APPENDIX E

# City of McMinnville Storm Drainage Design and Construction Standards

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## Standard Construction Details and Specifications

Except where specifically addressed by the current *City of McMinnville Storm Drainage Master Plan* or by adopted City of McMinnville drainage standards, the APWA *Standard Specifications and Drawings for Public Works Construction* (1990) prepared by the Oregon Chapter of APWA shall be used as the basis for materials, design detail, and construction specifications.

## Engineering

It is the intent of the *City of McMinnville Storm Drainage Design and Construction Standards* to provide specific design guidelines. These guidelines do not relieve the design engineer from responsibility in applying reasonable engineering judgment in the design of drainage systems within the City.

All plans and specifications for the construction of storm drainage facilities within the City of McMinnville shall be prepared by or under the direction of a professional engineer registered in the State of Oregon. All such plans and reports shall be stamped and signed by the engineer responsible for the preparation of the plans.

At the City Engineer's option, the applicable engineering calculations may need to be submitted with the plans and specifications to support the preparing engineer's choice of design elements.

All engineering plans and specifications shall be prepared in accordance with any specific requirements established by the City of McMinnville's Community Development Department and in accordance with good engineering practice.

## Drainageway Alignment

The installation or alteration of storm drainage conveyances shall provide for safe disposal of storm runoff waters from both private and public properties and shall provide for the orderly conveyance of future flows from any upstream watershed. Specific requirements include:

A. Any existing surface or groundwater flows from a higher situated property onto a lower situated parcel may not be increased unless it can be demonstrated by the applicant that there is no significant adverse impact from the 25-year event on the lower situated parcel. Otherwise, the potential increase in flow rate shall be mitigated with stormwater detention at the expense of the owner of the higher situated parcel to limit the future

peak flow from the 10-year event to the peak flow for the same storm under the current level of development.

B. Any existing concentration of stormwater flows, such as any gully, ditch, creek, or pipe, which transports storm runoff from a higher situated property onto a lower situated private parcel shall continue to be transported by that lower situated parcel to a point of acceptable discharge. (See item E below.) The location of the point of discharge onto another property shall not be changed without the permission of the owner of the receiving property, nor shall the location of the onsite drainageway be changed without the approval of the City Engineer except as specifically shown in the current approved storm drainage master plan.

C. A point of acceptable discharge is a storm drain, existing ditch, detention pond, or natural drainageway. Any proposed alteration in the point of discharge must demonstrate that there are no significant adverse impacts downstream. Any changes in alignment that are in accordance with the stormwater routing recommended in the current approved storm drainage master plan shall be considered to meet the intent of this requirement.

D. Where a new drainage conveyance, whether piped or open channel, is desired across another parcel in order to reach a point of acceptable discharge, a drainage utility easement must be obtained in writing from the impacted property owner. Maintenance responsibility for the new drainage conveyance remains with the grantee of the easement unless other arrangements are made in writing. Such a drainage conveyance shall be designed to convey, at a minimum, the 10-year event without causing erosion or otherwise damaging the property being crossed.

E. Drainage may be routed directly onto public streets through the curb if all of the following conditions are met:

   – The area being drained is a single family residential dwelling or a multi-family residential dwelling on a site that is less than approximately 1 acre

   – The floors of all occupied buildings on the site are at least 18 inches higher in elevation than the top of curb

   Otherwise, onsite drainage must be routed to a point of acceptable discharge as per item *C* above.

## Compliance with Master Drainage Plan

Drainage improvements for known inadequacies shall be implemented according to the recommendations of the current approved storm drainage master plan. Drainage facilities for future improvements shall be provided in accordance with the standards presented in the City of McMinnville Design and Construction Standards for any of the following developments within the City of McMinnville:

- All major or minor partitions and subdivisions.

- Construction of new roadways within the public right-of-way and major reconstruction of existing public streets.
- Any commercial, industrial, or multi-family developments or improvements within existing developments that would result in the creation of more than 10,000 square feet of impervious pavement.
- Any new or additional construction involving drainageways, both open channel and piped, that serve, or flow through, other upstream, or downstream, private properties.
- Any improvement that alters drainage patterns in terms of point of discharge, routing, channelizing, piping, or filling of existing watercourses.

