention.	
Site Analysis Issue	**Correction Factor**
Site variability and number of locations tested	CF_V =0.50
Degree of influent control to prevent siltation and bio-buildup	No correction factor required

Permeable Pavement

For sites proposing permeable pavement, infiltration tests shall be conducted as follows:

- On commercial property, conduct an infiltration test for every 5,000 sq. ft. of permeable pavement, but not less than one test per section of contiguous permeable pavement.
- On residential developments, conduct infiltration tests at every proposed lot, at least every 200 feet of roadway and within each length of road with significant differences in subsurface characteristics.
- The qualified professional may exercise discretion concerning the need for and extent of

infiltration rate testing. The professional may consider a reduction in the extent of infiltration testing if, in their judgment, information exists confirming that the site is unconsolidated sediment material with high infiltration rates, that the soils are homogeneous and consistent, and that there is one foot of separation from the bottom of the base course for permeable pavement to groundwater.

Unless seasonal high groundwater elevations across the site have already been determined, upon conclusion of the infiltration testing, infiltration sites should be over-excavated three feet to see any restrictive layers or groundwater. Observations through a winter season can identify a seasonal groundwater restriction.

Perform infiltration testing in the soil profile at the estimated bottom elevation of base materials for the permeable pavement. If no base materials, (e.g., a permeable concrete sidewalk), perform the testing at the estimated bottom elevation of the pavement.

Correction Factors

Correction factors are applicable to projects subject to Minimum Requirements #1 – #9 and to projects that must or choose to demonstrate compliance with the LID Performance Standard of Minimum Requirement #5.

Tests should be located and be at adequate frequency capable of producing a soil profile characterization that fully represents the infiltration capability where the permeable pavement is located. A correction factor of one (1) for the quality of pavement aggregate base material may be used if the aggregate base is clean washed material with 1% or less fines passing the 200 sieve. Otherwise use a factor of 0.9, as shown in Table 2.5.

Table 2.5: Correction Factors to Infiltration Rate for Permeable Pavement

This table gives correction factors for coefficient of permeability values to estimate design (long-term) infiltration rates of the subgrade for Permeable Pavement.	
Site Analysis Issue	**Correction Factor**
Site variability and number of locations tested	CF_v = 0.50
Quality of pavement aggregate base material	CF_m = 0.9 to 1

Total correction factor (CF_T) = CF_v x CF_m

2.3.5 Groundwater Assessment

For facilities serving over one acre, groundwater monitoring wells or test pits must be installed and monitored in each bioretention facility through at least one winter season (December 21 through March 21) unless:

- GIS groundwater data from Clark County ~~or~~ and available field information describing water table elevations within 500 feet of the site indicate that the seasonal high groundwater elevation is at least 15 feet below the base of the proposed facility. Examples of field information that can be used include public well records and groundwater monitoring reports from other development sites.
- The seasonal high groundwater elevation has been found to be at least 15 feet below the facility base from monitoring wells installed at the site where monitoring was conducted during at least one winter season in the preceding three years.

For facilities serving a drainage area less than one acre, establish that the depth to groundwater or other hydraulic restriction layer will be at least 10 feet below the base of the facility. This can be done through the use groundwater monitoring wells as described above, through subsurface explorations or through information from nearby wells (500 feet or closer).

If a single bioretention facility serves a drainage area exceeding one acre and the depth to a hydraulic restricting layer or groundwater from the bottom (subgrade) of the bioretention area is less than 15 feet, a groundwater mounding analysis must be done in accordance with Book 2, Section 5.1.1.2.

2.4 LID Infeasibility due to Competing Needs

The use of On-site Stormwater Management BMPs can be superseded or reduced where they are in conflict with:

- Requirements of the following federal or state laws, rules, and standards:
    - Historic Preservation Laws and Archaeology Laws as listed at http://www.dahp.wa.gov/learn-and-research/preservation-laws.
    - Federal Superfund (general information at: http://www.epa.gov/superfund/about.htm) or Washington State Model Toxics Control Act (RCW Chapter 70.105D and WAC 173-340).
    - Federal Aviation Administration requirements for airports. See WSDOT's *Airport Stormwater Design Manual*.
    - Americans with Disabilities Act. See the 2010 ADA Standards for Accessible Design.
- Where an LID requirement has been found to be in conflict with special zoning district design criteria adopted and being implemented pursuant to a community planning process, the existing local codes may supersede or reduce the LID requirement.
- Public health and safety standards.
- Transportation regulations to maintain the option for future expansion or multi-modal use of ~~public~~ Clark County rights-of-way.
- Critical areas code provides protection of tree species.

Document the use of Competing Needs criteria to supersede or reduce use of BMPs contained in the Required Table (see Section 2.2) in the preliminary and final Technical Information Reports (Sections 1.8.1.5 and 1.8.2.3).

2.5 Onsite Stormwater Management BMPs

2.5.1 Roof Downspout Control BMPs

2.5.1.1 Purpose and Description

Roof downspout controls include a mix of simple pre-engineered designs for infiltrating and/or dispersing runoff from roof areas. The pre-engineered downspout controls – Downspout Full Infiltration Drywell, Downspout Full Infiltration Trench, Downspout Dispersion, and Perforated Stub-out Connection – are intended only for use in infiltrating runoff from roof downspout drains on individual residential lots; however they may also be applied to commercial lot developments when the pollutant characteristics are comparable to those from residential lots.

Roof Downspout Controls include:

- BMP T5.30 A/B Full Dispersion
- BMP T5.10A Downspout Full Infiltration – Drywells
- BMP T5.10B Downspout Full Infiltration –Trenches
- BMP T5.10C Downspout Dispersion
- BMP T5.10D Perforated Stub-out Connection
- BMP T5.14A Rain Gardens (for projects that must meet MRs #1 - #5)
- BMP T5.14B Bioretention (for projects that must meet MRs #1 - #9)

These BMPs are mandated where feasible under Lists #1 and #2 in Minimum Requirement #5.

Other innovative downspout control BMPs such as rain barrels, ornamental ponds, downspout cisterns, or other downspout water storage devices may be used to supplement any of the above BMPs.

BMP T5.30A/B, Full Dispersion, BMP T5.14A, Rain Gardens, and BMP T5.14B, Bioretention, may be used to control runoff from other types of surfaces besides roof runoff and are not classified solely as roof downspout controls. See more information in Sections 2.5.3 and Section 2.5.4.

2.5.1.2 Roof Downspout Selection Process

The following types of roof downspout controls must be considered in descending order of preference, as shown in Figure 2.2:

1. Full Dispersion in accordance with BMP T5.30A and/or BMP T5.30B. [Note: Full Dispersion is not exclusively a roof downspout control and can be used to control runoff from other surfaces. See more information on this BMP in Section 2.5.3.]

2. Downspout Full Infiltration Systems in accordance with BMP T5.10A or BMP T5.10B.

3. Rain Gardens in accordance with BMP T5.14A; or if the project area is subject to Minimum Requirements #1 – #9, Bioretention in accordance with BMP T5.14B. [Note: Rain Gardens and Bioretention are not exclusively roof downspout controls and can be used to control runoff from other surfaces. See more information on these BMPs in Section 2.5.4.]

4. Downspout Dispersion Systems in accordance with BMP T5.10C.

5. Perforated Stub-out Connections in accordance with BMP T5.10D.

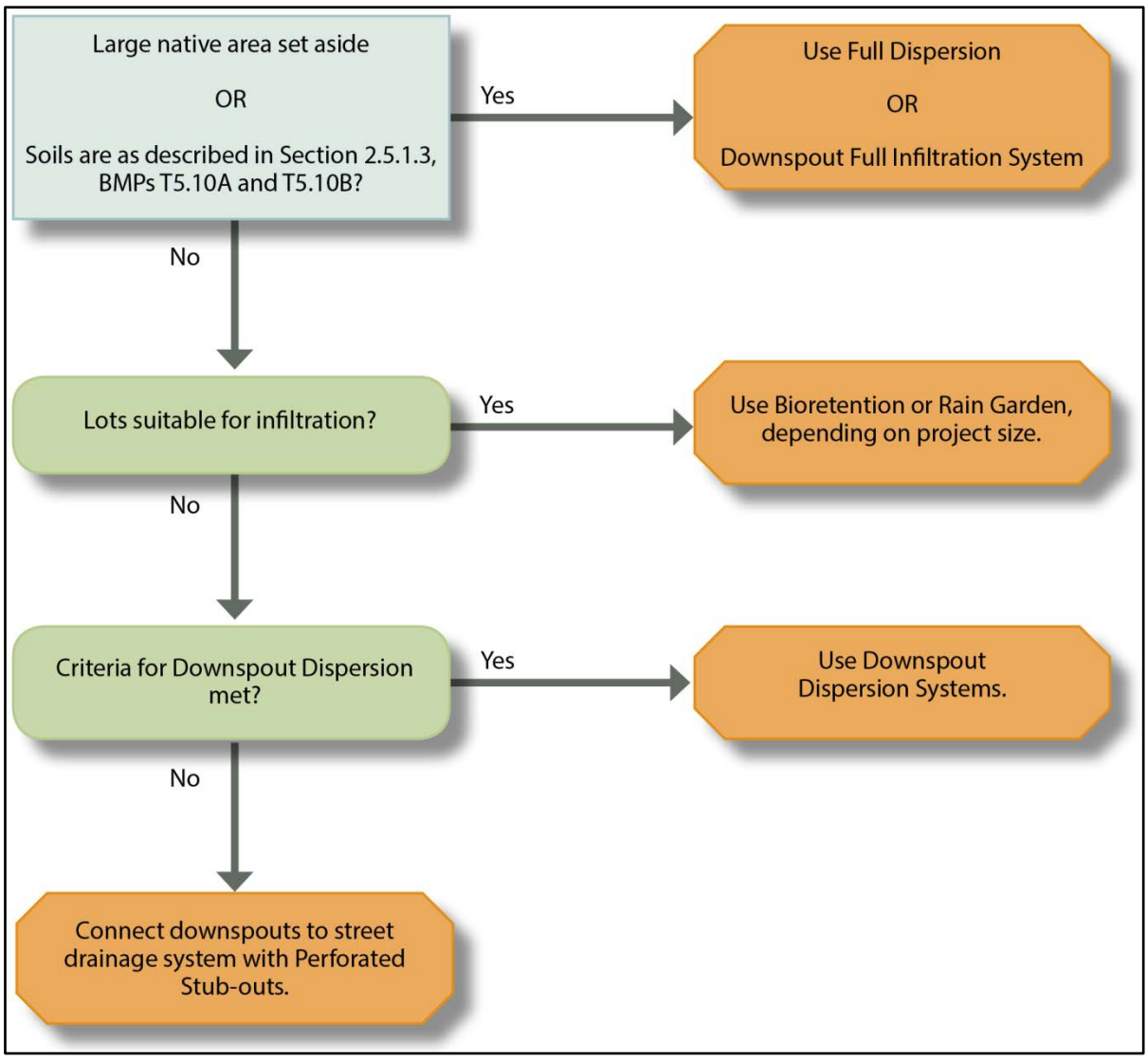

Figure 2.2: Roof Downspout Selection Process

2.5.1.3 Roof Downspout BMP Applications, Limitations and Infeasibility Criteria

BMP T5.30A: Full Dispersion and BMP T5.30B: Dispersion to Pasture and Cropland

See Section 2.5.3 for applications and limitations associated with these BMPs.

BMP T5.10A: Downspout Full Infiltration – Drywells and BMP T5.10B: Downspout Full Infiltration – Trenches

These systems are deemed feasible without infiltration testing when a qualified professional determines that USDA textural classes consisting of coarse sand to medium sand, loam, or cobbles

and gravels are present in the infiltration zone. If other soils are present in the infiltration zone consider a rain garden or bioretention facility instead. Other infeasibility criteria include:

- Less than three feet of permeable soil exists from the proposed finished ground elevation at the drywell or trench location to the seasonal high groundwater table.
- Less than one foot exists between the bottom of the infiltration trench or drywell to the groundwater elevation.
- It cannot meet the setback requirements in Section 2.5.1.4.

BMP T5.10C: Downspout Dispersion

- Downspout dispersion where feasible, must be used on lots where downspout full infiltration, full dispersion, and bioretention/rain gardens are not feasible.
- Splash blocks may be used if a vegetated flow path at least 50 feet in length is available, as measured from the downspout to the downstream property line, structure, slope over 15%, stream, wetland, or other impervious surface. Sensitive area buffers may count toward flow path lengths.
- If the vegetated flow path (measured as defined above) is less than 25 feet, a perforated stub-out connection may be used in lieu of downspout dispersion. A perforated stub-out may also be used where implementation of downspout dispersion might cause erosion or flooding problems, either on site or on adjacent lots. For example, this provision might be appropriate for lots constructed on steep hills where downspout discharge could culminate and might pose a potential hazard for lower lying lots, or where dispersed flows could create problems for adjacent off-site lots. This provision does not apply to situations where lots are flat and on-site downspout dispersal would result in saturated yards. Perforated stub-outs are not appropriate when seasonal water table is <1 foot below trench bottom.
- For sites with septic systems, the discharge point of all dispersion systems must be downgradient of the drainfield. This requirement may be waived if site topography clearly prohibits flows from intersecting the drainfield.

Dispersion trench limitations include:

- A vegetated flow path of at least 25 feet in length must be maintained between the outlet of the trench and any property line, structure, stream, wetland, or impervious surface.
- A vegetated flow path of at least 50 feet in length must be maintained between the outlet of the trench and any slope steeper than 15%. Sensitive area buffers may count towards flow path lengths.
- A setback of at least 5 feet between any edge of the trench and any structure or property line must be able to be provided.

BMP T5.10D: Perforated Stub-out Connection

In projects subject to Minimum Requirement #5 perforated stub-out connections may be used only when all other higher priority on-site stormwater management BMPs are not feasible, per the criteria for each of those BMPs.

Perforated stub-outs cannot be used when the seasonal water table is less than one foot below trench bottom.

A perforated stub-out may also be used where implementation of downspout dispersion might cause erosion or flooding problems, either on site or on adjacent lots.

BMP T5.14A: Rain Gardens and BMP T5.14B: Bioretention

See Section 2.5.4 for applications and limitations associated with these BMPs.

2.5.1.4 Roof Downspout Setbacks

The following setbacks are required for Downspout Full Infiltration:

- 100 feet from closed or active landfills.
- 10 feet from any sewage disposal drainfield, including reserve areas and grey water reuse systems.
- 100 feet upgradient from any septic system unless site topography clearly indicates that subsurface flows will not intersect the drainfield.
- 10 feet from an underground storage tank and its connecting pipes that is used to store petroleum products, chemical, or liquid hazardous wastes in which 10% or more of the storage volume of the tank and connecting pipes is beneath the ground.
- 10 feet from any structure, property line, or sensitive area. However, if the roof downspout infiltration system is a common system shared by two or more adjacent residential lots and contained within an easement for maintenance given to owners of all residential properties draining to the system, then the setback from the property line(s) shared by the adjacent lots may be waived.
- 200 feet from the top of any slope over 40%.
- Not on slopes steeper than 15% unless information from a geotechnical engineer is provided stating that slope stability will not be compromised.

The following setbacks are required for Downspout Dispersion:

- 10 feet from any sewage disposal drainfield, including reserve areas and grey water reuse systems.
- 100 feet upgradient from any septic system unless site topography clearly indicates that subsurface flows will not intersect the drainfield.
- At least 10 feet from any structure, property line, or sensitive area.

- 50 feet from the top of any slope over 15%. This setback may be reduced to 15 feet based on a geotechnical evaluation.

Setbacks for other BMPs that are not exclusively used for roof downspout controls (e.g. bioretention) are given in their respective sections.

2.5.2 Soil Amendment BMPs

2.5.2.1 Purpose and Description

Naturally occurring (undisturbed) soil and vegetation provide important stormwater functions including: water infiltration; nutrient, sediment, and pollutant adsorption; sediment and pollutant biofiltration; water interflow storage and transmission; and pollutant decomposition. These functions are largely lost when development strips away native soil and vegetation and replaces it with minimal topsoil and sod. Not only are these important stormwater functions lost, but such landscapes themselves become pollution generating pervious surfaces due to increased use of pesticides, fertilizers and other landscaping and household/industrial chemicals.

Establishing soil quality and depth regains greater stormwater functions in the post development landscape, provides increased treatment of pollutants and sediments that result from development and habitation, and minimizes the need for some landscaping chemicals, thus reducing pollution through prevention.

The following BMP is mandatory for all sites required to meet either Minimum Requirements #1 – #5 or Minimum Requirements #1 – #9:

- BMP T5.13 Post Construction Soil Quality and Depth

2.5.3 Dispersion BMPs

2.5.3.1 Purpose and Description

Dispersion BMPs spread runoff over the land and prevent runoff from concentrating over the length of the designated flow path. For flows that are initially concentrated, dispersion BMPs require a long flow path; for flows that are not concentrated, dispersion BMPs can be effective over a shorter flow path.

Dispersion helps attenuate peak flows by slowing entry of runoff into a conveyance system, allowing for some infiltration and providing some water quality benefits.

Dispersion BMPs include:

- BMP T5.11 Concentrated Flow Dispersion
- BMP T5.12 Sheet Flow Dispersion

- BMP T5.18 Reverse Slope Sidewalk
- BMP T5.30A Full Dispersion
- BMP T5.30B Dispersion to Pasture and Cropland

2.5.3.2 Applications and Limitations

- BMP T5.11 Concentrated Flow Dispersion can be used in any situation where concentrated flow can be dispersed through vegetation.
- BMP T5.12 Sheet Flow Dispersion is used on flat or moderately sloping (< 15% slope) surfaces such as driveways, sports courts, patios, roofs without gutters, lawns, pastures; or any situation where concentration of flows can be avoided.
- BMP T5.18 Reverse Slope Sidewalk requires 10 feet of vegetated surface downslope that is not directly connected into the storm drainage system.
- BMP T5.30A Full Dispersion is used in the following situations:
    - Rural single family residential developments should use these dispersion BMPs wherever possible to minimize effective impervious surface to less than 10% of the development site.
    - Other types of development that retain 65% of the site (or a threshold discharge area on the site) in a forested or native condition may also use these BMPs to avoid triggering the flow control facility requirement.
- On a single-family residential lot or an agriculture parcel or parcels under the same ownership and greater than 22,000 square feet, full dispersion onto pasture and croplands (BMP T5.30B) is allowed when in compliance with the following criteria:
    - Crop land shall consist of land used to grow grass, grain, or row crops also including berries, nursery stock and orchards.
    - The crop or pasture land shall be under the same ownership as the project site.
    - For soils with an infiltration rate greater than 4 inches per hour, pasture or cropland shall have been cleared prior to the adoption of this standard (November 2009).
    - The total site area shall consist of at least 75 percent cropland, and no more than 15 percent of the site draining to the dispersion area shall be impervious surfaces. Less stringent ratios of sending land and receiving land uses may be submitted, with supporting modeling results showing flow control requirements are satisfied for the site.
    - No more than 10 percent of the pasture or cropland used for dispersion shall be used for purposes other than plant growth (for example, but not limited to, unpaved roads, staging areas, equipment storage, animal pens, haystacks, wheel lines, campsites, trails, etc.).

- Runoff from a driveway through the dispersion area shall be dispersed per BMP T5.11 or BMP T5.12 and shall have a flow path exceeding 300 feet.
- Land used for dispersion shall be downslope from building sites and shall not exceed 5% slope.
- There shall be a minimum 3-foot depth to the average annual maximum groundwater elevation.
- The length used for dispersion shall be 300 feet or greater.
- The preserved area is not required to be placed in a separate tract or recorded easement.
- The Applications, Limitations and Setbacks for BMP T5.30A shall also apply to this BMP. Where conflicts between the requirements in BMP T5.30 and the requirements in this BMP occur, the requirements for this BMP shall apply.

- The following surfaces will be considered "fully dispersed per BMP T5.30A or BMP T5.30B if the meet the feasibility criteria listed for those BMPs, and if they meet the following:

Roof Surfaces

Roof surfaces are considered to be "fully dispersed" if they meet BMP T5.30A or BMP T5.30B and if they either: 1) comply with the Downspout Dispersion requirements of BMP T5.10C, but with vegetated flow paths of 100 feet or more through the native vegetation preserved area; or 2) disperse the roof runoff along with the road runoff in accordance with the roadway dispersion BMP section below.

Roadways

Roadway surfaces are considered to be "fully dispersed" if they meet BMP T5.30A or BMP T5.30B and if they comply with the following dispersion requirements:

1. The road section shall be designed to minimize collection and concentration of roadway runoff. Sheet flow over roadway fill slopes (i.e., where roadway subgrade is above adjacent right-of-way) should be used wherever possible to avoid concentration.

2. When it is necessary to collect and concentrate runoff from the roadway and adjacent upstream areas (e.g., in a ditch on a cut slope), concentrated flows shall be incrementally discharged from the ditch via cross culverts or at the ends of cut sections. These incremental discharges of newly concentrated flows shall not exceed 0.5 cfs at any one discharge point from a ditch for the 100-year runoff event. Where flows at a particular ditch discharge point were already concentrated under existing site conditions (e.g., in a natural channel that crosses the roadway alignment), the 0.5-cfs limit would be in addition to the existing concentrated peak flows.

3. Ditch discharge points with up to 0.2 cfs discharge for the peak 100-year flow shall use rock pads or dispersion trenches to disperse flows. Ditch discharge points with between 0.2 and 0.5 cfs discharge for the 100-year peak flow shall use only dispersion trenches to disperse flows.

