Chapter 5

CONVEYANCE DESIGN

5.01 General Provisions

5.02 Extension of Public Conveyance Systems

5.03 Conveyance Easements

- 5.03.1 General
- 5.03.2 Standard Conveyance Easement Widths
- 5.03.3 Reduced Conveyance Easement Widths
- 5.03.4 Encroachments

5.04 Flows

- 5.04.1 Flow Determination – Sanitary Conveyance
- 5.04.2 Flow Determination – Storm Conveyance

5.05 Storm Conveyance Design Considerations

- 5.05.1 Design for Full Build Out
- 5.05.2 Storm Conveyance Design Criteria
- 5.05.3 Upstream Impacts
- 5.05.4 Downstream Impacts
- 5.05.5 Cross-Lot Drainage
- 5.05.6 Dissipation of Runoff Discharge

5.06 Pipe Design

- 5.06.1 Pipe Size
- 5.06.2 Location
- 5.06.3 Separation
- 5.06.4 Alignment
- 5.06.5 Grade
- 5.06.6 Steep Slopes
- 5.06.7 Pipe Cover

5.07 Conveyance Structure Design

- 5.07.1 Manholes
- 5.07.2 Cleanouts (Sanitary only)
- 5.07.3 Catch Basins and Inlets (Storm only)
- 5.07.4 Area Drains and Ditch Inlets (Storm only)
- 5.07.5 Constructed Channels (Storm only)
- 5.07.6 Culverts (Storm only)
- 5.07.7 Outfalls (Storm only)
- 5.07.8 Headwalls (Storm only)
- 5.07.9 Trash Racks and Debris Barriers (Storm only)

5.08 Other Requirements for Public Conveyance Systems

5.08.1 Surveying
5.08.2 Railroad Crossings

5.09 Laterals

5.09.1 General Provisions
5.09.2 Planning Considerations
5.09.3 Design Considerations
5.09.4 Installation
5.09.5 Testing

5.10 Flood Management Design Standards

5.10.1 Purpose
5.10.2 Flood Management Areas Defined
5.10.3 Design Criteria

Chapter 5

CONVEYANCE DESIGN

5.01 General Provisions

a. The provisions of this chapter shall apply to all public conveyance systems within District and City jurisdiction. Interpretations of such provisions and their application in specific circumstances shall be made by the District and City.

b. In addition to these rules, all sanitary sewers shall be designed and constructed to the rules of the Oregon Department of Environmental Quality. Where these rules conflict with the state rules, the state rules shall apply.

c. Any City operating a local program may adopt stricter design specifications within its jurisdiction than the specifications stated in this Chapter.

d. Except as otherwise provided, the extension of the public conveyance systems to serve any parcel or tract of land shall be done by and at the expense of the Property Owner or applicant. The District and City reserve the statutory right to perform the work or cause it to be performed and bill the Owner for the cost or to pursue special assessment proceedings as otherwise provided by District and City ordinance or permit conditions.

e. Except as otherwise provided, the Standard Details shall be followed for all aspects of conveyance design. Variances from the Standard Details shall require approval of the District or City.

5.02 Extension of Public Conveyance Systems

A development requiring connection to the public sewer system shall extend the public sanitary sewer and storm conveyance systems to allow all adjacent uphill and/or upstream parcels to be served by the public systems. The District or City may waive this requirement for sanitary sewer or storm conveyance when one of the following conditions is met:

a. The proposed connection to the public conveyance system is for an existing building.

b. Topography prevents uphill and/or upstream parcels from being effectively served by the required conveyance extension.

c. The uphill and/or upstream parcels are outside the Urban Growth Boundary and, in the District's or City's view, the boundary is not likely to be expanded in the future to include uphill and/or upstream parcels.

d. An analysis is provided demonstrating that the uphill and/or upstream parcels are likely to be served via another routing of the conveyance system and the District or City agrees with this analysis.

When physical extension of the conveyance system is not required for reasons other than topography, the District or City may require an easement for future sanitary sewer or storm conveyance.

5.03 Conveyance Easements

5.03.1 General

a. Public sanitary sewers and storm conveyance facilities, not located within public right-of-way, shall be located within an easement granted to the District or City.

b. The District or City may require that an area 5 feet in all directions from the edge of a manhole, catch basin, cleanout, or field inlet be encompassed in a public right-of-way or easement granted to the District or City.

c. Access easements shall be provided to manholes, where required by the District or City.

5.03.2 Standard Conveyance Easement Widths

a. Easements for single lines shall be a minimum of 15-feet wide. Easements for multiple lines shall be a minimum of 20-feet wide. The District or City may require wider easements in the following situations:

   1. Large trunk sewers
   2. Sewers greater than 10 feet deep
   3. Areas with topographic constraints such as steep slopes or sites where bore pits may be required in the future.

b. When a pipe will be stubbed, the easement shall extend a minimum of five feet past the end of the stub.

