# *8. Stormwater Management Design Criteria*

## 8.1 General

### 8.1 A. **Applicability**

A Stormwater Management Plan is required when one or more of the following criteria apply:

1) Excavation and/or imported fill (borrow) exceeds 250 cubic yards.
2) 3,000 square feet or more of new impervious surface will be added to the site (i.e. new parking lots, structures, or other impervious surfaces that individually or in combination replace 3,000 square feet, or more, of existing pervious surface).
3) A combination of 6,000 square feet, or more, of impervious area will be added and/or reconstructed (i.e. 4,000 square foot of existing building reconstructed with the addition of a new 2,000 square foot parking lot, structure, or other impervious surface OR reconstruction of 6,000 square feet, or more, of existing impervious surface). A parking lot is considered to be "reconstructed" only when the base material, or a portion of the base material, is removed, replaced, or added. The removal and replacement of asphalt or asphalt overlays is not considered reconstruction.
4) Stormwater infrastructure will be constructed and dedicated to the City.
5) Private stormwater infrastructure will be constructed.
6) The site will be converted to a facility that will potentially affect downstream water quality (i.e. fueling station).
7) Any activity increasing runoff, equal to or greater than 0.05 cfs, over pre-developed conditions (i.e. tree removal, vegetation removal, soil compaction, etc.)

This criteria does not apply to single family homes or duplexes within existing sub-divisions that have approved stormwater plans which mitigate the stormwater runoff created from lot development, unless the approved subdivision stormwater plan included individual lot on-site stormwater management such as detention, retention, or other BMPs. This criteria is applicable for private stormwater infrastructure as it pertains to the quantity and quality of stormwater runoff leaving the site.

### 8.1 B. **Other Agency Reviews**

Other agencies may require drainage review. The policies in this manual shall not relieve the Owner from complying with the requirements of any federal, state, or local authority with jurisdiction over a development (e.g. ODOT, Oregon DEQ, Oregon DSL, USACE, ODFW, USFWS, and Hood River County).

8.1 C. **Minimum Criteria**

Recognizing that the field of stormwater management, both regulatory and design, is continually evolving in an effort to provide more effective long-term solutions to managing stormwater; the above stated standards are intended to set the minimum criteria which must be met, but are in no way intended to limit the ingenuity and creativity of either the applicant or Design Engineer for a specific site.

## 8.2 Stormwater Management Plan

8.2 A. **General**

- As part of the Planning Application submittal, a planning-level concept for the development's storm drainage system and BMPs is required.
- A preliminary Stormwater Management Plan is required as part of the Engineering pre-submittal process.
- A final Stormwater Management Plan is required at the time of Detailed Engineering Plan submittal.

8.2 B. **Minimum Criteria**

A Stormwater Management Plan is required to be prepared by the Design Engineer and shall include

1) Project Overview: Briefly describing the nature and goals of the project with a vicinity map showing the location of the project site.

2) Existing Conditions Summary: Including a topographic map and narrative describing existing drainage patterns of the site, surrounding areas, and upstream contributing areas. The map shall cover all areas presently draining to the site as well as adjoining and downstream areas that may be impacted by the development. The map shall indicate total site acreage, existing land use, drainage courses, flow direction, drainage basins, any existing development and/or drainage facilities, and information regarding areas such as wetlands that may require additional permits.

3) Proposed Improvements Summary: Shall include a map and narrative showing proposed improvements as relevant to the stormwater management plan. Include drawings as needed to show proposed topography (drainage arrows may be sufficient), structures and impervious areas, existing and proposed drainage infrastructure, and other BMP's. Include all required infiltration testing per *Appendix G*.

4) Operation and Maintenance Plan, O&M Plan: Shall describe the maintenance requirements and who will be responsible for operation and maintenance of all

proposed stormwater facilities. See *Section 8.9* for an exhaustive list of requirements.

5) Level of Detail: Detail included in the Stormwater Management Plan will vary greatly depending on the complexity of the site. The information shall be presented in a clear and concise format commensurate to the complexity of the site and sufficient to convey to the reviewer that the proposed design concept is feasible and will meet City standards if designed and constructed appropriately. It is in the discretion of the City Engineer, or his/her designee, to determine whether the proposed stormwater management design adequately addresses the following questions or if criteria additional to that in this section is required to provide safe and effective mitigation measures for the concentration of natural rainwater resulting from the proposed development. The following types of questions shall be addressed

   a) Are additional permits required?
   b) Where will the flows discharge?
   c) Are all off-site flows addressed?
   d) Is detention required? If so, how will this be addressed?
   e) How will the proposed plan protect water quality?
   f) Is ESC a significant concern? If so, how will this be addressed?
   g) Will any of the proposed facilities be maintenance intensive? If so, how will this be addressed?