4. Dispersion trenches shall be designed to accept surface flows (free discharge) from a pipe, culvert, or ditch end, shall be aligned perpendicular to the flow path, and shall be minimum 2 feet by 2 feet in section, 50 feet in length, filled with ¾-inch to 1½-inch washed rock, and provided with a level notched grade board. Manifolds may be used to split flows up to 2 cfs discharge for the 100-year peak flow between up to 4 trenches. Dispersion trenches shall have a minimum spacing of 50 feet between centerlines.

5. Flow paths from adjacent discharge points must not intersect within the 100-foot flow path lengths, and dispersed flow from a discharge point must not be intercepted by another discharge point. To enhance the flow control and water quality effects of dispersion, the flow path shall not exceed 15% slope, and shall be located within designated open space. Runoff may be conveyed to an area meeting these flow path criteria.

6. Ditch discharge points shall be located a minimum of 100 feet up gradient of steep slopes (i.e., slopes steeper than 40%), wetlands, and streams.

Driveways

Driveway surfaces are considered to be "fully dispersed" if they meet BMP T5.30A or BMP T5.30B AND if they either: 1) comply with BMP 5.11 for concentrated flow and BMP T5.12 for sheet flow- and have flow paths of 100 feet or more through native vegetation; or, 2) disperse driveway runoff along with the road runoff in accordance with the roadway dispersion BMP section below.

Cleared Areas

The runoff from cleared areas that are comprised of bare soil, non-native landscaping, lawn, and/or pasture of up to 25 feet in flow path length can be considered to be "fully dispersed" if it is dispersed through at least 25 feet of native vegetation in accordance with the following criteria:

1. The topography of the non-native pervious surface must be such that runoff will not concentrate prior to discharge to the dispersal area.

2. Slopes within the dispersal area should be no steeper than 15%.

If the width of the non-native pervious surface is greater than 25 feet, the vegetated flow path segment must be extended 1 foot for every 3 feet of width beyond 25 feet up to a maximum width of 250 feet.

2.5.3.3 Infeasibility Criteria for Dispersion BMPs

The infeasibility criteria in this section apply to the following BMPs:

- BMP T5.11 Concentrated Flow Dispersion
- BMP T5.12 Sheet Flow Dispersion
- BMP T5.30A Full Dispersion
- BMP T5.30B Pasture and Cropland Dispersion

The following criteria describe conditions that make dispersion LID BMPs infeasible to meet Minimum Requirement #5 for the BMPs listed above. It is important to note that even though a LID BMP is infeasible to meet the LID requirement, it may still be designed and used to meet the runoff treatment and/or flow control requirement for the TDA, if applicable.

Dispersion BMPs listed above are considered infeasible under the following conditions:

- Where a professional geotechnical evaluation recommends dispersion not be used due to reasonable concerns about erosion, slope failure or down gradient flooding.
- Where the only location available for the discharge location is less than 100 feet up gradient of a septic system.
- Where the only area available for the required length of the BMP's flow path is above an erosion hazard, toward a landslide hazard area, or on a slope greater than 20% unless a professional geotechnical engineer recommends dispersion can be used in these areas.
- Where the only area available to place the dispersion device (not the flow path), if applicable to the BMP, is located in a critical area or critical area buffer.
- Where the only area available to place the dispersion device (not the flow path), if applicable to the BMP, is located on a slope greater than 20% (5% for BMP T5.30B) or within 50 feet of a geohazard (CCC 40.430) area.
- Where the setbacks in Section 2.5.3.4 cannot be met.

Meeting any one of the criteria renders dispersion BMPs infeasible to meet Minimum Requirement #5 on the site. Citation of any of the infeasibility criteria must be based on an evaluation of site-specific conditions and must be documented in the Preliminary and Final TIR (Sections 1.8.1.5 and 1.8.2.3) on the LID Feasibility Checklist, along with any applicable written recommendations from a qualified professional. See Appendix 1-E for the LID Fesasibility Checklist.

2.5.3.4 Setbacks for Dispersion BMPs

- 100 feet upgradient from any septic system unless site topography clearly indicates that subsurface flows will not intersect the drainfield.
- 10 feet from any structure, property line, or sensitive area.

- 50 feet from a geohazard area per CCC 40.430.

2.5.4 Bioretention and Rain Garden BMPs

2.5.4.1 Purpose and Description

Bioretention facilities and rain gardens are designed to soak runoff into the ground and treat pollutants by filtering runoff through soil.

Bioretention facilities are engineered facilities that include a designed soil mix to treat pollutants. Rain gardens are non-engineered facilities that use a blend of native soil and compost as treatment media.

Bioretention areas and rain gardens also include plants adapted to the local climate and soil moisture conditions. Bioretention and rain garden BMPs include:

- BMP T5.14A Rain Garden
- BMP T5.14B Bioretention

The term bioretention is used to describe various designs using soil and plant complexes to manage stormwater. The following terminology is used in this manual:

- **Bioretention cells**: Shallow depressions with a designed planting soil mix and a variety of plant material, including trees, shrubs, grasses, and/or other herbaceous plants. Bioretention cells may or may not have an under-drain and are not designed as a conveyance system.
- **Bioretention swales**: Incorporate the same design features as bioretention cells; however, bioretention swales are designed as part of a system that can convey stormwater when maximum ponding depth is exceeded. Bioretention swales have relatively gentle side slopes and ponding depths that are typically 6 to 12 inches.
- **Bioretention planters and planter boxes**: Designed soil mix and a variety of plant material including trees, shrubs, grasses, and/or other herbaceous plants within a vertical walled container usually constructed from formed concrete, but could include other materials. Planter boxes are completely impervious and include a bottom (must include an under-drain). Planters have an open bottom and allow infiltration to the subgrade. These designs are often used in ultra-urban settings.

Where the surrounding native soils have adequate infiltration rates, bioretention can help comply with flow control and treatment requirements. Where the native soils have low infiltration rates, under-drain systems can be installed and the facility used to filter pollutants and detain flows that exceed infiltration capacity of the surrounding soil. However, designs utilizing under-drains provide less flow control benefits.

Rain gardens are generally used on smaller projects such as individual home sites where soils are not sufficiently well drained for roof downspout infiltration wells or trenches.

2.5.4.2 Applications and Limitations

BMP T5.14A: Rain Gardens

Rain gardens are an on-site stormwater management BMP option for projects that have to comply with Minimum Requirements #1 – #5, but they may not be used on sites complying with Minimum Requirements #1 – #9. For projects required to use List #1 of Minimum Requirement #5, Rain Gardens are to be used to the extent feasible for runoff from roofs and other hard surfaces unless a higher priority BMP is feasible.

Other applications and limitations are the same as for bioretention.

BMP T5.14B: Bioretention Facilities

Bioretention facilities are an on-site BMP option for projects that only have to comply with Minimum Requirements #1 – #5 (List #1). For projects required to meet Minimum requirements #1 - #9 and use List #2, bioretention facilities are to be used to the extent feasible for runoff from roofs and other hard surfaces unless a higher priority BMP is feasible.

Because bioretention facilities use an imported soil mix that has a moderate design infiltration rate, they are best applied for small drainages, and near the source of the stormwater. Cells may be scattered throughout a subdivision; a swale may run alongside the access road; or a series of planter boxes may serve the road. In these situations, they can but are not required to fully meet the requirement to treat 91% of the stormwater runoff file from pollution-generating surfaces. But the amount of stormwater that is predicted to pass through the soil profile may be estimated and subtracted from the 91% volume that must be treated. Downstream treatment facilities may be significantly smaller as a result.

Bioretention facilities that infiltrate into the ground can also serve a significant flow reduction function. They can, but are not required to fully meet the flow control duration standard of Minimum Requirement #7. Because they typically do not have an orifice restricting overflow or underflow discharge rates, they typically don't fully meet Minimum Requirement #7. However, their performance contributes to meeting the standard, and that can result in much smaller flow control facilities at the bottom of the project site. When used in combination with other low impact development techniques, they can also help achieve compliance with the Performance Standard option of Minimum Requirement #5.

Bioretention facilities constructed with imported compost materials must not be used within one-quarter mile of phosphorus-sensitive waterbodies if the underlying native soil does not meet the criteria for treatment described in Section 3.2.2.1. Bioretention also must not be used with an underdrain when the underdrain water would be routed to a phosphorus-sensitive receiving water. In Clark County, the Lacamas watershed above the dam at the south end of Round Lake is a phosphorus-sensitive water body.

2.5.4.3 Infeasibility Criteria for Rain Garden and Bioretention BMPs

Meeting any one of the following criteria make the Bioretention and Rain Garden BMPs not required to meet Minimum Requirement #5 on the site. Citation of any of the below infeasibility criteria must be based on an evaluation of site-specific conditions and must be documented in the Preliminary and Final TIR (Section 1.8.1.5 and Section 1.8.2.3) on the LID Feasibility Checklist, along with any applicable written recommendations from a qualified professional. See Appendix 1-E for the LID Feasibility Checklist.

It is important to note that even though a LID BMP is infeasible to meet the LID requirement, it may still be designed and used to meet the runoff treatment and/or flow control requirement, if applicable.

Bioretention and Rain Gardens are considered infeasible under the following conditions:

- Where the Responsible Official has determined that the BMP is not compatible with surrounding drainage systems (e.g. projects draining to existing stormwater collection system whose elevation or locale precludes connection to a properly functioning bioretention system).
- Where the land for the BMP is within an area designated as an erosion hazard or landslide hazard by the geotechnical report or county critical areas mapping.
- Where the site cannot reasonably be designed to locate the BMP on slopes less than 8%.
- On properties with known soil or groundwater contamination (typically federal Superfund sites or state cleanup sites under the Model Toxics Control Act (MTCA)) and any of the following criteria:
    - The proposed BMP is within 100 feet of an area known to have deep soil contamination. [Note: this criterion is also found in Setbacks.]
    - The site is in an area where groundwater modeling indicates infiltration will likely increase or change the direction of the migration of pollutants in groundwater.
    - The proposed BMP is located in an area where surface soils have been found to be contaminated, and contaminated soils are still in place within 10 horizontal feet of the infiltration area.
    - The BMP would be within any area where it would be prohibited by an approved cleanup plan under the state Model Toxics Control Act or Federal Superfund Law, or an environmental covenant under Chapter 64.70 RCW.
- For a bioretention system or a rain garden that would serve a drainage area that is 1) less than 5,000 sq. ft. of pollution-generating impervious surface, and 2) less than 10,000 sq. ft. of impervious surface; and 3) less than ¾ acres of pervious surface, where the minimum vertical separation of one foot to seasonal high water table, bedrock or other impervious layer cannot be achieved below the facility.

- For a bioretention system that would 1) serve a drainage area that is a) 5,000 sq. ft. or more of pollution-generating impervious surface, or b) 10,000 sq. ft. or more of impervious surface; or c) ¾ acres or more of pervious surface; and 2) cannot reasonably be broken down into amounts smaller than indicated in (1), where the minimum vertical separation of three feet to seasonal high water table, bedrock or other impervious layer cannot be achieved below the facility.
- Where field testing indicates that soils have a measured (a.k.a. initial) native soil coefficient of permeability less than 0.3 inches per hour. [Note: an LID infiltration BMP may still be feasible with the use of an underdrain to help meet Minimum Requirements #6 or #7, depending on soil and filtration media characteristics.]
- Where the site cannot reasonably be designed to avoid placing bioretention or rain garden within setbacks given in Section 2.5.4.4.
- Where a professional evaluation demonstrates that any condition below is met:
    - Where a professional geotechnical evaluation recommend infiltration not be used due to reasonable concerns about erosion, slope failure or down gradient flooding.
    - Where the site has groundwater that drains into an erosion hazard or landslide hazard area.
    - Where the only area available for siting the BMP threaten the safety or reliability of pre-existing underground utilities, pre-existing underground storage tanks, pre-existing structures and basements, or pre-existing road or parking lot surfaces.
    - Where infiltrating water would threaten existing below grade basements.
    - Where infiltrating water would threaten shoreline structures such as bulkheads.
    - Where the only area available for siting the BMP is one that does not allow for a safe overflow pathway to the municipal separate storm sewer system or to a private storm sewer system.
    - Where there is a lack of usable space for rain garden/bioretention facilities at redevelopment sites, or where there is insufficient space within the existing ~~public~~ Clark County right-of-way on ~~public~~ Clark County road projects.

2.5.4.4 Setbacks

The following setbacks shall be used for bioretention systems and rain gardens:

- 50 feet from the top of slopes greater than 20% or with more than 10 feet of vertical relief.
- 100 feet from a landfill (active or closed).
- 100 feet from a drinking water well or a spring used for drinking water.
- 10 feet from any small on-site sewage disposal drain field, including reserve areas, and grey water reuse systems. For setbacks from a "large on-site sewage disposal system," see Chapter 246-272B WAC.

- From an underground storage tank and its connecting pipes that is used to store petroleum products, chemicals, or liquid hazardous waste in which 10% or more of the storage volume of the tank and connecting pipes is beneath the ground:
    - 10 feet when the system capacity is 1100 gallons or less.
    - 100 feet when the system capacity is greater than 1100 gallons.
- 100 feet from an area with known deep soil contamination.
- For a bioretention system or raingarden that would serve a drainage area that is less than 5,000 sq. ft. of pollution-generating impervious surface and less than 10,000 sq. ft. of impervious surface, 10 feet from any structure or property lines.
- For a bioretention system that would serve a drainage area that is 5,000 sq. feet or more of pollution-generating impervious surface or 10,000 sq. ft. or more of impervious surface or ¾ acres or more of pervious surfaces, 20 feet from the downslope side of any foundation, structure, or property line and 100 feet from the upslope side of any foundation. These setbacks may be increased or decreased based on engineering analysis that shows the performance of a building's foundation system will not be adversely affected by the presence of the bioretention facility.

2.5.5 Permeable Pavement BMP T5.15

2.5.5.1 Purpose and Description

Permeable paving surfaces are an important integrated management practice within the LID approach and can be designed to accommodate pedestrian, bicycle and auto traffic while allowing infiltration, treatment and storage of stormwater. The general categories of permeable paving systems include:

- **Porous hot or warm-mix asphalt pavement** is a flexible pavement similar to standard asphalt that uses a bituminous binder to adhere aggregate together. However, the fine material (sand and finer) is reduced or eliminated and, as a result, voids form between the aggregate in the pavement surface and allow water to infiltrate.
- **Permeable Portland cement concrete** is a rigid pavement similar to conventional concrete that uses a cementitious material to bind aggregate together. However, the fine aggregate (sand) component is reduced or eliminated in the gradation and, as a result, voids form between the aggregate in the pavement surface and allow water to infiltrate.
- **Permeable interlocking concrete pavements (PICP) and aggregate pavers.** PICPs are solid, precast, manufactured modular units. The solid pavers are (impervious) high-strength Portland cement concrete manufactured with specialized production equipment. Pavements constructed with these units create joints that are filled with permeable aggregates and installed on an open-graded aggregate bedding course. Aggregate pavers (sometime called pervious pavers) are a different class of pavers from PICP. These include modular precast paving units made with similar sized aggregates bound together with Portland cement concrete with high-

strength epoxy or other adhesives. Like PICP, the joints or openings in the units are filled with open-graded aggregate and placed on an open-graded aggregate bedding course. Aggregate pavers are intended for pedestrian use only.

2.5.5.2 Applications and Limitations

Permeable pavements are appropriate in many applications where traditionally impermeable pavements have been used. Typical applications for permeable paving include parking lots, sidewalks, pedestrian and bike trails, driveways, residential access roads, and emergency and facility maintenance roads.

Limitations to the use of pervious pavement include:

- Run-on from pervious surfaces is not allowed, except from minor or incidental pervious areas that cannot be directed elsewhere. Those areas must be fully stabilized before discharging runoff to the pervious pavement.
- Unless the pavement, base course, and subgrade have been designed to accept runoff from adjacent impervious surfaces, slope impervious runoff away from the permeable pavement to the maximum extent practicable. Sheet flow from up-gradient impervious areas is not recommended, but permissible if the porous surface flow path is greater than the impervious surface flow path.

2.5.5.3 Infeasibility Criteria

Meeting any one of the following criteria make Permeable Pavement not required to meet Minimum Requirement #5 on the site. Citation of any of the below infeasibility criteria must be based on an evaluation of site-specific conditions and must be documented in the Preliminary and Final TIR (Section 1.8.1.5 and Section 1.8.2.3) on the LID Feasibility Checklist, along with any applicable written recommendations from a qualified professional. See Appendix 1-E for the LID Feasibility Checklist.

It is important to note that even though an LID BMP is infeasible to meet the LID requirement, it may still be designed and used to meet the runoff treatment and/or flow control requirement, if applicable.

Permeable pavements are considered infeasible under the following conditions:

- Roadways and parking areas where projected average daily traffic volumes are greater than 400 vehicles.
- Where the roadway will be subject to through truck traffic, not including such traffic as weekly garbage and recycling pick-up, daily school bus use, or frequent use by mail/parcel delivery trucks and maintenance vehicles.
- At multi-level parking garages, and over culverts and bridges.
- Where the site design cannot avoid putting pavement in areas likely to have long-term excessive

sediment deposition after construction (e.g., construction and landscaping material yards).

- Within an area designated as an erosion hazard or landslide hazard.
- On properties with known soil or groundwater contamination (typically federal Superfund sites or state cleanup sites under the Model Toxics Control Act (MTCA)) and any of the following criteria:
    - The proposed BMP is within 100 feet of an area known to have deep soil contamination. [Note: this criterion is also a Setback.]
    - The site is in an area where groundwater modeling indicates infiltration will likely increase or change the direction of the migration of pollutants in groundwater.
    - The proposed BMP is located in an area where surface soils have been found to be contaminated, and contaminated soils are still in place within 10 horizontal feet of the infiltration area.
    - The BMP would be within any area where it would be prohibited by an approved cleanup plan under the state Model Toxics Control Act or Federal Superfund Law, or an environmental covenant under Chapter 64.70 RCW.
- Where the site cannot be designed to have a porous asphalt surface at less than 5% slope, or a permeable concrete surface at less than 10% slope, or a permeable interlocking concrete pavement surface (where appropriate) at less than 12% slope. Grid systems upper slope limit can range from 6 to 12%; check with manufacturer and local supplier.
- Where the native soils below a pollution-generating permeable pavement (e.g., road or parking lot) do not meet the soil suitability criteria for providing treatment (See Book 2, Section 3.1.5.3).
- Where seasonal high groundwater or an underlying impermeable/low permeable layer would create saturated conditions within one foot of the bottom of the lowest gravel base course.
- Where underlying soils are unsuitable for supporting traffic loads when saturated. Soils meeting a California Bearing Ratio of 5% are considered suitable for residential access roads.
- Where measured coefficient of permeability is less than 0.3 inches per hour. In these instances, unless other infeasibility restrictions apply, roads and parking lots may be built with an underdrain, preferably elevated within the base course, if flow control benefits are desired.
- Where replacing existing impervious surfaces, unless the existing surface is a non-pollution generating surface over a soil with a coefficient of permeability of four inches per hour or greater.
- At sites defined as "high-use sites" as defined in Appendix 1-A.
- In areas with "industrial activity" as identified in 40 CFR 122.26(b)(14).
- Where the risk of concentrated pollutant spills is more likely such as gas stations, truck stops, and industrial chemical storage sites.
- Where routine, heavy applications of sand occur in frequent snow zones to maintain traction

during weeks of snow and ice accumulation. Most lowland western Washington areas do not fit this criterion.

- Where the surface(s) to be paved are within setbacks given in Section 2.5.5.4.
- Where a professional evaluation demonstrates any condition listed below is met:
    - Where professional geotechnical evaluation recommends infiltration not be used due to reasonable concerns about erosion, slope failure, or down gradient flooding.
    - Where the site has groundwater that drains into an erosion hazard or landslide hazard area.
    - Where infiltrating and ponded water below new permeable pavement area would compromise adjacent impervious pavements.
    - Where infiltrating water below a new permeable pavement area would threaten existing below grade basements.
    - Where infiltrating water would threaten shoreline structures such as bulkheads.
    - Downslope of steep, erosion prone areas that are likely to deliver sediment.
    - Where fill soils are used that can become unstable when saturated.
    - Where there are excessively steep slopes and water within the aggregate base layer or at the sub-grade surface cannot be controlled by detention structures and may cause erosion and structural failure, or where surface runoff velocities may preclude adequate infiltration at the pavement surface.
    - Where permeable pavements cannot provide sufficient strength to support heavy loads (such as at ports).
    - Where installation of permeable pavement would threaten the safety or reliability of pre-existing underground utilities, pre-existing underground storage tanks, or pre-existing road sub-grades.

The following soil suitability criteria apply to permeable pavement used to meet Minimum Requirement #6. Sites not meeting these criteria are not feasible for permeable pavements for pollution-generating hard surfaces (e.g. roads, driveways, and parking lots):

- One foot depth of soil with any of the following characteristics:
    - Cation Exchange Capacity ≥ 5 milliequivalents CEC/100 g dry soil (USEPA Method 9091)
    - Organic Content > 1%
    - Measured coefficient of permeability < 9 in./hr.

2.5.5.4 Setbacks

The following setbacks are required for permeable pavements:

- 50 feet from the top of slopes greater than 20% with more than 10 feet of vertical relief.
- 100 feet from a landfill (active or closed).
- 100 feet from a drinking water well or a spring used for drinking water, if the pavement is a pollution-generating surface.
- 10 feet from on-site sewage drainage.
- 10 feet from an underground storage tank and its connecting pipes that is used to store petroleum products, chemicals, or liquid hazardous waste in which 10% or more of the storage volume of the tank and connecting pipes is beneath the ground.
- 100 feet from an area with known deep soil contamination.