# Design Storm Selection

The selection of the design storm is necessary to establish the peak runoff rate that the drainage facility will be designed to accommodate. There are two aspects to determining this peak runoff rate: (1) selection of the appropriate storm frequency (also called return interval), and (2) calculation of flow from the upstream watershed once the frequency has been selected. These two aspects are defined below.

## Selection of Design Storm Frequency

Proposed public drainage improvements to the existing storm drainage system are shown in the current approved storm drainage master plan. As a long-term planning document, the master plan may not indicate all necessary improvements to accommodate a particular development. The design engineer is responsible for establishing a design that meets all criteria set forth in this guidance. Drainage facilities for the development categories listed in the Compliance with Master Drainage Plan section above shall be sized to accommodate the design storm event occurring within the watershed upstream from the point of interest according to the following frequency criteria:

- 10-Year
  - Residential. All residential development.
  - Commercial, Industrial, and Multi-family. All commercial, industrial, and multi-family site development qualifying under the Compliance with Master Drainage Plan section above.
  - Small and Moderate Pipe Systems. All piped systems within the public right-of-way that serve an upstream watershed that is not more than 320 acres.
  - Small Open Channel Crossings. Any crossings of natural streams or constructed open channel drainageways with upstream watersheds that are 20 acres or less.
- 25-Year
  - Large Pipe Systems. All piped systems within the public right-of-way that serve an upstream watershed that is greater than 320 acres.

  - Medium Open Channel Crossings. Any crossings of natural streams or constructed open channel drainageways with upstream watersheds that are greater than 20 acres but no larger than 160 acres, or that serve arterial roadways.

- 50-Year
  - Large Open Channel Crossings. Any crossings of natural streams or constructed open channel drainageways with upstream watersheds that are greater than 160 acres but less than 640 acres. Design event shall also be applied to sag curves or culvert crossings of major arterial roadways, emergency routes, or ODOT highways.

- 100-Year
  - Very Large Open Channel Systems. Any crossings of natural streams or constructed open channel drainageways with upstream watersheds that are greater than 640 acres or conveying a stream with a designated FEMA flood hazard area.

### Determination of Peak Runoff

Hydrologic calculations are used for design and investigation of three separate but related elements of the drainage system: conveyance, water quality treatment, and detention. These systems are often addressed with different hydrologic calculations specific to the needs of the design. The different calculations are summarized in Table E-1.

TABLE E-1
Summary of Recommended Hydrology Methods

| Basin Characteristics | Design Procedure |
|---|---|
| Less than 100 acres | Rational Method |
| Between 100 and 300 acres | Rational Method or SBUH/TR-55 |
| Greater than 300 acres* | SBUH/TR-55 |

* Reported flow from master plan may be used for delineated basins greater than 300 acres, if land use and routing assumptions have been reviewed and updated.

If using TR-55, the designer should use the same soil parameters and curve numbers reported in the current approved master plan to maintain consistency.

It is required that detention storage, for areas that require it per the current approved storm drainage master plan, be determined using SBUH or TR-55.

Using the frequency selected in the Selection of Design Storm Frequency section above and the area of the watershed lying upstream from the point of interest, follow the methodology outlined in Section 6.3 of the *City of McMinnville Storm Drainage Master Plan*.

## Storm Drain System Construction

The following subsections outline the standards to be used, in addition to good engineering judgment, in the design of drainage system components.

## Pipe

Pipe material and construction shall conform to the standards referred to in the Engineering section above unless specifically modified in the following section.

### Pipe Material

Pipe material selection shall be made according to manufacturer's recommendations for load requirements. Acceptable pipe materials for stormwater conveyance within all public rights-of-way or for any piped conveyance of drainage from a watershed area larger than 25 acres shall be as specified in the Standard Construction Details and Specification section above.

For private storm drain pipe materials refer to Section 1403 of the Oregon State Specialty Plumbing Code.

### Pipe Size

Storm drain pipes within public rights-of-way or storm drain pipes that are otherwise publicly maintained shall be no less than 12 inches inside diameter. (See exception for catch basin leads in the Catch Basin Connection section below.) In addition, except for the specific improvements noted in Section 7 of the *City of McMinnville Storm Drainage Master Plan*, storm drain pipes shall be designed to convey the design storm event at a minimum velocity when flowing full and without surcharge to the pipe. Use Manning's equation to size pipe with the equation variables determined as follows:

Manning's Equation:

$$Q = A \times (1.49 \div n) \times R(h)^{.67} \times S^{.5}$$

where:

A = cross sectional area in square feet
R(h) = hydraulic radius
R(h) = D ÷ 0.25 for full round pipe
D = Diameter of pipe in feet for sections other than full round pipe
R(h) = A ÷ P, where P = wetted perimeter

Other variables in the equation are determined as shown in Table E-2.