## 8.3 Determination of Design Flows (Hydrologic Analysis Methods)

### 8.3 A. **Acceptable Methods**

- Rational Method for sizing of conveyance systems only where attenuation effects of existing storage are ignored.
- Hydrograph Technique such as the Soil Conservation Service Unit Hydrograph (SCS) or similar method for volume and/or time-dependent analysis such as detention and water quality flows and volumes.

### 8.3 B. **Rainfall**

Rational Method – use the ODOT Zone 5 IDF curves in the *ODOT Hydraulics Manual*.

SCS Method – The rainfall distribution over the 24-hour period is based on the SCS Type 1A rainfall distribution which is standard for developing synthetic storms in the Pacific Northwest region. The National Oceanic and Atmospheric Administration (NOAA) Atlas 2, Volume 10, for Oregon presents the return frequencies of the storm events which varies significantly between the west side and east side of Hood River. This NOAA Atlas was published in 1973 and used various rain gauges to develop

regression equations based upon latitude, longitude, elevations, and hydrological regions within Oregon. The isopluvial lines shown on the maps are based upon the regression equations derived. In addition, two separate frequency analyses were performed on hourly precipitation records from the Hood River Experiment Station (HOXO). One Analysis covered the period of record from 1900-1997. The other analysis covered the period of record from 1990-2012. Based on the two extreme event analyses of the HOXO gauge and the NOAA Atlas, the following precipitation rates were selected to be used City wide for statistical design storms. The following precipitation depths for the 2, 5, 10, 25, 50, and 100-year return frequencies for a 24-hour maximum rainfall event are shown in *Table 8.3 B*.

**Table 8.3 B**
**24-hour Maximum Rainfall Events**

| Storm Return Period (year) | P (inches) |
|---|---|
| 2 | 2.0 |
| 5 | 2.6 |
| 10 | 3.3 |
| 25 | 3.9 |
| 50 | 4.2 |
| 100 | 4.8 |

Water quality design storm – One inch (1.0”) in 24 hours.

### 8.3 C. **Soils Information**

Hydrologic soil groups shall be determined from the SCS Soil Survey of Hood River County or as determined by a soils report prepared by a qualified Professional Engineer, geologist, or soils scientist.

### 8.3 D. **Runoff Coefficients and Curve Numbers**

Rational Method runoff coefficients shall be determined from the table in the *ODOT Hydraulics Manual.*

USDA NRCS *Urban Hydrology for Small Watersheds Technical Release 55* (TR55) shall be used for developing Runoff Curve Numbers (CN), but CN values listed in TR55 for various residential lot sizes shall not be used. Designers must supply the anticipated maximum impervious areas that will be developed for each lot/parcel. Runoff from impervious areas such as streets, sidewalks, and roofs shall be calculated independently of pervious areas. The separate impervious and pervious hydrographs shall be combined to calculate the runoff at a particular location and to size stormwater management facilities. In no case shall curve numbers with a difference of more than ten (10) be area averaged together.

### 8.3 E. **Time of Concentration**

Time of concentration – the time it takes for runoff to travel from the hydraulically most distant point in the watershed to the point of reference downstream, shall be calculated according to the methods in the *ODOT Hydraulics Manual* or the *TR-55: Urban Hydrology for Small Watersheds* with a minimum time of five (5) minutes.

Travel times for sheet flow, shallow concentrated flow, open channel flow, and pipe flow shall be included as applicable.

## 8.4 Sizing of System Components (Hydraulic Analysis Methods)

### 8.4 A. **General**

- Where a site presently receives flow from upstream properties, the site shall be designed to provide for conveyance of these same flows through the site in a manner consistent with these Engineering Standards while preserving existing streams and channels in their existing condition wherever possible.
- The design shall minimize existing site disturbances, maintain areas of existing sheet flow discharge, minimize the creation of new impervious surfaces, and lengthen the post-development time of concentration wherever feasible.
- The applicant must document that adequate downstream conveyance facilities exist to safely transport the concentrated discharge without causing erosion, sedimentation, flooding, or other harm. If conveyance facilities do not exist, existing sheet flow shall not be concentrated and discharged onto adjacent property. If flows are concentrated they must be redistributed over the downstream area to emulate the existing down gradient runoff hydrograph.
- Sizing of all conveyance systems within ODOT jurisdiction (i.e. City arterials and culverts under Interstate 84) shall conform to ODOT criteria.
- All portions of the stormwater system intended to meet quantity and quality controls shall be constructed separately from the City's conveyance system (i.e. utilizing the City's conveyance pipes for detention is not acceptable).