2.5.6 Soil and Vegetation Protection and Enhancement BMPs

2.5.6.1 Purpose and Description

Mature native vegetation and soils are necessary to maintain watershed hydrology, stable stream channels, wetland hydro-periods, and healthy aquatic systems (Booth et al., 2002). They are also the most cost-effective and efficient tools for reducing quantity of stormwater produced and for stormwater quality.

Soil and Vegetation Protection and Enhancement BMPs include:

- BMP T5.16 Tree Retention and Tree Planting (Book 2, Chapter 2)
- BMP T5.19 Minimal Excavation Foundation (Book 2, Chapter 2)
- BMP T5.40 Preserving Native Vegetation (Book 2, Chapter 2)
- BMP T5.41 Better Site Design (Book 2, Chapter 2)

Design guidance for these BMPs may also be found in the *Low Impact Technical Guidance Manual for Puget Sound.*

2.5.7 LID Runoff Harvest and Use BMPs

LID Runoff Harvest and Use BMPs detain runoff for use in another application. BMPs include:

- BMP T5.17 Vegetated Roof (Book 2, Chapter 2)
- BMP T5.20 Rainwater Harvesting (Book 2, Chapter 2)

Design guidance for these BMPs may also be found in the *Low Impact Technical Guidance Manual for Puget Sound.*

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Chapter 3 Stormwater Runoff Treatment

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3.1 Introduction

3.1.1 Purpose

Urbanization and land development can cause an increase in the types and quantities of pollutants in surface and groundwaters. Runoff from roads and highways can be contaminated with pollutants from vehicles. Oil and grease, polynuclear aromatic hydrocarbons (PAH's), lead, zinc, copper, cadmium, as well as sediments (soil particles) and road salts are typical pollutants in road runoff. Runoff from industrial areas typically contains even more types of heavy metals, sediments, and a broad range of man-made organic pollutants, including phthalates, PAH's, and other petroleum hydrocarbons. Residential areas contribute the same road-based pollutants to runoff, as well as herbicides, pesticides, nutrients (from fertilizers), bacteria and viruses (from animal waste). All of these contaminants can seriously impair beneficial uses of receiving waters.

Minimum Requirement #6 requires the installation of runoff treatment BMPs for land disturbing activities passing thresholds. See Section 1.5.6 for the thresholds that trigger this Minimum Requirement.

3.1.2 How to Use this Chapter

Consult this chapter to select and design specific runoff treatment BMPs for permanent use development and redevelopment sites. Consult Book 2, Chapters 3 and 4 for the detailed design of each treatment BMP.

- Section 3.1 serves as an introduction and summarizes available options for treatment of stormwater.
- Section 3.2 outlines a step-by-step process for selecting treatment facilities for new development and redevelopment projects.
- Section 3.3 discusses selection criteria for pretreatment BMPs.
- Section 3.4 discusses selection criteria for runoff treatment BMPs.

3.2 Treatment BMP Selection Process

This section describes a step-by-step process for selecting the type of treatment facilities to be applied on an individual project and gives four menus of best management practices (BMPs) for different types of treatment: oil control treatment, phosphorus treatment, enhanced treatment, and basic treatment.

3.2.1 Step-by-Step Process for Selecting Treatment Facilities

Use this six-step process to determine the type of treatment facilities applicable to the project. Please refer to Figure 3.1.

Briefly, the steps are:

1. Identify the pollutants of concern based on the proposed land use and determine the receiving waters based on off-site analysis
2. Determine if an Oil Control Facility/Device is Required
3. Determine if Infiltration for Pollutant Removal is Practicable
4. Determine if Phosphorous Control is Required
5. Determine if Enhanced Treatment is Required
6. Select a Basic Treatment Facility

After selecting any BMP in the Step-by-Step Process, refer to the selection criteria in Book 2, Section 3.1, which may affect the design and placement of the facility.

Step 1: Pollutants of Concern/Land Use/Receiving Waters

To obtain a more complete determination of the potential impacts of a stormwater discharge, complete the Off-site Analysis described in Chapter 5. Clark County will verify the identification of the receiving water from the Off-site Analysis. If the discharge is to the local municipal storm drainage system, determine the receiving water for the drainage system.

List the proposed land use(s) of the project.

Proceed to Step 2.

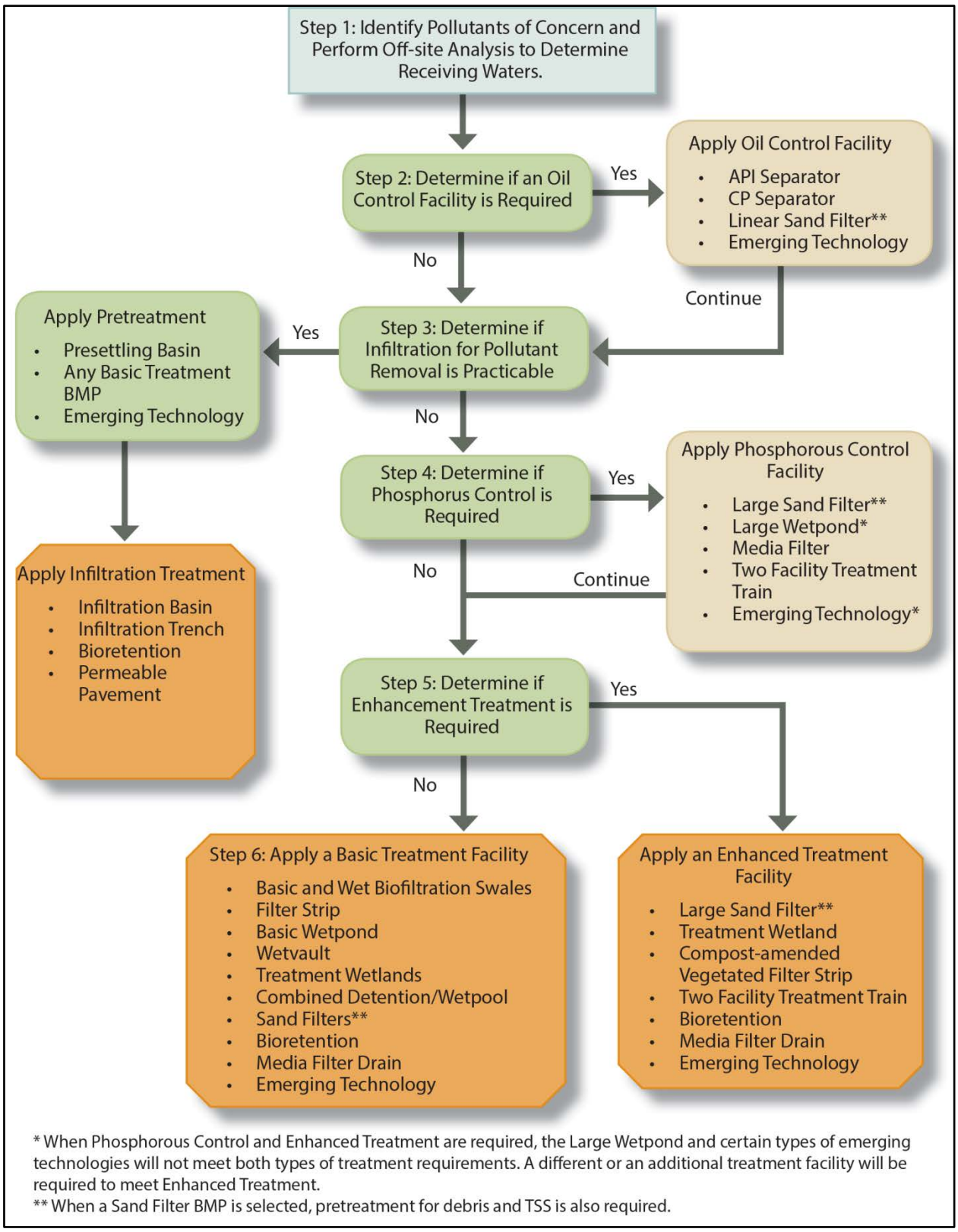

Figure 3.1: Treatment Facility Selection Flow Chart

Step 2: Determine if an Oil Control Facility/Device is Required

The use of oil control devices and facilities is dependent upon the specific land use proposed for development.

Where Applied

The Oil Control Menu applies to projects that have "high-use sites." High-use sites are those that typically generate high concentrations of oil due to high traffic turnover or the frequent transfer of oil. Select an oil control facility/device for sites meeting any the following conditions:

- An area of a commercial or industrial site subject to an expected average daily traffic (ADT) count equal to or greater than 100 vehicles per 1,000 square feet of gross building area.

Note: Gasoline stations, with or without small food stores, will likely exceed the high-use site threshold.

- An area of a commercial or industrial site subject to petroleum storage and transfer in excess of 1,500 gallons per year, not including routinely delivered heating oil. Some examples are discussed below.

Note: The petroleum storage and transfer criterion is intended to address regular transfer operations such as gasoline service stations, not occasional filling of heating oil tanks.

- An area of a commercial or industrial site subject to parking, storage or maintenance of 25 or more vehicles that are over 10 tons gross weight (trucks, buses, trains, heavy equipment, etc.). Some examples are discussed below.

Note: In general, all-day parking areas are not intended to be defined as high-use sites, and should not require an oil control facility.

- A road intersection with a measured ADT count of 25,000 vehicles or more on the main roadway and 15,000 vehicles or more on any intersecting roadway, excluding projects proposing primarily pedestrian or bicycle use improvements.

Note: The traffic count can be estimated from a traffic study prepared by a professional engineer or transportation specialist with experience in traffic estimation or using information from "Trip Generation," published by the Institute of Transportation Engineers (http://www.ite.org).

- The following land uses may have areas that fall within the definition of "high-use sites" and require oil control treatment. Further, these sites require special attention to the oil control treatment selected. Refer to Section 3.2.3.1 and 3.4.1 for more details.
    - Industrial machinery and equipment, and railroad equipment maintenance areas
    - Log storage and sorting yards
    - Aircraft maintenance areas

- Railroad yards
- Fueling stations
- Vehicle maintenance and repair sites
- Construction businesses (paving, heavy equipment storage and maintenance, storage of petroleum products)

Note: Some land use types require the use of a spill control (SC-type) oil/water separator. Those situations are described in Book 3, *Source Control*, and are separate from this treatment requirement.

Some of these sites will also be subject to the Washington Department of Ecology Industrial Stormwater Permit and should ensure that requirements of that permit are met.

For high-use sites located within a larger commercial center, only the impervious surface associated with the high-use portion of the site is subject to oil-control treatment requirements. If common parking for multiple businesses is provided, oil treatment shall be applied to the number of parking stalls required for the high-use business only. However, if the oil treatment collection area also receives runoff from other areas, the treatment facility must be sized to treat all water passing through it.

High-use roadway intersections shall treat lanes where vehicles accumulate during the signal cycle, including left and right turn lanes and through lanes, from the beginning of the left turn pocket. If no left turn pocket exists, the treatable area shall begin at a distance equal to three car lengths from the stop line. If runoff from the intersection drains to more than two collection areas that do not combine within the intersection, treatment may be limited to any two of the collection areas.

If an Oil Control Facility is required, select an appropriate Oil Control Facility from the Oil Control Menu in Section 3.2.3.1. After selecting an Oil Control Facility, proceed to Step 3.

If an Oil Control Facility is not required, proceed directly to Step 3.

Step 3: Determine if Infiltration for Pollutant Removal is Practicable

Infiltration can be effective at treating stormwater runoff, but soil properties must be appropriate to achieve effective treatment. This effectiveness is discussed in Section 3.2.2.1, Soil Type.

A proposed infiltration facility must also be checked to ensure that it does not adversely impact groundwater resources.

Unstable slopes can preclude the use of infiltration.

Infiltration treatment facilities must be preceded by a pretreatment facility, such as a presettling basin or vault, to reduce the occurrence of plugging. Any of the basic treatment facilities, and detention ponds designed to meet flow control requirements, can be used for pretreatment. If an

oil/water separator is necessary for oil control, it can function as the presettling basin as long as the influent suspended solids concentrations are not high.

Infiltration through soils that do not meet the criteria for treatment in Section 3.2.2.1 is allowable as a flow control BMP following a treatment facility. Note that if infiltration for flow control occurs within ¼ mile of a phosphorus sensitive receiving water, phosphorus treatment is required. If infiltration for flow control occurs within ¼ mile of a fresh water body designated for aquatic life use or has an aquatic life use, then enhanced treatment is required for the land-use types described in Step 5 below.

If infiltration treatment is practicable, select a pretreatment facility from the Pretreatment Menu and an infiltration treatment facility from the Infiltration Menu. Then stop here.

If infiltration treatment is not practicable, proceed directly to Step 4.

Step 4: Determine if Control of Phosphorous is Required

In Clark County, phosphorus treatment shall be provided in the Lacamas watershed above the dam at the south end of Round Lake for all project sites meeting the thresholds triggering Minimum Requirement #6. This requirement applies to stormwater conveyed to the lake by surface flow as well as to stormwater infiltrated within one-quarter mile of the lake in soils that do not meet the suitability for treatment.

If phosphorus control is required, select and apply a phosphorus treatment facility from the Phosphorus Treatment Menu in Section 3.2.3.4. Select an option from the menu after reviewing the applicability and limitations, site suitability, and design criteria of each for compatibility with the site.

Note: Project sites subject to the Phosphorus Treatment requirement could also be subject to the Enhanced Treatment requirement (see Step 5). In that event, apply a facility or a treatment train that is listed in both the Enhanced Treatment Menu and the Phosphorus Treatment Menu.

If phosphorus treatment is required for the site, provisionally select a Phosphorous Treatment Facility, then proceed to Step 5.

If phosphorus treatment is not required for the site, proceed directly to Step 5.

Step 5: Determine if Enhanced Treatment is Required

Except where specified under Step 6, enhanced treatment to reduce dissolved metals is required for the following project sites that 1) discharge directly to fresh waters or conveyance systems tributary to fresh waters designated for aquatic life use or that have an existing aquatic life use; or 2) use infiltration strictly for flow control – not treatment – and the discharge is within ¼ mile of a fresh water designated for aquatic life use or that has an existing aquatic life use:

- Industrial project sites
- Commercial project sites
- Multi-family residential project sites
- High AADT roads as follows:
    - Within Urban Growth Management Areas:
        - Fully controlled and partially controlled limited access highways with Annual Average Daily Traffic (AADT) counts of 15,000 or more
        - All other roads with an AADT of 7,500 or greater
    - Outside of Urban Growth Management Areas:
        - Roads with an AADT of 15,000 or greater unless discharging to a 4th Strahler order stream or larger;
        - Roads with an AADT of 30,000 or greater if discharging to a 4th Strahler order stream or larger (as determined using 1:24,000 scale maps to delineate stream order).

Areas of the above-listed project sites that are identified as subject to Basic Treatment requirements (see Step 6) are not also subject to Enhanced Treatment requirements. For developments with a mix of land use types, the Enhanced Treatment requirement shall apply when the runoff from the areas subject to the Enhanced Treatment requirement comprises 50% or more of the total runoff within a threshold discharge area.

If the project must apply Enhanced Treatment, select and apply an appropriate Enhanced Treatment facility. Please refer to the Enhanced Treatment Menu in Section 3.2.3.5. Select an option from the menu after reviewing the applicability and limitations, site suitability, and design criteria of each for compatibility with the site.

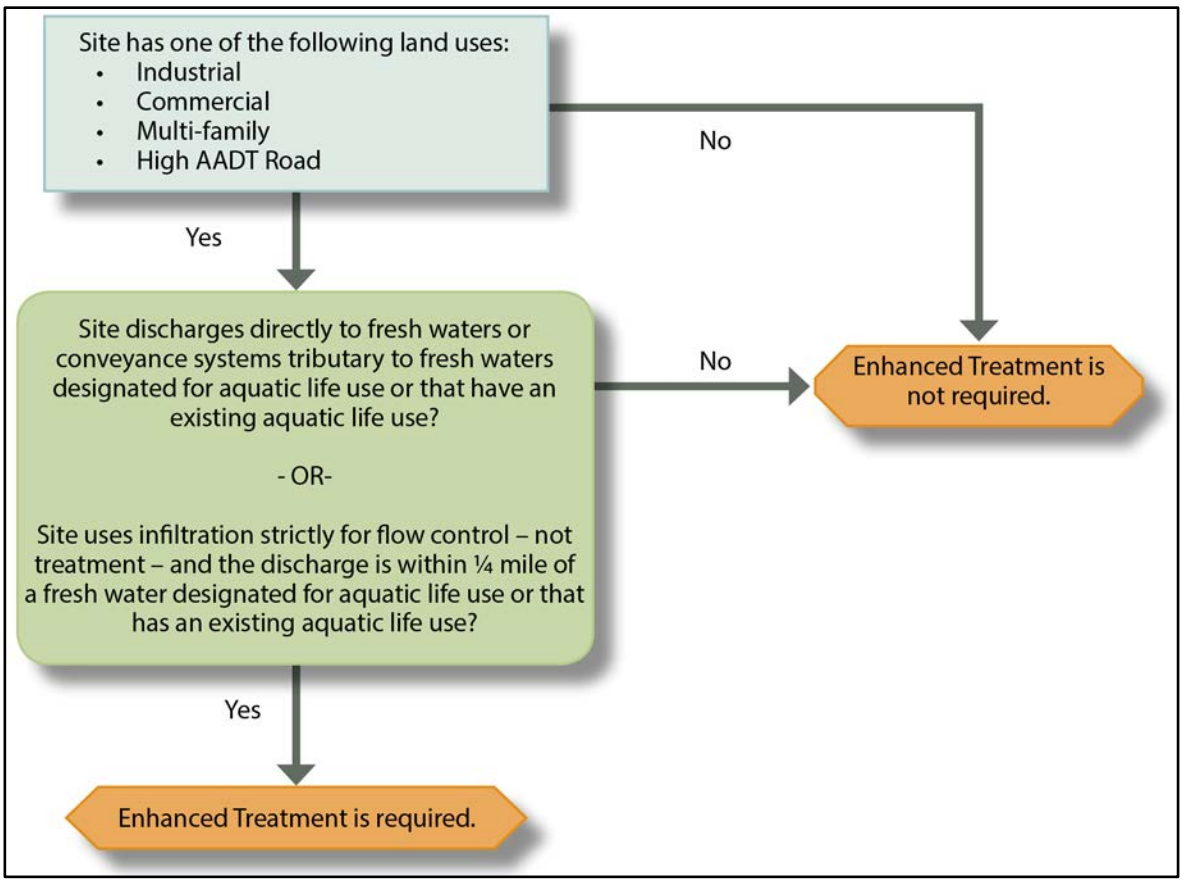

Figure 3.2: Enhanced Treatment Flow Chart

If Enhanced Treatment applies, and Phosphorous Treatment also applies (see Step 4), then select a facility or treatment train that is listed in both the Enhanced Menu and the Phosphorous Treatment menu, then stop here.

If Enhanced Treatment applies, select an appropriate Enhanced Treatment Facility, then stop here.

If Enhanced Treatment does not apply to the site, please proceed to Step 6.

Step 6: Select a Basic Treatment Facility

The Basic Treatment Menu is required in the following circumstances:

- Project sites that discharge to the ground, UNLESS:
    - The criteria for infiltration treatment are met and pretreatment is provided; OR
    - The project uses infiltration strictly for flow control – not treatment – and:
        - the discharge is within ¼-mile of a phosphorus sensitive lake (use the Phosphorus Treatment Menu), or

  - The land-use type is as is described in Step 5 and is within ¼ mile of a fresh water designated for aquatic life use or that has an existing aquatic life use (use the Enhanced Treatment Menu).

- Single Family Residential projects not otherwise needing phosphorus control in Step 4;
- Project sites discharging directly (or indirectly through a municipal separate storm sewer system) to identified Basic Treatment Receiving Waters. Basic Treatment Receiving Waters in Clark County are:
  - Columbia River
  - Lewis River
  - Washougal River
- Project sites that drain to fresh waters, or to waters tributary to fresh waters, that are not designated for aquatic life use or that do not have an existing aquatic life use;
- Landscaped areas of industrial, commercial, and multi-family project sites, and parking lots of industrial and commercial project sites, dedicated solely to parking of employees' private vehicles, which do not involve any other pollution-generating sources (e.g., industrial activities, customer parking, and storage of erodible or leachable material, wastes or chemicals).

For developments with a mix of land use types, the Basic Treatment requirement shall apply when the runoff from the areas subject to the Basic Treatment requirement comprises 50% or more of the total runoff within a threshold discharge area.

Please refer to the Basic Treatment Menu in Section 3.2.3.6. Select an option from the menu after reviewing the applicability and limitations, site suitability, and design criteria of each for compatibility with the site.

The treatment facility selection process is complete.

3.2.2 Other Treatment Facility Selection Factors

The selection of the most effective treatment facility should consider site physical factors and pollutants of concern. The types of site physical factors that influence facility selection are summarized below.

3.2.2.1 Soil Type

See Table 3.1 and the following for information on soil types suitable for use as treatment. The permeability of the soil underlying a treatment facility has a profound influence on its effectiveness. Facilities situated on soils with high infiltration rates will need a synthetic liner or the soils amended to reduce the infiltration rate and provide treatment. Maintaining a permanent pool in the first cell is necessary to avoid resuspension of settled solids. Biofiltration swales in coarse soils can also be amended to reduce the infiltration rate.