5.03.3 Reduced Conveyance Easement Widths

a. Conveyance easement widths may be reduced to 10-feet for single lines and 15-feet for two lines if all the following conditions are met to the satisfaction of the District or City:

   1. A reduced easement width is needed due to the location of existing buildings that prevent a standard easement width.
   2. Another conveyance route within the development site and public right-of-way is not possible due to topography.

b. When reduced conveyance easements are allowed, all the following additional requirements shall apply to the conveyance system within the reduced easement:

1. The sewer shall be constructed of ductile iron pipe or, where approved by the District or City, enclosed within a steel-casing pipe.
2. Manholes shall be located at the points where the conveyance system enters and exits the reduced easement section.
3. The sewer lines shall not be more than 8-feet deep.
4. If feasible, sewer lines shall not be located directly on the property line.

5.03.4 Encroachments

a. Structures constructed within conveyance easements shall require an encroachment agreement with the District or City. Approval of the encroachment is at the discretion of the District or City.

b. The encroachment agreement shall allow the District or City to remove the structure, as needed, to access the conveyance system. Replacement of the structure shall be at the property owner's expense.

c. The District or City may require special protection for the conveyance system in the vicinity of the encroachment.

5.04 Flows

5.04.1 Flow Determination – Sanitary Conveyance

a. Public sanitary sewers shall be sized to carry the ultimate flow for a basin in accordance with the current District adopted master plan and any applicable amendments and updates.

b. When required by the District or City, a report shall be submitted showing design calculations for sizing the proposed sanitary sewer system. The report shall include the information below. The District or City may waive parts of the informational requirements that they deem as unnecessary.

1. Drainage Basin

A reference map showing the drainage basin in which the project is located may be required. The map shall show the major basin that is consistent with the current District adopted master plan and any applicable amendments and updates.

2. Population Density

The population density figures shall be from the most recent information obtained for use by the zoning or planning department of the applicable public agency. If these figures vary from those of

the applicable master plan estimates, this difference shall be noted in the design calculations.

3. Flow Variations and Peaking Factor

   Accepted flow design practice shall be employed. The current adopted Master Plan Update, and any applicable amendments and updates, shall be used for approved flow parameters and peaking factor unless more current information particular to the basin in which the project is located is available and this information is approved by the District and City.

4. Infiltration and Inflow

   Infiltration and inflow shall be represented in flow calculations in the design of the sanitary system. The infiltration and inflow figures shall be from the current adopted Master Plan or any applicable amendments or updates.

5. Sewage Flows

   Sewage flows shall be calculated based on the design criteria in this chapter.

5.04.2 Flow Determination – Storm Conveyance

a. Land Use Assumptions for Flow Determination

   25 and 100-year flows for design of conveyance systems shall be based on full build-out of the upstream basin based upon the most recent approved County or City Comprehensive Land Use Plan and realistic estimates of development densities in areas included in recent additions to the Urban Growth Boundary.

b. Computational Methods for Runoff Calculations

   Unless an alternative method is approved by the District or City in writing, calculation of storm runoff used for conveyance design shall be based on one of the following methods with the limitations on use of each listed.

   1. Rational Method

      The rational method is allowed with the following limitations:

      A) Drainage subbasin area cannot exceed 1 acre for a single calculation without approval from District or City.
      B) The time of concentration shall be five minutes when computed to be less than five minutes.
      C) Rainfall intensities shall be from the IDF table included in the Appendix as Standard Drawing 1275.

   2. Santa Barbara Urban Hydrograph (SBUH)

      SBUH methods shall be based on the following information:

A) The rainfall distribution to be used within the District is the design storm of 24-hour duration based on the standard NRCS Type 1A rainfall distribution using the chart in Standard Details CA-3.
B) Curve numbers shall be derived from the National Resources Conservation Service's (NRCS) runoff curve numbers contained in Technical Release 55 (TR-55)-Urban Hydrology for Small Watersheds.
C) Soil types shall be derived from the NRCS Soil Survey for Washington County.

3. TR-55

The TR-55 method developed by NRCS when used for runoff calculations shall be based on the following information:

A) A standard NRCS Type 1A storm shall be assumed.
B) Curve numbers shall be derived from the National Resources Conservation Service's (NRCS) runoff curve numbers contained in Technical Release 55 (TR-55)-Urban Hydrology for Small Watersheds.
C) Soil types shall be derived from the NRCS Soil Survey for Washington County.

4. Stormwater Management Model (SWMM)

The SWMM method developed by EPA may be used on medium to large projects for computing runoff volumes for conveyance.

5.05 Storm Conveyance Design Considerations

5.05.1 Design for Full Build Out

Storm drainage facilities shall be designed and constructed to accommodate all future full build-out flows generated from upstream property.

5.05.2 Storm Conveyance Design Criteria

a. Design of the storm conveyance system shall provide a minimum 1 foot freeboard between the hydraulic grade line and the top of the structure or finish grade above pipe for 25-year post development peak rate of runoff.

b. Design surcharge (hydraulic grade line) in pipe systems for the 25-year design storm event shall not cause flooding in portions of a habitable structure, including below floor crawl spaces, or otherwise create a hazard or danger to the health and safety of the public.

c. Flows in streets during the 25-year event shall not run deeper than 4 inches against the curb or extend more than two feet into the motor vehicle travel lane.

d. This overland flow component to accommodate the 100-year event shall not be allowed to flow through or inundate an existing building.

e. Open channel systems shall be designed for minimum 1 foot freeboard from bank full provided no structures are impacted by the design water surface elevation.

f. A maximum overland distance for sheet flow used in calculations shall be 50 feet.