### 8.4 B. **Outlets**

Appropriate Discharge Location: All surface and stormwater runoff from a site must discharge directly into the City storm drainage system or other approved discharge location. The applicant must document that adequate downstream conveyance facilities exist to safely transport the concentrated discharge without causing erosion, sedimentation, flooding, or other harm. If the downstream system does not have sufficient capacity to handle the flows or increased volume from the site, or is a documented problem area (see Capital Facilities Plan), the applicant will not be allowed to connect to the system without the necessary improvements to relieve the documented problems or prove that the proposed improvements will not worsen the existing conditions (note: increasing volume to downstream systems will likely result

in increased duration of flooding even if peak flows are not increased). In general, stormwater runoff shall not be diverted from one drainage basin to another. If this is proposed for any reason, the applicant must document the ability of the downstream system to safely convey the additional flows at basin build-out conditions without causing erosion, sedimentation, flooding, surcharging within two feet (2') of finished grade, or other public safety concerns within the system.

Outlet Protection: The receiving channel at the outlet shall be protected from erosion. A rock lining, as specified in *Table 8.4 B*, is generally acceptable.

**Table 8.4 B**
**Required Outlet Protection for Receiving Channels**

| | Required Protection (Minimum Dimensions) | | | |
|---|---|---|---|---|
| Design Flow Discharge Velocity (fps) | Type (ODOT/AWA Specs) | Thickness (feet) | Width (feet) | Length (feet) |
| 0-5 | Riprap Class 50 | 1 | Diameter +6 ft. | 8 ft. or 4x Diameter (whichever is greater) |
| >5-10 | Riprap Class 100 | 2 | Diameter +6 ft. or 3x Diameter (whichever is greater) | 12 ft. or 3x Diameter (whichever is greater) |
| >10 | Site specific design by Design Engineer and approved by the City Engineer | | | |

Outlet protection shall also meet the following requirements:

1) The rock lining shall have a minimum height equal to the pipe crown + 1 foot.
2) Filter blanket or geotextile shall be placed under all riprap.
3) Engineered energy dissipaters including stilling basins, drop pools, etc. are required for design flow velocities exceeding 20 fps.
4) Design reference shall be included on the plan submittal for all design flow velocities exceeding ten feet per second (10 fps).

### 8.4 C. **Catchbasin & Inlet Sizing/Spacing**

Inlets shall be designed for the 10-year storm and shall be spaced such that

1) The maximum encroachment of runoff on the roadway pavement shall not exceed one half of the traveled lane during the design storm.
2) Bypass flow shall be limited to a maximum of 30 percent.
3) Runoff greater than 0.5 cfs does not flow across intersections (i.e. catch basins placed just before the beginning of the curb radius).
4) Maximum inlet spacing is 300 feet.

5) In limited cases, inlets may be used as junction structures (pipes 18 inches in diameter and less) as approved by the City Engineer through Design Exception.
6) Inlets shall be connected to the stormwater system using a wye, tee, or manhole. In general, connections shall be perpendicular to the stormwater mainline.
7) Design is in accordance with methodology described in the *ODOT Hydraulics Manual*.

### 8.4 D. **Pipes**

Local collector pipes shall be designed to convey the 10-year storm event by gravity flow. Additionally, pipes receiving flows from sumps (low points) on collectors shall be designed to convey the 25-year storm event by gravity flow. Arterial pipes shall be designed to convey the 25-year storm event by gravity flow. In addition, mainline stormwater sewers that receive runoff from ditches or streams should be designed for the 25-year storm event. More stringent criteria may be required by other agencies with jurisdiction on a given project.

A backwater and/or hydraulic grade line analysis may be required for a proposed or existing pipe system if tailwater conditions could potentially affect the ability of the system to carry the design flows. In the case of a system where private service lines are connected to the storm pipe network, calculations must show that the 100-year storm will not back up in the pipes to the point of connection at the building, otherwise, a backflow prevention or overflow device must be provided.

### 8.4 E. **Channels**

- All channels shall be designed for the 25-year storm with 0.5 foot freeboard. These channels will also be required to contain the 100-year storm when overtopping of the channel could result in flooding of any structures or excessive damage to private property.
- Sizing of channels shall be in accordance with the design methodology described in the ODOT Hydraulics Manual.
- Channels shall be designed to provide required conveyance capacity while minimizing erosion and allowing for aesthetics and preservation of riparian habitat.
- All channels shall be designed to be stable with flexible linings such as vegetation, riprap, temporary matting, etc. Reference the Federal Highway Administration Design of Roadside channels with Flexible Linings for design methodology. *Table 8.4 E* summarizes acceptable channel types based on design flow velocities.

**Table 8.4 E**
**Channel Lining Types Based On Design Flow Velocities**

| Velocity at Design Flow (fps) | Channel Type | Min. Height above Design Water Surface | Maximum Side Slopes |
|---|---|---|---|
| 0-5 | Vegetative Lining | 6 inches | 3:1 |
| >5 – 8 | Riprap or Bioengineered Lining | 1 foot | 2:1 |
| >8 – 12 | Riprap | 2 feet | 2:1 |
| >12 – 20 | Site specific design by qualified Engineer and approved by the City Engineer. | | |

- If the design velocity of a channel to be vegetated by seeding exceeds two feet per second (2 fps), a temporary channel liner (ESC matting) is required before the channel can be used to convey stormwater.