TABLE E-2
Other Manning Equation Variables

| | Units | Variable | Section Title of these Standards |
|---|---|---|---|
| Q | Cubic feet per second | Flow | Design Storm Selection |
| n | none | Roughness | Pipe Roughness Coefficient |
| S | ft/100 ft | Slope | Pipe Slope |

Slope and diameter should be varied until capacity as represented by right side of the equation equals or exceeds the required flow (Q) on the left side of the equation.

## Pipe Roughness Coefficient

Pipe roughness coefficient *n* is the coefficient that is used in Manning's equation as required by Section 11.7.1.2 above and its value depends on the type of pipe or culvert material. Assume the roughness coefficients for various pipe and culvert materials as shown in Table E-3.

TABLE E-3
Roughness Coefficients for Various Pipe and Culvert Materials

| Material | *n* |
|---|---|
| Concrete | .013 |
| Corrugated Metal Pipe | .024 |
| Polyvinyl chloride (PVC) | .010 |

If manufacturer's recommendations for roughness coefficient are greater than the values listed above, use manufacturer's recommendations.

## Pipe Slope

The slope of any storm drain that is within the public right-of-way or is otherwise publicly maintained shall be designed with a recommended mean flow velocity of 3.0 feet per second when flowing full. For concrete sewer pipe (n = .013), the minimum pipe slopes to meet this requirement are as shown in Table E-4.

TABLE E-4
Minimum Pipe Slope
*Slope (Feet Fall per 100 Feet)*

| Pipe Diameter inches | Concrete | CMP | PVC |
|---|---|---|---|
| 12 | 0.44 | 1.50 | 0.26 |
| 15 | 0.33 | 1.11 | 0.19 |
| 18 | 0.26 | 0.87 | 0.15 |
| 21 | 0.21 | 0.71 | 0.12 |
| 24 | 0.17 | 0.59 | 0.10 |
| 27 | 0.15 | 0.50 | NA |
| 30 | 0.13 | 0.44 | NA |
| 36 | 0.10 | 0.34 | NA |
| 42 | 0.08 | 0.28 | NA |
| 48 and above | 0.08 | 0.23 | NA |

If this minimum slope cannot be met due to outfall constraints, the minimum mean flow velocity for the pipe flowing full can be reduced to 2.5 feet per second upon approval by the City Engineer.

## Pipe Cover

A minimum of 36 inches of cover shall be provided over publicly owned or publicly maintained storm drains. "Cover" is defined as the distance between the outer diameter of the pipe (excluding bell) and the street or ground surface immediately above the pipe.

Where it is impractical to maintain 36 inches of cover, the amount of cover can be reduced provided that the manufacturer's recommendation for protection from loading are met, the installation is designed by a registered civil engineer with stamped calculations, and the method of pipe protection is approved by the City Engineer.

## Pipe Connections

Storm drain pipes within the public right-of-way, or which are publicly maintained, shall begin at the upstream end at an inlet structure or at a manhole and shall terminate at an outlet structure. See these two sections below: Manholes and Inlet and Outlet Structures.

At the point where storm drain pipes change diameter, the top (crown) of the two pipes should be matched, that is, the inverts shall be offset by the difference in pipe diameter, except that, where such depression of the downstream pipe is not feasible (due to outfall elevation constraints, high groundwater, or similar) and upon approval by the City Engineer, the two pipes can be aligned by matching the point in each pipe that is two-thirds of the distance up from the pipe invert in each pipe. Generally, changes in pipe diameters shall be made only at manholes or other such structures.

Where leads from catch basins, private service laterals, or minor incoming storm drains are connected to the "main" storm drain pipe and where that connection is made outside of a manhole, the incoming pipe shall be connected to the "main" storm drain by aligning the center of the incoming pipe with a radius from the center of the "main" storm drain. In any case, the incoming pipe must enter the "main" storm drain at an angle that is between 0 degrees and 45 degrees as measured upward from horizontal.

