# 2.0 Stormwater Facility Sizing and Submittals

Successful design of stormwater facilities and conveyance features requires careful planning. Where and how stormwater management will occur for any development should be integrated as the site plan is being developed, rather than trying to figure out where it will fit after the site has already been planned.

The following section describes 1) the methods available for sizing stormwater facilities, 2) the submittals required to demonstrate compliance with the stormwater requirements in **section 1.0**, and 3) the process for getting submittals reviewed and approved by the City.

## 2.1 Development Process

For most development projects, the following steps should be followed to plan and construct stormwater facilities that meet the requirements in this manual.

1. **Evaluate the Site.** Identify surface water, drainages, wetlands, and groundwater features; existing utilities (water, sanitary, storm, other); and delineate trees to be preserved.
2. **Determine All Requirements.** Development code may have requirements that apply beyond stormwater, such as habitat buffers, setbacks, screening requirements, cut and fill, etc.
3. **Characterize Site Drainage and Runoff.** Determine soil type (or measure infiltration rate); determine depth to groundwater; determine if/where discharge will occur.
4. **Develop a Conceptual Design.** Develop site grading plan, proposed structures to be added, and ensure that water from impervious area added to the site will be treated by stormwater facilities. Verify that areas to be treated by stormwater facilities can physically drain to those facilities, and that the facilities have been adequately sized to treat actual contributing area.
5. **Develop Landscape Plan.** Integrate stormwater facilities with site landscape plan.
6. **Finalize Stormwater Report.** Confirm that stormwater facility sizing is adequate for the proposed development.
7. **Determine Operation and Maintenance Needs.** Facilities must be maintained according to the requirements in this manual (see Chapter 6). Stormwater facilities not described in **section 3.0** will require development of a maintenance plan and agreement.
8. **Submit Final Plans and Obtain Permits**. Submit site plan, stormwater facility sizing form and calculations, and other submittal requirements listed in **section 2.4.**
9. **Construct and Inspect.** Construct structures and facilities according to permit and call for City inspections to ensure facilities meet approval.

## 2.2 Submittal Review and Approval

Any development or project that will create or alter public infrastructure (e.g. street frontage improvements) must go through the City of Gresham's Development Engineering (DE) group.

Development which isn't required to install public improvements can fill out the required forms and work directly with the City's Permit Center/Building Department on obtaining permits for grading, erosion control, and construction.

City plan review and approval will consider whether the following goals were considered in the proposed development:

- Ensure that the existing topography, tree canopy, riparian buffers and drainage conditions are considered before streets, parking lots, buildings, and other man-made structures are constructed;
- Optimize site design and reduce or eliminate potential conflicts between planned development and required stormwater management systems;
- Reduce new impervious surfaces to minimize stormwater requirements;
- Integrate site attributes to mimic natural hydrology and preserve natural resources;
- Optimize multifunctional uses such as neighborhood greenways and wildlife habitat.

## 2.3 Stormwater Facility Sizing

There are two methods that can be used to size facilities to meet the water quality and flow control requirements in **section 1.2**, the Simple Method and the Engineered Method.

### 2.3.1 Simple Method

The Simple Method uses pre-defined sizing factors to size stormwater facilities based on the amount of impervious area being added or replaced; this includes the building roof area and any other structures or hardened surfaces (e.g. driveway, patio, walkways, etc.) that will be included in the final site design.

To size stormwater facilities, the project designer quantifies the amount of new or redeveloped impervious area that is proposed and multiplies that area by the sizing factor for the stormwater facility being proposed. The sizing factors are listed on the Simple Sizing Form, which is described in **section 2.4.2** and included at the end of this section (page 2-11).

The Simple Sizing Form was developed assuming retention of the 10-year/24-hour storm event using generalized infiltration rates based on hydrologic soil types (see **Table D-2** in **Appendix D** for values assumed for each soil type). Based on the mapped soils at the development site, a stormwater facility sized using the factors on the Simple Sizing Form is assumed to comply with the City's flow control and pollution reduction requirements. On-site and off-site conveyance (**section 4.0**) needs to be addressed for pipes, outfalls and channels based on **Table 4-1**.