8.4 F. **Culverts**

- Roadway culverts shall be designed to carry the 25-year storm unless more stringent criteria is required by other governing jurisdictions.
- For new culverts up to 18 inches in diameter, the maximum allowable design storm headwater (measured from the inlet invert) shall not exceed two (2) times the pipe diameter and shall not overtop the road, driveway, or parking lot surface.
- For larger culverts, the maximum allowable design storm headwater shall be a minimum of one foot (1') below the road, driveway, or parking lot surface. Structural analysis of embankment may be required.
- Culvert design shall be in accordance with the design methodology described in the ODOT Hydraulics Manual. The Federal Highway Administration's Hydraulic Design of Highway Culverts is also a good reference.

8.4 G. **Overflow Route**

Plans must show that an overflow route exists for the 100-year storm allowing for a one foot (1') freeboard below building finished floors.

## 8.5 Water Quantity Controls (Detention)

8.5 A. **General**

- Water quantity control is required for all developments, new or existing, that add over 3,000 square feet of impervious surface area or for redevelopment projects with a combination of 6,000 square feet, or more, of new and/or redeveloped impervious area. Water quantity control is also required for all developments that ultimately flow through one of ODOT's system, unless it can be shown by the

applicant that ODOT's detention criteria can be met without providing water quantity controls. Developments requiring water quantity control will require construction of detention or retention to limit runoff at the downstream discharge of the site to a rate less than or equal to the peak flow for the 2, 10, and 25-year storms under pre-development conditions. Pre-development conditions for redevelopment is forest ground cover type. Assume the ground cover conditions are "fair", or provide justification for other ground cover conditions to the City Engineer for evaluation and approval.

- If an acceptable channel or stormwater facility downstream does not exist, the applicant shall be required, as a condition of approval, to build conveyance infrastructure to an approved stormwater conveyance facility. If the cost of building such infrastructure is considered disproportionate to the project cost and the Design Engineer can satisfactorily demonstrate to the City Engineer that the site layout, grades, and stormwater design will mitigate the potential for damage to properties immediately downstream of the development, the concentrated mitigated flows may be evenly re-dispersed over the original area where the existing runoff sheet flowed from the property. In addition to the 2, 10 and 25-year design storms, these systems shall be designed to mitigate the 100-year design storm. Furthermore, the 2-year design storm flows shall be limited to half of the pre-development 2-year flows.
- Detention/retention facilities shall adequately show all necessary elevations, including water surface level of the design storm events on the control structure.

Note: If the site discharges directly to an ODOT system, ODOT criteria shall apply.

### 8.5 B. **Downstream Capacity**

For sites not otherwise required to provide water quantity controls as outlined above, water quantity controls may be required if, in the opinion of the City Engineer, the downstream pipe or drainage course does not have sufficient capacity to convey the design storm. In lieu of providing water quantity controls, the applicant may elect to increase the downstream capacity.

### 8.5 C. **Post-Development Runoff**

For all sites regardless of size, limiting increases in post-development runoff is encouraged. Landscaping, landscape planters, vegetative filters, vegetated swales, porous pavement, and eco-roofs are examples of the types of systems that reduce runoff while also improving water quality. A good reference for the appropriate application of these types of systems is the *City of Portland Bureau of Environmental Services Stormwater Management Manual*.

8.5 D. **Roof Drains**

Roof drains shall not be piped directly to the public or private stormwater conveyance systems unless site conditions warrant. Properly designed retention systems or splash blocks are preferred. It will be the applicant's responsibility to confirm that DEQ's Underground Injection Control (UIC) requirements are met.

8.5 E. **Additional Quantity Control Requirements**

The City Engineer may impose additional requirements for sites where existing downstream erosion or flooding problems may be aggravated due to increased total runoff volume. The additional measures may include but are not limited to

1) Additional detention to further control peak flows (e.g. applicant may be required to over-detain to match the capacity available in the downstream system).
2) Retention of stormwater rather than detention or a combined detention/retention system to limit discharge to less than pre-development volumes.
3) Upsizing of downstream pipes to address the problem.
4) When there are small pre-development flows, increasing the time of concentration and use of surface infiltration facilities, where appropriate, are encouraged to decrease the post-development peak flow.

8.5 F. **Control Structures**

- All control structures shall be designed to accommodate the 100-year design storm.
- All detention or retention systems shall have a separate emergency overflow structure designed to safely convey the 100-year design storm in case of clogging of the primary control structure. Appropriate screening devices shall be provided for all outlets with clogging potential.
- The minimum orifice size shall be two inches (2") for quantity control facilities serving open ponds. Buried detention facilities with filters protecting control structures shall have an orifice not smaller than one inch (1").
- All control structures shall be designed so that the orifices can be easily accessed and cleaned during storm events.