Consider the soil texture and design infiltration rates along with the physical and chemical characteristics specified below to determine if the soil is adequate for removing the target pollutants. The following criteria must be met to use the soil for treatment:

- Treatment soil must have a minimum 0.5 inches per hour design coefficient of permeability.
- Treatment soil must have a maximum measured infiltration rate of 9 inches per hour. Design (long-term) infiltration rates up to 3 inches per hour can also be considered, if in the judgement of the qualified professional, the treatment soil meets the characteristics of this section.
- Cation exchange capacity (CEC) of the treatment soil must be ≥5 milliequivalents CEC/100 g dry soil (USEPA Method 9081). *Consider empirical testing of soil sorption capacity, if practicable.* Ensure that soil CEC is sufficient for expected pollutant loadings, particularly heavy metals. CEC values of >5 meq/100g are expected in loamy sands, according to Rawls, et al.
- Depth of soil used for infiltration treatment must be a minimum of 18 inches. Depth of soil below permeable pavements serving as pollution-generating hard surfaces may be reduced to one foot if the permeable pavement does not accept run-on from other surfaces.
- Organic Content of the treatment soil (ASTM D 2974): Organic matter can increase the sorptive capacity of the soil for some pollutants. A minimum of 1.0 percent organic content is necessary.
- Waste fill materials shall not be used as infiltration soil media nor shall infiltration soil media be placed over uncontrolled or non-engineered fill soils.
- For engineered soils or for soils with very low permeability, the potential to bypass the treatment soil through the side-walls may be significant. In those cases, line the side-walls with at least 18 inches of treatment soil to prevent seepage of untreated flows through the side walls.
- For soils that do not meet the requirements of this section, treatment liners may be used. See Book 2, Section 3.1.6 for more information on treatment liners.

Note: Soil maps show topsoils and may not reflect material found several feet below ground surface. In Clark County it is common for sandy soils to be found under lower permeability topsoil.

Table 3.1 Preliminary Screening of Treatment Facilities Based on Soil Type

Soil Type	Infiltration/ Bioretention	Wet Pond*	Biofiltration* (Swale or Filter Strip)
Coarse Sand or Cobbles	✕	✕	✕
Sand	✔	✕	✕
Loamy Sand	✔	✕	✔
Sandy Loam	✔	✕	✔
Loam	✕	✕	✔
Silt Loam	✕	✕	✔
Sandy Clay Loam	✕	✔	✔
Silty Clay Loam	✕	✔	✔
Sandy Clay	✕	✔	✔
Silty Clay	✕	✔	✕
Clay	✕	✔	✕

Notes:

✔ Indicates that use of the technology is generally appropriate for this soil type.

✕ Indicates that use of the technology is generally not appropriate for this soil type

* Coarser soils may be used for these facilities if a liner is installed to prevent infiltration, or if the soils are amended to reduce the infiltration rate.

Note: Sand filtration is not listed because its feasibility is not dependent on soil type.

Bioretention using engineered media may also be used for treatment.

3.2.3 Treatment Facility Menus

This section identifies choices that comprise the treatment facility menus. The menus in this chapter are discussed in the order of the decision process shown in Figure 3.1 and are as follows:

- Oil Control Menu
- Pretreatment Menu
- Infiltration Menu
- Phosphorus Treatment Menu
- Enhanced Treatment Menu

- Basic Treatment Menu

Use the menus below as follows:

1. Follow the step-by-step selection process for treatment facilities in Section 3.2.1.
2. If the project requires oil control, choose one option in the Oil Control Menu.
3. If infiltration for treatment in practicable, choose one option from the Pretreatment Menu and one option from the Infiltration Menu.
4. Find the treatment menu that applies to the project – Phosphorous, Enhanced or Basic – and select one option from the appropriate menu.
    a. If no options appear to work well for the project site and pollutants of concern, consider selecting an emerging technology as discussed in Section 3.4.7.
5. Detailed facility designs for many possible options are given in Book 2, Chapter 4 of this manual.

3.2.3.1 Oil Control Menu

Note: Where this menu is applicable, it is in addition to facilities required by one of the other Treatment Menus.

Performance Goal

The facility choices in the Oil Control Menu are intended to achieve the goals of no ongoing or recurring visible sheen in the discharge or in the receiving water, and to have a 24-hour average Total Petroleum Hydrocarbon (TPH) concentration no greater than 10 mg/l, and a maximum of 15 mg/l for a discrete sample (grab sample).

Options

Oil control options include facilities that are small, treat runoff from a limited area, and require frequent maintenance. The options also include facilities that treat runoff from larger areas and generally have less frequent maintenance needs.

- API-Type Oil/Water Separator (BMP T11.10)
- Coalescing Plate Oil/Water Separator (BMP T11.11)
- Linear Sand Filter (BMP T8.30)
- Proprietary BMPs:
    - Filterra® System (BMP T12.20)
    - Filterra® Bioscape™ (BMP T12.20)

- Emerging Technology (see Section 3.4.7)

Note: The linear sand filter is used in the Basic, Enhanced, and Phosphorus Treatment menus also. If used to satisfy one of those treatment requirements, the same facility cannot also be used to satisfy the oil control requirement.

3.2.3.2 Pretreatment Menu

Options

Any one of the following options may be chosen to satisfy the pretreatment requirement.

- Presettling Basin (BMP T6.10)
- Any Basic Treatment BMP (see Basic Treatment Menu, below)
- Emerging Technology (see Section 3.4.7)

3.2.3.3 Infiltration Treatment Menu

Options

Any one of the following options may be chosen if infiltration for treatment can meet the applicable criteria of this manual and the site soils meet minimum soil criteria for treatment in accordance with Section 3.2.2.1, Soil Type.

- Infiltration Basin (also see Book 2, Chapter 5)
- Infiltration Trench (also see Book 2, Chapter 5)
- Bioretention (BMP T5.14B) (also see Book 2, Chapter 2)
- Permeable Pavement (BMP T5.15) (also see Book 2, Chapter 2)

3.2.3.4 Phosphorus Treatment Menu

Performance Goal

The Phosphorus Menu facility choices are intended to achieve a goal of 50% total phosphorus removal for a range of influent concentrations of 0.1 – 0.5 mg/l total phosphorus. In addition, the choices are intended to achieve the Basic Treatment performance goal. The performance goal applies to the water quality design storm volume or flow rate, whichever is applicable.

Options

Any one of the following options may be chosen to satisfy the phosphorus treatment requirement.

- Large Sand Filter (BMP T8.11)
- Large Wetpond (BMP T10.10)

Note: If a Large Wetpond is used to satisfy the phosphorus treatment requirements, the same facility cannot be used to meet the enhanced treatment requirement too.

- Proprietary BMPs:
    - Filterra® System (BMP T12.20)
    - Filterra® Bioscape™ (BMP T12.20)
    - FloGard Perk Filter® (BMP T12.11)
    - Stormfilter using Phosphosorb media® (BMP T12.10)
- Two-Facility Treatment Train (see Table 3.2)
- Infiltration (Chapter 4) with appropriate pretreatment

  If infiltration is through soils meeting treatment requirements, then a presettling basin or a basic treatment facility can serve for pretreatment.
- Infiltration preceded by Basic Treatment

  If infiltration is through soils that do not meet treatment requirements, treatment must be provided by a basic treatment facility unless the soil and site fit the description in the next option below.
- Infiltration preceded by Phosphorus Treatment

  If the soils do not meet treatment requirements and the infiltration site is within ¼ mile of a phosphorus-sensitive receiving water, or a tributary to that water, treatment must be provided by a treatment facility option listed here:
    - Large Sand Filter (BMP T8.11)
    - Large Wetpond (BMP T10.10)
    - Two-Facility Treatment Train
    - Proprietary BMPs:
        - Filterra® System (BMP T12.20)
        - Filterra® Bioscape™ (BMP T12.20)
        - FloGard Perk Filter® (BMP T12.11)
- Emerging Technology (see Section 3.4.7)

Table 3.2 Treatment Trains for Phosphorous Removal

First Basic Treatment Facility	Second Treatment Facility
Biofiltration Swale	Basic Sand Filter or Sand Filter Vault
Filter Strip	Linear Sand Filter (no presettling needed)
Linear Sand Filter	Filter Strip
Basic Wetpond	Basic Sand Filter or Sand Filter Vault
Wetvault	Basic Sand Filter or Sand Filter Vault
Stormwater Treatment Wetland	Basic Sand Filter or Sand Filter Vault
Basic Combined Detention and Wetpool	Basic Sand Filter or Sand Filter Vault

3.2.3.5 Enhanced Treatment Menu

Performance Goal

The Enhanced Menu facility choices are intended to provide a higher rate of removal of dissolved metals than Basic Treatment facilities (greater than 30% dissolved copper removal, and greater than 60% dissolved zinc removal). In addition, the menu choices are intended to achieve the Basic Treatment performance goal. The performance goal assumes that the facility is treating stormwater with dissolved Copper typically ranging from 0.005 to 0.02 mg/l, and dissolved Zinc ranging from 0.02 to 0.3 mg/l.

The performance goal applies to the water quality design storm volume or flow rate, whichever is applicable.

Options

Any one of the following options may be chosen to satisfy the enhanced treatment requirement:

- Large Sand Filter (BMP T8.11)
- Stormwater Treatment Wetland (BMP T10.30)
- Compost-amended Vegetated Filter Strip (CAVFS) (BMP T7.40)
- Two Facility Treatment Trains (See Table 3.3)
- Bioretention, when 91% of the influent runoff infiltrates through the imported soil mix (BMP T5.14B)
- Media Filter Drain (MFD) (BMP T8.40)
- Proprietary BMPs:

- Filterra® System
- Filterra® Boxless™

- Infiltration (Chapter 4) with appropriate pretreatment
  - Infiltration Treatment - If infiltration is through soils meeting treatment requirements (see Section 3.2.2.1), a presettling basin or a basic treatment facility can serve for pretreatment.
  - Infiltration preceded by Basic Treatment - If infiltration is through soils that do not meet treatment requirements per Section 3.2.2.1, treatment must be provided by a basic treatment facility unless the soil and site fit the description in the next option below.
  - Infiltration preceded by Enhanced Treatment - If the soils do not meet treatment requirements per Section 3.2.2.1 and the infiltration site is within ¼ mile of a fresh water designated for aquatic life use or that has an existing aquatic life use, treatment must be provided by one of the other treatment facility options listed above.
- Emerging Technology (see Section 3.4.7)

Table 3.3 Treatment Trains for Dissolved Metals Removal

First Basic Treatment Facility	Second Treatment Facility
Biofiltration Swale	Basic Sand Filter or Sand Filter Vault or Media Filter(1)
Filter Strip	Linear Sand Filter with no presettling cell needed
Linear Sand Filter	Filter Strip
Basic Wetpond	Basic Sand Filter or Sand Filter Vault or Media Filter(1)
Wetvault	Basic Sand Filter or Sand Filter Vault or Media Filter(1)
Basic Combined Detention/Wetpool	Basic Sand Filter or Sand Filter Vault or Media Filter(1)
Basic Sand Filter or Sand Filter Vault with a presettling cell if the filter isn't preceded by a detention facility	Media Filter(1)

(1) The media must be a type approved for basic or enhanced treatment use by Ecology. See "Emerging Technologies" on page 141 for approved media filters.

3.2.3.6 Basic Treatment Menu

Performance Goal

The Basic Treatment Menu facility choices are intended to achieve 80% removal of total suspended solids for influent concentrations that are greater than 100 mg/l, but less than 200 mg/l. For influent concentrations greater than 200 mg/l, a higher treatment goal may be appropriate. For influent concentrations less than 100 mg/l, the facilities are intended to achieve an effluent goal of 20 mg/l total suspended solids.

The performance goal applies to the water quality design storm volume or flow rate, whichever is applicable. The performance goal assumes that the facility is treating stormwater with a typical particle size distribution (see stormwater monitoring protocol on the Department of Ecology website).

Options

Any one of the following options may be chosen to satisfy the basic treatment requirement:

- Infiltration Treatment
- Sand Filters (BMP T8.10; BMP T8.11; BMP T8.20; BMP T 8.30)
- Basic and Wet Biofiltration Swales (BMP T9.10 and BMPT9.20)
- Basic Filter Strip (BMP T9.40)
- Compost-amended Vegetated Filter Strip (CAVFS) (BMP T7.40)
- Basic Wetpond (BMP T10.10)
- Wetvault (BMP T10.20)

  A wetvault may be used for commercial, industrial, or road projects if there are space limitations. Clark County discourages the use of wetvaults for residential projects. Combined detention/wetvaults are allowed.
- Stormwater Treatment Wetland (BMP T10.30)
- Combined Detention and Wetpool Facilities (BMP B6.40)
- Bioretention (BMP T5.14B)

  Where bioretention is intended to fully meet treatment requirements for its drainage area, it must be designed, using an approved continuous flow model, to pass at least 91% of the influent runoff file through the imported soil mix.
- Media Filter Drain (MFD) (BMP T8.40)
- Proprietary BMPs:
    - Filterra® System (BMP T12.20)

- Filterra® Bioscape ™ (BMP T12.20)
- StormFilter® (using ZPG Media) (BMP T12.10)
- FloGard Perk Filter® (BMP T12.11)

- Emerging Technology (see Section 3.4.7)

Where media filters are used as the second BMP in a treatment train, consider whether the flow rate to the filter vault is high enough to ensure activation of the filters. Consult with the manufacturer for requirements.

3.3 Pretreatment BMPs

3.3.1 Purpose and Description

This section presents the methods that may be used to provide pretreatment prior to basic or enhanced runoff treatment facilities.

Presettling basins are a typical pretreatment BMP used to remove suspended solids. All of the basic runoff treatment facilities may also be used for pretreatment to reduce suspended solids.

A detention pond sized to meet the flow control standard in Chapter 1, Minimum Requirement #7, may be used to provide pretreatment for suspended solids removal.

3.3.2 Applications and Limitations

Pretreatment must be provided in the following applications.

- For sand filters and infiltration BMPs to protect them from excessive siltation and debris.

3.3.3 Best Management Practices (BMPs) for Pretreatment

This section has only one non-proprietary BMP for pretreatment. Note that pretreatment may also be provided by any Basic Treatment BMP, including Proprietary BMPs approved for Basic Treatment.

3.3.3.1 Purpose and Description

A Presettling Basin provides pretreatment of runoff in order to remove suspended solids, which can impact other runoff treatment BMPs.

3.3.3.2 Application, Limitations and Setbacks

- Runoff treated by a Presettling Basin may not be discharged directly to a receiving water; it must be further treated by a basic or enhanced runoff treatment BMP.

- All facilities shall be a minimum of 20 feet from any structure, property line, and any critical area buffer.
- All facilities shall be 100 feet from any septic tank/drainfield (except wet vaults shall be a minimum of 20 feet).
- All facilities shall be a minimum of 50 feet from any steep (greater than 15 percent) slope. A geotechnical report must address the potential impact of a wet pond on a steep slope.
- Embankments that impound water must comply with the Washington State Dam Safety Regulations (Chapter 173-175 WAC). If the impoundment has a storage capacity (including both water and sediment storage volumes) greater than 10 acre-feet (435,600 cubic feet or 3.26 million gallons) above natural ground level, then dam safety design and review are required by Ecology.

3.3.3.3 Pretreatment BMPs List

The following BMPs may be used for Pretreatment. See Book 2, Chapter 4 for specific design criteria.

- BMP T6.10: Presettling Basin
- Any Basic Treatment BMP (see Basic Treatment Menu, above)

3.4 Runoff Treatment BMPs

3.4.1 Oil and Water Separators

This section provides a discussion of oil and water separators, including their application and design criteria. BMPs are described for baffle type and coalescing plate separators.

3.4.1.1 Purpose and Description

Oil and water separators remove oil and other water-insoluble hydrocarbons as well as settleable solids from stormwater runoff.

See Book 2, Chapters 3 and 4 for specific design criteria for the two typical configurations of oil and water separators:

- BMP T11.10: The American Petroleum Institute (API) (also called baffle type) (American Petroleum Institute, 1990).
- BMP T11.11: The coalescing plate (CP) type using a gravity mechanism for separation.

Oil removal separators typically consist of three bays: forebay, separator section, and the afterbay. The CP separators need considerably less space for separation of the floating oil due to the shorter travel distances between parallel plates. A spill control manhole is a simple catch basin with a T-inlet for temporarily trapping small volumes of oil. The spill control manhole may be used for source

control (see Book 3) and is included here for comparison only; it is not designed for, or to be used for, treatment purposes.

3.4.1.2 Applications and Limitations

Pretreatment should be considered if the level of TSS in the inlet flow would cause clogging or otherwise impair the long-term efficiency of the separator.

For low concentrations of oil, other treatments may be more applicable. These include sand filters and emerging technologies.

There is concern that oil/water separators used for stormwater treatment have not performed to expectations.(Watershed Protection Techniques, 1994; Schueler, Thomas R., 1992) Therefore, emphasis should be given to proper application, design, maintenance (particularly sludge and oil removal), and prevention of fouling and plugging of the coalescing plate.(US Army of Engineers, 1994) Other treatment systems, such as sand filters and emerging technologies, should be considered for the removal of insoluble oil and TPH.

The following information should be considered when considering the use of API or CP oil/water separators:

- If practicable, determine oil/grease (or TPH) and TSS concentrations, lowest temperature, pH; and empirical oil rise rates in the runoff, and the viscosity, and specific gravity of the oil. Also determine whether the oil is emulsified or dissolved. (Washington State Department of Ecology, 1995). Do not use oil/water separators for the removal of dissolved or emulsified oils such as coolants, soluble lubricants, glycols, and alcohols.
- Locate the separator off-line and bypass the incremental portion of flows that exceed the off-line 15-minute, Water Quality design flow rate multiplied by the ratio indicated in Book 2, Figure 4.3. If it is necessary to locate the separator on-line, try to minimize the size of the area needing oil control, and use the on-line water quality design flow rate multiplied by the ratio indicated in Book 2, Figure 4.2.
- Use only impervious conveyances for oil contaminated stormwater.
- Specify appropriate performance tests after installation and shakedown, and/or certification by a professional engineer that the separator is functioning in accordance with design objectives. Expeditious corrective actions must be taken if it is determined the separator is not achieving acceptable performance levels.
- Add pretreatment for TSS that could cause clogging of the CP separator, or otherwise impair the long-term effectiveness of the separator.

3.4.1.3 Performance Objectives

Oil and water separators should be designed to achieve the goals of no ongoing or recurring visible sheen in the discharge or in the receiving water and to have a 24-hour average Total Petroleum

Hydrocarbon (TPH) concentration no greater than 10 mg/l, and a maximum of 15 mg/l for a discrete sample (grab sample).

3.4.1.4 Oil and Water Separator BMPs

The following BMPs may be used for Oil Control:

- BMP T11.10: API (Baffle type) Separator Bay
- BMP T11.11: Coalescing Plate Separator

3.4.2 Sand Filter Treatment BMPs

3.4.2.1 Purpose and Description

This section presents criteria for the design, construction and maintenance of runoff treatment sand filters including basin, vault, and linear filters.

Sand filtration treatment facilities collect and treat design runoff volumes to remove total suspended solids (TSS), phosphorus, and insoluble organics (including oils) from stormwater. A typical sand filtration system consists of a pretreatment system, flow spreader(s), sand bed, and underdrain piping. The sand filter bed includes a geotextile fabric between the sand bed and the bottom underdrain system.

The variations of a sand filter include a basic sand filter basin, large sand filter basin, sand filter vault, and linear sand filter. Various sand filter configurations are given in Book 2, Chapter 4.

3.4.2.2 Applications and Limitations

Sand filtration can be used in most residential, commercial, and industrial developments where debris, heavy sediment loads, and oils and greases will not clog or prematurely overload the sand, or where adequate pretreatment is provided for these pollutants.

Locate sand filters off-line before or after detention (Chang, 2000). Sand filters are also suited for locations with space constraints in retrofit, and new/redevelopment situations. Size off-line systems to treat 91% of the runoff volume predicted by an approved continuous flow model. If a project must comply with Minimum Requirement #7, Flow Control, design an overflow of bypass structure to route flows from larger storms to a retention/detention facility.

Pretreatment is necessary to reduce velocities to the sand filter and remove debris, floatables, large particulate matter, and oils. In high water table areas, adequate drainage of the sand filter may require additional engineering analysis and design considerations. Consider an underground filter in areas subject to freezing conditions (Urbonas, 1997).

3.4.2.3 Site Suitability

Consider the following site characteristics when considering a sand filtration system:

- Space availability, including room for a presettling basin
- Sufficient hydraulic head, at least 4 feet from inlet to outlet
- Adequate operation and maintenance capability including accessibility requirements for O & M
- Pretreatment requirements for oil, debris and solids in the tributary runoff

3.4.2.4 Performance Objectives

Basic and Large Sand Filter

Basic sand filters are intended to achieve the following average pollutant removals:

- Basic Performance Treatment Goal: 80% total suspended solids (TSS) at influent Event Mean Concentrations (EMCs) of 100-200 mg/L.
- Oil Performance Treatment Goal: Oil and grease to below 10 mg/L daily average and 15 mg/L at any time, with no ongoing or recurring visible sheen in the discharge.

