City of Gig Harbor
Stormwater Management and Site Development Manual

Volume VI
Comprehensive Low Impact Development Site Designs

Prepared by:
Pierce County Planning and Public Works
Modified for:
City of Gig Harbor Public Works Department
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Chapter 1 - Introduction and Requirements

The primary focus of this volume is on the strategies and practices necessary to achieve the City's Comprehensive LID Site Design requirements, as required by Title 17 of the Gig Harbor Municipal Code (GHMC)or other requirements.

1.1 Volume Intent

This volume presents general guidelines and strategies for site assessment and site layout, as well as detailed requirements for LID BMPs that are integral to Comprehensive LID Site Design. The guidelines and requirements outlined in this volume are to be used primarily to achieve the City's Comprehensive LID Site Design requirements, but also apply to other types of projects. **Regardless, all projects still must also review and adhere to the minimum requirements outlined in Volume I.**

1.2 Applicability and Administration

1.2.1 Applicability

This volume is applicable to development projects required to achieve the City's Comprehensive LID Site Design approach, per Title 17 GHMC.

Chapter 2 of this volume contains BMPs that are also applicable to projects **not** subject to the City's Comprehensive LID Site Design approach. Some of the BMPs in Chapter 2 are standard LID BMPs that may be necessary to meet the minimum requirements of this manual.

1.2.2 Compliance with the Provisions of this Volume

The application of the Comprehensive LID Site Design approach is intended to reduce total impervious area, eliminate effective impervious area where possible, retain or restore native soils and vegetation, and reduce the overall development footprint and impact. A successful Comprehensive LID Site Design will use a combination of the LID BMPs included in Chapter 2 of this volume, and additional flow control LID BMPs included in Volume III. This comprehensive approach will achieve the performance goal and objectives outlined in Section 1.3, and will help meet several of the key minimum requirements for all development projects outlined in Volume I.

Where a Comprehensive LID Site Design is required by Title 17 GHMC (or other requirements), it will be at the discretion of the city review staff to determine whether the Comprehensive LID Site Design performance goals and objectives have been adequately achieved through the proposed LID site design.

In addition, the applicant is required to meet any applicable requirements set forth in Volumes I through V of this manual. To determine the applicable minimum requirements and the thresholds that trigger those requirements, see Volume I, Chapter 2.

1.2.3 Submittal Requirements

Comprehensive LID Site Design proposals shall comply with the submittal requirements outlined in Volume I, Chapter 3 of this manual. In addition, the following is required with an application for a short plat, preliminary plat, large lot, or land use which has proposed a Comprehensive LID Site Design:

- A LID site design inventory (as outlined in Section 1.4).
- Preliminary road and stormwater design calculations to assure that the design of stormwater treatment for the site has been adequately considered during the lot and open space layout process.
- Documentation showing that any applicable maintenance, management, or ownership submittal requirements outlined in Section 3.2.
- Where required (per the performance goals and objectives outlined in Section 1.3), documentation showing that the BMPs outlined in Chapter 2 have been considered and applied where feasible, and that every attempt was made to achieve near zero effective impervious area for the project.

1.3 Performance Goal and Objectives

This section outlines the performance goals and objectives that govern the review of any proposed Comprehensive LID Site Design. Note that the project proponent must also review and meet any applicable requirements set forth in Volumes I through V of this manual. **With the exception of projects implementing Full Dispersion, the Comprehensive LID Site Design requirements outlined in this volume are insufficient by themselves to achieve Volume I, Minimum Requirements #5, #6, and #7.** See additional notes below, and Volume I for further guidance and requirements.

The LID site design goal shall be achieved through adherence to the following:

- **Target Comprehensive LID Site Design goal for <u>residential</u> projects:**
    - Retain or restore 65 percent of the site's native soils and vegetation and set aside these areas into permanent open space areas, such as within a natural resource protection area, or designated tract for the stormwater drainage system.
    - Limit the total impervious area of the site to no more than 10 percent, and disperse all impervious areas in accordance with Section 2.3, Full Dispersion.
    - Residential projects meeting the full dispersion requirements and amaximum of 10 percent impervious area dispersed to 65 percent native forest protection areas **have fully met the requirements of Volume I, Minimum Requirements #5, #6, and #7**, and are not required to

demonstrate that additional BMPs outlined in Chapter 2 have been considered.

- **Minimum Comprehensive LID Site Design goal for <u>residential</u> projects:**

  - Where the above target goal of applying a maximum of 10 percent impervious area dispersed to 65 percent native forest protection area is not achieved, the applicant must retain or restore a minimum of 50 percent of the site's native soils and vegetation and limit the total impervious area of the site to no more than 25 percent. (Note that sites unable to maintain or create a 65 percent forested or native condition may still use a portion of the retained area to achieve full dispersion for a lesser portion of the developed area, as long as the ratio of the native vegetation area to the dispersed impervious area is not less than 65 to 10. See Section 2.3, Full Dispersion for further details.)

  - Where the above target goal of applying full dispersion is not achieved, the applicant must also demonstrate that the BMPs outlined in Chapter 2 have been considered and applied where feasible, and that every attempt was made to minimize effective impervious area for the project.

  - In addition, where the above target goal of applying full dispersion is not achieved, the applicant must demonstrate that Volume I, Minimum Requirements #5, #6, and #7 (if applicable) have been met.

- **Minimum Comprehensive LID Site Design goal for <u>commercial</u> projects:**

  - Retain or restore a minimum of 25 percent of the site's native soils and vegetation and set aside these areas into permanent open space areas such as within a natural resource protection area, or designated tract for the stormwater drainage system.

  - Limit the total impervious area of the site to no more than 25 percent, and disperse as much impervious area as feasible in accordance with Section 2.3, Full Dispersion.

  - Demonstrate that the BMPs outlined in Chapter 2 and Volume III have been considered and applied where feasible, and that every attempt was made to minimize effective impervious area for the project.

  - Unlike for residential sites, commercial projects that meet the target Comprehensive LID Site Design goal still may not fully meet Volume I, Minimum Requirements #5, #6, or #7.

1.4 Conduct a Site Analysis Prior to Designing a LID Project

The site analysis is a method of evaluating the topography, soils, vegetation, and water features to determine how the site currently processes stormwater. This evaluation

provides information essential for developing strategies to configure lots, determine where best to locate natural resource protection areas, and align road networks in a way that retains and restores natural hydrologic function.

1.4.1 Site Inventory Process

In addition to the site design techniques and requirements outlined in Volume I, the following LID site inventory is a required component of a Comprehensive LID Site Design, and shall be submitted with the application for the project.

Key physical and environmental features shall be inventoried on the proposed development site prior to the site planning process. In addition, important site characteristics on adjacent properties shall be assessed to identify how the project will impact or be influenced by the surrounding area. The functions of key environmental features shall be assessed for performance to determine potential impacts. Development areas shall be identified in the inventory, and ultimately shall be located outside of the natural resource protection areas and within designated buildable areas to minimize soil and vegetation disturbance. Development areas shall also take advantage of a site's natural ability to store and infiltrate stormwater.