8.5 G. **Acceptable Systems**

1) Ponds: Ponds are the most desirable alternative for detention facilities for water quality benefits, relative ease of inspection, and access for maintenance. All ponds shall

    a) For ponds used to achieve both water quantity and quality standards, maximize the flow length from inlet to outlet with a minimum length to width

ratio of 2:1. Should site conditions necessitate short circuiting, additional water quality features may be required.

b) Have an emergency overflow capable of discharging the 100-year storm, assuming the primary discharge is clogged.
c) Provide a minimum of one foot (1') freeboard above the design storm to the emergency overflow and one foot (1') freeboard between the emergency overflow and the top of berm.
d) Have sufficient depth such that the maximum design water surface in the pond is below the invert of the pond inlet pipe. If this is not feasible, a backwater analysis will be required to show that the pond backwater does not adversely impact the operation of the upstream storm drain system.
e) Have maximum interior slopes of 3:1 and be seeded with mixes that are water tolerant and require minimal mowing, or do not need to be mowed. If the slopes are intended to be mowed, the interior slopes shall not exceed 4:1.
f) Have maximum exterior slopes of 2:1 unless they will be mowed, in which case they shall be 4:1 max.
g) Construction requirements for pond berm embankments addressing compaction, keys, lifts, etc. shall be clearly noted on the plans. The Owner will be responsible for addressing all slope stability issues and involving a qualified Geotechnical Engineer as necessary.
h) If the pond berm is to accommodate vehicular access, the top of the berm shall be designed to be 15 feet wide and designed for traffic loads. If the pond berm will not accommodate vehicular access, the minimum top width of the pond berm shall be three feet (3') in width.
i) Have an access road to the pond for maintenance. Access roads shall meet the conditions of *Section 5.2 B* unless otherwise allowed by the City Engineer. Additionally, an access road shall be constructed allowing maintenance equipment to access the bottom of the pond. In lieu of an access road to the bottom of the pond, the pond side slope adjacent to the access road may be designed at a 4:1 grade to allow maintenance equipment to access the bottom of the pond.
j) Provide a minimum of five feet (5') or half (1/2) the berm height, whichever is greater, between toe of berm and adjacent property lines.
k) Include fencing if required by the City Engineer (note: fencing is not desirable).
l) Be designed to avoid standing water unless designed as a constructed wetland or wet pond.
m) Be lined if necessary to protect downstream properties.

2) <u>Underground Pipes and Vaults:</u> Underground detention pipes and vaults, although a more efficient use of land, provide less water quality benefit. The Design Engineer shall include adequate provisions for cleaning, accessing, and maintaining the buried facility and its flow control mechanisms. The design shall include methods for preventing or minimizing sediment and debris from entering the buried facility such as pretreatment devices and filtering mechanisms.

3) Private Parking Lot Ponding: The following guidelines shall apply for parking lots used for detention volume:

   a) The depth of the detained water cannot exceed half foot (1/2') at any location.
   b) The minimum gradient of the parking lot area subject to ponding shall be 2%.
   c) The emergency overflow path shall not create a hazard.
   d) Fire lanes used for emergency equipment shall be free from standing water.
   e) The parking lot shall remain functional during the design event (i.e. pedestrian pathways to parked vehicles).
   f) ADA designated routes and parking stalls shall be free of standing water.

4) Retention Systems: Retention systems are an acceptable alternate to detention and can provide both water quantity and quality improvements when properly designed and constructed. These systems are only appropriate in specific conditions where the soils infiltrate well and the potential for groundwater contamination has been properly addressed. A report from a qualified geotechnical professional is required to confirm the site's suitability for the proposed systems. All retention facilities must comply with the Oregon DEQ UIC Rules and be approved by the City Engineer.

   a) The minimum infiltration rate for concentrated flows is 0.5 inch/hour.
   b) The minimum infiltration rate for rain on events is 0.3 inch/hour.
   c) Retention/Detention ponds shall be designed to drain within 48 hours of the design storm event.

### 8.5 H. **Design Methodology**

There are many references describing accepted practices for the design of detention and retention facilities including the *Federal Highway Administration Hydraulic Engineering Circular 22: Urban Drainage Design Manual*. The following minimum procedures shall be followed:

1) Stage-storage and stage-discharge calculations shall be used to model the proposed system. Typically, half foot (1/2') intervals provide a satisfactory model. Note that a prismoidal formula, or other accepted procedure, shall be required to determine the stage-storage curve for sloped pipes.
2) The inflow hydrograph shall be routed through the detention/retention system using the Storage Indication method: Inflow – Outflow = Change in Storage

## 8.6 Water Quality Controls

Recognizing that the regulatory controls for non-point source pollution are steadily increasing, the following criteria are established as minimum measures and are expected to be updated on a regular basis. Water quality treatment is required for all sites that add or reconstruct over 3,000 square feet of impervious surface area. Water quality treatment is not required for infiltration

systems receiving roof runoff from one single family home. Water quality treatment shall be required, as determined by the City Engineer, for all existing commercial parking areas when the development applies for a Building Permit or Construction Site/ROW Permit, or repaves the parking lot.