Stormwater facilities designed using the Simple Method are not required to be stamped by an engineer unless the project will be going through the Development Engineering review process.

Development projects that add or alter public infrastructure can utilize the Simple Sizing Form for sizing on-site stormwater facilities, but a Stormwater Report completed by a licensed engineer must be submitted to Development Engineering to demonstrate that water quality, flow control and conveyance requirements are being met.

Development projects in Type A and B soils should be able to fully infiltrate stormwater on-site using a facility following sizing factors on the Simple Sizing Form. When on-site infiltration is not feasible, an on-site facility meeting the sizing requirements for Type A soils may be installed (assumed to treat the water quality event), and then the Engineered Method must be used to design a downstream centralized facility to detain and provide flow control to meet the requirements in **section 1.2.5**.

Projects in Type C and D soils that use the Simple Sizing Form to size lot-level facilities for water quality (using the Type A soil sizing factor) must then use the Engineered Method to size a facility to provide detention and flow control. Facilities designed in this manner can assume a 50% reduction in the

impervious area draining from water quality treated areas for hydrologic calculations to size detention facilities.

### 2.3.2 Engineered Method

The Engineered Method uses hydraulic and hydrologic engineering calculations to determine the facility size required. Any project is allowed to use the Engineered Method, which requires design by a licensed engineer. Detailed engineering calculations must be provided in a Stormwater Report (described in **section 2.4.4**) as evidence of the proposed design's performance with respect to the stormwater requirements provided in this manual.

Facilities sized by routing a hydrograph through the facility (rate-based facilities with a storage volume component) may use a continuous simulation program (using a minimum of 20 years of Gresham rainfall data) or a single-storm hydrograph-based analysis method, such as the Santa Barbara Urban Hydrograph (SBUH), to demonstrate that the facility is adequately designed to manage the volume of the water quality and/or detention event required in **section 1.0**. The Soil Conservation Service Type 1-A, 24-hour rainfall distribution, shall be used in all single storm hydrograph methods.

Whatever method is selected to route stormwater through a facility designed to meet the water quality treatment required described in **section 1.2.3** and/or the flow control requirements in **section 1.2.5** must account for inflow from the appropriate rainfall event, storage within the soil, rock/structural soil, and ponding depth, and outflow due to infiltration and any proposed orifices that meet the flow control targets in **Table 1-1**. The design depth of the proposed facility shall meet the facility design criteria outlined in **section 3.0** (e.g. 6-inch ponding depth in stormwater tree well) without overflow. For open graded rock or structural soil, the designer shall use 40% void space, and for the 3-way blended stormwater topsoil described in **Appendix F**, the assumed void space shall be 10%. If a vegetated facility is being designed for filtration, an assumed flow rate of 2-inches per hour may be used for the 3-way stormwater facility soil blend.

Volume-based stormwater facilities shall be designed to drain down enough between storm events to allow the subsequent storm to be properly managed. When full, the drawdown time to the reference point must not exceed 48 hours for the following facilities (with the reference point for measuring drawdown listed in parentheses after each facility):

- Vegetated facilities, except ponds (the top of the growing media);
- Dry detention ponds (the bottom of the pond at the lowest outlet rim elevation);
- Wet ponds and submerged gravel ponds (the top of the permanent pool);
- Soakage trenches and permeable pavement (the bottom of the aggregate, where it meets the native soil);
- Drywells (the bottom of the drywell);
- Detention pipes (the top of the dead storage).

For projects following the Engineered Method, the engineer must demonstrate that the proposed stormwater management meets or exceeds all stormwater requirements in this manual.

**Appendix D** has additional details about the Engineered Method, and the overview of details and assumptions that should be made using this method are outlined in **sections 2.3.2.1** through **2.3.2.4**.