## Pipe Alignment

Public storm drains shall generally be placed along straight alignments between manholes or cleanout structures.

## Storm Drain Pipe Access

Storm drain pipes shall be located in one of the following locations:

A. Generally, storm drain pipes shall be placed along the centerline of traveled lanes within the public right-of-way. On curving streets, storm drain pipes placed in a straight line between manholes will not necessarily lie along lane center lines, but such pipes shall be located within the curb lines.

B. Where a replacement storm drain pipe must be added to an existing street, alignment outside of the paved area but within the public right-of-way may be considered by the City Engineer if the impact to existing development is minimal and if the construction cost savings is significant.

C. Where storm drain pipes cannot be placed within or along public roads, drainage utility corridors may be dedicated to the City provided that all of the following conditions are met:

   – The right-of-way is at least 20 feet wide and the outside edge of the storm drain pipe is located at least 9 feet from either side of the right-of-way.

   – If other utilities are located within the right-of-way, they shall be placed in a horizontal and vertical alignment that will allow the storm drain pipe to be excavated, if needed for repair, without disturbing the other utilities.

   – Vegetation, structures, walls, utility poles, and other features shall not be placed within the right-of-way in such a manner as to obstruct access to the storm drain pipe. Further, vegetation planted within the access route provided to access the full length of the storm drain pipe shall be of a type that can tolerate periodic vehicle access.

D. Placement of storm drain pipes, which are intended to be maintained by the City within utility easements, is permitted only upon specific approval of the City Engineer. In such cases, all of the access criteria listed in item *C* above will apply.

## Manholes

### Manhole Types

Manholes shall be constructed in accordance with the specifications referred to in Section 11.2 of this plan.

### Manhole Spacing

Manholes must be provided for storm drains within the public right-of-way or for publicly maintained storm drains at each of the following locations:

- At all points where size of the storm drain pipe changes and where the larger pipe is 18 inches or greater.
- At all points where the storm drain "main" pipe changes horizontal alignment by more than 5 degrees or vertical alignment by more than 2 percent.
- At all storm drain pipe intersections, except where all incoming pipes besides the largest straight-through pipe are 12 inches or less and where the invert of the largest pipe is at a depth of 6 feet below ground surface or less.

In any case, manholes shall be installed along storm drain pipes at least every 500 feet.

## Catch Basins

### Catch Basin Types

All catch basins within the public right-of-way shall be constructed as specified in Section 11.2 of this plan.

All catch basins located outside of the public right-of-way but located to serve private streets that have a defined curb line and are essentially constructed to City street standards shall be constructed as specified in the Standard Construction Details and Specifications section above.

All catch basins located outside of the public right-of-way and intended to serve area wide drainage without the benefit of a curb to direct surface water directly into the catch basin shall be constructed in accordance with the Oregon State Specialty Plumbing Code.

### Catch Basin Spacing

All stormwater entering a closed pipe system shall be via a catch basin, except that creeks and other open channel conveyances may enter a piped system through an approved inlet structure (see Inlet and Outlet Structures section below).

Catch basins shall be sized and spaced to accept the 10-year design storm event, provided, however, that catch basins within the public right-of-way are not located to serve more than 300 linear feet of curb line in any one direction.

Where street drainage in a public right-of-way drains to a sag from more than a total of 800 feet of curb line, the storm drainage inlet structure shall be a "curb inlet" of a design approved by the City Engineer.

### Catch Basin Connection

Catch basin leads shall be a minimum of 10 inches in diameter and shall be no longer than 50 feet in length.

Catch basins may serve as a juncture point for the intersection of private storm drain services or catch basin leads provided that the connection is less than 4 feet below ground surface, the pipe diameter is 15 inches or less, and provided that a double catch basin is installed.

## Curb, Gutter, and Roadside Ditch

In general, all new street construction shall include curb and gutters to direct stormwater runoff into catch basins. Roadside ditches shall not be permitted unless specific approval from the City Engineer is obtained. Curb types shall be according to the standards specified in the Standard Construction Details and Specifications section above.

## Culverts

Culverts must be designed to meet all Oregon requirements for fish passage (OAR 635-412), unless a waiver or programmatic approval has been obtained. Reference Oregon Department of Fish and Wildlife guidance when fish passage is required, and the design criteria that apply.