5.05.3 Upstream Impacts

Modifications to the existing on-site storm drainage facilities shall not restrict flows thereby creating backwater onto off-site property to levels greater than the existing situation, unless approved by the impacted off-site Property Owners and the District or City. When approved, the off-site Property Owner(s) shall agree to and sign a permanent easement legally describing the location of the backwater storage and authorizing the use of their property for stormwater drainage and detention purposes. The easement shall be in a form approved by the District or City.

5.05.4 Downstream Impacts

a. Downstream restrictions that create backwater during the 25-year design storm in the current or post-development condition may be required to be removed by the developer, at the discretion of the District or City.

b. Removal of downstream obstructions shall not be allowed if the removal will cause, contribute, or exacerbate damage from flooding to existing buildings or dwellings in the 100-year design storm.

c. When downstream restrictions are not removed, an on-site detention facility shall be required.

5.05.5 Cross-Lot Drainage

a. Developments shall not materially increase or concentrate runoff onto adjacent properties, except when the runoff is contained in an existing drainage way.

b. Developments shall accommodate existing off-site drainage entering a development site so as to not impact upstream property owners.

5.05.6 Dissipation of Runoff Discharge

Runoff exiting a development site shall be discharged with adequate energy dissipaters to prevent downstream damage.

5.06 Pipe Design

5.06.1 Pipe Size

a. General

1. Sanitary and storm conveyance systems shall be designed to accommodate flows identified under Section 5.04, with storm design also recognizing the design considerations of Section 5.05.
2. The Manning's coefficient value ("n") to be used in design shall be 0.013 for pipes.
3. Sewers of sizes which are obviously larger than necessary for flows, but what are designed oversized to meet grade requirements, are not allowed.
4. Sewers shall not decrease in size as they move downstream.

b. Sanitary Sewer Minimums

1. Public sanitary sewers shall be a minimum of 8 inches in diameter unless otherwise approved by the District.
2. 6-inch sanitary sewers may be approved by the District or City, if the line is no more than 250 feet long and is located at the end of a system with no requirement or anticipated need to be extended.
3. Side sewers shall have a minimum 4-inch inside diameter.

c. Storm Sewer Minimums

1. Pipes from catch basins to the main line in the public right-of-way shall be minimum nominal 10-inch diameter.
2. Main line pipe shall be a minimum nominal 12-inch diameter. Where there is no requirement or anticipated need to extend the pipe for adjacent development, the main line pipe diameter may be nominal 10-inch diameter for the furthest upstream section.
3. Storm pipes serving area drains and located out of a public street right-of-way with no requirement to be extended shall be a minimum 8-inch diameter.
4. Side Sewers serving roof drains and foundation drains shall be a minimum 4-inch diameter.

5.06.2 Location

a. Sanitary

1. Sanitary sewers within a public right-of-way shall be located within 5 feet of the right-of-way center line and no closer than 10 feet from the edge of the right-of-way, unless otherwise approved by the District or City.

2. Sanitary sewers in easements shall be located no closer than five feet from the easement line, unless otherwise approved by the District or City.

3. The District or City may require maintenance access easements.

b. Storm

1. Storm sewers within a public right-of-way for a local street with curbs, shall be located in the street and 5 feet from the curbs, unless otherwise approved by the District or City.

2. Storm pipes within a public right-of-way for a collector or arterial may be located behind and parallel to the curb with the approval of the District or City.

3. Storm pipes in easements shall be located no closer than 5 feet from the easement line, unless otherwise approved by the District or City.

5.06.3 Separation

a. General

Unless approved by the District or City, the minimum separation distance between parallel sanitary and storm sewers and utilities shall be 5 feet clear. If vertical separation between utilities is greater than 3 feet, additional horizontal spacing may be required to allow for maintenance access.

b. Sanitary Sewer in Vicinity of Water Supplies

1. No sanitary sewer shall be less than 10 feet from any well, spring, or other source of domestic water supply.

2. All sanitary sewers which are located within 50 feet from any such source of domestic water supply shall be constructed of ductile iron water pipe with watertight joints, C 900/905 PVC (Polyvinyl Chloride), or other District approved pipe.

3. Sanitary sewers and domestic water lines shall not be laid in the same trench.

4. Parallel water and sanitary sewer lines, wherever possible, shall be at least 10 feet apart horizontally when there is less than 18 inches of vertical clearance between water and sanitary sewer. When

physical conditions render this spacing impossible or impractical, ductile iron pipe with watertight joints, concrete encasement, C-900/905 PVC, or pipe approved by District shall be required.

5. Wherever it is necessary for sanitary sewer and water lines to cross each other, the crossing should be at an angle of approximately 90 degrees. The sanitary sewer shall be located 18 inches or more below the water line or be constructed of District approved pipe for a distance of 9 feet on both sides of the water line.

5.06.4 Alignment

Public sanitary and storm sewers shall be laid on a straight alignment and at uniform grade.

5.06.5 Grade

a. Sanitary

Sanitary sewer grades shall meet both the following requirements:

1. Sanitary sewers shall have sufficient slope to maintain a minimum flow velocity of 2.0 feet per second when flowing full or half full.