### 2.3.2.1 Pre-developed Surface Conditions

The pre-developed condition Runoff Coefficients (C) and Runoff Curve Numbers (CN) shall be based on conditions that existed at a site prior to any grading and land clearing activities related to the proposed development. The most common CN and C values for pre-developed conditions are listed in **Tables 2-1** and **2-2**.

**Table 2-1.** Common Curve Number (CN) values for Pre-developed conditions

| **Hydrologic Soil Type:** | **A** | **B** | **C** | **D** |
|---|---|---|---|---|
| CN values for Forest/Woods | 30 | 55 | 70 | 77 |
| CN values for Woods/Grass combination | 32 | 58 | 72 | 79 |
| CN values for Pasture or Grass | 39 | 61 | 74 | 80 |
| CN values for Impervious Surfaces | 98 | 98 | 98 | 98 |

**Table 2-2.** Common Runoff Coefficient (C) values for Pre-developed conditions

| **Site slope:** | **Flat 0% to 2%** | **Rolling 2% to 10%** | **Hill Over 10%** |
|---|---|---|---|
| C values for Woodland and Forest | 0.1 | 0.15 | 0.2 |
| C values for Meadow, Pasture or Farm | 0.25 | 0.3 | 0.35 |
| C values for Mixed (Forest/Grass) | 0.15 | 0.2 | 0.25 |
| C values for Impervious Surfaces | 0.9 | 0.9 | 0.9 |

For modeling other pre-development surfaces, see the Runoff Curve Number, CN, table (**Table D-3**) and the Runoff Coefficient, C, table (**Table D-6**) in **Appendix D**.

### 2.3.2.2 Post-developed Surface Conditions

The Runoff Curve Numbers (CN) used for post-developed surface conditions shall be based on conditions that will exist after development. The most common CN values for post-developed conditions are listed in **Table 2-3**. For developments doing stormwater quality treatment at the localized scale and treating 50% of the impervious surface as pervious, the CN value for "lawn/landscaped areas with amended soils" shall be used for areas being treated by on-site facilities when designing flow control facilities.

**Table 2-3.** Common Curve Number (CN) values for Post-developed conditions

| **Hydrologic Soil Type:** | **A** | **B** | **C** | **D** |
|---|---|---|---|---|
| CN values for lawn/landscaped areas with un-amended soils | 68 | 79 | 86 | 89 |
| CN values for lawn/landscaped areas with amended soils | 39 | 61 | 74 | 80 |
| CN values for Impervious Surfaces | 98 | 98 | 98 | 98 |
| CN values for Porous Pavement | 76 | 85 | 89 | 91 |
| CN values for Green Roof | 61 | 61 | 61 | 61 |
| CN values for Infiltration and Filtration Stormwater Planter | 30 | 48 | 65 | 73 |

#### 2.3.2.3 Time of Concentration

Time of concentration (Tc) calculations shall consist of three segments: sheet flow, shallow concentrated flow, and channel/pipe flow. Total time of concentration should be a minimum of 10 minutes for pre-developed conditions. For post-developed conditions, minimum of 5 minutes and a maximum of 10 minutes. However, if the portion of the contributing area within 300' upstream of the developed site will remain in an undeveloped condition and is 50% or more of the total contributing area, the post-developed Tc shall be calculated and documented by the engineer of record and may exceed 10 minutes.

#### 2.3.2.4 Rainfall Depths

Table 2-4 lists the 24-hour rainfall depths that shall be used for sizing stormwater facilities and determining conveyance.

**Table 2-4.** Gresham 24-hour rainfall depths

| **Recurrence Interval (Years):** | **WQ** | **2** | **10** | **25** | **50** | **100** |
|---|---|---|---|---|---|---|
| 24-Hour Rainfall Depth (inches) | 1.2 | 2.8 | 3.6 | 4.0 | 4.4 | 4.9 |

## 2.4 Submittal Plans, Forms and Reports

In order to demonstrate compliance with the stormwater requirements in this manual, the forms, plans and information listed in **Table 2-5** are required to be included with permit application materials submitted to the City.