A Comprehensive LID Site Design cannot be properly planned and implemented through desktop/map reconnaissance alone and will require onsite inventory and assessment. The following outlines the required elements of the "desktop" assessment only. (It will be up to the design engineer to identify additional onsite assessment requirements for Comprehensive LID Site Designs.)

- Soil surveys to provide broad characterization of regional soils (additional detailed analyses will be required for making detailed design decisions).
- Soil analyses from adjacent properties.
- Critical areas and associated buffers as set forth in Chapter 18.08 GHMC.
- Tree conservation areas as set forth in Title 17 GHMC. This should include the tree species, seral stage, diameter breast height, canopy cover, and condition of groundcover and shrub layer.
- Historic records documenting filling/altering of wetlands or stream channels.
- Aerial photos.
- Topographic features that may act as natural stormwater storage/conveyance (or alternatively, may hinder stormwater and LID approaches).
- Location of groundwater protection areas and/or 1-, 5-, and 10-year time-of-travel zones for municipal well protection areas.

- A description of local site geology, including soil or rock units likely to be encountered, the groundwater regime, and geologic history of the site.

- Identification of natural resource protection areas (e.g., riparian areas, wetlands, steep slopes, and other critical areas; significant wildlife habitat areas and their associated buffers; tree conservation areas; and permeable soils offering the best available infiltration potential).

- Areas suitable and/or proposed for development.

Chapter 2 - Low Impact Development Strategies and BMPs

2.1 Introduction

In contrast to conventional BMPs that typically collect and convey runoff to one location on the site, LID BMPs manage stormwater in small-scale, dispersed facilities located as close to the source of the runoff as possible. Most of the strategies and BMPs outlined in this chapter are general approaches applicable to overall site design and construction. Additional design guidelines for several more common engineered LID BMPs are provided in Volume III, Chapter 3. In addition, Volume II, Chapter 3 provides information on requirements for protecting LID BMPs during construction (in accordance with Volume I, Minimum Requirement #2).

BMPs discussed in this chapter include:

- Full Dispersion
- Better Site Design
- Preserving Native Vegetation
- Restoring Site Vegetation
- Minimize Impervious Areas
- Soil Preservation and Amendment.

2.2 Maintenance Criteria

Adequate operation and maintenance (O&M) must be provided for in the design, installation, and operation of all LID BMPs. See Minimum Requirement #9 in Volume I, as well Volume I, Appendix I-A for additional information on maintenance requirements. In addition, maintenance considerations and requirements specific to LID site designs are outlined in Chapter 3.

2.3 Full Dispersion (Ecology BMP T5.30)

This BMP allows for "fully dispersing" runoff from impervious surfaces and cleared areas of Project Sites into areas preserved as forest, native vegetation, or cleared area. See Volume III, Section 3.2.1 for General Dispersion Facility Design Criteria.

Projects that meet the requirements outlined below have fully met the requirements of Volume I, Minimum Requirements #5, #6, and #7, and are not required to demonstrate that additional LID BMPs outlined in Chapter 2 have been considered.

2.3.1 Applicability and Limitations

The site (or area of the site) that is applying full dispersion per this BMP must be laid out to allow the runoff from impervious (or cleared) surface to fully disperse into the preserved dispersion area (i.e., have full access to and not be intercepted by pipe(s), ditch(es), stream(s), river(s), pond(s), lake(s), or wetland(s)).

Projects that successfully apply this BMP on all or a portion of their site will decrease effective impervious surfaces, and may void triggering the TDA Thresholds in Minimum Requirement #7.

A site (or an area of a site) that applies full dispersion per this BMP consists of the following elements:

- **An impervious (or cleared) area.** The impervious (or cleared) area is the area that the design is mitigating for by using this BMP.

- **A flow spreader.** Runoff from the impervious (or cleared) area may need to be routed through a flow spreader (see Volume III, Section 4.9), depending on the site layout and type of impervious surface, as further described below.

- **A dispersion area.** This area defines the limits of the Full Dispersion BMP. The impervious (or cleared) area must disperse into the preserved dispersion area.

    - The dispersion area must be forest, native vegetation, or a cleared area depending on the site type. Details are provided below for what amount of vegetation the dispersion area must contain based on site type.
    - Preservation of existing vegetation areas must meet the requirements outlined under Section 2.5, Preserving Native Vegetation.
    - If the dispersion area must be preserved as forest or native vegetation, it may be a previously cleared area that has been replanted in accordance with **Native Vegetation Landscape Specifications** (below). For projects required to meet the Comprehensive LID Site Design, refer to Section 2.6, Restoring Site Vegetation for replanting requirements.
    - The dispersion area shall be situated to minimize the clearing of existing forest cover, to maximize the preservation of wetlands (though the wetland area and any streams and lakes do not count as part of the dispersion area), and to buffer stream corridors.
    - The dispersion area for single-family lots shall be protected through recorded covenants, permanent signage and fencing in accordance with Section 2.5.3 Vegetation Protection Post-construction. All other individual lots shall be placed in a tract or easement.

- The dispersion area(s) shall be shown on all property maps and shall be clearly marked during clearing and construction on the site.

- All trees within the preserved area at the time of permit application shall be retained, aside from the removal of dangerous or diseased trees.

- The dispersion area may be used for passive recreation and related facilities, including pedestrian and bicycle trails, nature viewing areas, fishing and camping areas, and other similar activities that do not require permanent structures. Cleared areas and areas of compacted soil associated with these areas and facilities must not exceed 8 percent of the dispersion area.

- The dispersion area may contain utilities and utility easements, but not septic systems. For the purpose of this BMP utilities are defined as potable and wastewater underground piping, underground wiring, and power and telephone poles.

- For sites with onsite sewage disposal systems, the discharge of runoff from the dispersion area must be located 30-feet upgradient, or 10-feet downgradient of the primary and reserve drainfield areas. This requirement may be modified by the Tacoma-Pierce County Health Department if site topography clearly prohibits flows from intersecting the drainfield or where site conditions (soil permeability, distance between systems, etc.) indicate that this is unnecessary.

- **A flow path through the dispersion area.** The length of the flow path from the impervious (or cleared) area through the dispersion area varies based on the site layout and type of impervious surface, as further described below. Regardless of the site layout and type of impervious surface the flow path must meet the following criteria:

  - The slope of the flow path must be no steeper than 15 percent for any 20-foot reach of the flow path. Slopes up to 20 percent are allowed where flow spreaders are located upstream of the dispersion area and at sites where vegetation can be established.
  - The flow paths from adjacent flow spreaders must be sufficiently spaced to prevent overlap of flows in the flow path area.