2. The minimum grades for sanitary sewers shall be those specified in Table 5-1.

TABLE 5-1
SANITARY SEWER MINIMUM GRADES

Inside Pipe Diameter (Inches)	Grade (ft per 100 ft)
6	0.60
8	0.40
10	0.28
12	0.22
15	0.15
18	0.12
21	0.10
24	0.08
27	0.07
30	0.06

b. Storm

Storm sewers shall have sufficient slope to maintain a minimum flow velocity of 2.5 feet per second when flowing full, except that storm sewers in flow-through systems, as defined in subsection 5.07.3(a)(3), shall have a minimum flow velocity of 3.0 feet per second.

5.06.6 Steep Slopes

Sewers on slopes in excess of 20 percent shall be secured with anchor walls or metal pipe slope anchors as shown in Standard Details.

5.06.7 Pipe Cover

a. In paved areas or areas anticipated to receive vehicular traffic, pipe cover shall be measured from the top of the paved surface (finish grade) to the upper exterior surface of the pipe barrel. The pipe bell shall not intrude into the subbase. In areas without pavement or vehicular traffic, pipe cover shall be measured from finish grade to the upper exterior surface of the pipe barrel.

b. Except as specified in subsection c, minimum cover shall comply with Table 5-2, unless an exception is approved by the District, City, or County.

TABLE 5-2
MINIMUM PIPE COVER

Type of Pipe	Paved Areas (inches)	Unpaved Areas (inches)
Other Approved Pipe	48	36
RCP Class III	30	18
RCP Class IV	24	12
RCP Class V	18	6
AWWA C900	24	12
AWWA C905	24	12
Ductile Iron	18	6

c. Pipe cover for catch basin leads in paved areas can be reduced to 18 inches if AWWA C900 or C905 pipe is used.

5.07 Conveyance Structure Design

5.07.1 Manholes

a. Sanitary and Storm

1. Manholes shall be provided at least every 500 feet, at every grade change, and at every change in alignment. When pipe slopes are 5% or greater, manholes shall be provided at least every 300 feet.
2. Manhole lids shall not be in a wheel path of the motor vehicle travel way.
3. All manholes shall be a minimum of 48 inches in diameter and have a minimum 12 inch ledge in the base.
4. A detail shall be submitted with the plans where pipes into or out of a manhole are larger than 24 inches or where more than four mainline connections are made.
5. A minimum of 8 inches of un-perforated wall separating the cut-outs or break-outs for the individual pipe connections shall be provided in manholes.
6. Where a connection is proposed to an existing manhole, elevation of the existing ledge, location of steps, and elevations of existing inlets and outlets shall be submitted with the plans.
7. Manholes constructed on lines with 12 inch or smaller pipes shall have a minimum 0.2 foot fall through the manhole unless otherwise approved by the District or City.
8. Where different size public conveyance pipes enter a manhole, the crowns of the upstream pipes shall be no lower than the crown on the downstream pipe without District or City approval.
9. A lateral entering a manhole at the end of the public conveyance system shall be designed so that the invert of the lateral is 6 inches above the invert of the outlet pipe.
10. All manhole bases shall be properly channelized.
11. No more than three side laterals or side sewers are allowed to be connected to a manhole unless an exception is approved by the District or City.
12. Manhole lids shall be in conformance with the Standard Details.

b. Sanitary – Additional Requirements:

1. A manhole shall be located at the upstream end of the pipe except as allowed in Section 5.07.2.

2. Unless approved by the District or City, manholes shall not be closer than five feet to a curb line.

3. If the vertical distance from the inlet pipe invert to the lowest pipe invert exceeds 12 inches, an inside drop may be required.

c. Storm – Additional Requirements:

1. Manhole lids shall have a minimum of 12 inches of clearance from the edge of a curb and gutter.

2. All piped inside drop manholes with 12-inch or larger pipe shall be a minimum of 60 inches in diameter.

3. Permanent Clean Outs shall not be allowed in storm sewers. Temporary Clean Outs will be evaluated by the District or City on a case-by-case basis.

4. Pipes entering manholes may have a maximum free fall of 48 inches as measured to the lowest invert of the manhole base.

5. A Curb Inlet Manhole or Modified Curb Inlet Manhole per Standard Details may be used in lieu of a manhole, when approved as part of a flow-through system. Standard inlets shall not be allowed in lieu of manholes in any system.

5.07.2 Cleanouts (Sanitary only)

a. Cleanouts shall be allowed only on pipelines where the sewer line has no possibility for future extension and the distance between the cleanout and a manhole is a maximum of 150 feet. The standpipe shall be the same size as the pipeline up to a maximum of 8-inches.

b. Locations of permanent cleanouts shall be approved by the District or City. Permanent cleanouts shall not be installed within a paved street or driveway.

c. Temporary cleanouts may be installed within the right-of-way at the end of a stub street where the street is expected to be extended in the future and the design of the sewer system does not warrant that a manhole be constructed at this location. The maximum distance of a main line extension without a temporary cleanout is 15 feet. The District or City will make the determination when and where temporary cleanouts are allowed. When the sewer is extended, the temporary cleanout shall be removed.