**Table 2-5.** List of Stormwater Plans and Submittals

| **Section** | **Plan, Form or Report** | **Simple Method** | **Engineered Method** |
|---|---|---|---|
| 2.4.1 | Erosion Prevention and Sediment Control Plan | X | X |
| 2.4.2 | Simple Sizing Form | X | |
| 2.4.3 | Site Plan | X | X |
| 2.4.4 | Stormwater Report | | X |
| 2.4.5 | Infiltration Testing | | X |
| 2.4.6 | Facility Planting Plan | For vegetated facilities | For vegetated facilities |
| 2.4.7 | Operation and Maintenance Plan | | For facilities not detailed in **section 3.0** |
| 4.3 | Downstream Conditions Assessment | | X |

### 2.4.1 Erosion Prevention and Sediment Control Plan

Prior to any ground clearing activity or work being conducted on site, an erosion prevention and sediment control (EPSC) plan shall be submitted and approved by the City. There are 9 minimum erosion control requirements which need to be addressed in the EPSC plan:

1. Preserve Vegetation/Mark Clearing Limits
2. Construction Entrance Protection
3. Perimeter Control
4. Storm Drain Inlet Protection

5. Soil and Slope Protection
6. Control Runoff (may not apply for detached dwelling sites)
7. Sediment Containment and Removal (not applicable for detached dwelling sites)
8. Soil Stockpile Management (may not apply for detached dwelling sites)
9. Construction Site Pollution Prevention

The Erosion Prevention and Sediment Control Manual in **Appendix C** contains details on what needs to be included in the EPSC plan and best management practices (BMPs) to address the 9 minimum requirements.

### 2.4.2 Simple Sizing Form

For projects following the Simple Method, the Simple Sizing Form (included at the end of this section) provides the sizing factors for proposed stormwater facilities. The formulas on this form allow the project designer to determine whether the stormwater facilities they propose will be adequate to manage stormwater (quality and quantity) from impervious areas they will be adding or replacing.

### 2.4.3 Site Plan

All projects must submit a site plan that shows the location of the proposed stormwater facility and any piping to and from the facilities, the emergency overflow route through or from the site for the 100-year storm, as well as addressing the site plan requirements in the *City of Gresham CAD (Computer Aided Drafting) Manual.*

### 2.4.4 Stormwater Report

Development proposals that will be following the Development Engineering (DE) process must submit a Stormwater Report to DE for review and approval.

The Stormwater Report shall be prepared by and bear the seal and signature of a Professional Engineer registered in the State of Oregon. Along with the Site Plan components in **section 2.4.3**, a sheet (or multiple, if needed) shall be included in the plan set based upon the Stormwater Report Template provided in the *City of Gresham CAD Manual*. A submittal following the template will address all of the following, and will require attaching documents listed in the appendices.

1. General project information, including:
   - ☐ the project name and location;
   - ☐ submittal date;
   - ☐ applicant's name, address, and telephone number;
   - ☐ design engineer's name, address, telephone number, stamp, and signature.

2. Project description, including size and location of the project site, proposed site improvements, square feet of new and replaced impervious area (stormwater management requirement threshold listed in **section 1.2**), and a summary of the proposed stormwater management approach and how it prioritizes the use of green development practices as described in **section 1.2.4**.

3. Applicable stormwater requirements. If the project is subject to federal stormwater requirements such as SLOPES V, list those requirements in addition to the City of Gresham's water quality and flow control requirements and design storms. If multiple standards apply,

project shall use the most stringent of all applicable standards. Include the City of Gresham design storm rainfall depths listed in **section 2.3.2.4**, the water quality storm, and the flow rate targets.

4. Describe Existing Conditions, including but not limited to project site slope and land cover, points of discharge for existing drainage from the project site, any off-site drainage onto the property; location of any channels, wetlands, creeks, and sensitive areas on or adjacent to the project site; soil conditions, including NRCS Hydrologic Soil Group and infiltration test results; depth to groundwater. Include NRCS soils map and geotechnical report in appendices.