  - The flow path is not permitted within an erosion hazard, or landslide hazard area (as defined by Chapter 18.08 GHMC) unless the slope stability impacts of such systems have been analyzed and mitigated by a geotechnical professional, and appropriate analysis indicates that the impacts are negligible.

  - The flow path must be onsite or in an offsite tract or easement area reserved for such dispersion.

2.3.2 Design Criteria for Residential, Commercial, and Industrial Projects

Rural developments should use this BMP wherever possible to minimize effective impervious surfaces.

Full Dispersion from Impervious Surfaces

Impervious surfaces within the project may be "fully dispersed" if they are within a TDA that is less than 10 percent impervious. If the TDA has more than 10 percent impervious area, the design may still fully disperse up to 10 percent of the TDA's area. The impervious areas that are beyond the 10 percent cannot drain to the dispersion area and are subject to the thresholds in Minimum Requirements #6 and #7.. The lawn and landscaping areas associated with the impervious areas being mitigated may be dispersed into the dispersion area. The lawn and landscaped area must comply with Volume III, Section 3.1 Soil Preservation and Amendment.

The dispersion area must be preserved as forest or native vegetation.

The dispersion area shall have a minimum area 6.5 times the area of impervious surface draining to it.

The flow path from the impervious surface through the area preserved as forest or native vegetation must be at least 100-feet in length, or 25-feet for sheet flow from lawn and landscaping areas associated with the impervious area being mitigated.

The following additional guidelines must be followed for the following types of impervious surfaces within the project:

- **Full dispersion from roof surfaces:** Runoff from roof surfaces must either:
    - Provide dispersion BMPs as described in Downspout Dispersion Systems (Volume III, Section 3.9.4) prior to the runoff entering the dispersion area. The dispersion area and flow path must meet the criteria described in this BMP.

or

    - Combine the roof runoff with the road runoff and follow the guidance for full dispersion from roadway surfaces (below).

- **Full dispersion from driveway surfaces:** Runoff from driveway surfaces must either:
    - Provide dispersion BMPs as described in Sheet Flow Dispersion (Volume III, Section 3.2.3) and Concentrated Flow Dispersion (Volume III, Section 3.2.4) prior to the runoff entering the dispersion area. The dispersion area and flow path must meet the criteria described in this BMP.

or

- Combine the driveway runoff with the road runoff and follow the guidance for full dispersion from roadway surfaces (below).

- **Full Dispersion from Roadway Surfaces:** Runoff from roadway surfaces must comply with all of the following 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 into the dispersion area. Ditch discharges with between 0.2 and 0.5 cfs discharge for the 100-year peak flow shall use only dispersion trenches to disperse flows into the dispersion area. See Outfalls (Volume III, Section 4.8) for details on rock pads and dispersion trenches.

  - 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 have a minimum 2 feet by 2 feet cross-section, 50-feet in length, filled with 0.75-inch to 1.5-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 four trenches. Dispersion trenches shall have a minimum spacing of 50-feet between centerlines.

  - 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 percent slope unless a level spreader is used (see criteria above), and shall be located within a designated open space.

  - Where the city determines there is a potential for significant adverse impacts downstream (e.g., erosive steep slopes or existing downstream

drainage problems), dispersion of roadway runoff may not be allowed, or other measures may be required.

Full Dispersion from Cleared Areas

The runoff from cleared areas that are comprised of bare soil, non-native landscaping, lawn, and/or pasture is "fully dispersed" if it meets all the following criteria:

- Cleared areas must comply with Soil Preservation and Amendment BMP (Volume III, Section 3.1).
- The dispersion area must be preserved as forest or native vegetation.
- The flow path through the cleared area (and leading to the dispersion area) must not be greater than 25-feet.
- If the cleared area has a width of up to 25-feet:
    - The minimum flow path length from the cleared area through the dispersion area must be at least 25-feet.
- If the cleared area has a width of 25- to 250-feet:
    - The minimum flow path length from the cleared area through the dispersion area must be 25-feet, plus an additional 1-foot for every 3-feet of width of the cleared area (beyond the initial 25-feet) up to a maximum width of 250-feet.
- The topography of the cleared area pervious surface must be such that runoff will not concentrate prior to discharge to the dispersion area.
- The width of the dispersion area must equal the width of the cleared area.

2.3.3 Design Criteria for Roadway Projects

These dispersion criteria apply to the construction of public and private roads not within the context of residential, commercial, or industrial site development. They will likely only be implementable on roads outside of the urban growth areas where roadside areas are not planned for urban density development.

Full dispersion can be applied to public and private road projects that meet the following requirements:

- The dispersion area must be outside of the urban growth area; or if inside the urban growth area, must be in legally protected areas (easements, conservation tracts, public parks).

- If the dispersion area is outside urban growth areas, legal agreements shall be reached with the owner(s) of the property(ies) that contain the dispersion area.

- An agreement with the property owner(s) is advised for any dispersion areas that represent a continuation of past practice. If not a continuation of past practice, an agreement shall be reached with the property owner.

Full Dispersion by Sheet Flow from Uncollected, Unconcentrated Runoff into the Dispersion Area

The runoff from public and private road projects that sheet flow into the dispersion area is "fully dispersed" if it meets all of the following criteria:

- The dispersion area must be preserved as forest or native vegetation.

- Depth to the average annual maximum groundwater elevation shall be at least 3-feet.

- The flow path through any impervious area leading to the dispersion area must not be greater than 75-feet.

- The flow path through any pervious area leading to the dispersion area must not be greater than 150-feet. Pervious flow paths include upgradient road side slopes that run onto the road and downgradient road side slopes that precede the dispersion area.

- The width of the dispersion area shall be equivalent to the width of impervious surface sheet flowing into it.

- Flow path length through the dispersion area:

    - For outwash soils: The following criteria apply to sites (or areas of sites) with outwash soils (Type A – sands and sandy gravels, possibly some Type B – loamy sands). The outwash soils must have an initial saturated hydraulic conductivity rate of 4 inches per hour or greater. The saturated hydraulic conductivity must be based on a Pilot Infiltration Test or the Soil Grain Size Analysis method as identified in Appendix III-A – Methods for Determining Design Infiltration Rates.

        - If the impervious area has a flow path length of up to 20-feet, the flow path length through the dispersion area must be at least 10-feet.

        - If the impervious area has a flow path length greater than 20-feet, the flow path length through the dispersion area must be 10-feet, plus an additional 0.25-feet for every 1-foot of impervious flow path length beyond the initial 20-feet.

- For other soils: The following criteria apply to sites (or areas of sites) with soils other than those described in the bullet above (Types C and D and some Type B not meeting the criterion described in the bullet above).
  - For every 1-foot of flow path length across the impervious surface . the flow path length through the dispersion area must be 6.5-feet.
  - The minimum flow path length through the dispersion area is 100-feet.