5.07.3 Catch Basins and Inlets (Storm only)

a. Types of Systems

1. Standard Catch Basin System

   All catch basins shall be sumped. The main storm line shall not pass through any catch basins or sumped manholes unless approved by the District. No more than three catch basins may be connected in series before connecting to the main storm line. A ditch inlet or area drain may be connected directly to the end of the main storm line.

2. Series Catch Basin System

   Unsumped catch basins located on non-arterial and collector roadways are allowed provided a sumped manhole is constructed below the unsumped catch basins before the flow enters the main storm line. No more than three unsumped catch basins may be constructed above a sumped manhole. The main storm line may not pass through the catch basins or sumped manholes. No ditch inlet or area drain may be part of a series of unsumped catch basins. All catch basins located on arterial or collector roadways that may receive wintertime sanding shall be sumped.

3. Flow-through Catch Basin System

   This system is allowed within an arterial or major collector road, provided the main line storm pipe has a design velocity of at least 3.0 feet per second. All catch basins shall be sumped. An adequately sized water quality manhole is required at the downstream end of the flow-through system.

b. Design Considerations

1. All inlets and catch basins shall be designed to accept a 10-year storm event. Grates shall, as far as practical, be designed to avoid failure due to accumulation of debris.

2. Precast and poured in place catch basins, and gutter inlets are allowed.

3. All sumped catch basins shall be constructed with an 18-inch minimum sump.

4. The spacing of catch basins along a street shall be determined by the capacity of each catch basin to pass a 10-year storm event. Where finish street grade is greater than or equal to 5 percent, catch basin spacing shall not exceed 300 feet. Where finish street grade is less than 5 percent, catch basin spacing shall not exceed 400 feet. In addition, catch basins shall be provided just prior to curb returns on streets with a centerline gradient of three percent or more and a street gutter drainage run of 100 feet or more.

5. Catch basins, except for CG-48 manholes shall be a maximum depth of 60 inches from the top of grate to the lowest pipe invert elevation, unless approved by the District or City.

6. The maximum distance for storm sewer connections between catch basins, inlets, and other structures shall be 250 feet.

7. In the case of inlets in streets, the maximum length of sewer between the inlet and a mainline structure shall be 40 feet for 10-inch pipe and 60 feet for 12-inch pipe unless additional length is required to cross the street right-of-way.

8. Tee connections from the main line sewer to catch basins and inlets may only be used in street rights of way if the jurisdiction having authority over the street approves them and the lateral connecting the main line and the catch basin or inlet is no longer than 10 feet.

9. Inlet grates or tops shall be marked with "Dump No Waste" in accordance with the Standard Details.

10. Where design criteria and methodology are not specified in this Chapter, the following publications shall be used:

    A) ODOT Hydraulics Manual
    B) Hydraulic Engineering Circular No. 12 (FHWA-TS-84-202) Drainage of Highway Pavements

5.07.4 Area Drains and Ditch Inlets (Storm only)

a. Area drains in rear or side yards shall not be sumped and shall be properly channelized. Ditch inlets shall be equipped with an 18-inch sump.

b. A main storm line shall not pass through an area drain or ditch inlet.

c. Area drains or ditch inlets may be located at the upper terminus of a main storm line, may connect to the main storm line at a manhole, or may connect to the main storm line through a tee with a lateral no longer than 10 feet.

d. The maximum acceptable intake flow rates for Type II area drains and ditch inlets with a grate angle of 30 degrees are shown in Table 5-3 where H is the Hydraulic Head measured in feet from the bottom of the grate to headwater and Q is the flowrate in cubic feet per second.

TABLE 5-3
MAXIMUM INTAKE FLOW RATES FOR TYPE II AREA DRAINS AND DITCH INLETS WITH GRATE ANGLE OF 30°

H	0.5	1.0	1.5	2.0	2.5	3.0	4.0	5.0	7.0	10.0
Q	2.0	5.6	10.3	11.9	13.3	14.6	16.8	18.8	22.3	26.6

5.07.5 Constructed Channels (Storm only)

a. Application

This section shall apply to open channels constructed to convey runoff to the existing public storm and surface water conveyance system. This section does not apply to design or construction of new roadside ditches or work within existing stream channels.

Development which re-grades existing roadside ditches or constructs new roadside ditches shall meet Washington County Uniform Road Improvement Design Standards and applicable City regulations.

b. Channel Design

1. Open channels shall be designed to prevent scouring of the channel.
2. Vegetation-lined channels shall be used whenever practicable as determined by the District or City. Rock-lined channels shall be used only where a vegetative lining will not provide adequate protection from erosion.
3. Where riprap protection is specified, riprap shall be placed over a woven geo-textile fabric.
4. Constructed open channels shall be sized to pass the required flows without causing erosion and shall have side slopes no steeper than 2H:1V.
5. No protruding pipes, culverts or other structures, which reduce or hinder the flow characteristics of the channel, will be allowed. Channels connections shall be designed to prevent scouring. All pipe connections shall match side slopes and incorporate a headwall.
6. Open channel designs shall be based on the minimum level or protection shown in Table 5-4.