Culverts are pipes less than 200 feet in length that are placed within predominantly open channel systems, either natural or man-made, to allow fill crossings of those channels. The following design criteria apply to culvert installation:

- Use the design storm selection criteria outlined in the Selection of Design Storm Frequency section above.
- Use Manning's Equation with slope assumed to be 1 percent, flowing full but not surcharged, and with the roughness coefficient set at the appropriate value listed in the Pipe Roughness Coefficient section above.
- Corrugated metal pipe coated for rust protection, reinforced concrete pipe, or cast-in-place concrete may be used for culvert construction.
- Entrance head losses shall be limited to less than 6 inches for the design storm event.
- The culvert fill shall be placed on an area that has been cleared of uncompacted organic vegetation and debris, and the fill placed over the culvert shall be compacted.
- Culvert inverts shall be placed approximately 6 inches to 12 inches above the prevailing creek bottom profile. (This standard does not apply to overflow culverts that function only at higher water elevations.)
- Culverts shall be protected against erosion at both the upstream and downstream ends. The protection shall extend outward from the culvert as summarized in Table E-5.

TABLE E-5
Culvert Erosion Protection Guidelines

| Direction | Upstream End | Downstream End |
|---|---|---|
| Above Pipe | 12 Inches + Pipe Diameter | Pipe Diameter |
| Below Pipe | 24 Inches + Pipe Diameter | To Channel Bottom |
| Along Channel Bottom | No requirement | 2 x Pipe Diameter |
| Sides | 6 Inches + Pipe Diameter | Same |

The erosion protection specified above shall consist of riprap, concrete, or other approved method. The riprap shall be a durable rock with a density of at least 160 pounds per cubic foot and shall be of a size sufficient to prevent displacement during the design storm event; calculations to be provided.

## Inlet and Outlet Structures

### Inlet Structures

Inlet structures shall be constructed where a predominantly open channel system is routed into a predominantly closed channel system with a pipe diameter of 12 inches or larger. The intent of this structure is to prevent larger materials from entering and possibly clogging the closed pipe system. Inlet structures shall be provided with a rectangular, sloped inlet grate. The grate shall be installed with vertical bars to the outside to facilitate cleaning of debris off the grate with a rake from above.

Inlet structures shall be protected by riprap or other method according to the standards listed for culverts (see the Culverts section above) of similar capacity.

### Outlet Structures

Outlet structures shall be constructed where a closed pipe system discharges into a stream or river and at least one of the following conditions are met:

- Pipe diameter is 30 inches or larger
- During the design storm event, flow velocity in the pipe immediately prior to discharge is greater than 5 feet per second

Outlet structures shall be oriented to discharge at a downstream angle into the creek. For large flows into relatively small streams, applicant must demonstrate that the opposite bank will not be impacted by the flow. Outlet structure shall be constructed so as to be more or less flush with the prevailing creek bank with concrete headwalls and sidewalls as necessary to retain adjacent bank soils.

Outlet structures shall be protected by riprap or other method according to the standards listed for culverts (see the Culverts section above) of similar capacity.

## Open Channels

### Open Channel Types

An open channel system is defined as a drainageway system, either natural or manmade, that is predominantly non-piped, although some culverts may be located within open channel systems.

The following open channel types are defined:

- Large Watershed, Multiple Ownership. A manmade open channel serving more than one upstream properties with a total watershed of larger than 40 acres must meet the requirements of both the Open Channel Size and Open Channel Access sections below.
- Small Watershed, Multiple Ownership. A manmade open channel serving more than one upstream properties with a total watershed greater than 5 up to 40 acres must meet the requirements of the Open Channel Size section below.
- Larger, Single Ownership. A man-made open channel serving only one ownership with a total developed watershed of 5 acres or more must meet the requirements of the Open Channel Size section below.
- Small, Single Ownership. A man-made open channel serving only one ownership with a total developed watershed less than 5 acres is not required to meet the standards of either the Open Channel Size or Open Channel Access sections below.

### Open Channel Size

Open channels shall be constructed according to the following criteria:

- The design storm selected for open channels shall be according to the criteria listed in the Selection of Design Storm Frequency section above.
- Manning's Equation shall be used to determine the size of man-made open channels. The *n* values shown in Table E-6 shall be used.