### 8.6 A. **Design Criteria**

- The water quality design storm = 1.0 inch in 24 hours.
- The water quality volume and runoff rates are calculated using all pollution generating surfaces, existing and new.
- All water quality facilities shall be designed to bypass or convey the larger storm events.
- Vegetation/plantings within the water quality facilities shall be appropriate for the intended use (i.e. water tolerant, dense stand of vegetation, etc.). The construction plans will specify all plants and seed mixes and all installation requirements. Several current seed mixes and appropriate uses are included in *Appendix F*. Consultation with a landscape designer or biologist is recommended and may be required by the City Engineer depending on the proposed facility.

### 8.6 B. **Acceptable Systems**

The following systems are the most common acceptable facilities. Other types of facilities shall be approved on a case by case basis. Incorporation of BMPs in the site design and the use of 'natural' systems (i.e vegetated swales, vegetative filters, etc.) incorporating bio-filtration is preferred. Additional stormwater treatment measures (i.e. oil separation, etc.) shall be required for sites converted to a use that is a potentially significant source of pollution.

1) <u>Extended Dry Pond:</u>

   a) The water quality storm shall be released over a minimum of 48-hours.
   b) The water quality storm shall be routed through the pond to size the pond and outflow controls or the following simplified approach may be used:

      i. Use total effective runoff volume (V) of the water quality storm to determine the water quality storage requirements.
      ii. The water surface at the top of the water quality storage volume is used to determine the effective head, "H", to be used in solving for the required orifice size or other outlet control. The water quality storage outflow rate in cfs is Q = V/(48)(60)(60), where V is in cubic feet.
      iii. If this simplified approach is used for combined facilities, water quality and quantity controls, the water quality volume shall be assumed full prior to routing of the water quantity storm.

c) When the primary orifice is required to be less than two inches (2") to meet the water quality criteria of this section, the secondary outlet shall be a weir or other non-clogging outlet control.
d) See additional criteria for Ponds in the Water Quantity Control section.

2) Vegetated Swale:

a) Hydraulic residence time = 9 minutes (preferred), 5 minutes (minimum)
b) Maximum Design Depth = 0.5 foot
c) Manning's "n" value = 0.24 (appropriate vegetation must be used)
d) Maximum velocity = 2 fps
e) Minimum length = 100 feet
f) Minimum slope = 0.5%
g) Minimum bottom width = 4 feet
h) Maximum side slope = 4:1 (within treatment depth)
i) Include flow spreader where pipe enters swale and at 50-foot intervals

3) Vegetated Filter Strips:

a) Maximum length of impervious area flowing towards the filter is 60 feet.
b) Minimum length of filter in the direction of flow is 15 feet.
c) Width of filter shall be the same as the tributary area.
d) Maximum filter slope = 10%
e) Filter slopes greater than 5% require check dams at five foot (5') intervals.
f) Check dams, when required, shall be 3-5 inches high, constructed of durable, non-toxic material and run the full length of the vegetated filter.
g) Flow spreaders may be required at the entrance to the vegetated filter, depending on site conditions.
h) Filters shall be maintained with complete vegetative covering and shall be kept free of sediment build-up.
i) All vegetated filter strips shall drain to an approved stormwater conveyance/disposal system.

### 8.6 C. **Alternative Water Quality Treatment Methods**

All alternative water quality treatment systems must be approved by the City Engineer. To be considered for approval, the proposed alternative treatment system must meet the following minimum requirements:

1) The basic treatment goal of the water quality treatment facilities is to remove 80% of total suspended solids for an influent concentration range of 100 mg/L to 200 mg/L. For influent concentration less than 100 mg/L, the effluent goal is 20 mg/L total suspended solids. For influent concentrations higher than 200 mg/L, enhanced treatment at a higher level than 80% removal may be required. Proprietary water quality treatment methods approved for basic treatment are those listed in

Washington State Department of Ecology's list of Stormwater Treatment Technologies Approved through the Treatment Assessment Protocol Program (TAPE) and Chemical Treatment Assessment Protocol Program (CTAPE) process.

2) Calculations showing the pollutant removal capability of the structure for the specific site shall be required.
3) An operation and maintenance manual shall be provided for all water quality structures.
4) In general, Water Quality Maintenance contracts with qualified providers will be required for the approval of priority systems.

## 8.7 Stormwater Piping

### 8.7 A. **Minimum Pipe Sizes**

| | |
|---|---|
| Mains & Culverts: | 12 inches |
| Laterals (catch basin to main): | 10 inches |

### 8.7 B. **Pipe Materials**

- Service laterals shall be white PVC, SDR 35 pipe meeting ASTM D3034.
- Mains shall be PVC, SDR 35 pipe meeting ASTM D3034 for pipes 10-15 inches and ASTM F679 for larger pipes with gasketed bell end, or other approved materials.
- Acceptable materials for culverts may include HDPE, ADS N-12 (or equal), concrete, or ductile iron pipe. Water-tight joints required.
- It shall be the responsibility of the Design Engineer to specify the appropriate pipe for the design conditions (soil, depth, buoyancy, and design loadings).