5. Pre-developed runoff analysis. Discuss existing drainage basin areas and associated curve numbers and times of concentration. Include any offsite basins that drain to the site. Provide an exhibit showing the existing drainage basins, contours, labels for drainage features, significant development such as roadways and structures, and flow paths. Provide Time of Concentration and flow rate calculations in an appendix.

**Table 2-6.** Example Table of Pre-Developed Basin Areas

| Drainage Basin | Total Area (sf or ac) | Pervious Area (sf or ac) | Impervious Area (sf or ac) | Pervious land cover type | Hydrologic Soil Group | Pervious Curve Number (CN) | Time of Concen-tration (min.) |
|---|---|---|---|---|---|---|---|
| Basin A | | | | | | | |
| Basin B | | | | | | | |
| Total | | | | - | - | - | - |

6. Developed runoff analysis. Discuss proposed drainage basin areas and associated curve numbers and times of concentration. Include any offsite basins that drain to the site. Provide an exhibit showing the proposed drainage basins, contours, flow paths, and any points of discharge from the site. Provide post-development flow rate calculations in an appendix.

   If street-level treatment is being provided to the MEP as described in **sections 1.2.4.2** and **1.2.4.3**, calculate the impervious area reduction for each treated basin and show the adjusted impervious areas in table 2-7.

**Table 2-7.** Example Table of Developed Basin Areas

| Drainage Basin | Total Area (sf or ac) | Pervious Area (sf or ac) | Impervious Area (Adjusted) (sf or ac) | Pervious land cover type | Hydrologic Soil Group | Pervious Curve Number (CN) | Time of Concen-tration (min.) |
|---|---|---|---|---|---|---|---|
| Basin A | | | | | | | |
| Basin B | | | | | | | |
| Total | | | | - | - | - | - |

7. Stormwater Quality Treatment
   - Describe how the facility will address the stormwater quality treatment requirement outlined in **section 1.2.3**. Identify the basin area draining to each facility, and provide sizing calculations following the guidance in **sections 2.3.2** and **3.0**. For dry ponds, ensure that the

bottom area meets the swale sizing criteria to meet the stormwater quality treatment requirement. For wet ponds, show that the permanent pool is equivalent to the water quality storm volume.
- Provide sizing calculations for any sedimentation manholes per **section 3.2.6**

8. Flow Control: Describe the methods and software used, and provide hydrologic analysis inputs and results in an appendix. Provide a comparison table of the flow rates for pre-and post-construction for each flow control facility. Table must show that the project meets the flow control requirements set forth in **section 1.2.5**.

**Table 2-8.** Example Flow Rate Comparison Table

| Flow Controlled Peak Discharge Rates for Basin A | | |
|---|---|---|
| **Design Storm** | **Pre-Developed Peak Discharge Rate** | **Post-Developed Peak Discharge Rate with Flow Control** |
| 2-year | | * |
| 10-year | | |
| 25-year | | |

*Ensure that post-developed peak flow for 2-year event is less than or equal to half the pre-developed 2-year peak flow

- For ponds, provide a cross-section drawing that shows the 100-year maximum water surface elevation, water quality elevation, and freeboard elevation; discuss the location and design of the emergency overflow path for the 100-year storm. For examples, see details ST-230 and ST-250.
- For flow control manholes, list the orifice elevations and diameters.

9. Conveyance: Demonstrate that proposed public stormwater conveyance systems have the capacity to meet the requirements of section 4, including the expected future build-out of any offsite areas that drain to the proposed system. Conveyance systems shall be designed to convey the flows stated in the *Public Works Standards* section 4.07. Describe the analysis methods used and provide associated calculations in an appendix.
   - Provide inlet calculations to demonstrate that the stormwater flow at the curb line meets the requirements in *Public Works Standards* section 4.07
   - Describe proposed methods for outfall protection, following *Public Works Standards* section 4.05.05 for outfall energy dissipation design.
   - Evaluate tailwater conditions at outfall

10. Downstream Conditions Assessment: Discuss any downstream capacity deficiencies or impacts of the project that were identified in the downstream analysis. Provide the downstream analysis as an appendix following guidelines in **section 4.3**.