TABLE E-6
Manning's Equation *n* Values to Use to Determine Size of Man-made Open Channels

| | ***n*** |
|---|---|
| Maintained grass line swale with side slopes 4 feet horizontal to 1 foot vertical, or flatter. | 0.035 |
| Riprapped channels | 0.045 |
| All other channels | 0.065 |
| Other treatments considered on a case-by-case basis. | |

- Man-made channels shall be either straight or curvilinear. Man-made open channels that drain more than 40 acres shall not be constructed with curves in channel centerline less than 200 feet in radius unless banks are protected with gabions, riprap, concrete retaining walls or other methods to prevent significant erosion.
- Open channels that flow at a design velocity of greater than 3.5 feet per second or greater than 2.0 feet per second in a channel segment where there is a change of channel direction that is more abrupt than a 200-foot radius as measured along channel centerline, shall be protected to avoid bank erosion using riprap, gabions, or similar method.
- Side slopes shall not be constructed steeper than 2 feet horizontal to 1 foot vertical unless the method of bank stabilization is designed by a registered professional engineer.
- Open channels shall be designed with the following freeboard depths (measured vertically) for the design storm:
  - 12 inches 10 cubic feet per second (cfs) or less
  - 18 inches 10 to 20 cfs
  - 24 inches 20 to 50 cfs
  - 36 inches More than 50 cfs
- All open channels shall be seeded, riprapped, or otherwise protected immediately upon completion of construction.
- Seeded open channels with side slopes steeper than 4 feet horizontal to 1 foot vertical shall be protected with erosion control matting, or similar, until vegetation becomes established sufficiently to prevent erosion.

## Open Channel Access

Where access to a publicly maintained open channel is required, it will be provided in one of the following ways:

- The open channel shall be located directly adjacent to and along a street right-of-way with the street available to provide machinery access to at least one side of the channel
- The open channel shall be located within a dedicated public right-of-way with a 20-foot-wide access within the right-of-way along the top of one bank
- The open channel shall be placed within a drainage utility easement granted to the City

NOTE: Any other utilities placed within the right-of-way or easement and located in the vicinity of the access path shall be constructed to accommodate equipment such as backhoes and dump trucks to drive on, and to operate from, the access path.

### Open Channel Vegetation

Open channels shall be seeded or planted immediately upon completion of construction. The following standards are recommended:

- Trees and shrubs that grow rapidly out into the channel, such as willows, should be avoided.
- Dense reed species, such as cattails and reed canarygrass, should be avoided.
- Grass should not be seeded on slopes steeper than 2.5 feet horizontal to 1 foot vertical without temporary erosion control protection.
- Plantings should be planned so that taller species will not be periodically disturbed by equipment accessing the channel for maintenance; i.e., plant low shrubs or grass on the equipment access side and plant taller species, if desired, on the far side.

### Sumps (Dry Wells)

Sumps, which are also referred to as dry wells or infiltration sumps, are not permitted as discharge points for storm drain systems within the public right-of-way or for storm drain systems that are publicly maintained.

## Natural Drainage Watercourses

It is the intent of this master plan to provide for the preservation of natural drainageways to the extent practical. The following provisions apply:

- Natural watercourses shall remain undisturbed to the maximum extent practical. Existing vegetation shall be allowed to grow undisturbed unless it interferes with the flow of water in a way that could cause flooding problems in upstream areas.
- Any alteration to natural drainage watercourses shall be consistent with the recommendations of this master drainage plan and shall require the approval of the City Engineer.
- Livestock or horses shall be restrained by fencing or other means from grazing within or on the banks of a natural drainage watercourse.
- The number of private road crossings of natural drainageways shall be minimized to the extent practical. Where necessary, they shall meet the size requirements of the Culverts section above.
- Fills placed into natural drainage watercourses is not permitted without approval of the City Engineer. Dumping of soils, construction debris, yard wastes, trash, garbage, or any other natural or man-made wastes into natural drainage watercourses is not permitted under any circumstances.

- In-water impacts may have special permit requirements that apply for floodplain or environmental regulations. These permits may require approval from other authorities, such as the U.S. Army Corps of Engineers, Oregon Department of State Lands, or others. These may also include long-term maintenance requirements for flood storage, etc.
- Outlet pipes to natural channels from piped drainage systems should be set near ordinary high water to the extent practicable to reduce erosion.