- The lateral slope of the impervious area must be less than 8 percent.
- Road side slopes must be less than 25 percent. Road side slopes do not count as part of the dispersion area unless native vegetation is re-established and slopes are less than 15 percent. Road shoulders that are paved or graveled to withstand occasional vehicle loading count as impervious surface.
- The longitudinal slope of road must be less than or equal to 5 percent.
- The average longitudinal (parallel to road) slope of the dispersion area must be less than or equal to 15 percent.
- The average lateral slope of the dispersion area must be less than or equal to 15 percent.

Full Dispersion of Channelized (Collected and Re-dispersed) Stormwater into the Dispersion Area

The runoff from public and private road projects that is collected and re-dispersed is "fully dispersed" if it meets all of the following criteria:

1. The dispersion area may be either:
   - Preserved as forest or native vegetation.

   or

   - Cleared land. This cleared land option may be only used if the site is outside the Urban Growth Area and does not have a natural or man-made drainage system.
2. Depth to the average annual maximum groundwater elevation must be at least 3-feet.
3. Channelized flow must be re-dispersed to produce the longest possible flow path.

4. Flows must be evenly dispersed across the dispersion area.

5. 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 into the dispersion area. Ditch discharge points with between 0.2 and 0.5 cfs discharge for the 100-year peak flow shall use dispersion trenches to disperse flows into the dispersion area. See Outfalls (Section 4.8) for rock pads and dispersion trenches.

   - 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 have a minimum 2-feet by 2-feet cross section, 50-feet in length, filled with 0.75-inch to 1.5-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.

6. Approved energy dissipation techniques may be used.

7. Limited to onsite (associated with the road) flows.

8. The width of the dispersion area shall be equivalent to length of the road from which runoff is collected.

9. The average longitudinal and lateral slopes of the dispersion area must be less than or equal to 8 percent.

10. The slope of any flow path segment within the dispersion area must be no steeper than 15 percent for any 20-foot reach of the flow path segment.

11. Flows path length through the dispersion area:

    - For outwash soils: The following criteria apply to sites (or areas of sites) with outwash soils (Type A – sands and sandy gravels, possibly some Type B – loamy sands) that have an initial saturated hydraulic conductivity rate of 4 inches per hour or greater. The saturated hydraulic conductivity must be based on field results using procedures (Pilot Infiltration Test or Soil Grain Size Analysis Method) identified in Appendix III-A – Methods for Determining Design Infiltration Rates.
      - The dispersion area shall be at least half of the impervious drainage area.

    - For other soils: The following criteria apply to sites (or areas of sites) with soils other than those described in the bullet above (Types C and D and some Type B not meeting the criterion in the bullet above).

- For every 1 foot of flow path length across the impervious surface, the flow path length through the dispersion area must be 6.5-feet.
- The minimum flow path length through the dispersion area is 100-feet.

Full Dispersion by Engineered Dispersion

The runoff from public and private road projects is "fully dispersed" if it meets all of the following criteria:

12. Stormwater can be dispersed via sheet flow or via collection and re-dispersion in accordance with the techniques for Full Dispersion of Channelized (Collected and Re-dispersed) Stormwater into the Dispersion Area (above).

13. The dispersion area shall be planted with native trees and shrubs.

14. For outwash soils: The following criteria apply to sites (or areas of sites) with outwash soils (Type A – sands and sandy gravels, possibly some Type B – loamy sands) that have an initial saturated hydraulic conductivity rate of 4-inches per hour or greater. The saturated hydraulic conductivity must be based on field results using procedures (Pilot Infiltration Test or Soil Grain Size Analysis Method) identified in Appendix III-A – Methods for Determining Design Infiltration Rates.

    - The dispersion area must be compost amended in accordance with the guidelines in Soil Preservation and Amendment BMP in Volume III, Section 3.1.
    - If the impervious area has a flow path length of up to 20-feet, the flow path length through the dispersion area must be at least 10-feet.
    - If the impervious area has a flow path length greater than 20-feet, the flow path length through the dispersion area must be 10-feet, plus an additional 0.25-feet for every 1-foot of impervious flow path length beyond the initial 20-feet.

15. For other soils: The following criteria apply to sites (or areas of sites) with soils other than those described in the bullet above (Types C and D and some Type B not meeting the criterion in the bullet above).
16. If the dispersion area has Type C or D soils:

    - The dispersion area must be compost amended in accordance with the guidelines in Soil Preservation and Amendment BMP in Volume III, Section 3.1.
    - The dispersion area must be 6.5 times the area of the surface(s) draining to it.

17. The average longitudinal (parallel to the road) slope of the dispersion area shall be less than or equal to 15 percent.

18. The average lateral slope of the dispersion area shall be less than or equal to 15 percent.

19. The depth to the average annual maximum groundwater elevation shall be at least 3-feet.

Native Vegetation Landscape Specifications

These specifications may be used in situations where an applicant wishes to convert a previously developed surface to a native vegetation landscape for purposes of meeting full dispersion requirements or code requirements for forest retention. Native vegetation landscape is intended to have the soil, vegetation, and runoff characteristics approaching that of natural forestland.

Conversion of a developed surface to native vegetation landscape requires the removal of impervious surface, de-compaction of soils, and the planting of native trees, shrubs, and groundcover in compost-amended soil according to all of the following specifications:

1. Existing impervious surface and any underlying base course (e.g., crushed rock, gravel) must be completely removed from the conversion area(s).

2. Underlying soils must be broken up to a depth of 18-inches. This can be accomplished by excavation or ripping with either a backhoe equipped with a bucket with teeth, or a ripper towed behind a tractor.

3. At least 4-inches of well-decomposed compost must be tilled into the broken up soil as deeply as possible. The finished surface should be gently undulating and must be only lightly compacted.

4. Title 17 GHMC contains recommended tree species to be used. The area of native vegetated landscape must be planted with native species trees, shrubs, and ground cover. Species must be selected based on the underlying soils, shade, and moisture conditions; as well as the historic, native indigenous plant community type for the site. Vegetation shall be selected in accordance with the following requirements:

    a. **Trees:** a minimum of two species of trees must be planted, one of which is a conifer. Conifer trees shall be no less than 3-feet in height and deciduous trees shall have a minimum caliber of 1 inch at the time of planting. Conifer and other tree species must cover the entire landscape area at a spacing of 15- to 20-feet on center or as recommended by a professional landscaper or in accordance with city requirements. No individual species of replacement tree should exceed 50 percent of the total nor should any individual species be less than 10 percent of the total.

    b. **Shrubs:** a minimum of two species of shrubs should be planted.

Space 3 gallon plants at 4-feet on center to cover the entire landscape area, excluding points where trees are planted.

c. **Groundcover:** a minimum of two species of ground cover should be planted. Space plants so as to cover the entire landscape area, excluding points where trees or shrubs are planted.