Large Sand Filter

Large sand filters are intended to meet the Phosphorous Treatment Goal by removing at least 50% of the total phosphorus compounds (influent 0.1 to 0.5 mg/l, as total phosphorus) and by collecting and treating 95% of the runoff volume. (ASCE and WEF, 1998)

3.4.2.5 Best Management Practices (BMPs) for Sand Filtration

The following BMPs are Sand Filtration BMPs:

- BMP T8.10: Basic Sand Filter Basin
- BMP T8.11: Large Sand Filter Basin
- BMP T8.20: Sand Filter Vault
- BMP T8.30: Linear Sand Filter

3.4.3 Media Filter Drains

3.4.3.1 Purpose and Description

The media filter drain (MFD), previously referred to as the ecology embankment, is a linear flow-through stormwater runoff treatment device that can be sited along street or highway side slopes (conventional design) and medians (dual media filter drains), borrow ditches, or other linear depressions. Cut-slope applications may also be considered. The media filter drain can be used

where available right of way is limited, sheet flow from the street surface is feasible, and lateral gradients are generally less than 25% (4H:1V).

The Media Filter Drain (MFD) has four basic components: a gravel no-vegetation zone, a grass strip, the MFD mix bed, and a conveyance system for flows leaving the MFD mix. The MFD mix is composed of gravel, perlite, dolomite, and gypsum.

3.4.3.2 Applications and Limitations

Applications

The media filter drain and the dual media filter drain designs are runoff treatment options that can be sited in most right of way confined situations. In many cases, a media filter drain or a dual media filter drain can be sited without the acquisition of additional right of way needed for conventional stormwater facilities or capital-intensive expenditures for underground wet vaults.

Since maintaining sheet flow across the media filter drain is required for its proper function, the ideal locations for media filter drains are along long, linear grades with lateral side slopes less than 4H:1V and longitudinal slopes no steeper than 5%. As side slopes approach 3H:1V, without design modifications, sloughing may become a problem due to friction limitations between the separation geotextile and underlying soils. The longest flow path from the contributing area delivering sheet flow to the media filter drain should not exceed 150 feet.

Limitations

- Steep slopes. Avoid construction on longitudinal slopes steeper than 5%. Avoid construction on 3H:1V lateral slopes, and preferably use less than 4H:1V slopes. In areas where lateral slopes exceed 4H:1V, it may be possible to construct terraces to create 4H:1V slopes or to otherwise stabilize up to 3H:1V slopes. (For details, see Geometry, Components and Sizing Criteria, Cross Section in the Structural Design Considerations section below).
- Wetlands. Do not construct in wetlands and wetland buffers. In many cases, a media filter drain (due to its small lateral footprint) can fit within the highway fill slopes adjacent to a wetland buffer. In those situations where the highway fill prism is located adjacent to wetlands, an interception trench/underdrain will need to be incorporated as a design element in the media filter drain.
- Shallow groundwater. Mean high water table levels at the project site need to be determined to ensure the media filter drain mix bed and the underdrain (if needed) will not become saturated by shallow groundwater.
- Unstable slopes. In areas where slope stability may be problematic, consult a geotechnical engineer.

For more information on Media Filter Drains consult WSDOT's *Highway Runoff Manual*.

3.4.3.3 Performance Objectives

Media filter drains are intended to achieve the:

- Basic Treatment Goal
- Phosphorous Treatment Goal
- Enhanced Treatment Goals: greater than 30% reduction of dissolved copper, and greater than 60% reduction of dissolved zinc.

3.4.4 Biofiltration Treatment BMPs

3.4.4.1 Purpose and Description

This section discusses biofiltration treatment facilities such as swales and filter strips. These include biofiltration swales, wet biofiltration swales, continuous inflow swales, and filter strips.

Wet biofiltration swales are used where a grassy biofiltration swale is desired but not allowed or advisable because one or more of the following conditions exist:

- The swale is on clay soils and is downstream of a detention pond providing flow control.
- Saturated soil conditions are likely because of seeps or base flows on the site.
- Longitudinal slopes are slight (generally less than 2 percent).
- The swale is part of a treatment train.

A continuous inflow biofiltration swale is to be used when inflows are not concentrated, such as locations along the shoulder of a road without curbs. This design may also be used where frequent, small point flows enter a swale, such as through curb inlet ports spaced at intervals along a road, or from a parking lot with frequent curb cuts. In general, no inlet port should carry more than about 10 percent of the flow.

A continuous inflow swale is not appropriate for a situation in which significant lateral flows enter a swale at some point downstream from the head of the swale. In this situation, the swale width and length must be recalculated from the point of confluence to the discharge point in order to provide adequate treatment for the increased flows.

3.4.4.2 Applications and Limitations

Biofiltration can be used as a basic treatment BMP for stormwater runoff from roadways, driveways, parking lots, and highly impervious ultra-urban areas or as the first stage of a treatment train. In cases where hydrocarbons, high TSS, or debris would be present in the runoff, such as high-use sites, a pretreatment system for those components is necessary. An off-line location is preferred to avoid flattening vegetation and the erosive effects of high flows. Consider biofilters in retrofit situations where appropriate.

Data suggest that the performance of biofiltration swales is highly variable from storm to storm. Clark County recommends considering other treatment methods that perform more consistently, such as sand filters, wet ponds, filter vaults and bioretention before choosing a biofiltration swale.

The basic filter strip is typically used on-line and adjacent and parallel to paved areas such as parking lots, driveways, and roadways.

3.4.4.3 Site Suitability

Consider the following factors for determining site suitability:

- Target pollutants that can be treated by biofiltration.
- Accessibility requirements for Operation and Maintenance.
- Suitable growth environment (soil, etc.) for the vegetation.
- Adequate siting for a pretreatment facility if high petroleum hydrocarbon levels (oil/grease) or high TSS loads could impair treatment capacity or efficiency.

3.4.4.4 Best Management Practices (BMPs) for Biofiltration

The following BMPs are Biofiltration BMPs:

- BMP T9.10: Basic Grassy Biofiltration Swale
- BMP T9.20: Wet Biofiltration Swale
- BMP T9.30: Continuous Inflow Biofiltration Swale
- BMP T9:40: Basic Filter Strip
- BMP T7.40: Compost-amended Vegetated Filter Strip (CAVFS)

3.4.5 Wetpool Facilities

3.4.5.1 Purpose and Description

This section presents the methods, criteria, and details for analysis and design of wetponds, wetvaults, and stormwater wetlands.

These facilities have as a common element a permanent pool of water - the wetpool. Each of the wetpool facilities can be joined with a detention or flow control pond in a combined facility.

3.4.5.2 Applications and Limitations

A wetpond can be integrated to the contours of a site fairly easily. In clayey soils and where groundwater is near the land surface, the wetpond holds a permanent pool of water. In more porous soils, wetponds may still be used, but water seepage from unlined cells could result in a dry pond, particularly in the summer months. Lining the first cell with a low permeability liner is one way to

deal with this situation. As long as the first cell retains a permanent pool of water during the wet season, this situation will not reduce the pond's effectiveness but may be an aesthetic drawback.

Wetponds work best when the water already in the pond is moved out en masse by incoming flows, a phenomenon called "plug flow." Because treatment works on this displacement principle, the wetpool storage of wetponds may be provided below the groundwater level without interfering unduly with treatment effectiveness. However, if combined with a detention function, the live storage must be above the seasonal high groundwater level.

Wetponds may be single-purpose facilities, providing only runoff treatment, or they may be combined with a detention pond to also provide flow control. If combined, the wetpond can often be stacked under the detention pond with little further loss of development area. See BMP D6.40 for a description of combined detention and wetpool facilities.

A wetvault may be used for commercial, industrial, or roadway projects if there are space limitations precluding the use of other treatment BMPs. The use of wetvaults for residential development is highly discouraged. Combined detention and wetvaults are allowed; see BMP D6.40.

The stormwater wetland design occupies about the same surface area as wetponds, but has the potential for better aesthetic integration because of the abundance of emergent aquatic vegetation. The most critical factor for a successful design is the provision of an adequate supply of water for most of the year. Careful planning is needed to ensure sufficient water will be retained to sustain good wetland plant growth. Since water depths are shallower than in wetponds, water loss by evaporation is an important concern. Stormwater wetlands are a good stormwater treatment facility choice in areas with high winter groundwater levels

Note that BMP D6.40 includes a treatment wetland with detention.

The basis for pollutant removal in combined facilities is the same as in the stand-alone water quality facilities. However, in the combined facility, the detention function creates fluctuating water levels and adds turbulence. For simplicity, the positive effect of the extra live storage volume and the negative effect of increased turbulence are assumed to balance, and are thus ignored when sizing the wetpool volume. For the combined detention/stormwater wetland, criteria that limit the extent of water level fluctuation are specified to better ensure survival of the wetland plants.

Unlike the wetpool volume, the live storage component of the facility should be provided above the seasonal high water table.

3.4.5.3 Best Management Practices (BMPs) for Wetpool Facilities

The four BMPs listed are currently recognized as effective treatment techniques using wetpool facilities. Select the appropriate BMPs using the Step-by-Step process and the Treatment Facility Menus in Section 3.2.3.

- BMP T10.10: Wetpond – Basic and Large

- BMP T10.20: Wetvault
- BMP T10.30: Stormwater Treatment Wetland
- BMP D6.40: Combined Detention and Wetpool

3.4.6 Proprietary BMPs

As of the printing of this manual, the following proprietary BMPs are accepted by Clark County for applicable treatment uses:

- StormFilter® using ZPG Media is accepted for Basic Treatment.
- Filterra® System and Filterra® Bioscape™ are accepted for Oil Treatment, Basic Treatment, Enhanced Treatment, and Phosphorous Treatment.
- Perk Filter® is accepted for Basic Treatment and Phosphorous Treatment.
- Stormfilter® using Phosphosorb for basic treatment and phosphorus treatment.

Consult a BMPs GULD and manufacturer for design, specifications, and installation criteria.

Proprietary BMPs that have not been accepted by Clark County or that may emerge after the printing of this manual are known as Emerging Technologies. Section 3.4.7, below, discusses the use of Emerging Technologies in Clark County.

3.4.7 Emerging Technologies

3.4.7.1 Background

Traditional best management practices (BMPs) such as wetponds and filtration swales may not be appropriate in some situations due to size and space restraints or inability to remove target pollutants. Therefore the stormwater treatment industry emerged to develop new stormwater treatment devices.

Emerging technologies are stormwater treatment devices that are new to the stormwater treatment marketplace. These devices include both permanent and construction site treatment technologies. Many of these devices have not undergone complete performance testing so their performance claims cannot be verified. Emerging technologies often lack a documented maintenance history that supports understanding long-term operational costs.

Washington State Department of Ecology developed the Technology Assessment Protocol – Ecology (TAPE) and Chemical Technology Assessment Protocol Ecology (CTAPE) protocols to help local governments in selecting new stormwater treatment technologies. Ecology posts information on emerging technologies at the emerging technologies website: http://www.ecy.wa.gov/programs/wq/stormwater/newtech/index.html

Use Levels for Emerging Technologies

Ecology's use level designations describe how an emerging technology may be used in Washington. There are three use level designations: pilot use level designation, conditional use level designation, and general use level designation.

Ecology lists technologies that have obtained a use level designation through the TAPE process on its Emerging Technologies website: http://www.ecy.wa.gov/programs/wq/stormwater/newtech/technologies.html.

Pilot Use Level Designation (PULD)

For technologies that have limited performance data, the pilot use level designation allows limited use to conduct field-testing

Conditional Use Level Designation (CULD)

Ecology may give a conditional use level designation if a manufacturer collected field data through a protocol reasonably consistent with but not fully meeting the TAPE protocol. Conditional Use Level Designations have monitoring requirements and expiration dates. Therefore it is uncertain whether they will eventually receive approvable for general use.

General Use Level Designation (GULD)

The general use level designation (GULD) confers a general acceptance for the specified applications (land uses). General Use Level Designation BMPs may be used for new development, redevelopment, or retrofit situations anywhere in Washington, subject to conditions that Ecology places within the Use Designation document and acceptance of the BMP by the permitting municipality.

3.4.7.2 Using Emerging Technology BMPs in Clark County

Clark County accepts several Proprietary BMPs as listed in Section 3.4.6 of this manual.

For Emerging Technologies arising after the publication of this manual, the Responsible Official maintains a list of BMPs accepted by Clark County. Applicants may petition the Responsible Official to include an Emerging Technology on the approved list.

Information the Responsible Official may consider before including a new Emerging Technology on the approved list includes:

- Equivalence with the most current *Stormwater Management Manual for Western Washington* – Washington Department of Ecology approval level.

- Cost of maintenance – information describing the nature and frequency of maintenance actions and materials costs to predict maintenance costs, knowledge to maintain the BMP, and capital costs for maintenance equipment.
- Ease of access – degree of need for confined space entry. Equipment required to perform maintenance.
- Worker safety – the BMP's typical location (e.g. street, tract, etc.), weights of components or materials to be lifted and confined space concerns.
- Long-term serviceability – demonstrated track record of the manufacturer. Ramifications if the manufacturer goes out of business. The use of the BMP regionally or nationally.
- Sole source availability – replacement parts and media are available from more than one source.

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Chapter 4 Flow Control

Chapter Contents

Chapter Tables

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4.1 Introduction

4.1.1 Purpose

This chapter presents methods, criteria, and details for analysis and selection of flow control BMPs. Flow control facilities are detention or infiltration facilities engineered to meet the flow control standards specified in Minimum Requirement #7. This chapter can also be used to meet the LID Performance Standard for Minimum Requirement #5.

4.1.2 How to Use this Chapter

The standards of this chapter must be used to select flow control facilities that meet Minimum Requirement #7.

4.2 Flow Control BMP Selection

Minimum Requirement #7 (Flow Control) includes area thresholds that determine applicability. Those thresholds determine whether each threshold discharge area (TDA) of a project must use flow control facilities designed by a professional engineer. TDAs falling under the threshold may only need to meet Minimum Requirement #5 (On-Site Stormwater Management). The following outlines steps in selecting Flow Control Facilities.

1. Read the definitions in Appendix 1-A to become acquainted with the following terms: effective impervious surface, impervious surface, hard surface, pollution-generating impervious surface (PGIS), pollution-generating hard surface (PGHS), pollution-generating pervious surface (PGPS), converted vegetation areas, and threshold discharge area.

2. Outline the threshold discharge areas (TDA) for the project site.

3. Determine the area of pollution-generating hard surfaces (including pollution-generating permeable pavements) and pollution-generating pervious surfaces (not including permeable pavements) in each TDA. Compare those totals to the project thresholds in Section 1.5.7 to determine where flow control facilities are required. Note that On-site Stormwater Management BMPs (Minimum Requirement #5) are always applicable.

4. Compute the totals for effective impervious surface and converted vegetation areas in each TDA. Compare those totals to the project thresholds in Section 1.5.7.2 to determine if flow control facilities are required.

5. Select Flow Control BMPs and Facilities. On-site Stormwater Management BMPs must be applied to the maximum extent practicable in accordance with Minimum Requirement #5. In addition, flow control facilities must be provided for discharges from those threshold discharge areas that exceed the Minimum Requirement #7 thresholds. Use an approved

continuous flow model and Chapter 5 (infiltration) and Chapter 6 (Detention) in Book 2 to size and design flow control facilities.

6. Select either an infiltration facility and/or a detention facility to meet Minimum Requirement #7, using the following criteria:

A: Determine whether the site is suitable for infiltration.

Perform the site characterization study per Section 4.3.1.2 and infiltration testing per Section 4.3.1.3 to determine if infiltration is feasible to meet Minimum Requirement #7. If infiltration is feasible, use the design criteria for infiltration basins, drywells, or trenches in Book 2, Chapter 5 to design these facilities.

Note that if the soils are suitable, infiltration can be used to meet runoff treatment (Minimum Requirement #6) and flow control (Minimum Requirement #7) requirements. However, since such a facility would have to be located on-line it would be quite large in order to achieve the flow duration standard of Minimum Requirement #7. See Chapter 3 for more information about using infiltration to meet the runoff treatment standard.

B: If infiltration is not feasible, detention facilities must be used to meet Minimum Requirement #7. These facilities must be sized using an approved continuous flow model. Refer to Book 2, Chapter 6 for Detention Facility design.

Note that the more the site is left undisturbed, and the fewer impervious surfaces are created, the smaller the detention facility. In addition, the greater the use of On-site Stormwater Management BMPs, the smaller the detention facility.

4.3 Flow Control BMPs

4.3.1 Infiltration Facilities

Infiltration facilities for flow control are used to reduce the volume and rate of stormwater runoff by conveying flows from new development or redevelopment to the ground after appropriate treatment. Proper design of infiltration facilities requires careful determination of the infiltration rates on the project site.

All UIC wells receiving runoff from pollutant generating surfaces are required to have basic treatment. All underground infiltration BMPs receiving runoff from surfaces other than pollutant generating must have a pretreatment BMP.

The following steps must be followed in the selection of infiltration as a flow control BMP:

1. Select a site or sites for potential infiltration facilities and pretreatment facilities.

2. Perform a site characterization study as described in Section 4.3.1.2. The information from this study must be included in the Soils Report (See Section 1.8.3).

3. Perform field tests and determine the field measured coefficient of permeability (the infiltration rate) as described in Section 4.3.1.3 and Appendix 1-C.

4. Apply correction factors per Section 4.3.1.3 to determine the design infiltration rate.

5. Determine if infiltration is feasible (i.e. the infiltration rate is high enough that infiltration of stormwater meeting Minimum Requirement #7 is feasible) and if so select an infiltration BMP.

6. If infiltration is feasible, size the facilities using the design criteria in Book 2, Chapter 5.

Typical BMPs for infiltration include infiltration ponds, infiltration trenches, drywells, and perforated pipe.

4.3.1.1 Regulatory Requirements

Washington State Department of Ecology Underground Injection Control

Below-surface stormwater infiltration facilities, such as drywells and perforated pipes, are classified by Ecology as Underground Injection Control (UIC) wells (See Underground Injection Control Program, Chapter 173-218 WAC). The two major requirements of Ecology's UIC regulations are to register UIC wells with the Washington State Department of Ecology prior to their installation and to make sure that underground sources of groundwater are not endangered by pollutants in the discharge (Non-Endangerment Standard). These regulations have requirements on minimum depth to groundwater (5 feet), as well as siting and installation requirements. They also list development activities that are prohibited from using UICs.

Ecology's UIC guidelines, as found in ~~*Guidance for UIC Wells that Manage Stormwater* (Ecology 2006)~~ Stormwater Management Manual for Western Washington (2019), Chapter I-4, provides information on what is classified as a UIC, provides design information that must be followed for UIC installation, and provides information on requirements to meet the Non-endangerment Standard.

Clark County requires verification of UIC registration before approval of final plans. Where UIC regulations conflict with County code, the more stringent of the two regulations shall apply, as determined by the Responsible Official.

Clark County Code 40.410 CARA

The county's Critical Aquifer Recharge Area (CARA) regulation, CCC 40.410, prohibits placement of Class V injection wells in Category I CARAs and requires a permit for placement of Class V injection wells for certain non-residential developments in Category II CARAs. Consult CCC 40.410 for further information, and see Maps Online at Clark County's web site for the locations of CARAs (http://gis.clark.wa.gov/mapsonline/).

4.3.1.2 Site Characterization Study

One of the first steps in siting and designing infiltration facilities is to conduct a site characterization study. This study must include the following steps.

Step 1: Surface Features Characterization

1. Gather information on the following site features:
    - Topography within 500 feet of the proposed facility.
    - Location of water supply wells within 500 feet of proposed facility.
    - Location of CARAs regulated under Chapter 40.410 within 500 feet of the proposed facility.
    - A description of local site geology, including soil or rock units likely to be encountered, the groundwater regime, and geologic history of the site.
2. Review the following site suitability criteria. When a site investigation reveals that any of the criteria in this section cannot be met, consider appropriate measures such as relocation or resizing so that the infiltration facility will not pose a threat to safety, health, and the environment and meet the requirements in this section.
    a. Setback Criteria: Setback requirements are listed in Table 4.1.

Table 4.1: Stormwater Infiltration Facility Setbacks

Stormwater infiltration facility setback from:	Distance
Drinking water wells	100 feet minimum
Building foundations	20 feet minimum from the downslope side of foundations 100 feet minimum from the upslope side of foundations These setbacks may be increased or decreased based on engineering analysis that shows the performance of the building's foundation system will not be adversely affected by the presence of the stormwater facility
Slopes equal to or greater than 15%	50 feet minimum from the crests of slopes. This setback may be increased or decreased based on engineering analysis that shows the stability of the slope will not be adversely affected by the presence of the stormwater facility.
Property lines	20 feet from any property line. However, if an infiltration trench is a common system shared by the two or more adjacent lots and contained within an easement for maintenance given to owners of all lots draining to the system, then the setback from the property line(s) shared by the adjacent lots may be waived.

b. Critical Aquifer Recharge Areas (CARA): Review Section 4.3.1.1 and CCC 40.410 for regulation regarding installation of infiltration facilities within CARA sites.

c. High Vehicle Traffic Areas: An infiltration BMP can be used in areas of industrial activity and the high vehicle traffic areas described below. For such applications, provide sufficient pollutant removal (including oil removal) upstream of the infiltration facility to ensure that groundwater quality standards will not be violated and that the infiltration facility will not be adversely affected. High Vehicle Traffic Areas are:

- Commercial or industrial sites subject to an expected average daily traffic count (ADT) ≥100 vehicles/1,000 ft² gross building area (trip generation).
- Road intersections with an ADT of ≥ 25,000 on the main roadway and ≥ 15,000 on any intersecting roadway.

Step 2: Subsurface Characterization

1. Subsurface explorations (test holes, wells or test pits) for site characterization should include:

    a. For drywells, at least one exploration per drywell(s) location.

b. For infiltration basins, at least one exploration per 5,000 ft^2 of basin infiltrating surface (in no case less than two per basin).

c. For infiltration trenches, at least one exploration per 200 feet of trench length (in no case less than two per trench).