# Stormwater Detention

Detention of stormwater is intended to reduce the hydraulic impact on drainage facilities downstream of the site.

## Applicability of Stormwater Detention Criteria

Detention of stormwater is not required except in the following circumstances:

A. Development of sites greater than 2 acres in size located within Sub-basins N-30L2, N-50, and C-80R2.

B. Any commercial or industrial development that creates more than 5 new acres of impervious area or creates more than 3 additional impervious acres on a site with 5 acres or more of existing impervious acres.

C. Any multi-family residential development that develops a total land area greater than 10 acres in size. If construction of-a multi-family development is phased with less than 10 acres being constructed in any one phase, then drainage patterns shall be planned for future stormwater quality facilities with the actual construction of such facilities postponed until more than 10 acres are actually constructed.

NOTE: Detention is not required for any development if the site discharges directly into the North Yamhill River, the South Yamhill River, or into Main Cozine Creek downstream of its confluence with North Cozine Creek.

## Detention Design Criteria

- For the sites identified in items C and D of the Applicability of Stormwater Detention Criteria section above, detention shall be provided by the developer to limit site runoff from the 10-year developed peak flow to be equal to or less than the 10-year existing peak from the site. The following methodology may be used:

  For sites less than 20 acres, use the Rational Method:

  $$Q = C \times i \times A$$

  where

  Q = Peak Flow, in cfs
  C = Runoff Coefficient
  I = Rainfall Intensity at TOC
  TOC = Time of Concentration, in minutes
  A = Area, in acres

- For sites larger than 20 acres, use TR-55, Santa Barbara Urban Hydrograph, or another approved method.
- Construct an assumed future site hydrograph by the following method (if rational method is used):
  - Assume a triangular hydrograph with the high point occurring at the time of concentration (TOC) and being equal to the peak 10-year future flow.
  - To determine the required volume of detention, use the formula:

    $$v = \frac{1}{2} \times (Qf - Qe) \times (180 \times TOC) \times (1 - [Qe/Qf])$$

    where

    Qf = Future Peak Flow, in cfs
    Qe = Existing Peak Flow, in cfs
    TOC = Future Time of Concentration, in minutes

    NOTE: If detention volume is less than 2,000 cubic feet, detention is not required.
- Size the low flow outlet pipe to restrict the flow out of the detention basin to the existing peak flow when the pond is at full storage capacity. Provide for an overflow for events greater than the 10-year event to be provided at an elevation at or above the maximum water storage elevation of the detention facility.
- The detention pond shall be constructed so as to avoid any significant negative impact on any properties upstream of the facility and so as to avoid any failure (ponding at onsite catch basins) for the design storm event.
- A vegetation control plan shall be submitted with all detention pond design showing the following:
  - Vegetation to be planted at the time of construction.
  - Location of maintenance access to pond.
  - Areas of vegetation that will be maintained, i.e., periodically trimmed and/or removed.
  - Name, address, and telephone number of entity or individual responsible for maintenance of detention facility.
- Detention ponds may also serve as water quality enhancement facilities provided that the more stringent of any design criteria for either is used.
- Multiple uses of detention ponds are encouraged.

## Stormwater Quality Facilities

Commercial and industrial developments that create more than 5 acres of impervious area subsequent to the adoption of this master plan shall be required to construct stormwater quality treatment facilities. These facilities shall be located so as to pass stormwater from

newly developed areas through the treatment facilities before discharge from the site. The following design criteria apply:

A. **Removal Requirements**. Stormwater quality treatment facilities shall be designed to remove phosphorus according to the following percentage of removal:

   Percent Removal > 100 - [24.5 ÷ R(v)]

   where R(v) = Area weighted average of site runoff coefficients

B. **Removal Methods**. Either of the following methods may be used to accomplish the required rate of phosphorus removal. Treatment facilities constructed in accordance with the following design criteria will be considered sufficient to meet the intent of item *A* above. In other words, actual performance may vary from the standard if the facilities are constructed according to the design criteria shown below.