Note: For landscape areas larger than 10,000 square feet, planting a greater variety of species than the minimum required above is strongly encouraged. For example an acre could easily accommodate three tree species, three species of shrubs and two or three species of ground cover.

5. Trees selected for replacement purposes must be free from injury, pests, diseases, and nutritional disorders. Trees must be fully branched and have a healthy root system.

6. At least 4-inches of hog fuel or other suitable mulch must be placed between plants as mulch for weed control. It is also possible to mulch the entire area before planting; however, an 18-inch diameter circle must be cleared for each plant when it is planted in the underlying amended soil. *Note: Plants and their root systems that come in contact with hog fuel or raw bark have a poor chance of survival.*

7. Plantings must be watered consistently once per week during the dry season for the first two years.

8. The plantings must be well established on at least 90 percent of the converted area. A minimum of 90 percent plant survival is required after 3 years.

Conversion of an area that was under cultivation to native vegetation landscape requires a different treatment. Elimination of cultivated plants, grasses, and weeds is required before planting and will be required on an on-going basis until native plants are well-established. In addition:

1. The soil shall be tilled to a depth of 18-inches. A minimum of 8-inches of soil having an organic content of 6 to 12 percent is required, or a 4-inch layer of compost may be placed on the surface before planting, or 4-inches of clean wood chips may be tilled into the soil, as recommended by a landscape architect or forester.

2. After soil preparation is complete, continue with steps 4 through 8 above. Placing 4-inches of compost on the surface may be substituted for the hog fuel or mulch. For large areas where frequent watering is not practical, bare-root stock may be substituted at a variable spacing from 10- to 12-feet on center (with an average of 360 trees per acre) to allow for natural groupings and 4- to 6-feet on center for shrubs. Allowable bare-root stock types are 1-1, 2-1, P-1, and P-2. Live stakes at 4-feet on center may be substituted for willow and red-osier dogwood in wet areas.

Maintenance shall include intensive site preparation, including weed control and soil amendment. Ongoing maintenance shall include weeding and watering for a minimum of 3 years from installation so as to achieve a minimum 90 percent survival of all planted vegetation. If during the 3-year period survival of planted vegetation falls below 90 percent, additional vegetation shall be installed as necessary to achieve the required survival percentage. Additionally, the likely cause of the high rate of plant mortality shall be determined and corrective actions shall be taken as needed to insure plant survival. If it is determined that the original plant choices are not well suited to site conditions, these plants shall be replaced with plant species that are better suited to the site.

Clearly written management plans and protection mechanisms are necessary for maintaining the benefits of vegetation restoration areas for the long term. Some of the mechanisms for protection include dedicated tracts, transfer to local land trusts (large areas), and homeowner association covenants. Property owner education should be incorporated in all of these strategies.

Runoff Model Representation

Areas that are fully dispersed do not have to use approved runoff models to demonstrate compliance. They are presumed to fully meet the Runoff Treatment and Flow Control requirements Minimum Requirements #6 and #7.

2.3.4 Calculation of the Total Native Vegetation Retention Achieved

Calculation of native vegetation retention achieved shall exclude water bodies (such as large ponds or lakes 10 acres or greater) and include areas part of a common conservation easement (such as parks, stormwater, open space, wetland buffers, or critical area tracts) or areas incorporated into the individual lot design where conservation easements are placed on that portion of the lot. However, proposed residential subdivisions and PDDs shall locate a minimum of 75 percent of the required native vegetation within areas of land separate from residential lots, such as those listed above. When lots or building sites are located contiguous to protective tracts the preferred location of the native vegetation areas is the area adjacent to these tracts.

2.4 Better Site Design (Ecology BMP T5.41)

Fundamental hydrological and stormwater management concepts must be applied at the site design phase that are:

- more integrated with natural topography,
- reinforcing the hydrologic cycle,
- more aesthetically pleasing, and
- often less expensive to build.

A few site planning principles help to:

- locate development on the least sensitive areas of a site;
- accommodate residential land use; and
- mitigate the impact on stormwater quantity and quality.

2.4.1 Design Criteria

Knowing how the site processed stormwater historically is important in determining appropriate Better Site Design strategies. The site analysis (see Section 1.4) will provide information on how the site and the surrounding areas process stormwater both currently and historically (before any land use changes had altered those processes). This information will aid the designer in determining preferred site layout options, and in deciding what appropriate site design BMPs will help either maintain or restore natural pre-developed stormwater processes.

Initial delineation, site management, and site design strategies to be considered and implemented as feasible include:

- **Define Development Envelope and Protected Areas –** The first step in site planning is to define the development envelope. This is done by identifying protected areas, setbacks, easements and other site features, and by consulting applicable local standards and requirements. Site features to be protected may include important existing trees, steep slopes, erosive soils, riparian areas, or wetlands.

  By keeping the development envelope compact, environmental impacts can be minimized, construction costs can be reduced, and many of the site's most attractive landscape features can be retained. In some cases, economics or other factors may not allow avoidance of all sensitive areas. In these cases, care can be taken to mitigate the impacts of development through site work and other landscape treatments.

- **Minimize Directly Connected Impervious Areas -** Impervious areas directly connected to the drainage system are the greatest contributors to urban nonpoint source pollution. Any impervious surface that drains into a catch basin or other conveyance structure is a "directly connected impervious surface." As stormwater runoff flows across parking lots, roadways, and other paved areas, the oil, sediment, metals, and other pollutants are collected and concentrated. If this runoff is collected by a drainage structure and carried directly along impervious gutters or in sealed underground pipes, it has no opportunity for filtering by plant material or infiltration into the soil. It also increases in velocity and amount, causing increased peak-flows in the winter and decreased base- flows in the summer.

  A basic site design principle for stormwater management is to minimize these directly connected impervious areas. This can be done by limiting

overall impervious land coverage or by infiltrating and/or dispersing runoff within these impervious areas.

Maximize Permeability – Within the development envelope, many opportunities are available to maximize the permeability of new construction. These include minimizing impervious areas, paving with permeable materials, clustering buildings, and reducing the land coverage of buildings by smaller footprints. All of these strategies make more land available for infiltration and dispersion through natural vegetation.

Clustered driveways, small visitor parking bays and other strategies can also minimize the impact of transportation-related surfaces while still providing adequate access.

Once site coverage is minimized through clustering and careful planning, pavement surfaces can be selected for permeability. A patio of brick-on-sand, for example, is more permeable than a large concrete slab. Engineered soil/landscape systems are permeable ground covers suitable for a wide variety of uses. Permeable/porous pavements can be used in place of traditional concrete or asphalt pavements in many low traffic applications.

Maximizing permeability at every possible opportunity requires the integration of many small strategies. These strategies will be reflected at all levels of a project, from site planning to materials selection. In addition to the environmental and aesthetic benefits, a high-permeability site plan may allow the reduction or elimination of expensive underground conveyance systems, Flow Control BMPs, and/or Runoff Treatment BMPs, yielding significant savings in development costs.