NOTE: The depth and number of exploration, and samples can be adjusted, if in the judgment of an engineer with geotechnical expertise (P.E.), a geologist, engineering geologist, or hydrogeologist licensed in the State of Washington that the conditions are such that the changes still provide enough data to accurately estimate the performance of the infiltration system. Written proof shall be provided in the Soils Report (Section 1.8.3).

2. Subsurface explorations to a depth below the base of the infiltration facility of at least 5 times the maximum design depth of ponded water proposed for the infiltration facility, but not less than 10 feet below the base of the facility. At sites with shallow groundwater (less than 15 feet from the estimated base of facility), and where a groundwater mounding analysis is necessary, determine the thickness of the saturated zone. In high water table sites, the subsurface exploration sampling need not be conducted lower than two (2) feet below the groundwater table.

3. Continuous sampling (representative samples from each soil type and/or unit within the infiltration receptor) to a depth below the base of the infiltration facility of 2.5 times the maximum design ponded water depth, but not less than 10 feet. For large infiltration facilities serving drainage areas of 10 acres or more, sampling up to 50 or more feet may be required.

4. If using the soil grain size analysis method for estimating infiltration rates: laboratory testing as necessary to establish the soil gradation characteristics and other properties as necessary, to complete the infiltration facility design. At a minimum, conduct one grain size analysis per soil stratum in each test hole within 2.5 times the maximum design water depth, but not less than 10 feet. When assessing the soil characteristics of the site, soil layers at greater depths must be considered if the licensed professional conducting the investigation determines that deeper layers will influence the rate of infiltration for the facility, requiring soil gradation/classification testing for layers deeper than indicated above.

5. Prepare detailed logs for each test pit or test hole and a map showing the location of the test pits or test holes. Logs must include at a minimum, depth of pit or hole, soil descriptions, depth to water, presence of stratification. NOTE: Logs must substantiate whether stratification does or does not exist. The licensed professional may consider additional methods of analysis to substantiate the presence of stratification that will significantly impact the design of the infiltration facility.

6. Soil characterization for each soil unit (soils of the same texture, color, density, compaction, consolidation and permeability) encountered should include:

- Grain size distribution (ASTM D422 or equivalent AASHTO specification), if using the soil grain size analysis method to estimate infiltration rates;
- Visual grain size classification;
- Percent clay content (include type of clay, if known);
- Color/mottling;
- Variations and nature of stratification.

7. Locate the groundwater table and establish its gradient, direction of flow, and seasonal variations, considering the water table aquifer (defined as the uppermost aquifer in open conditions). Groundwater monitoring wells shall be installed to monitor variations in groundwater level through at least one wet season (October 1 through April 30).

8. For facilities serving a drainage area of one acre or over, one groundwater monitoring well shall be installed in each proposed infiltration facility location, unless:
   - GIS groundwater data from Clark County and available field information describing water table elevations within 500 feet of the site indicates that the seasonal high groundwater elevation is at least 15 feet below the base of the proposed facility. Examples of field information that can be used include public well records and groundwater monitoring reports from other development sites.; OR
   - The seasonal high groundwater elevation has been found to be at least 15 feet below the facility base from monitoring wells installed at the site where monitoring was conducted during at least one wet season in the preceding three years.

9. For facilities serving a drainage area less than one acre, establish that the depth to groundwater or other hydraulic restriction layer will be at least 10 feet below the base of the facility. This can be determined through the use groundwater monitoring wells as described above, through subsurface explorations or through information from nearby wells (500 feet or closer).

Step 3: Soil Testing

1. Field measured infiltration test to determine the coefficient of permeability must be conducted using one of the methods listed in Section 4.3.1.3.

2. If the infiltration facility will provide treatment the soil characterization must also include:
   - Cation exchange capacity (CEC) and organic matter content for each soil type and strata where distinct changes in soil properties occur, to a depth below the base of the facility of at least 2.5 times the maximum design water depth, but not less than 6 feet.

4.3.1.3 Coefficient of Permeability

Field-measured coefficient of permeability rates (also termed infiltration rates) can be determined using one of the three in-situ field measurements, or, if the site has unconsolidated and uncemented sediments, by a correlation to grain size distribution from soil samples. The latter method uses the ASTM soil size distribution test procedure (ASTM D422), which considers the full range of soil particle sizes, to develop soil size distribution curves.

Once the coefficient of permeability has been measured in the field, the design rate needs to be determined. This section discusses the procedures for adjusting the field-determined rate for use in designing facilities.

Field Measurements

Select one of the four methods described below to measure the field coefficient of permeability rate at the site. Use the field-measured coefficient of permeability to determine the design (long-term) infiltration rate. Then use the design (long-term) rate for routing and sizing the infiltration facility, and for checking for compliance with the maximum drawdown time of 48 hours. A detailed description of these test methods can be found in Appendix 1-C.

1. Modified Single-Ring Falling Head Test

   This test was developed by local (Clark County) geotechnical engineers and was approved for use by Ecology in Clark County's 2009 *Stormwater Manual*. More information on this test method can be found in ASCE 2009 and the methodology associated with this test is described in Appendix 1-C.

2. Large-Scale Pilot Infiltration Test (PIT)

   The Pilot Infiltration Test (PIT) is a field procedure for estimating the measured coefficient of permeability of the soil profile beneath the proposed infiltration facility. More information on this method can be found in Appendix 1-C.

3. Small-Scale Pilot Infiltration Test

   A small-scale PIT can be substituted for the large-scale PIT in any of the following instances:

   - The drainage area to the infiltration site is less than one acre.
   - The testing is for the LID BMPs of bioretention or permeable pavement that either serve small drainage areas (less than an acre) and /or are widely dispersed throughout a project site.
   - The site has a high infiltration rate, making a full-scale PIT difficult, and the site geotechnical investigation suggests uniform subsurface characteristics.
   - Site accessibility or safety concerns impede the ability to conduct a large-scale PIT.

4. Soil Grain Size Analysis Method

   If the site has unconsolidated or uncemented sediments, then measured coefficient of permeability rates can be determined by a correlation to grain size distribution from soil samples. This method uses the ASTM soil size distribution test procedure (ASTM D422), which considers the full range of soil particle sizes, to develop soil size distribution curves.

Correction Factors / Design Infiltration Rate

The coefficient of permeability obtained from the field tests above is a measured rate. This rate must be reduced through correction factors that are appropriate for the design situation to produce a design rate.

Correction factors account for site variability, number of tests conducted, uncertainty of the test method, and the potential for long-term clogging due to siltation and bio-buildup. Table 4.2 summarizes the typical range of correction factors to account for these issues. The specific correction factors used shall be determined based on the professional judgment of the licensed engineer considering all issues that may affect the infiltration rate over the long term, subject to the approval of Clark County.

The correction factors in Table 4.2 shall be used to establish the allowable infiltration rate for both the PIT test and the single-ring falling head test. The safety factor for a sacrificial system can be reduced if the system is designed to infiltrate runoff for a design event with a 2-year return period.

Table 4.2: Infiltration Rate Correction Factors

Base Correction Factor	
The base correction factor is meant to account for soil variability and long-term system degradation due to siltation, crusting, or other factors.	2
Soils Correction Factor	
Additive correction factor recommended by geotechnical professional as a result of soil or groundwater conditions.	Minimum value of 2, or greater as recommended by the geotechnical engineer
System Design Correction Factors	
If the infiltration facility serves a basin with an impervious area greater than 2 acres.	Add ½
If the infiltration facility serves a basin with an impervious area greater than 5 acres.	Add 1
Infiltration facilities in closed depressions.	Add 2
If a sacrificial system is provided and left operational following permanent site stabilization.	Subtract ½

4.3.2 Detention

This section presents criteria for selecting a detention facility to meet Minimum Requirement #7, while detailed design criteria are presented in Book 2, Chapter 6. Detention facilities provide for the temporary storage of increased surface water runoff resulting from development pursuant to the performance standards set forth in Minimum Requirement #7 for flow control. Detention facilities can also provide for retention of stormwater through infiltration in the bottom of the pond.

4.3.2.1 Detention Standard

Please see Section 1.5.7 for the standard requirements for meeting Minimum Requirement 7 using detention.

4.3.2.2 Applications and Limitations

1. Stormwater detention facilities that can impound 10 acre-feet (435,600 cubic feet; 3.26 million gallons) or more with the water level measured at the embankment crest are subject to the state's dam safety requirements, even if water storage is intermittent and infrequent (WAC 173-175-020(1)). For stormwater detention facilities, this means sizing the emergency spillway to accommodate the runoff from the dam safety design storm. Other dam safety requirements include geotechnical issues, construction inspection and documentation, dam breach analysis, inundation mapping, emergency action planning, and periodic inspections by project owners and by Dam Safety engineers. Electronic versions of the guidance documents are available on the Department of Ecology Web site at http://www.ecy.wa.gov/programs/wr/dams/dss.html.

2. Ponds must be designed as flow-through systems (however, parking lot storage may be utilized through a back-up system). Stormwater must enter through a conveyance system separate from the control structure and outflow conveyance system. Maximizing distance between the inlet and outlet is encouraged to promote sedimentation.

3. Pond bottoms should be level and located a minimum of 0.5 foot (preferably 1 foot) below the inlet and outlet to provide sediment storage.

4. A geotechnical analysis and report must be prepared for facilities associated with slopes over 15%, or if located within 200 feet of the top of a slope steeper than 40%, or landslide hazard area. The scope of the geotechnical report should include the assessment of impoundment seepage on the stability of the natural slope where the facility will be located within the setback limits set forth in this section.

4.3.2.3 Detention Ponds in Infiltrative Soils

Detention ponds may be sited on soils that are sufficiently permeable for a properly functioning infiltration system. These detention ponds have a surface discharge and may also utilize infiltration

as a second pond outflow. Detention ponds sized with infiltration as a second outflow must meet all the requirements of this chapter, and Book 2, Chapter 5 for infiltration basins, including a soils report, testing, groundwater protection, presettling, and construction techniques.

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Chapter 5 Off-site Analysis

Chapter Contents

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5.1 Introduction

5.1.1 Purpose

This chapter provides requirements for off-site analysis and mitigation. These requirements are in addition to the minimum requirements identified in Chapter 1.The off-site analysis is a field investigation of downstream impacts on water quality and surface water conditions resulting from a development, redevelopment, or other land-disturbing activity.

5.1.2 How to Use this Chapter

An off-site analysis is required when a project that must meet Minimum Requirements #1 – #9 meets any of the following criteria:

- Adds 35,000 square feet or more of new pervious surface.
- Constructs or modifies a drainage pipe or ditch that is 12 inches or more in size/depth or that receives runoff from a drainage pipe or ditch that is 12 inches or more in size/depth.
- Contains or lies adjacent to a landslide, steep slope, or erosion hazard area.
- Is not exempt from Minimum Requirement #8.
- The project changes the rate, volume, duration, or location of discharges to and from the project site.

If any of the above criteria are met, the applicant shall complete the Qualitative Analysis in Section 5.2.1.

Depending upon the presence of existing or predicted flooding, erosion or water quality problems, and on the proposed design of the on-site drainage facilities, the County may require a qualitative analysis further downstream, mitigation measures, or a quantitative analysis.

Existing off-site impacts that are not affected by the project site do not require mitigation. However, in cases where the project site is the cause of the existing impact, the applicant shall mitigate for those impacts.

5.2 Off-site Analysis

5.2.1 Qualitative Analysis

The qualitative downstream analysis shall extend downstream for the entire flow path, from the project site to the receiving water, or up to one-quarter mile, whichever is less. The qualitative analysis may be stopped shorter than the required ¼ mile downstream if the analysis reaches a

County identified trunk main. Trunk mains are defined as public stormwater drainage pipes equal to or greater than 36 inches and installed at a minimum slope of 0.5%.

The upstream qualitative analysis shall identify and describe points where water enters the site and the tributary area that contributes water to those run-on locations.

A basin map delineating the on-site and off-site basin upstream and downstream for the site shall be provided. The basin map shall be to a defined scale and must show the receiving water body. Maps printed from the County's GIS website may be used as a base for the basin map, and to obtain contours and existing stormwater facility information. Field verification of county information may be required as directed by the Responsible Official. The following describes components (or tasks) of the qualitative analysis.

The project engineer shall make a finding on the downstream conveyance suitability to accept flows from the proposed project based on the qualitative analysis.

Task 1: Inspection of Conveyance System and Outfall

The existing conditions and potential impacts to be evaluated shall include, at a minimum, but not be limited to:

1. Erosion at outfalls
2. Conveyance system capacity.
3. Localized flooding.
4. Historic groundwater flooding based 1996 infrared flood photos.

The design engineer shall physically inspect the existing on-site and off-site drainage systems of the study area for each discharge location for existing or potential problems and drainage features. An inspection and investigation shall include the following:

1. Collect information on pipe sizes, channel characteristics, and drainage structures.
2. Identify existing/potential constrictions or capacity deficiencies in the drainage system.
3. Identify existing/potential flooding problems.
4. Identify existing/potential erosion, scouring, or bank sloughing at outfalls.
5. Note date and weather at time of inspection.

Task 2: Description of the Drainage System and Its Existing and Predicted Problems

For each drainage system component (e.g., pipe, culvert, bridge, outfall, pond, vault), the analysis shall include the location, physical description, problems, and field observations.

All existing or potential problems (e.g., flooding, erosion) identified in Task 1 shall be described. The descriptions shall be used to determine whether adequate mitigation can be identified or whether more detailed quantitative analysis is necessary. The following information shall be provided for each existing or potential problem:

1. Magnitude of or damage caused by the problem.
2. General frequency and duration.
3. Return frequency of storm or flow when the problem occurs (may require quantitative analysis).
4. Water elevation when the problem occurs.
5. Names and concerns of the parties involved.
6. Current mitigation of the problem.
7. Possible cause of the problem.
8. Whether the project is likely to aggravate the problem or create a new one.

5.2.2 Quantitative Analysis

Upon review of the qualitative analysis, Clark County may require a quantitative analysis, depending on the presence of existing or predicted flooding, erosion, or water quality problems and on the proposed design of the on-site drainage facilities.

The quantitative analysis shall extend downstream for the entire flow path, from the project site to the receiving water, or up to one-quarter mile, whichever is less. The quantitative analysis may be stopped shorter than the required ¼ mile downstream if the analysis reaches a trunk main. Trunk mains are defined as public stormwater drainage pipes equal to or greater than 36 inches and installed at a minimum slope of 0.5%. All existing and proposed off-site stormwater conveyance shall meet the design criteria described in the methods of analyses.

If a capacity problem or streambank erosion problem is found during the quantitative downstream analysis, mitigation measures may be required.

Include the following as part of the quantitative downstream analysis:

- Capacity and percent full in each reach.

- Description of design flows used in analysis.
- Velocity in each reach.
- Upstream and downstream basin maps showing the flow route for both on-site and offsite stormwater.
- Include all model assumptions, outputs, and equations used in the analysis. If model parameters are used that are different than typical standards of practice, justification of the parameters is required.
- Clearly describe headwater and tailwater assumptions.
- The 25-year and 100-year hydraulic gradelines must be shown.
- Include model outputs for both under capacity conditions and if the applicant is proposing to upsize the downstream system, outputs showing the upsized conditions.

The quantitative analysis shall provide information on the severity and frequency of an existing problem or the likelihood of creating a new problem. It shall evaluate proposed mitigation intended to avoid aggravation of the existing problem and creation of a new problem.

As-built drawings may be utilized to obtain structure information to be used in the downstream analysis. If as-built drawings are used, the engineer is responsible for verifying that all elevations are in the same datum. The County may require a field survey of the existing storm drainage system downstream from the project for a minimum of ¼ mile from the point of connection to the existing public drainage system, or may require portions of the system to be field surveyed.

5.2.3 Mitigation Measures

Clark County may require mitigation measures, depending on the results of the off-site analysis. Possible mitigation measures could include upsizing of off-site conveyance or additional flow control measures. Where required, the mitigation will be of a type to be determined by the Responsible Official.

Chapter 6 Construction Stormwater Pollution Prevention

Chapter Contents

Chapter Tables

6.1 Introduction

6.1.1 Purpose

This chapter presents guidance on the selection of BMPs to manage construction site stormwater in accordance with Minimum Requirement #2, Construction Stormwater Pollution Prevention. The chapter also guides the applicant in developing a Stormwater Pollution Prevention Plan (SWPPP) for projects that require it. All new development and redevelopment projects are responsible for preventing erosion and discharge of sediment or other pollutants into receiving waters and to meet Minimum Requirement #2.

Construction stormwater pollution prevention is a set of activities and best management practices (BMPs) focused on managing stormwater impacts associated with construction activities. BMPs that, when properly planned, installed, and maintained, can minimize stormwater impacts, such as heavy stormwater flows, soil erosion, water-borne sediment, and degradation of water quality. Proper implementation of BMPs selected in accordance with this chapter can help minimize construction delays and save money otherwise spent on repairing erosion. These BMPs are usually temporary, lasting as long as construction activity on the site.

All projects that include land disturbing activities such as development projects, grading projects and building construction are responsible for preventing erosion and discharge of sediment and other pollutants into receiving waters. Thresholds and requirements are defined in Chapter 1.

For more information on the impacts of erosion and sediment on the environment and how erosion occurs, see Volume II~~, Sections 1.4 through 1.6~~ Chapter II-1of the Stormwater Management Manual for Western Washington (Ecology, ~~2014~~2019).

6.1.2 How to Use this Chapter

Clark County allows development and redevelopment projects to meet Minimum Requirement #2 by either using the standards of this Chapter or a SWPPP created to meet requirements of the Ecology Construction Stormwater General Permit.

Chapter 6 addresses preparing for and implementing a Construction Stormwater Pollution Prevention Plans (SWPPP). Use this chapter to develop a SWPPP and select BMPs to control erosion, sediment and other pollutants during construction. Submit the Construction SWPPP according to the submittal requirements in Sections 1.8. Projects disturbing less than 1 acre of land may use the Abbreviated Construction SWPPP in Appendix 1-J in lieu of using the instructions in this Chapter.

- Section 6.2 gives guidance to project proponents that must develop a SWPPP for the County and also must obtain a NPDES Construction Stormwater General Permit from Department of Ecology.

- Section 6.3 describes the SWPPP and presents a step-by-step method for developing a Construction SWPPP. It includes lists of suggested BMPs to meet each of the 13 elements of construction stormwater pollution prevention.
- Section 6.4 lists and describes the required 13 elements of a Construction SWPPP. All elements must be included in the SWPPP.
- Section 6.5 lists BMPs for construction stormwater control and site management, including BMPs for source control and BMPs that address runoff, conveyance, and treatment.
- Alternately, the BMPs listed in 2019 SWMMW Volume II, Chapter 3 may be used to complete a SWPPP.

Optional: Applicants with large and engineered projects that will disturb less than one acre of land may prepare the Abbreviated Construction SWPPP in Appendix 1-J in lieu of using the instructions in this Chapter.

Applicants with projects that qualify for a Small Project submittal in accordance with Section 1.7 should use the Stormwater Site Plan Short Form in Appendix 1-I to develop and submit the SWPPP.

6.2 Relationship to Construction Stormwater General Permit

Many projects permitted in Clark County will also require a NPDES Construction Stormwater General Permit from Washington Department of Ecology. Generally, projects that disturb an acre or more of land and discharge stormwater to surface waters of the state require the state construction permit in addition to the land use, engineering and building permits required by the county. Some exceptions are noted in the Construction Stormwater General Permit itself.

Clark County erosion and sediment control requirements are equivalent to the ~~2014~~2019 *Stormwater Management Manual for Western Washington*. The state construction permit has its own set of requirements that are very similar. The state permit includes requirements such as site discharge monitoring and water quality reporting requirements that are not included in county code.

~~If a development site permitted under Clark County code 40.386 and the Department of Ecology also requires a NPDES Construction Stormwater General Permit (CSWGP)., then the site operator is obligated to follow both sets of construction stormwater prevention rules. Use Table 6.1 as a general guideline for how to meet both with the least duplication of effort. Clark County makes no guarantee that the guidance provided in Table 6.1 will result in timely processing or issuance of the Construction Stormwater General Permit by Department of Ecology.~~

~~Note: the guidance in Table 6.1 does not apply to sites that do not require a CSWGP.~~

Table 6.1 Coordinating Construction Stormwater General Permit with Minimum Requirement #2

Construction permit Document / Action	Clark County Requirement	Ecology Construction Permit	Do This
Notice of Intent (NOI)	Not Required	Submit NOI to Ecology and Clark County 60 days prior to discharging stormwater from the site.[6]	Submit NOI to Ecology and Clark County at least 60 days prior to discharging stormwater from the site.
Public Notice	Not Required (specific to stormwater discharges from the site)	1 x each week for 2 consecutive weeks, at least 7 days apart. Specific language is in the CSWGP.	Advertise a public notice 1 x each week for 2 consecutive weeks, at least 7 days apart. Follow guidelines for specific language in the CSWGP.
Erosivity Waiver	Not Applicable	Optional	If the site qualifies for an erosivity waiver from the CSWGP, submit the waiver to Ecology. Continue to use the CCSM to meet Minimum Requirement #2 for Clark County.
Stormwater Pollution Prevention Plan (SWPPP)	Prepare a SWPPP according to the CCSM, including 13 Elements. Clark County allows fewer BMPs to select from than CSWGP. Submit to Clark County with Erosion Control Inspection fee.	Prepare a SWPPP according to CSWGP., including 12 elements[7].	Prepare a SWPPP according instructions in the CCSM and add a contingency plan per Section S9B(1)(e) of the CSWGP to the narrative. Submit to Clark County with the Erosion Control inspection fee and before discharging stormwater from the site.
Monitoring	Not Required	Required, depending on site size. Use Section S4 beginning on page 12 of the CSWGP to determine requirements.	Monitor the construction site per Section of the CSWGP.