   – Grassy Swale: If the facility selected is a grassy swale, then all stormwaters from the site should be routed through the swale and the swale should be designed in accordance with the following criteria:

| | | |
|---|---|---|
| Rainfall Event | = | 2-Year Frequency |
| Peak Runoff | = | Use Rational Method (Q = CiA) |
| Length | = | 200 feet for 75 percent removal, correspondingly shorter for lesser removal rates |
| Velocity | = | Less than 1.5 feet/second |
| Design water depth | = | 3 to 6 inches |
| Side slopes of swale | = | 3 feet horizontal to l foot vertical |

   – Wet Ponds: If the facility selected is a wet pond, the facility should be-designed by a registered engineer, using the manual titled *Controlling Urban Runoff*, by the Metropolitan Washington (District of Columbia) Council of Governments, July 1987, for design standards with the pond sized as follows:

   Pond Volume = 4 x D x R(v) x AREA x (43,560 ÷ 12)

   where

| | | |
|---|---|---|
| D | = | 0.36 inch of rainfall |
| R(v) | = | Area weighted average of site runoff coefficients |
| AREA | = | Tributary area in acres |
| Length-to-Width Ratio | = | 3:1 or longer |
| Normal Water Depth | = | 3 feet minimum, 6 feet maximum (during storm events) |
| Side slopes | = | 3 feet horizontal to l foot vertical or flatter (except side slopes as steep as 1½ feet horizontal to 1 foot vertical are allowed if riprapped, or otherwise stabilized) |

The outlet of the pond shall be designed to release the working volume of water over a 40-hour period for storms of a 2-year frequency or smaller. Storms of greater magnitude shall be allowed to pass through the pond to avoid flooding of adjacent lands.

# Erosion Control

## Erosion Control Provisions

Erosion control provisions shall be required for all new development on sites larger than 1 acre, including subdivision with a total land area greater than 1 acre, but not including construction of one single-family house. The erosion control provisions, when approved by the City, shall serve as the minimum acceptable procedure for control of soil erosion on the site during construction. Additional measures may become apparent during construction to meet the erosion standard. In general, no visible or measurable sediment should be allowed to leave a disturbed site or enter a storm drain or natural channel. Any additional measures are the responsibility of the holder of the building permit. The erosion control provisions may be shown on the construction site plan sheet submitted for approval to the City.

The following measures are required:

A. **Summer Construction**. If the construction is to be started and completed between June 15 and September 10, inclusive, and the construction does not involve work directly in drainageways or on slopes greater than 15 percent, then a statement to that effect shall be included on the construction plans and no special erosion control measures are required. (NOTE: The building permit holder remains responsible for any erosional discharges into public waters.) If construction starts before June 15 or extends later than September 10, then the following erosion control measures are required.

B. **Flat Lands**. For lands with prevailing grades less than 5 percent, the following measures shall be taken:

   – Straw bales, silt fences, or similar shall be placed in any swales, ditches, or gullies leaving the site from the time the vegetative ground cover is disturbed until the ground cover has been replaced and has stabilized. If a creek or significant open channel drainageway passes through the site, then such measures shall be taken before discharge into the creek or drainageway.

   – A gravel exit ramp shall be provided during the period of disturbance when trucks are entering and leaving the site. The exit ramp is intended to cause most of the mud to be removed from vehicle tires before leaving the site. All vehicles and equipment leaving the site shall exit across this exit ramp. The exit ramp shall be a minimum of 30 feet in length and 15 feet wide and shall have a minimum aggregate depth of 6 inches. Drain rock on geotextile fabric is recommended.

   – Any soil stockpiles more than 5 cubic yards in size shall be protected with a ring of straw bales, silt fence, or similar if surrounding topography would cause erosion from the pile to be transported away from the immediate vicinity of the pile.

C. **Moderately Sloping Lands**. For lands with grades between 5 percent and 10 percent, the conditions of item *B* above apply. In addition, the following measures are required:

   – If the grounds are to be seeded, erosion control matting, polyethylene sheeting, or similar methods shall be used to minimize erosion during the initial growing period.

- Straw bales, silt fences, or similar shall be placed at approximately 50-foot intervals along ditches, swales, or gullies within any disturbed areas.

D. **Steep Lands**. For lands with prevailing slopes greater than 10 percent, the Erosion Control Plan shall be prepared by a registered engineer to comply with the maximum soil loss requirement.

### Landscaping, Operations, and Maintenance

Preparation of an Operations and Maintenance Manual for water quality and detention facilities is required. Include site map with labeled access points and easements, procedures, and frequency of activities. Include a copy of an agreement indicating who is responsible for implementing the plan.

## Design Submittal Checklist

[Reserved for future development.]