- **Build Narrower Streets -** More than any other single element, street design has a powerful impact on stormwater quantity and quality. In residential development, streets and other transportation-related structures typically can comprise between 60 and 70 percent of the total impervious area, and, unlike rooftops, streets are almost always directly connected to the drainage system.

  The combination of large, directly connected impervious areas, together with the pollutants generated by automobiles, makes the street network a principal contributor to stormwater pollution in residential areas.

  Street design is usually mandated by local municipal standards. These standards have been developed to facilitate efficient automobile traffic, maximize parking, and allow for emergency vehicle access. Most require large impervious land coverage. In recent years, new street standards have been gaining acceptance that meet the access requirements of local residential streets while reducing impervious land coverage. These standards generally create a new class of street that is narrower than the current local street standard, called an “access” street. An access street is intended only to provide access to a limited number of residences.

Because street design is the greatest factor in a residential development's impact on stormwater quantity and quality, it is important that designers, municipalities and developers employ street standards that reduce impervious land coverage.

- **Maximize Choices for Mobility –** Given the cost of automobile use, both in land area consumed and pollutants generated, maximizing choices for mobility is a basic principle for environmentally responsible site design. By designing residential developments to promote alternatives to automobile use, a primary source of stormwater pollution can be mitigated.

  Bicycle lanes and paths, secure bicycle parking at community centers and shops, direct, safe pedestrian connections, and transit facilities are all site-planning elements that maximize choices for mobility.

- **Use Drainage as a Design Element –** Unlike conveyance drainage systems that hide water beneath the surface and work independently of surface topography, a drainage system for stormwater infiltration or dispersion can work with natural land forms and land uses to become a major design element of a site plan.

  By applying stormwater management techniques early in the site plan development, the drainage system can suggest pathway alignments, optimum locations for parks and play areas, and potential building sites. In this way, the drainage system helps to generate urban form, giving the development an integral, more aesthetically pleasing relationship to the natural features of the site. Not only does the integrated site plan complement the land, it can also save on development costs by minimizing earthwork and expensive drainage features.

- See Volume II, Section 3.3 for additional requirements specific to protection of LID BMPs during construction (in accordance with Volume I, Minimum Requirement #2, Element #13).

Finally, designers should also refer to the Low Impact Development Technical Guidance Manual for Puget Sound (WSU 2012), specifically Chapter 3, for additional guidelines and graphics for better site designs and layouts.

2.4.2 Lot Layout

In addition to the general delineation, site management, and site design strategies outlined above, lot layout can play a particularly important role in Comprehensive LID Site Designs. Comprehensive LID projects shall employ planning strategies to minimize site disturbance, maximize protection of native soil and vegetation, and permanently set aside the open tracts for multiple objectives including stormwater management. The following general objectives should guide the placement and orientation of lots for LID projects:

- Cluster homes to reduce overall development envelope and road length.

- Orient lots to use shared driveways to access houses along common lot lines.
- Reduce front yard setbacks to reduce driveway length.
- Strategically locate lots for dispersing stormwater to open space areas.
- Orient lots and buildings to maximize opportunities for on-lot infiltration or open conveyance through vegetated systems.

2.5 Preserving Native Vegetation (Ecology BMP T5.40)

Preserving native vegetation onsite to the maximum extent feasible will minimize the impacts of development on stormwater runoff. Per Section 1.3, it is preferable that 65 percent or more of the project site be protected for the purposes of retaining or enhancing existing forest cover and preserving wetlands and stream corridors. Where that cannot be achieved, the minimum vegetation retention requirements outlined in Section 1.3 must be met. The following sections present the strategies and practices for meeting the native vegetation preservation requirements. Additional details on flow dispersion to native vegetation areas are presented under Section 2.3, Full Dispersion.

2.5.1 Applicability

New development often takes place on tracts of forested land. Unless sufficient care is taken and planning done, in the interval between buying the property and completing construction much of this resource is likely to be destroyed.

With vegetation retention, the primary goal is to retain large, connected tracts of native vegetation areas, either through a cluster design or on individual lots, to maintain the natural hydrologic function and provide infiltration areas for overland flows generated in developed portions of the site. Forest and native growth areas allow rainwater to naturally percolate into the soil, recharging groundwater for summer stream flows and reducing surface water runoff that creates erosion and flooding. Conifers can retain up to about 50 percent of all rain that falls during a typical storm. Of this rainfall, 20 to 30 percent may never reach the ground but evaporates or is taken up by the tree.

On lots that are one acre or greater, preservation of 65 percent or more of the site in native vegetation will allow the use of flow dispersion techniques presented in Section 2.3,Full Dispersion. Sites that can fully meet the requirements of full dispersion are not required to provide runoff treatment or flow control facilities (as required by Volume I, Minimum Requirements #5, #6, and #7).

2.5.2 Design Criteria

- The preserved area shall be situated to minimize the clearing of existing forest cover, to maximize the preservation of wetlands, and to buffer stream corridors.

- Where feasible, trees and other native vegetation shall be retained in groups of sufficient size to maintain adequate growing conditions to support natural successional patterns and develop diverse multilayer canopy structure, snags, large woody debris, understory vegetation, and forest duff. Growing conditions include slope, aspect, soil structure and moisture, sun exposure, humidity, wind, co-dependence on or competition among adjacent plants as well as other microclimatic factors.

- The preserved area shall be shown on all property maps and shall be clearly marked during clearing and construction on the site.

- Maximize the amount of preserved area that can be located downslope from the building sites, to optimize the use of Full dispersion.

2.5.3 Vegetation Protection Post-construction

The following steps must be taken to protect vegetation after construction:

- Mechanisms shall be put in place to assure long-term protection of vegetation retention areas. Mechanisms to protect conservation areas include setting aside conservation areas into separate tracts, permanent easements, homeowner covenants, maintenance agreements, and education (see Chapter 3 for additional detail).

- Maintenance plans and agreements must be in compliance with Volume I, Chapter 3, and must address issues including but not limited to:

    - Pest and disease management practices

    - Pruning requirements

    - Irrigation requirements

    - Fertilization requirements

    - Fire fuel management practices.

- Permanent signs shall be installed indicating that removal of trees or vegetation is prohibited within the native vegetation retention areas (with the exception of the removal of dangerous and diseased trees).

- Permanent fencing is required around the limits of the vegetation retention areas. The type, size, and location of the fencing shall be approved by city review staff and should be made of materials that blend in with the natural surroundings (e.g., wood split-rail, pinned if necessary) and located in such a manner as to not impede the movement of wildlife within the vegetation retention areas.

2.5.4 Additional Requirements

In addition to the general requirements outlined above, and as outlined by Title 17 of the Gig Harbor Municipal Code,developers should be aware of the specific measures to protect trees during construction.