Table continues on following page.

[6] Submission of the NOI 60 days prior to discharging stormwater is a minimum established by Washington Department of Ecology. However, Ecology may take significantly longer than 60 days to review a NOI in some circumstances. The applicant is responsible for communicating with Ecology directly to determine Ecology's review timelines in different circumstances and for submitting the NOI accordingly.

[7] At time of publication, Ecology has issued a draft CSWGP that contains the 13 elements of a SWPPP currently required by Clark County. Clark County assumes that the updated CSWGP permit will go into effect around the time this manual becomes effective in Clark County.

~~Construction permit Document / Action~~	~~Clark County Requirement~~	~~Ecology Construction Permit~~	~~Do This~~
~~Site Log Book~~	~~Required~~	~~Required as part of Monitoring, Section S4.~~	~~Maintain a site log book that contains a record of the implementation of the SWPPP. Ensure the log is available for county and state inspectors.~~
~~Inspections~~	~~Operator is required to inspect, maintain and repair using qualified personnel all BMPs as needed to assure continued performance of their intended function.~~	~~Required as Part of Monitoring in Section S4 of the CSWGP.~~	~~Follow inspection requirements in Section S4 of the CSWGP.~~
~~CESCL~~	~~Required for sites that disturb 1 acre or more or that use a licensed contractor for land-disturbing activity~~	~~Required for sites that disturb 1 acre or more~~	~~Identify a CESCL in the SWPPP.~~
~~Sampling for water quality criteria for discharges to specific water bodies listed by Ecology~~	~~Not Required~~	~~Required depending on size of disturbed area. Specialized sampling is required depending on receiving water body.~~	~~Follow sampling requirements in Section S4 of the CSWGP and in Special Condition S8.~~
~~Notice of Termination (NOT)~~	~~Not Required~~	~~Required after final site stabilization or temporary stabilization and homeowners have taken possession of residences~~	~~Follow NOT requirements in S10 of the CSWGP.~~

6.3 Stormwater Pollution Prevention Plan Development

The Construction SWPPP must include each of the 13 elements listed in Section 6.4 unless site conditions render any of the elements unnecessary and the exemption from that element is clearly justified in writing.

Use Sections 6.3, 6.4, and 6.5 if the project is not developing a SWPPP to meet requirements of the state CSWGP.

A complete description of each element and associated BMPs is given Section 6.4.

The Construction SWPPP must describe best management practices (BMPs) to prevent erosion and sedimentation, and to identify, reduce, eliminate or prevent stormwater contamination and water pollution from construction activity. The primary project proponent shall evaluate, with input from

utilities and other contractors, the stormwater management requirements for the entire project, including the utilities, when preparing the Construction SWPPP.

6.3.1 What is a Construction SWPPP?

A Construction Stormwater Pollution Prevention Plan (SWPPP) is a written plan to implement measures to identify, prevent, and control the contamination of point source discharge of stormwater. The Construction SWPPP explains and illustrates the measures, usually in the form of best management practices (BMPs), to take on a construction site to control potential pollution problems. The primary pollutant of concern on construction sites is sediment from erosion.

As site work progresses, the plan must be modified routinely in prescribed time periods to reflect changing site conditions. The Construction SWPPP must be located on the construction site or within reasonable access to the site for construction and inspection personnel, although a copy of the drawings must be kept on the construction site at all times.

6.3.2 BMP Selection, Standards, and Specifications

Section 6.5 contains list of approved BMPs for each of the 13 elements of a SWPPP. BMPs must be selected from the lists, or from other approved BMPs in this manual, and designed and installed in accordance with the standards and specifications given in Book 2, Chapter 8. BMPs may be used singularly or in combination. The Responsible Official may allow BMPs from other guidance documents or manuals which Washington Department of Ecology has approved as equivalent under the NPDES Phase I Municipal Stormwater Permit.

6.3.3 Construction SWPPP Process

The Construction SWPPP consists of two parts: a narrative and drawings. Both parts shall contain information specific to the construction site.

6.3.3.1 Narrative

The Construction SWPPP narrative must address the following subject areas:

- Site and Project Description
    - Project description: Describe the nature and purpose of the construction project. Include the total size of the area, any increase in existing impervious area; the total area expected to be disturbed by clearing, grading, excavation or other construction activities, including off-site borrow and fill areas; and the volumes of grading cut and fill that are proposed.
    - Existing site conditions: Describe the existing topography, vegetation, and drainage. Include a description of any structures or development on the parcel including the area of existing impervious surfaces.

- Adjacent areas: Describe adjacent areas, including streams, lakes, wetlands, residential areas, and roads that might be affected by the construction project. Describe how areas draining to the project may affect the site. Provide a description of the upstream drainage leading to the site and the downstream drainage leading from the site to the receiving body of water.
- Critical areas: Describe areas on or adjacent to the site that are classified as critical areas. Critical areas that receive runoff from the site shall be described up to ¼ mile away. Describe special requirements for working near or within these areas.
- Soil: Describe the soil on the site, giving such information as soil names, mapping unit, erodibility, settleability, permeability, depth, depth to groundwater, texture, and soil structure.
- Potential erosion problem areas: Describe areas on the site that have potential erosion problems.

- The Thirteen Elements: Describe how the Construction SWPPP addresses each of the 13 required elements. Include the type and location of BMPs used to satisfy the required element. If an element is not applicable to a project, provide a written justification for why it is not necessary.
- Construction Schedule and Phasing: Describe the construction schedule. If the schedule extends into the wet season, describe what activities will continue during the wet season and how the transport of sediment from the construction site to receiving waters will be prevented. Describe the intended sequence and timing of construction activities and any proposed construction phasing.
- Financial/ownership Responsibilities: Describe ownership and obligations for the project. Include bond forms and other evidence of financial responsibility for environmental liabilities associated with construction.
- Engineering calculations: Attach any calculations made for the design of such items as sediment ponds, diversions, and waterways, as well as calculations for runoff and stormwater detention design (if applicable). Engineering calculations must bear the signature and stamp of an engineer licensed in the state of Washington.
- Certified Erosion and Sediment Control Lead (CESCL): Identify a CESCL along with their contact information and expiration of their CESCL certification.

6.3.3.2 Drawings

1. Vicinity map - Provide a map with enough detail to identify the location of the construction site, adjacent roads, and receiving waters.

2. Site map - Provide a site map(s) showing the following features:

3. A legal description of the property boundaries or an illustration of property lines (including distances) in the drawings.

4. The direction of north in relation to the site.

5. Existing structures and roads, if present.

6. Boundaries and labeling of different soil types.

7. Areas of potential erosion problems.

8. Any on-site and adjacent surface waters, critical areas, their buffers, FEMA base flood boundaries, and shoreline management boundaries.

9. Existing contours and drainage basins and the direction of flow for the different drainage areas.

10. Final and interim grade contours as appropriate, drainage basins, and the direction of stormwater flow during and upon completion of construction.

11. Areas of proposed soil disturbance, including all areas affected by clearing, grading and excavation.

12. Locations where stormwater discharges to surface waters during and upon completion of construction.

13. Existing unique or valuable vegetation and the vegetation that is to be preserved.

14. Cut and fill slopes indicating top and bottom of slope catch lines.

15. Stockpile, waste storage, and vehicle storage/maintenance areas.

16. Total cut and fill quantities and the method of disposal for excess material.

17. Conveyance systems - Provide a map that shows the following temporary and permanent conveyance features:

    a. Locations for temporary and permanent swales, interceptor trenches, or ditches.

    b. Drainage pipes, ditches, or cut-off trenches associated with erosion and sediment control and stormwater management.

    c. Temporary and permanent pipe inverts and minimum slopes and cover.

    d. Grades, dimensions, and direction of flow in all ditches and swales, culverts, and pipes.

e. Details for bypassing off-site runoff around disturbed areas.

f. Locations and outlets of any dewatering systems.

18. Location of detention BMPs – Provide a map that shows the locations of stormwater detention BMPs.

19. Erosion and Sediment Control (ESC) BMPs – provide a map that shows all major structural and nonstructural ESC BMPs including:

    a. The location of sediment pond(s), pipes and structures.

    b. Dimension pond berm widths and inside and outside pond slopes.

    c. The trap/pond storage required and the depth, length, and width dimensions.

    d. Typical section views through pond and outlet structure.

    e. Typical details of gravel cone and standpipe, and/or other filtering devices.

    f. Stabilization technique details for inlets and outlets.

    g. Control/restrictor device location and details.

    h. Stabilization practices for berms, slopes, and disturbed areas.

    i. Rock specifications and detail for rock check dam, if used.

    j. Spacing for rock check dams as required.

    k. Front and side sections of typical rock check dams.

    l. The location, detail, and specification for silt fence.

20. The construction entrance location and a detail.

21. Other Maps – Provide a map that indicates:

    a. Pollutant BMPs – the location of BMPs to be used for the control of pollutants other than sediment, such as high or low pH and hydrocarbons.

    b. Monitoring locations – water quality sampling locations, if sampling is required by Clark County.

22. Detailed drawings – Any structural source control practices used that are not referenced in this manual or other manuals approved as equivalent by Ecology must be explained and illustrated with detailed drawings.

23. Notes addressing construction phasing and scheduling must be included on the drawings.

6.3.4 Step-By-Step Procedure

There are three basic steps in producing a Construction SWPPP:

Step 1 – Data Collection

Step 2 – Data Analysis

Step 3 – Construction SWPPP Development and Implementation

Guidance for developing a Construction SWPPP is included as the Construction SWPPP Checklist in Appendix 1-F.

6.3.4.1 Step 1 - Data Collection

Evaluate existing site conditions and gather information that will help develop the most effective Construction SWPPP. The Construction SWPPP author may use the information collected during the development of the Stormwater Site Plan to provide the information listed below.

Topography

Prepare a topographic drawing of the site to show the existing contour elevations at intervals of 1 to 5 feet depending upon the slope of the terrain.

Drainage

Locate and clearly mark existing drainage swales and patterns on the drawing, including existing storm drain pipe systems.

Soils

Identify and label soil type(s) and erodibility (low, medium, high or an index value) on the drawing or in the narrative.

Characterize soils for permeability, percent organic matter, and effective depth. This information is available in generalized descriptions for the county in a federal Natural Resource Conservation Service report. Typical general descriptions include:

- A sieve analysis of the soils
- Permeability (in/hr)
- Available water-holding capacity (in/in)
- The percent of organic matter

Soils information can be obtained from a Natural Resource Conservation Service (NRCS) manual or the NRCS' Web Soil Survey website at http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm.

Washington state soil survey information is available at: http://www.nrcs.usda.gov/wps/portal/nrcs/surveylist/soils/survey/state/?stateId=WA

Additionally, site-specific soil data can be obtained through site soil analysis as a part of preparation of a Technical Information Report and a Soils Report (see Section 1.8.1.5 and Section 1.8.3).

Ground Cover and Native Vegetation

Label existing vegetation on the drawing. Show features such as tree clusters, grassy areas, and unique or sensitive vegetation. Unique vegetation may include existing trees above a given diameter. Indicate existing denuded or exposed soil areas. Show other special features such as individual trees and areas of native vegetation required to be protected during construction. Projects may protect areas of native vegetation to meet LID requirements.

Critical Areas

Delineate critical areas adjacent to or within the site on the drawing. Show features such as steep slopes, erosion hazard areas, riparian habitat buffers, streams, floodplains, lakes, wetlands and wetland buffers, and geologic hazard areas. Delineate setbacks and buffer limits for these features on the drawings. On the drawings, show other related jurisdictional boundaries such as Shorelines Management and the Federal Emergency Management Agency (FEMA) base floodplain.

Adjacent Areas

Identify existing buildings, roads, and facilities adjacent to or within the project site on the drawings. Identify existing and proposed utility locations, construction clearing limits and erosion and sediment control BMPs on the drawings.

Existing Encumbrances

Identify wells, existing and abandoned septic drainfield, utilities, easements, setbacks, and site constraints.

Precipitation Records

Determine the average monthly rainfall and rainfall intensity for the required design storm events. These records may be available from the local permitting agency. Book 2 Appendix 2-A also has resources for determining rainfall values.

6.3.4.2 Step 2 - Data Analysis

Consider the data collected in Step 1 to identify potential problems and limitations of the site. The following are some important factors to consider in data analysis:

Topography

The primary topographic considerations are slope steepness and length. Steeper and longer slopes have greater erosion potential than do flat and short slopes. A qualified engineer, licensed geologist, soil professional, or certified erosion and sediment control lead should determine erosion potential.

Drainage

Convey runoff through the use of natural drainage patterns that consist of overland flow, swales and depressions to avoid constructing an artificial drainage system. Properly stabilize man-made ditches and waterways so they do not create erosion problems. Take care to ensure that increased runoff from the site will not erode or flood the existing natural drainage system. Consider possible sites for temporary stormwater retention and detention.

Direct construction away from areas of saturated soil where groundwater may be encountered and away from critical areas where drainage will concentrate. Preserve natural drainage patterns on the site.

Soils

Evaluate soil properties such as surface and subsurface runoff characteristics, depth to impermeable layer, depth to seasonal groundwater table, permeability, shrink-swell potential, texture, settleability, and erodibility. Develop the Construction SWPPP based on known soil characteristics and topography.

Protect infiltration sites from clay and silt, which will reduce infiltration capacities.

Ground Cover

Ground cover is the most important factor in terms of preventing erosion. Preserving existing vegetation will prevent erosion better than constructing BMPs to treat polluted runoff. Trees and other vegetation protect the soil structure. If the existing vegetation cannot be saved, consider such practices as phasing construction, temporary seeding, and mulching. Phasing construction involves stabilizing one part of the site before disturbing another. In this way, the entire site is not disturbed at once.

Critical Areas

Any critical areas within or adjacent to the development should exert a strong influence on land development decisions. Delineate critical areas and their buffers on the drawings and clearly flag

critical areas in the field. For example, chain link fencing may be more useful than flagging to assure that equipment operators stay out of critical areas. Only unavoidable work should take place within critical areas and their buffers. Such unavoidable work will require special BMPs, county critical area permitting, restrictions, and mitigation plans.

Adjacent Areas

An analysis of adjacent properties should focus on areas upslope and downslope from the project. Water bodies that will receive direct runoff from the site are a major concern. Evaluate the types, values, and sensitivities of and risks to downstream resources, such as property, stormwater facilities, infrastructure or aquatic systems. Select erosion and sediment controls accordingly.

Precipitation Records

Refer to Book 2, Chapter 1 to determine the required rainfall records and the method of analysis for design of BMPs such as ponds and Book 2, Chapter 7 for design of conveyances.

Timing of the Project

Consider the timing and duration of the project when selecting BMPs. Projects that will proceed during the wet season and projects that will last through several seasons must take all necessary precautions to remain in compliance with the water quality standards.

6.3.4.3 Step 3 – Develop and Implement the Construction SWPPP

After collecting and analyzing the data to determine the site limitations, develop a Construction SWPPP. The project proponent shall include each of the 13 elements in the Construction SWPPP, unless site conditions render the element unnecessary and the exemption from that element is clearly justified in the narrative of the SWPPP. All items in each element are required, as long as the project is not exempt from the element.

6.4 The Thirteen Elements Described

6.4.1 Element #1: Preserve Vegetation/Mark Clearing Limits

- Before beginning land disturbing activities, including clearing and grading, clearly mark all clearing limits, sensitive areas and their buffers, and trees that are to be preserved within the construction area.
- Retain the duff layer, native top soil, and natural vegetation in an undisturbed state to the maximum degree practical. If not practical to retain it in place, then stockpile it on-site, cover it to prevent erosion, and replace it immediately when the site is ready for stabilization.

Suggested BMPs

- BMP C101: Preserving Natural Vegetation
- BMP C102: Buffer Zones
- BMP C103: High Visibility Plastic or Metal Fence
- BMP C233: Silt Fence

6.4.2 Element #2: Establish Construction Access

- Limit construction vehicle access and exit to one route, if possible.
- Stabilize access points with a pad of quarry spalls, crushed rock, or other equivalent BMPs, to minimize tracking sediment onto roads.
- Locate wheel wash or tire baths on site, if the stabilized construction entrance is not effective in preventing tracking sediment onto roads.
- If sediment is tracked off site, clean the affected roadway thoroughly at the end of each day, or more frequently as necessary (for example, during wet weather). Remove sediment from roads by shoveling, sweeping, or pick up and transport the sediment to a controlled sediment disposal area.
- Conduct street washing only after sediment is removed in accordance with the above bullet.
- Control street wash wastewater by pumping back on site or otherwise preventing it from discharging into systems tributary to waters of the State.

Suggested BMPs

- BMP C105: Stabilized Construction Entrance/Exit
- BMP C106: Wheel Wash
- BMP C107: Construction Road/Parking Area Stabilization

6.4.3 Element #3: Control Flow Rates

- Protect properties and waterways downstream of development sites from erosion and the associated discharge of turbid waters due to increases in the velocity and peak volumetric flow rate of stormwater runoff from the project site.
- Where necessary to comply with the bullet above, construct permanent stormwater ~~retention~~ infiltration or detention facilities as one of the first steps in grading. Such facilities must function properly before constructing site improvements (e.g. impervious surfaces).
- If permanent infiltration basins are used for flow control during construction, protect these facilities from siltation during the construction phase. The Responsible Official may require installation of a temporary sedimentation pond.

Sites that must implement flow control for the developed site condition must also control stormwater release rates during construction. Construction site stormwater discharges shall not exceed the discharge durations of the pre-developed condition for the range of pre-developed discharge rates from ½ of the 2-year flow through the 10-year flow as predicted by an approved continuous flow model. The pre-developed condition to be matched shall be the land cover condition immediately prior to the development project. This restriction on release rates can affect the size of the storage pond and treatment cells.

Suggested BMPs

- BMP C203: Water Bars
- BMP C207: Check Dams
- BMP C209: Outlet Protection
- BMP C235: Wattles
- BMP C240: Sediment Trap
- BMP C241: Temporary Sediment Pond
- Refer to Chapter 4 for selection of ponds, and Book 2, Chapter 6 for design of ponds; also see Book 2, Chapter 7 for design of conveyance

6.4.4 Element #4: Install Sediment Controls

- Design, install and maintain effective erosion controls and sediment controls to minimize the discharge of pollutants.
- Construct sediment control BMPs (sediment ponds, traps, filters, etc.) as one of the first steps in grading. These BMPs ~~shall~~ ~~must~~ be functional before other land disturbing activities take place.
- Minimize sediment discharges from the site. The design, installation and maintenance of erosion and sediment controls must address factors such as the amount, frequency, intensity and duration of precipitation, the nature of resulting stormwater runoff, and soil characteristics, including the range of soil particle sizes expected to be present on the site.
- Direct stormwater runoff from disturbed areas through ~~a sediment pond~~ BMP C241or other appropriate sediment removal BMP, before the runoff leaves a construction site or before discharge to an infiltration facility. Runoff from fully stabilized areas may be discharged without a sediment removal BMP, but must meet the flow ~~control performance standard~~ flow rates in Element #3: Control Flow Rates~~., bullet #1~~.
- Locate BMPs intended to trap sediment on site in a manner to avoid interference with the movement of juvenile salmonids attempting to enter off-channel areas or drainages.
- Provide and maintain natural buffers around surface waters, direct stormwater to vegetated areas to increase sediment removal and maximize stormwater infiltration, unless infeasible.

- Where feasible, design outlet structures that withdraw impounded stormwater from the surface to avoid discharging sediment that is still suspended lower in the water column.

Suggested BMPs

- BMP C231: Brush Barrier
- BMP C232: Gravel Filter Berm
- BMP C233: Silt Fence
- BMP C234: Vegetated Strip
- BMP C235: Wattles
- BMP C240: Sediment Trap
- BMP C241: Temporary Sediment Pond
- BMP C250: Construction Stormwater Chemical Treatment
- BMP C251: Construction Stormwater Filtration

6.4.5 Element #5: Stabilize Soils

- Stabilize exposed and unworked soils by application of effective BMPs that prevent erosion. Control stormwater volume and velocity within the site to minimize soil erosion.
- Control stormwater discharges, including both peak flow rates and total stormwater volume, to minimize erosion at outlets and to minimize downstream channel and stream bank erosion.
- Soils must not remain exposed and unworked for more than the time periods set forth below:
    - During the dry season (May 1 - Sept. 30): 7 days
    - During the wet season (October 1 - April 30): 2 days
- Stabilize soils at the end of the shift before a holiday or weekend if needed based on the weather forecast.
- Stabilize soil stockpiles from erosion, protect with sediment trapping measures, and where possible, locate away from storm drain inlets, waterways, and drainage channels.
- Minimize the amount of soil exposed during construction activity.
- Minimize the disturbance of steep slopes.
- Minimize soil compaction and, unless infeasible, preserve topsoil.