### 8.7 C. **Pipe Identification**

All stormwater mains shall be identifiable as follows

1) All pipes shall be installed with detectable, green, six inch (6") wide marking tape one foot (1') above the crown of the pipe along its entire length. The marking tape shall be marked with the phrase "Storm Sewer" every five feet (5'), or as approved by the City Engineer.
2) Stormwater pipes shall be installed with a toning wire along their entire length, terminated underneath the manhole frame, and accessible from ground level. The toning wire shall be size 12 AWG Solid Cooper with green insulation suitable for direct burial. Any splices in the toning wire shall be made using King Innovations DryConn DBSR direct bury gel caps with strain relief, or approved equal. See the Standard Drawings (*Appendix H*) for toning wire termination practices.

8.7 D. **Minimum Cover**

| | |
|---|---|
| Mains & Laterals: | Three feet (3') except at catch basins, refer to standard detail |
| Culverts: | Two feet (2') preferred, depth of pavement section minimum* |

*Note: All proposed culverts shall be designed to meet traffic loadings (HS-20) based on the cover provided and the material used.

8.7 E. **Minimum Slopes**

Mains and Laterals: Minimum desirable slopes for mains and laterals are 1% with an absolute minimum of 0.5%. In all cases where less than 1% is used, a Design Exception is required.

Culverts: Minimum slope is 0.5%, 1% preferred.

HDPE & ADS N-12 Pipe: Absolute minimum slope is 1%. Use alternate pipe material if minimum slope cannot be achieved, as directed by the City Engineer.

8.7 F. **Steep Slopes**

Pipes on slopes steeper than 20% must be properly anchored.

8.7 G. **Decreasing Pipe Size**

Downstream decrease in pipe size is not a recommended practice and will only be allowed as a Design Exception.

8.7 H. **Trash Racks/Grates**

Trash racks or grates are required for all inlet and outlet ends of pipes 18 inches and larger, accessible by the public. Trash racks and grates shall be designed to be accessible and easily cleared of debris.

## 8.8 Catch Basins and Manholes

In general, stormwater mains shall be constructed between stormwater manholes. Stormwater mains shall not be constructed running parallel underneath curb and gutter and shall be a minimum of three feet from outer diameter of the pipe to the edge of the gutter. Catch basins shall collect runoff from the gutter and discharge to the stormwater main via tees, wyes, or manholes. Configurations other than the aforementioned shall require a Design Exception.

### 8.8 A. **Junction Structures**

Manholes shall be required at all changes in horizontal or vertical alignment and at all pipe intersections. Wyes and tees are allowed where catch basin laterals connect to the storm main. If a Design Exception is granted for the use of catch basins as a junction, the following conditions must be met:

1) Pipe diameters are 18 inches and smaller,
2) Pipe cover is less than 48 inches in depth,
3) Pipe cover is greater than 36 inches in depth.

### 8.8 B. **Maximum Manhole Spacing**

Maximum spacing is 300 feet.

### 8.8 C. **Private Lateral Connections to Manholes**

Private lateral connections to manholes will not be allowed. Storm sewer services (laterals) shall be connected directly to the catch basins or the public main and not to publicly owned manholes.

### 8.8 D. **Manhole Floor Elevation**

The manhole floor elevation shall be no lower than 18 inches below the invert elevation of the outlet pipe. Sumps in manholes are generally not required. When hydraulic efficiency is required, manholes serving mains shall be channelized to reduce entrance and exit losses within the manhole.

### 8.8 E. **Catch Basin and Manhole Sizing**

Catch basin and manhole sizing shall be determined by pipe size and orientation at the junction structure. A plan view of the junction structure, drawn to scale, will be required when angles of approach and clearance between pipes is a concern. The integrity of the structure to support the design loadings shall not be compromised. The minimum manhole diameter shall be 48 inches. Minimum distance between hole penetrations into catch basins or manholes shall be per the manufactures minimum recommendations. Manhole sections shall not have hole penetrations within eight inches (8”) of the edge of the top or bottom of the section.

### 8.8 F. **Maximum Catch Basin Depth**

Maximum depth of catch basins shall be five and a half feet (5’-6”) to lowest invert unless otherwise approved by the City Engineer. The maximum cover over pipes entering and leaving catch basins shall be 48 inches. Use storm water manholes for pipes requiring more than 48 inches of cover.

8.8 G. **Sumps**

All newly installed catch basins shall have an 18 inch minimum depth sump below the invert out. If a sump is provided in a storm manhole, the manhole shall have an 18 inch maximum sump below the invert out. Sumps in manholes are generally not required.