2.6 Restoring Site Vegetation

2.6.1 Application

Restoration of site vegetation shall be applied in the following situations:

1. Where project areas have been disturbed and are scheduled to be replanted with native trees and vegetation, in order to maximize the hydrologic benefits of a native site (in accordance with the Comprehensive LID Site Design performance goals outlined in Section 1.3).

2. Where a project wishes to convert a previously developed surface to a native vegetation landscape, either for purposes of meeting the requirements of Full dispersion or code requirements for vegetation restoration.

Vegetation restoration/planting methods shall conform to published standards as appropriate to the type of natural resource protection area.

2.6.2 Design Criteria

In situations where it is not feasible to retain existing trees and vegetation of sufficient size and quantity to achieve the target amount of tree cover, additional tree cover shall be provided where feasible through supplemental tree and vegetation plantings. In addition, on those sites where vegetation cover does not exist due to previous removal, vegetation cover shall be reestablished to the maximum extent feasible. The following standards shall be utilized:

2.6.3 Planning and Design

- The applicant shall comply with the provisions for tree replacement as set forth in Title 17 GHMC.

- Trees selected for replacement purposes must be free from injury, pests, diseases, and nutritional disorders. Trees must be fully branched and have a healthy root system.

- Coniferous and broad leaf evergreen trees shall be no less than 4-feet in height at time of planting. Deciduous trees shall be a minimum of 8-feet in height or have a minimum caliper size of 1.5-inch at time of planting.

- Title 17 GHMC contains recommended tree species to be used. The area of native vegetated landscape must be planted with native species trees, shrubs, and ground cover. Species must be selected based on the underlying soils,

shade, and moisture conditions; as well as the historic, native indigenous plant community type for the site. Vegetation shall be selected in accordance with the following requirements:

- **Trees:** a minimum of two species of trees must be planted, one of which is a conifer. Conifer and other tree species must cover the entire landscape area at a spacing recommended by a professional landscaper or in accordance with city requirements. No individual species of replacement tree should exceed 50 percent of the total nor should any individual species be less than 10 percent of the total.

- **Shrubs:** a minimum of two species of shrubs should be planted. Space plants to cover the entire landscape area, excluding points where trees are planted.

- **Groundcover:** a minimum of two species of ground cover should be planted. Space plants so as to cover the entire landscape area, excluding points where trees or shrubs are planted.

Note: for landscape areas larger than 10,000 square feet, planting a greater variety of species than the minimum suggested above is strongly encouraged. For example, an acre could easily accommodate three tree species, three species of shrubs, and two or three species of groundcover.

2.6.4 Construction and Operation

Conversion of a developed surface to native vegetation landscape requires the removal of impervious surface; de-compaction of soils; and/or the planting of native trees, shrubs, and ground cover in compost-amended soil according to all of the following specifications:

1. Existing impervious surface and any underlying base course (e.g., crushed rock, gravel, etc.) must be completely removed from the conversion area(s).
2. Underlying soils must be broken up to a depth of 18-inches. This can be accomplished by excavation or ripping with either a backhoe equipped with a bucket with teeth, or a ripper towed behind a tractor.
3. At least 4-inches of well-decomposed compost must be tilled into the broken up soil as deeply as possible. The finished surface should be gently undulating and must be only lightly compacted.
4. At least 4-inches of hog fuel or other suitable mulch must be placed between plants as mulch for weed control. It is also possible to mulch the entire area before planting; however, an 18-inch-diameter circle must be cleared for each plant when it is planted in the underlying amended soil. *Note: plants and their root systems that come in contact with hog fuel or raw bark have a poor chance of survival.*

Conversion of an area that was under cultivation to native vegetation landscape requires a different treatment. Elimination of cultivated plants, grasses, and weeds is required before planting and will be required on an on-going basis until native plants are well-established. In addition:

1. The soil shall be tilled to a depth of 18-inches. A minimum of 8-inches of soil having an organic content of 6 to 12 percent is required, or a four inch layer of compost may be placed on the surface before planting, or 4-inches of clean wood chips may be tilled into the soil, as recommended by a landscape architect or forester.
2. After soil preparation is complete, continue with steps 3 through 4 above. Placing 4-inches of compost on the surface may be substituted for the hog fuel or mulch. For large areas where frequent watering is not practical, bare-root stock may be substituted at a variable spacing from 10- to 12-feet on center (with an average of 360 trees per acre) to allow for natural groupings and 4- to 6-feet on center for shrubs. Allowable bare-root stock types are 1-1, 2-1, P-1, and P-2. Live stakes at 4 feet on center may be substituted for willow and red-osier dogwood in wet areas.

Maintenance shall include intensive site preparation, including weed control and soil amendment. Ongoing maintenance shall include weeding and watering for a minimum of 3 years from installation so as to achieve a minimum 90 percent survival of all planted vegetation. If during the 3-year period survival of planted vegetation falls below 90 percent, additional vegetation shall be installed as necessary to achieve the required survival percentage. Additionally, the likely cause of the high rate of plant mortality shall be determined and corrective actions shall be taken as needed to ensure plant survival. If it is determined that the original plant choices are not well suited to site conditions, these plants shall be replaced with plant species that are better suited to the site.

Clearly written management plans and protection mechanisms are necessary for maintaining the benefits of vegetation restoration areas for the long term. Some of the mechanisms for protection include dedicated tracts, transfer to local land trusts (large areas), and homeowner association covenants. Property owner education should be incorporated in all of these strategies.

2.7 Minimize Impervious Areas

The following sections contain strategies for reducing the impacts of impervious surfaces associated with transportation and mobility related networks.

2.7.1 Road Design

The objective for a Comprehensive LID roadway system design is to reduce the amount of impervious area associated with the road network. This may be achieved by utilizing permeable pavement, examining alternative street layouts, and determining the best option for increasing the number of homes per unit length of road, as well as aligning roads to maximize opportunities for discharging to adjacent dispersion or bioretention areas. Strategies to be applied (where feasible) for reducing the amount and impact of impervious area associated with the road network include:

- Design the road layout to follow the existing topographic contours to minimize cuts and fills.

- Design the road layout to avoid crossing natural resource protection areas, thereby minimizing the disruption of sheet flow within these areas.

- Natural resource protection areas or bioretention areas shall be located down-gradient of roads, alleys, and other impervious surfaces when feasible.

- Infiltrate or slowly convey storm flows in roadside bioretention cells and swales, and through permeable paving and aggregate storage systems under the pavement. (Note that if using infiltration and/or conveyance under roads and parking areas in a retrofit setting the design must consider the integrity and protection of adjacent infrastructure.)

- Roads should be designed to service clusters of development located within the buildable portions of the site (i.e., cluster housing), thereby reducing the overall length of the roadway network.