TABLE 5-4
PROTECTION FOR NEW CHANNEL CONSTRUCTION

Velocity at Design Flow (fps)				
Greater than	Less than or Equal	Required Protection	Thickness (ft)	Min. Ht. above Design Water Surface (ft)
0	5	Vegetation Lining	Not Applicable	0.5
5	8	Bioengineered lining	Not Applicable	1
		ODOT Class 50 Riprap*	1.5	
8	12	ODOT Class 200 Riprap	2.5	2
12	20	Slope Mattress, etc.	Varies	2
20		Engineer designed		

* *The District or City may require ODOT Class 100 Riprap in areas with a likelihood of vandalism.*

5.07.6 Culverts (Storm only)

a. Application

1. This section shall apply to culverts placed across streams and drainageways. Culverts pass water under or through obstructions.

2. For culverts with diameters of 36 inches or greater or for driveway culverts which are part of a roadside ditch system, the County or City is the jurisdictional entity and their road design standards shall apply.

3. Culverts within FEMA floodplains shall be reviewed and approved by the local FEMA designated authority.

4. For culverts which convey flows from or through water quality sensitive areas; a local representative of Oregon Department of Fish and Wildlife (ODFW) or other applicable state or federal agency shall be contacted to determine if fish passage is required and to identify site specific design criteria. All culverts shall be designed for fish passage in accordance with ODFW guidance for fish passage unless otherwise exempted by ODFW and the District or City.

b. Hydraulic Design

1. Culverts will be designed to safely pass the 25-year flow.

2. Headwater

A) For new culverts 18 inches in diameter or less, the maximum allowable design storm event headwater elevation (measured from the inlet invert) shall not exceed two times the pipe diameter or three times the pipe diameter with a seepage collar unless an exception is approved by the District or City.

B) For new culverts larger than 18 inches in diameter the maximum allowable design storm event headwater elevation (measured from the inlet invert) shall not exceed 1.5 times the pipe diameter unless an exception is approved by the District or City.

C) The maximum headwater elevation of a design storm event for new culverts shall be at least one-foot lower than the road or parking lot sub-grade.

3. Inlet

For culverts 18 inches in diameter and larger, the embankment around the culvert inlet shall be protected from erosion by lining around inlet with rock or other protection. The lining shall extend upstream from the culvert a minimum of five feet and shall be as high as the designed headwater elevation.

4. Outlets

For culverts 12 inches in diameter and larger, the receiving channel of the outlet shall be protected from erosion by rock lining, bio-engineering, or other District or City approved energy dissipater.

5. Inlet Control Analysis

The headwater depth for pipes under inlet control shall be determined using the nomographs contained in the Standard Details, ODOT Hydraulics Manual, or a modeling methodology consistent with FHWA's HY8.

6. Outlet Control Analysis

The headwater depth for pipes under outlet control shall be determined using the nomographs contained in the Standard Details, the ODOT Hydraulics Manual, or a modeling methodology consistent with FHWA's HY8.

5.07.7 Outfalls (Storm only)

a. Outfalls will be designed to prevent scouring at the outfall discharge and provide velocity reduction prior to discharge to the receiving channel.

b. Where riprap protection is specified, riprap protection shall be placed over a woven geo-textile fabric.

c. Outfalls shall be above the mean low water level unless an exception is approved by the District or City.

d. Engineered energy dissipaters, including but not limited to, stilling basins, drop pools, hydraulic jump basins, baffled aprons, and bucket aprons, shall be designed using published references such as Hydraulic Design of Energy Dissipaters for Culverts and Channels published by the Federal Highway Administration of the United States Department of Transportation, the ODOT Hydraulics Manual and others. The design reference shall be cited on the construction plan submittal.

e. All outfalls shall be provided with a rock splash pad or other approved erosion control measure. Rock protection at outfalls shall be designed in accordance with Table 5-5.

TABLE 5-5
ROCK PROTECTION AT OUTFALLS

Discharge Velocity at Design Flow (fps)		Minimum Required Protection Dimensions				
Greater than	Less than or Equal	Type	Thickness (ft)	Width	Length (use greater of)	Height Over Crown
0	5	ODOT Class 50 Riprap*	1.5	Diam. + 6 ft	8 ft. or 4 x diam.	1 ft
5	10	ODOT Class 200 Riprap	2.5	Greater of: Diam. + 6 ft	12 ft. or 4 x diam.	1 ft
10		Engineered Energy Dissipater Required				

* *The District or City may require ODOT Class 100 Riprap in areas with a likelihood of vandalism.*

5.07.8 Headwalls (Storm only)

Pipe headwalls or other approved end protection shall be required where pipe material other than concrete or ductile iron is exposed in the design of an

outlet or inlet pipe or where required to stabilize slope. Details of all headwalls and end protection shall be included in the construction drawings.

5.07.9 Trash Racks and Debris Barriers (Storm only)

If trash racks or debris barriers are required by the District or City for pipe or culvert systems, the Engineer shall submit the trash-rock-debris barrier system design to the District or City for approval.

5.08 Other Requirements for Public Conveyance Systems

5.08.1 Surveying

The Owner's Engineer or Surveyor shall be responsible for establishing the location of the sanitary and storm sewer system by means of construction stakes offset along the center lines prior to commencement of construction. Moving upstream, there shall be a construction stake placed within 25 feet of each manhole, and at no more than 100-foot intervals along the mainline. Each lateral location shall be staked.