Suggested BMPs

- BMP C120: Temporary and Permanent Seeding
- BMP C121: Mulching
- BMP C122: Nets and Blankets

- BMP C123: Plastic Covering
- BMP C124: Sodding
- BMP C125: Topsoiling/Composting
- BMP C126: Polyacrylamide for Soil Erosion Protection
- BMP C130: Surface Roughening
- BMP C131: Gradient Terraces
- BMP C140: Dust Control

6.4.6 Element #6: Protect Slopes

- Design and construct cut-and-fill slopes in a manner to minimize erosion. Applicable practices include, but are not limited to, reducing continuous length of slope with terracing and diversions, reducing slope steepness, and roughening slope surfaces (for example, track walking).
- Divert off-site stormwater (run-on) or groundwater away from slopes and disturbed areas. Manage off-site stormwater separately from stormwater generated on the site.
- At the top of slopes, collect drainage in pipe slope drains or protected channels to prevent erosion. Temporary pipe slope drains must be sized to convey the flow rate calculated by one of the following methods:

  ~~Temporary pipe slope drains must handle the peak~~ Single Event Hydrograph Method: The peak volumetric flow rate calculated using 10-minute time step from a Type 1A, 10-year, 24-hour frequency storm.

  OR

  Continuous Simulation Method: The 10-year peak flow rate as determined by an approved continuous flow model with a 15-minute time step.

  ~~velocity of flow from a Type 1A, 10-year, 24-hour frequency storm for the developed condition. Alternatively, the 10-year, 1-hour flow rate predicted by an approved continuous flow model, increased by a factor of 1.6, may be used.~~ The hydrologic analysis must use the existing land cover condition for predicting flow rates from tributary areas outside the project limits. For tributary areas on the project site, the analysis must use the temporary or permanent project land cover condition, whichever will produce the highest flow rates. If using an approved continuous flow model to predict flows, bare soil areas should be modeled as "landscaped" area.
- Place excavated material on the uphill side of trenches, consistent with safety and space considerations.
- Place check dams at regular intervals within constructed channels that are cut down a slope.

Additional Guidance

- BMP combinations are the most effective method of protecting slopes with disturbed soils. For example use both mulching and straw erosion control blankets in combination.

Suggested BMPs

- BMP C120: Temporary and Permanent Seeding
- BMP C121: Mulching
- BMP C122: Nets and Blankets
- BMP C130: Surface Roughening
- BMP C131: Gradient Terraces
- BMP C200: Interceptor Dike and Swale
- BMP C201: Grass-Lined Channels
- BMP C203: Water Bars
- BMP C204: Pipe Slope Drains
- BMP C205: Subsurface Drains
- BMP C206: Level Spreader
- BMP C207: Check Dams
- BMP C208: Triangular Silt Dike (Geotextile-Encased Check Dam)

6.4.7 Element #7: Protect Drain Inlets

- Protect all storm drain inlets made operable during construction and existing storm drain inlets that receive runoff from the site so that stormwater runoff does not enter the conveyance system without first being filtered or treated to remove sediment.
- Clean or remove and replace inlet protection devices when sediment has filled one-third of the available storage or when the standard specified by the product manufacturer is exceeded.
- Inspect inlets weekly, at a minimum, and daily during storm events.

Suggested BMPs

- BMP C220: Storm Drain Inlet Protection

6.4.8 Element #8: Stabilize Channels and Outlets

- Design, construct, and stabilize all on-site conveyance channels to prevent erosion from the flow rate calculated by one of the following methods ~~expected peak flows~~:
    - Single Event Hydrograph Method: The peak volumetric flow rate calculated using a 10-minute time step from a TypeA, 10-year, 24-hour frequency storm. ~~Channels~~

~~must handle the peak 10-minute velocity of flow from a Type 1A, 10-year, 24-hour frequency storm for the developed condition.~~

- OR
- Continuous Simulation Method: The 10-year peak flow rate as determined by an approved continuous flow model with a 15-minute time step.
- ~~Alternatively, the 10-year, 1-hour flow rate indicated by an approved continuous flow model, increased by a factor of 1.6, may be used.~~ The hydrologic analysis must use the existing land cover condition for predicting flow rates from tributary areas outside the project limits. For tributary areas on the project site, the analysis must use the temporary or permanent project land cover condition, whichever will produce the highest flow rates. If using an approved continuous flow model to predict flows, bare soil areas should be modeled as "landscaped area".

- Provide stabilization and armoring, adequate to prevent erosion of outlets, adjacent streambanks, slopes, and downstream reaches at the outlets of all conveyance systems.

Suggested BMPs

- BMP C202: Channel Lining
- BMP C122: Nets and Blankets
- BMP C201: Grass-Lined Channels
- BMP C206: Level Spreader
- BMP C207: Check Dams
- BMP C208: Triangular Silt Dike (Geotextile-Encased Check Dam)
- BMP C209: Outlet Protection

6.4.9 Element #9: Control Pollutants

- Design, install, implement and maintain effective pollution prevention measures to minimize the discharge of pollutants. The project proponent must:
- Handle and dispose of all pollutants, including waste materials and demolition debris that occur on-site in a manner that does not cause contamination of stormwater.
- Provide cover, containment, and protection from vandalism for all chemicals, liquid products, petroleum products, and other materials that have the potential to pose a threat to human health or the environment. On-site fueling tanks must include secondary containment. Secondary containment means placing tanks or containers within an impervious structure capable of containing 110% of the volume contained in the largest tank within the containment structure. Double-walled tanks do not require additional secondary containment.
- Conduct maintenance, fueling, and repair of heavy equipment and vehicles using spill prevention and control measures. Clean contaminated surfaces immediately following any spill incident.

Emergency repairs may be performed on-site using temporary plastic placed beneath and, if raining, over the vehicle.

- Discharge wheel wash or tire bath wastewater to a separate on-site treatment system that prevents discharge to surface water, ~~such as closed-loop recirculation or upland land application~~, or to the sanitary sewer, with local sewer district approval.
- Apply fertilizers and pesticides in a manner and at application rates that will not result in loss of chemical to stormwater runoff. Follow manufacturers' label requirements for application rates and procedures.
- Use BMPs to prevent contamination of stormwater runoff by pH-modifying sources. The sources for this contamination include, but are not limited to: recycled concrete stockpiles, bulk cement, cement kiln dust, fly ash, new concrete washing and curing waters, waste streams generated from concrete grinding and sawing, exposed aggregate processes, dewatering concrete vaults, concrete pumping and mixer washout waters.
- Adjust the pH of stormwater if necessary to prevent violations of the water quality standards.
- Assure that washout of concrete trucks is performed off-site or in designated concrete washout areas only. Do not wash out concrete ~~trucks~~ truck drums or concrete handling equipment onto the ground, or into storm drains, open ditches, streets, or streams. Washout of small concrete handling equipment may be disposed of in a formed area awaiting concrete surface water or ground water will not be contaminated. Do not dump excess concrete on site, except in designated concrete washout areas. Concrete spillage or concrete discharge ~~to~~ directly to groundwater or surface waters of the State is prohibited. Do not wash out to areas awaiting infiltration BMPs.
- Obtain written approval from the Department of Ecology before using chemical treatment other than CO_2 or dry ice, or food grade vinegar to adjust pH.
- Uncontaminated water from water-only based shaft drilling for construction of building, road, and bridge foundations may be infiltrated provided the wastewater is managed in a way that prohibits discharge to surface waters. Prior to infiltration, water from water-only based shaft drilling that comes into contact with curing concrete must be neutralized until pH is in the range of 6.5 to 8.5 su.

Suggested BMPs

- BMP C151: Concrete Handling
- BMP C152: Sawcutting and Surfacing Pollution Prevention
- BMP C153: Material Delivery, Storage and Containment
- BMP C154: Concrete Washout Area
- BMP C250: Construction Stormwater Chemical Treatment
- BMP C251: Construction Stormwater Filtration

- BMP C252: High pH Neutralization Using CO_2
- BMP C253: pH Control for High pH Water
- See Book 3 – Source Control

6.4.10 Element #10: Control Dewatering

- Discharge foundation, vault, and trench dewatering water, which have characteristics similar to stormwater runoff at the site, into a controlled conveyance system before discharge to a BMP C240 Sediment Trap or BMP C241 Sediment Pond.
- Discharge clean, non-turbid dewatering water, such as well-point groundwater, to systems tributary to, or directly into surface waters of the state, as specified in Element #8, provided the dewatering flow does not cause erosion or flooding of receiving waters or interfere with the operation of the system. Do not route clean dewatering water through stormwater sediment pond BMPs. Note that "surface waters of the State" may exist on a construction site as well as off site; for example, a creek running through a site.
- Handle highly turbid or contaminated dewatering water separately from stormwater.
- Other dewatering treatment or disposal options may include:
    - Infiltration.
    - Transport off-site in a vehicle, such as a vacuum flush truck, for legal disposal in a manner that does not pollute state waters.
    - Ecology-approved on-site chemical treatment or other suitable treatment technologies.
    - Sanitary sewer discharge with local sewer district approval, if there is no other option.
    - Use of a sedimentation bag with outfall to a ditch or swale for small volumes of localized dewatering.

Suggested BMPs

- BMP C203: Water Bars
- BMP C236: Vegetative Filtration

6.4.11 Element #11: Maintain BMPs

- Maintain and repair all temporary and permanent erosion and sediment control BMPs as needed to assure continued performance of their intended function in accordance with BMP specifications.
- Remove all temporary erosion and sediment control BMPs within 30 days after achieving final site stabilization or after the temporary BMPs are no longer needed, unless the BMP is biodegradable and designed to remain in place after construction (e.g. compost socks).

- Protect all BMPs installed for the permanent control of stormwater from sediment and compaction. All BMPs that are to remain in place following completion of construction shall be examined and placed in full operating conditions. If sediment enters the BMPs during construction, it shall be removed and the facility shall be returned to the conditions specified in the construction documents.
- Remove or stabilize trapped sediment on site. Permanently stabilize disturbed soil resulting from removal of BMPs or vegetation.

Suggested BMPs

- BMP C150: Materials On Hand
- BMP C160: Certified Erosion and Sediment Control Lead

6.4.12 Element #12: Manage the Project

- Phase development projects to the maximum degree practicable and take into account seasonal work limits.
- Inspect, maintain, and repair all BMPs as needed to assure continued performance of their intended function.
    - All land disturbing activities performed by licensed contractors must have site inspections conducted by an individual who possesses a valid CESCL certification.
    - All projects disturbing one acre or more must have site inspections conducted by an individual who possesses a valid CESCL certification.
    - Prior to initiating land-disturbing activities, all sites must identify an inspector, which will be the CESCL on sites meeting criteria above, in the SWPPP.
        - The inspector/CESCL must attend the Preconstruction Conference and the Preconstruction Site Inspection.
    - The inspector/CESCL shall be present on-site or be on-call at all times.
- Construction site operators shall maintain, update, and implement the Construction SWPPP.

Site Inspection Requirements

- The CESCL or inspector must assess the:
    - Site conditions and construction activities that could impact the quality of stormwater.
    - Effectiveness of erosion and sediment control measures used to control the quality of stormwater discharges.
- The CESCL or inspector must examine stormwater visually for the presence of suspended sediment, turbidity, discoloration, and oil sheen. They must evaluate the effectiveness of BMPs

and determine if it is necessary to install, maintain, or repair BMPs to improve the quality of stormwater discharges.

Based on the results of the inspection, construction site operators must correct problems identified by:

- Reviewing the SWPPP for compliance with the 13 construction SWPPP elements and making appropriate revisions within 7 days of the inspection.
- Immediately beginning the process of fully implementing and maintaining appropriate source control and/or treatment BMPs as soon as possible, addressing the problems no later than within 10 days of the inspection. If installation of necessary treatment BMPs is not feasible within 10 days, the construction site operator may request an extension from the Responsible Official within the initial 10-day response period.
- Documenting BMP implementation and maintenance in the site log book (sites larger than 1 acre).

- The CESCL or inspector must inspect all areas disturbed by construction activities, all BMPs, and all stormwater discharge points at least once every calendar week and within 24 hours of any discharge from the site. (For purposes of this condition, individual discharge events that last more than one day do not require daily inspections. For example, if a stormwater pond discharges continuously over the course of a week, only one inspection is required that week.) The CESCL or inspector may reduce the inspection frequency for temporarily stabilized, inactive sites to once every calendar month

Wet Season Requirements

- From October 1 through April 30, clearing, grading, and other soil disturbing activities is permitted only if shown to the satisfaction of Clark County that the site operator will prevent silt-laden runoff from leaving the site through a combination of the following:
  - Site conditions including existing vegetative coverage, slope, soil type, and proximity to receiving waters.
  - Limit activities and the extent of disturbed areas.
  - Proposed erosion and sediment control measures.
  - Based on the information provided and/or local weather conditions, the Responsible Official may expand or restrict the seasonal limitation on site disturbance. The Responsible Official may take enforcement action – such as a notice of violation, administrative order, penalty, or stop-work order under any of the following circumstances:
    - If, during the course of any construction activity or soil disturbance during the seasonal limitation period, sediment leaves the construction site causing a violation of the surface water quality standard.

- If clearing and grading limits or erosion and sediment control measures shown in the approved plan are not maintained.

The following activities are exempt from the seasonal clearing and grading limitations:

- Routine maintenance and necessary repair of erosion and sediment control BMPs.
- Routine maintenance of public facilities or existing utility structures that do not expose the soil or result in the removal of the vegetative cover to soil.
- Activities where there is one hundred percent infiltration of surface water runoff within the site in approved and installed erosion and sediment control facilities.

Suggested BMPs

- BMP C150: Materials On Hand
- BMP C160: Certified Erosion and Sediment Control Lead
- BMP C162: Scheduling

6.4.13 Element #13: Protect Low Impact Development BMPs

The primary purpose of On-Site Stormwater Management is to reduce the disruption of the natural site hydrology by infiltrating rainfall. BMPs used to meet Minimum Requirement #5 On-Site Stormwater Management (LID) are permeable facilities susceptible to clogging.

- Protect all LID BMPs, including bioretention facilities, ~~and~~ rain gardens and permeable pavements from sedimentation through installation and maintenance of erosion and sediment control BMPs on portions of the site that drain into them. Restore the BMPs to their fully functioning condition if they accumulate sediment during construction. Restoring the BMP must include removal of sediment and any sediment-laden bioretention/rain garden soils, and replacing the removed soils with soils meeting the design specification.
- ~~Prevent compacting bioretention and rain garden BMPs~~ Maintain the infiltration capacity of LID BMPs by protecting against compaction by excluding construction equipment and foot traffic. Protect completed lawn and landscaped areas from compaction by construction equipment.
- Control erosion and avoid introducing sediment from surrounding land uses onto permeable pavements. Do not allow muddy construction equipment on the base material or pavement. Do not allow sediment-laden runoff onto permeable pavements or base materials.
- Permeable pavement fouled with sediments or no longer passing an initial infiltration text must be cleaned using procedures from Book 4 or the manufacturer's procedures.
- Keep all heavy equipment off existing soils under LID facilities that have been excavated to final grade to retain the infiltration rate of the soils.

See Chapter 5: Precision Site Preparation and Construction in the LID Technical Guidance Manual for Puget Sound for more detail on protecting LID integrated management practices.

Suggested BMPs

- BMP C102: Buffer Zone
- BMP C103: High Visibility Fence
- BMP C200: Interceptor Dike and Swale
- BMP C201: Grass-Lined Channels
- BMP C207: Check Dams
- BMP C208: Triangular Silt Dike (TSD) (Geotextile-Encased Check Dam)
- BMP C231: Brush Barrier
- BMP C233: Silt Fence
- BMP C234: Vegetated Strip

6.5 BMP Selection

Table 6.2 summarizes the Source Control BMPs that are applicable to the 13 Elements. Use this table to help select source control BMPs for the project site. Elements not shown are not satisfied through installation of Source Controls. BMP Information Sheets for design and installation of the BMPs are found in Book 2, Chapter 8.

Table 6.3 summarizes the Conveyance and Treatment BMPs that are applicable to the 13 Elements. Use this table to help select conveyance and treatment BMPs for the project site. Elements not shown are not satisfied through installation of runoff conveyance and treatment BMPs. BMP Information Sheets for design and installation of the BMPs are found in Book 2, Chapter 8.

Table 6.2 Source Control BMPs by SWPPP Element

▼ BMP / Element No. ▶	1 Preserve Vegetation / Mark Clearing Limits	2 Establish Construction Access	5 Stabilize Soils	6 Protect Slopes	8 Stabilize Channels and Outlets	9 Control Pollutants	11 Maintain BMPs	12 Manage the Project	13 Protect Low Impact Development BMPs
BMP C101: Preserving Natural Vegetation	✔								
BMP C102: Buffer Zones	✔								✔
BMP C103: High Visibility Plastic or Metal Fence	✔								✔
BMP C105: Stabilized Construction Entrance/Exit		✔							
BMP C106: Wheel Wash		✔							
BMP C107: Construction Road/ Parking Stabilization		✔							
BMP C120: Temporary & Permanent Seeding			✔	✔					
BMP C121: Mulching			✔	✔					
BMP C122: Nets & Blankets			✔	✔	✔				
BMP C123: Plastic Covering			✔						
BMP C124: Sodding			✔						
BMP C125: Topsoiling/ Composting			✔						
BMP C126: Polyacrylamide for Soil Erosion Protection			✔						
BMP C130: Surface Roughening			✔	✔					
BMP C131: Gradient Terraces			✔	✔					
BMP C140: Dust Control			✔						
BMP C150: Materials on Hand							✔	✔	
BMP C151: Concrete Handling						✔			
BMP C152: Sawcutting and Surfacing Pollution Prevention						✔			
BMP C153: Material Delivery, Storage & Containment						✔			
BMP C154: Concrete Washout Area						✔			
BMP C160: Certified Erosion & Sediment Control Lead							✔	✔	
BMP C162: Scheduling								✔	

Table 6.3 Runoff Conveyance and Treatment BMPs by SWPPP Element

▼ BMP / Element No. ▶	3	4	6	7	8	9	10	13
	Control Flow Rates	Install Sediment Controls	Protect Slopes	Protect Drain Inlets	Stabilize Channels and Outlets	Control Pollutants	Control Dewatering	Protect Low Impact Development BMPs
BMP C200: Interceptor Dike and Swale			✔					✔
BMP C201: Grass-lined Channels			✔					✔
BMP C202: Channel Lining					✔			
BMP C203: Water Bars	✔		✔				✔	
BMP C204: Pipe Slope Drains			✔					
BMP C205: Surface Drains			✔					
BMP C206: Level Spreader			✔				✔	✔
BMP C207: Check Dams	✔		✔		✔			✔
BMP C208: Triangular Silt Dike (Geotextile Encased Check Dam)			✔					
BMP C209: Outlet Protection	✔				✔			
BMP C220: Storm Drain Inlet Protection				✔				
BMP C231: Brush Barrier		✔						✔
BMP C232: Gravel Filter Berm		✔						
BMP C233: Silt Fence		✔						✔
BMP C234: Vegetated Strip		✔						✔
BMP C235: Wattles	✔	✔						
BMP C236: Vegetated Filtration							✔	
BMP C240: Sediment Trap	✔	✔						
BMP C241: Temporary Sediment Pond	✔	✔						
BMP C250: Construction Stormwater Chemical Treatment		✔				✔		
BMP C251: Construction Stormwater Filtration		✔				✔		
BMP C252: High pH Neutralization Using CO_2						✔		
BMP C253: pH Control for High pH Water						✔		

6.5.1 Products Approved as Equivalent

Ecology has approved products as equivalent to some BMPs in this chapter. The products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. Clark County may choose not to accept a product approved as equivalent. The products are available for review on Ecology's website at http://www.ecy.wa.gov/programs/wq/stormwater/newtech/equivalent.html

BMPs that have approved equivalents will contain a notation in the Conditions of Use. Obtain approval in the Construction SWPPP from the Responsible Official prior to using an approved equivalent.

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Book I References

American Petroleum Institute, "Design and Operation of Oil-Water Separators," Publication 421, Feb. 1990.

Chow, V.T., "Open Channel Hydraulics", McGraw-Hill Book Co., New York, 1959.

Corbitt, Robert A., "Oil and Grease Removal," Handbook of Environmental Engineering, McGraw-Hill, Inc., 1990.

Hinman, Curtis, "Rain Garden Handbook for Western Washington Homeowners", WSU Pierce County Extension, June 2013.

Hinman, Curtis, "Low Impact Development Technical Guidance Manual for Puget Sound", WSU Puyallup Research & Extension Center and Puget Sound Partnership, December 2012.

Massmann, Joel and Carolyn Butchart. Infiltration Characteristics, Performance, and Design of Storm Water Facilities, U. of Washington, March 2000.

U.S. Dept. of Commerce, Bureau of Public Roads, "Design Charts for Open-Channel Flow, Hydraulic Design Series 3", Washington, D.C., 1961.

Urbonas, Ben, Hydraulic Design of Sand Filters for Stormwater Quality, 1997.

Wa. Dept. of Ecology, "NPDES and State Waste Discharge General Permit for Stormwater Discharges Associated with Industrial Activities," ~~October 21, 2009~~ November 2019.

Wa. Dept. of Ecology, "Stormwater Management Manual for Western Washington", August 2012.

Wa. Dept. of Ecology, "Stormwater Management Manual for Western Washington", ~~August 2012, as amended December 2014~~2019.

Wa. Dept. of Fish and Wildlife, "Integrated Streambank Protection Guidelines", 2003.

Wa. Dept. of Fish and Wildlife, "Water Crossing Design Guidelines", 2013.

Wa. Dept. of Transportation, "Highway Runoff Manual", 2019.

Wa. Dept. of Transportation, "Hydraulics Manual", 2019.

Washington State University Extension, "Rain Garden Handbook for Western Washington", 2013.