11. Appendices:
    - NRCS soil report, infiltration test and geotechnical report
    - Time of concentration calculations
    - Hydraulic calculations
    - Geotechnical review of Stormwater Report providing a determination on

a. any infiltration feasibility criteria listed in **section 1.2.2**;
b. any stormwater facility being proposed within the setbacks in **section 3.0.2** or other specific facility design criteria in **section 3.0**;
c. any outfall or discharge point.

### 2.4.5 Infiltration Testing

Infiltration testing is required for any project proposing to utilize infiltration to meet stormwater management requirements.

For sites needing to perform infiltration testing, **Appendix E** has instructions and forms. The most reliable infiltration rates are determined using either the falling head percolation test procedure (EPA 1980) or the double ring infiltrometer test (ASTM D3385), and follow the following guidance:

- Test must be conducted or observed by a qualified Professional Engineer, Registered Geologist, or Certified Engineering Geologist licensed in the State of Oregon;
- The test must be performed in the location of the proposed facility. At least one infiltration test is required for any potential location where a stormwater facility will be sited. Unless the professional performing the testing recommends differently, additional tests should be considered every 100 feet for linear facilities, or every 10,000 sf of project area;
- The test shall be made at the bottom elevation of the proposed facility;
- Test should be performed during saturated conditions. If test is performed during dry conditions, the test shall be performed 3 times, with the final test providing the best measure of infiltration rate;
- A minimum factor of safety of 2 shall be used for any measured infiltration rate.

A post-installation infiltration performance test is required for any facility designed to infiltrate the 100-year storm event. The drywell capacity testing procedures is in **Appendix E**.

### 2.4.6 Facility Planting Plan

Landscape specifications and plans are required with all permits that include at least one vegetated stormwater facility. The facility planting plan for any proposed vegetated stormwater facility must meet the plant density and size requirements in **Appendix G**. Plants that can be planted in stormwater facilities are listed in the **Gresham List of Stormwater Plants**.

Landscape specifications and plans must address all elements that ensure plant survival and overall stormwater facility functional success. At a minimum, landscape specifications and plans must include:

- A planting plan that indicates existing vegetation to be preserved, the location of all landscape elements, and the size, species and location of all proposed plantings. The plant species should be selected and placed in accordance with proper delineation of Zone A (wet zone) and Zone B (moderate to dry zone), where appropriate.
- A plant list or table, including botanical and common names, size at time of planting, quantity, spacing, type of container, evergreen or deciduous, and other information related to the facility-specific planting, in accordance with landscape industry standards.
- A soil analysis may be requested for the stormwater facility growing medium. The source of the growing medium must be provided.

- The location of all stockpiles must be indicated on plans, including erosion protection measures per the City's Erosion Prevention and Sediment Control Manual (**Appendix C**).
- The method of irrigation to be used for the establishment period and if planned for permanent long-term irrigation. Public stormwater management facilities must be designed so permanent long-term irrigation systems are not needed.

### 2.4.7 Operations and Maintenance Plan

The Operations and Maintenance requirements in **Section 6.0** apply to all stormwater facilities installed in the City.

Stormwater facilities designed in accordance with the facility design requirements in **section 3.0** do not need to submit an O&M Plan, but must still follow the typical maintenance activities listed in **section 6.3**.

If a stormwater facility is proposed that does not meet the standard facility design specifications described in **section 3.0**, then a custom O&M Plan must be developed and submitted. Stormwater facilities requiring a custom O&M Plan must develop an agreement following the requirements in **section 6.2** and complete the Operations and Maintenance Agreement Form in **section 6.3** – both must be developed and recorded with the County prior to final permit approval or any issuance of certificate of occupancy for the site being served by the facility.