5.08.2 Railroad Crossings

Crossing of railroad rights-of-way shall be done in a manner which conforms to the requirements of the railroad having jurisdiction. If bonds or certificates of insurance protection are required, they shall be furnished by the Contractor or Owner to the railroad company concerned. The District or City shall be named as an additional insured.

Actual permits or easements for such crossings shall be obtained by the Owner and all terms for such permits or easements shall be met by the Owner and Contractor.

5.09 Laterals

5.09.1 General Provisions

a. The specifications contained herein, together with the State of Oregon Uniform Plumbing Code and all other applicable requirements of federal, state, and local law shall govern the installation of laterals.

b. The provisions of District ordinances requiring permits, fees, and other requirements shall be complied with prior to the start of work on any portion of the sanitary or storm pipeline systems.

5.09.2 Planning Considerations

a. Where a parcel requiring connection to a public sanitary sewer or storm conveyance system cannot connect through a lateral meeting the

requirements of this section, then extension of the public conveyance system shall be required. This extension of the public system is in addition to the requirements of Section 5.02.

b. Each parcel shall be served by individual laterals for sanitary and storm, except in the following situations:

1. Duplexes, townhouses, and other buildings that cross property lines may be served by a single storm lateral.

2. Two adjacent single-family dwellings or two duplexes may be served by a single sanitary or storm lateral where, in the judgment of the District or City, all the following conditions are met:

A) An existing public street must be trenched to install the lateral(s).
B) The elevation of the lowest floor with plumbing in the buildings to be served does not differ by more than 1 foot.
C) The laterals are at least 6 inches in diameter and meet all requirements for public sewer construction as specified in Chapter 8 of these standards.
D) A cleanout meeting the requirements of Standard Drawing 500 is installed at the boundary of the right-of-way line or at a location approved by the District or City.
E) Backflow prevention devices are installed on each sanitary building sewer upstream of the cleanout at the right-of-way or public sewer easement.

5.09.3 Design Considerations

a. Gravity Service

1. Laterals shall provide gravity service to a parcel.

2. Sanitary laterals shall provide gravity service to the main living area of a dwelling or primary use area of a non-dwelling such that a majority of the fixtures units, including those in kitchens, can achieve gravity sanitary sewer service.

3. Grinder pumps shall only be used to serve portions of buildings that cannot be served by gravity, such as daylight basements.

4. Storm laterals shall provide gravity service to the roof drains of buildings on a parcel.

5. The District or City may require the minimum first floor finished floor elevations to be shown on the plans to demonstrate that gravity service can be provided.

b. When allowed by the local Building Official, laterals may cross a single adjoining property if the following criteria are met:

1. The portion of the lateral on the adjoining property has a minimum 3 feet of cover over the pipe and the pipe is ductile iron.
2. The portion of the lateral on the adjoining property contains no bends.
3. The lateral crosses the adjoining property in a private easement that is a minimum of 10 feet wide.
4. A copy of the private easement is provided to the District or City, demonstrating the legal right of the parcel being served to install and maintain a private lateral on the adjoining property.
5. The portion of the lateral crossing the adjoining parcel is less than 100 feet long.
6. The lateral can be used for only one property.
7. The lateral crossing is not one of a number of lateral crossings in a new development designed to avoid constructing a sanitary sewer extension.
8. The Engineer provides justification, to the satisfaction of the District or City, that the crossing is needed.

c. Side sewers shall be less than 50 feet in length. The District or City may approve side sewers in excess of 50 feet in extraordinary circumstances.

d. Side sewers shall connect to the mainline sewer with a 90 degree tee or connect to a manhole at an angle of 60 to 90 degrees from the mainline sewer.

e. Side sewers shall contain no bends.

f. A minimum grade of 2 percent is required for side sewers, unless a lesser grade is approved by the District or City.

g. The use of weepholes in place of storm laterals shall be allowed where all the following conditions are met:

1. Adequate fall exists so that foundation drains discharge by gravity through the weepholes or other approved discharge point.
2. Calculations are provided with submitted plans showing pipe slope and cover meet the minimums required by the reviewing authority.
3. All portions of the lot can be adequately drained so runoff does not cross onto other property.

5.09.4 Installation

a. Material

Side sewer pipes shall meet the requirements of Section 8.04.2.

b. Excavation and Backfill

All excavation and backfill for laterals shall comply with Section 7.02.

c. Markings

1. Laterals shall be marked with a detectable underground magnetic tape. The magnetic tape shall be placed from the main pipeline to the end of the lateral with 18-inches vertical separation between the tape and pipe. The magnetic tape shall be green in color and have the following marking depending on whether it is a sanitary or storm line:

A) CAUTION SEWER BURIED BELOW
B) CAUTION STORM DRAIN BURIED BELOW

A 2 x 4 stake shall be installed at the end of the sanitary or storm lateral extending from the invert of the pipe to 3 feet above the ground surface. The stake shall be marked as whether it is a sanitary or storm lateral. A magnetic tape shall be placed alongside the 2 x 4.