Road Cross Sections

The objective of modifying road cross sections is to reduce the roadway width to the minimum amount of impervious surface necessary, while still accommodating emergency vehicle access, and utilizing permeable pavements where feasible. Note: Existing applicable road standards still apply except as modified below:

- For projects that trigger Minimum Requirements #1 through #5 or #1 through #10 (see Volume I, Chapter 2), permeable pavement is one option that must be evaluated for onsite stormwater management for roads with very low traffic volumes and very low truck traffic (see Volume III, Section 3.5.2 for additional details). If permeable pavement surfaces are used adjacent to conventional impervious road sections for sidewalks or pullout parking, use design techniques described in Volume III, Section 3.5 to prevent saturation of the impervious road section and migration of aggregate base material from the impervious to the permeable section.

- An example LID road section is provided in Attachments Section A, Detail 27.0.

- Sidewalks and trails must be disconnected from the traveled way portion of the road, to the maximum extent feasible. Sidewalks may be separated from the roadway by placement of a vegetated open channel or bioretention area between the sidewalk and the roadway.

- Sidewalks and trails shall be constructed of permeable pavement, provided that the runoff through the material will not be directed towards the subgrade of the traveled lane portion of a roadway (unless the subgrade is designed to handle these flows). Permeable pavement for sidewalks and trails which abut

lots, in lieu of a roadside sidewalk, shall be Americans with Disabilities Act (ADA) compliant. An example sidewalk design is provided in the City of Gig Harbor Public Works Standard Details, Chapter 2 and Section A, Detail 35.0.

Alleys shall be constructed with permeable pavement, provided that the runoff through the material will not be directed towards the subgrade of the traveled lane portion of a roadway (unless the subgrade is designed to handle these flows).

2.7.2 Parking Lots

The objective of alternative parking lot designs is to eliminate excessive impervious areas dedicated to parking and to minimize the effective impervious area of parking areas, while still providing adequate parking for various land use classifications.

Parking Lot Requirements

- Utilize the minimum off-street parking requirements outlined in Title 17 GHMC for non-residential uses. The total amount of parking spaces may exceed the minimums outlined in Title 17 GHMC. However, any parking lot space above the required minimum amount shall be constructed of permeable pavement or accommodated in a multi-storied or underground parking structure.

- The designer must incorporate permeable pavement to the maximum extent feasible into the parking lot to promote infiltration of runoff (see also Volume III, Section 3.5, as well as Volume I, Minimum Requirement #5).

- Bioretention areas shall be used to maximize infiltration and attenuation of surface runoff (see also Volume III, Section 3.4).

2.7.3 Driveways

Driveways are typically constructed with impervious surfaces and as such represent an opportunity to further minimize impervious surfaces and their hydrologic impacts. The following methods shall be used to reduce the amount and hydrologic impact of impervious surfaces associated with driveways:

- Driveways shall be constructed using permeable pavement and graded in such a manner to prevent stormwater runoff from saturating the subgrade of the traveled lane portion of the roadway (if not using permeable pavement for the adjacent road). Surface and subsurface (e.g., discharge from the permeable pavement) stormwater runoff should drain to the adjacent permeable road, vegetated infiltration areas such as soil amended lawns, vegetated open channels, or bioretention areas.

- Runoff from driveways constructed of impervious surfaces shall be directed to vegetated infiltration areas such as soil amended lawns, dispersion areas, or bioretention areas.

2.7.4 Curb and Gutter Alternatives

Because of the effect they have on concentrating runoff flows, the use of curb and gutter systems is highly discouraged in Comprehensive LID Site Designs. The discussion below is intended to give guidance for appropriate LID methods for designing curb and gutter alternatives in situations where there is a need for constructing a curb and gutter system.

Applicability

- Needs where use of curb and gutter may be considered include incorporation of or tie into a road with a functional classification of Collector, Secondary, or Major Arterial roadways, or in an ultra-urban setting. Local feeder roads in Comprehensive LID sites should not be designed with curb and gutter systems.

- Where specific community design standards require the use of curb and gutters in all or part of the road network, alternative curb and gutter designs (discussed below) must be considered that will still meet the functional requirements.

Design Criteria

- Where curb and gutters are required in a community to provide a means of separation between the pedestrians and the motorized traffic, an alternative design using placement of a vegetated channel between the sidewalk and the roadway should be considered. In addition, a visual barrier consisting of a 1-foot-wide concrete strip along the edge of the pavement at the same surface elevation of the pavement shall be constructed. This concrete strip gives drivers a visual cue of the edge of the driving surface and can help protect the vegetated channel from tire ruts.

- Another alternative is to provide through curb inlets in the curb at 10 to 15 foot spacing to allow runoff to enter adjacent stormwater management areas. See Volume III, Section 4.9 for additional flow spreading options.

- Design options for curb and gutter alternatives are provided in Attachments Section A, Detail 26.3.

2.8 Soil Preservation and Amendment (Ecology BMP T5.13)

Preservation and enhancement of the existing upper soil horizon is of primary importance to the success of Comprehensive LID Site Designs. Maintaining and amending the upper soil structure plays a significant role in maintaining natural stormwater processes on the site, and can be a low-cost way to minimize impacts to site hydrology. The details of this BMP are provided in Volume III, Section 3.1, and must be incorporated into Comprehensive LID Site Designs to the maximum extent feasible.

Chapter 3 - Easements, Maintenance, and Enforcement

In order to assure that the Comprehensive LID Site Design techniques continue to function over time, long-term management and maintenance strategies need to be addressed. The goal is to ensure successful management and maintenance of the vegetation retention areas, open space tracts, and LID BMPs through proper transition to subsequent owners and/or organizations that have long-term responsibility and vested interest. In addition to the O&M requirements for individual BMPs required under Volume I, Minimum Requirement #9, and outlined in Appendix I-A; the following apply specifically to Comprehensive LID Site Design projects.

3.1 Dedicated Tracts and Conservation Easements

- Any vegetation retention, open space areas, bioretention areas, bioswales, or any other feature utilized for stormwater purposes shall be adequately protected through the application of dedicated tracts and, where applicable, conservation easements, so that these elements will remain in such capacity in perpetuity.

- Large open space areas adjacent to riparian areas, wetlands, or critical fish and wildlife habitat areas may be transferred to local land trusts for long-term management and stewardship or managed by homeowners/building associations with specific maintenance covenants.

- Stewardship and management plans that address long-term protection and maintenance shall be developed for these sites and submitted to the city for approval.

3.2 Maintenance Requirements

Management plans and maintenance agreements for vegetation retention areas, open space tracts, and LID BMPs shall be in conformance with the requirements set forth in Section 2.5, Preserving Native Vegetation, and Volume I, Chapter 3 of this manual.

3.3 Enforcement

Enforcement of this volume shall be in conformance with provisions established in GHMC Title 17.

Volume VI References

WSU. Low Impact Development Technical Guidance Manual for Puget Sound. 2012.