8.8 H. **Invert Elevations**

The drop from the highest inlet invert to the outlet invert shall not exceed 24 inches in catch basins or manholes. If the drop between pipe invert elevations exceed 24 inches, an outside drop structure is required. The minimum drop from the lowest invert in to the invert out shall be 0.2 feet for manholes or catch basins used as junction structures.

8.8 I. **Crown Elevations**

Match crown elevations of different diameter pipes at catch basins and manhole penetrations unless otherwise allowed by City Engineer.

8.8 J. **Field Verification**

The Contractor shall be required to field verify all existing invert elevations prior to making connections to existing structures or constructing new manholes over existing pipes. Deviations in elevation or alignment from those shown on the Final Approved Plans shall be immediately reported to the City Engineer. Any required changes to the plan must be approved through the City Engineer.

8.8 K. **Manhole Steps**

Steps shall not be allowed in manholes.

## 8.9 Provisions for Maintenance and Operation

8.9 A. **Public O&M Responsibility**

The City will provide operation and maintenance on all publicly owned facilities.

8.9 A. **Private O&M Responsibility**

1) Storm drainage facilities to be managed by the person(s) responsible (i.e. the owner/developer/their successors or assigned) include but are not limited to:

    a) A storm drainage facility not located on City owned property, City ROW, or City easement;
    b) A private parking lot storm drain;

c) Any roof, footing, or area drain;
d) A storm drainage facilities not designed and constructed for use by the general public;
e) An open drainage way;
f) Access drive culverts in the public ROW or on private property;
g) A detention, retention, or treatment system, in the construction of which the City did not financially participate;
h) All private LID facilities that are a part of the development approval.

2) Any person(s) responsible shall keep open drainage ways on property which they possess or control cleared of debris and vegetation as required.
3) Any person(s) responsible for non-public stormwater facilities shall enter into a Private Stormwater Maintenance Agreement with the City, and maintain such facilities so as to prevent flooding or damage to other property not possessed or controlled by the person(s) responsible and to prevent injury to any person or property not owned or controlled by the person(s) responsible. The Private Stormwater Maintenance Agreement shall be recorded in the deed records of Hood River County, Oregon for each individual lot/unit. This agreement shall run with the title to the land. This agreement will be in place prior to final plat approval.
4) Any person responsible shall not alter a detention, retention, or treatment system from its original properly functioning condition or intended design without prior written approval of the City Engineer.
5) Private parking lots and private streets must be swept or cleaned at least semi-annually. Prior to the sweeping or cleaning, bio-filter bags must be installed to prevent pollution during the maintenance effort from entering the City's storm drainage system and impacting downstream water quality. The property owner or manager must certify every year through a cleaning contractor that the inspections and cleanings have been completed.
6) The person(s) responsible shall provide the City up to date contact information within 10 days of any changes.
7) The person(s) responsible shall bear all costs, expenses, and risks arising out of or in any way relating to the operation, maintenance, and repair of the private stormwater facility.

8.9 B. **Access (Public Facilities)**

Public ingress/egress easements shall be provided for all public stormwater facilities which require maintenance. Public ingress/egress easement shall be a minimum of 20 feet wide and shall have an all-weather access road as described in *Section 5.2 B*. Easements shall be recorded prior to Final Acceptance.

8.9 C. **Access (Private Facilities)**

A 20 foot wide exclusive, perpetual, access easement, benefiting the City of Hood River is required for all private stormwater facilities. Easements shall have an all-

weather access road as described in *Section 5.2 B*. Easements shall be recorded prior to Final Acceptance.

This easement gives the City and its authorized agents and employees the right, but not the obligation, of immediate entry to maintain access to the private stormwater facility to inspect, repair, or maintain the private stormwater facility in the event the person(s) responsible (i.e. owner/developer/their successors or assigned) fail to operate, maintain, and repair the private stormwater facility in a timely manner, as required. If upon inspection by the City, the private stormwater facility is not being properly operated, maintained, or repaired, the City shall make the necessary repairs and all expenses for those repairs or maintenance shall be paid by the person(s) responsible. The City is under no obligation to maintain or repair private stormwater facilities.

8.9 D. **Operations and Maintenance Manual**

As part of the Final Plan Submittal, the Design Engineer shall submit an O&M manual that includes

1) O&M Drawing/Map: Detailing which portions of the proposed storm sewer system will be dedicated to the City, which will remain in private ownership, and easements (if any) that will be provided (with map narrative if necessary).

2) O&M Narrative: Describing the required maintenance criteria (frequency of inspection, description of maintenance practices, etc.) for all water quality and quantity systems, and who will be responsible for maintenance of these facilities once the project is completed.

3) Proprietary Systems: Provide proof of maintenance agreements and provide yearly proof of inspections unless otherwise approved by the City Engineer.