2. The location of laterals shall be indicated by a permanent marker, acceptable to the District or City.

A) Where the sewer is in a street with curbs, the marker shall be on the curb.
B) Where the sewer is in a street without curbs, the marker shall be on the sidewalk.
C) Where the sewer is in a street without curbs or sidewalks, the Engineer shall present to the District or City for approval an alternative permanent marking method.
D) A sanitary sewer cleanout located on the private side of the right-of-way boundary is an acceptable permanent marker.

5.09.5 Testing

Sanitary laterals shall be tested in accordance with the requirements of Chapter 8.

5.10 Flood Management Design Standards

5.10.1 Purpose

The purpose of these standards is to reduce the risk of flooding, prevent or reduce the risk to human life and property, and maintain the functions and values of floodplains, such as allowing for the storage and conveyance of stream flows through existing and natural flood conveyance systems.

5.10.2 Flood Management Areas Defined

a. Flood management areas shall include, but are not limited to, the following:

1. Land identified within the 100-year floodplain and floodway as shown on the Federal Emergency Management Agency Flood Insurance maps

2. Land identified in updated flood studies or any other authoritative data documenting flood elevations as approved by the District or City/County

b. Applicants shall use the most recent and technically accurate watershed model information available from the District, or other updated data as approved by the District, to determine flood areas.

c. Notwithstanding any other provisions of these rules, the area within the town center of the City of Tualatin is not subject to the Flood Management Design Standards set out in Section 5.10 of these rules.

5.10.3 Design Criteria

The standards that apply to the flood management areas apply in addition to local, state, and federal restrictions governing floodplains and flood hazard areas.

a. All fill placed in a floodplain shall be balanced with an equal amount of soil material removal and shall not decrease floodplain storage capacity at any stage of a flood (2, 25, or 100-yr event). No net fill in any floodplain is allowed except when all of the following conditions are met:

1. When an area has received special protection from floodplain improvement projects which either lower the floodplain, or otherwise protect affected properties;

2. Where the exceptions comply with adopted master plans, watershed management plans, or subbasin plans, if any; and

3. When all required permits and approvals have been obtained in compliance with FEMA rules and other local, state, and federal laws regarding fill in floodplains.

b. Large areas may not be excavated in order to gain a small amount of fill in a floodplain. Excavation areas shall not exceed the fill areas by more than 50 percent of the square footage, unless approved by the District.

c. Any excavation dug below the winter "low water" elevation shall not count toward compensating for fill since these areas would be full of water

in the winter and not available to hold stormwater following a rain. Winter "low water" elevation is defined as the water surface elevation during the winter when it has not rained for at least three days, and the flows resulting from storms have receded. This elevation may be determined from records, studies, or field observation. Any fill placed above the 100-year floodplain will not count towards the fill volume.

d. The excavated area shall be designed to drain if it is an area identified to be dry in the summer, e.g., if it is used for a park or mowed in the summer. Excavated areas identified to remain wet in the summer, such as a constructed wetland, shall be designed not to drain. For areas that are to drain, the lowest elevation shall be at least 6 inches above the winter "low water" elevation, and sloped to drain. One percent slopes will be allowed in areas less than 1,000 square feet.

e. Excavation to balance a fill shall be located on the same parcel as the fill unless it is not reasonable or practicable to do so. In such cases, the excavation shall be in the same drainage basin, within points of constriction on the conveyance system, if any, as near as practical to the fill site, and shall be constructed as a part of the same development project.

f. Short term parking (motor vehicles remain parked for less than 18 hours per day) in the floodplain may be located at an elevation of no more than one foot below the ten year floodplain so long as the parking facilities do not occur in a Water Quality Sensitive Area or vegetated corridor. Long term parking (motor vehicles remain parked for greater than 18 hours without being moved) in the floodplain may be located at an elevation of no more than one foot below the 100-year floodplain so long as the parking facilities do not occur in a Water Quality Sensitive Area or Vegetated Corridor.

g. Temporary fills permitted during construction shall be removed upon completion of construction prior to the close of the in-stream work window as defined by Oregon Department of Fish and Wildlife or other local, state or federal authority.

h. Excavation and fill required for the construction of detention facilities or other facilities, such as levees, shall be specifically designed to reduce or mitigate flood impacts. Levees shall not be used to create vacant buildable land.

i. Excavation and fill required to restore or enhance floodplains, riparian areas, wetlands, uplands, and streams, including but not limited to the planting of vegetation and daylighting existing storm pipes, shall be permitted as long as the design complies with applicable federal, state and local standards.

j. The floodplain may not be modified to increase water velocities such that stream bank erosion will be increased, unless the stream banks are protected to prevent the increased erosion.

k. Uncontained areas of hazardous materials are prohibited within flood management areas.

l. Existing nonconforming uses are allowed to continue in the flood management area. Existing nonconforming uses may be modified with approval from the District or City/County.

m. Any proposed work within or modification to a floodway shall be certified by an Oregon Registered Professional Engineer as to how it conforms to these standards and all other local, state, and FEMA regulations.

n. For streams, creeks, rivers and other watercourses where the floodway has not been identified, the entire floodplain shall be treated as a floodway unless a study has been prepared by an Oregon Registered Professional Engineer and approved by the District/City/County to define the floodway limits for a stream section.