CITY OF SALEM
DEPARTMENT OF PUBLIC WORKS
ADMINISTRATIVE RULES
DESIGN STANDARDS

TABLE OF CONTENTS

Main Menu

CITY OF SALEM
DEPARTMENT OF PUBLIC WORKS
ADMINISTRATIVE RULES
CHAPTER 109
DIVISION 001
GENERAL—DESIGN STANDARDS

SECTION

TABLES

APPENDICES

Go To TOC Div 1

1.1—Introduction

(a) Purpose. The purpose of the Public Works Design Standards (Design Standards *or* Standards) is to establish minimum design parameters and practices for the City of Salem's (City) public infrastructure and certain private infrastructure as required in Salem Revised Code (SRC) that enhance public health and safety, protect the environment, and provide for the delivery of quality infrastructure. The City reserves the right, consistent with law, to impose requirements beyond these Design Standards to address specific issues or to protect the public interest.

The City manages the public infrastructure utilizing asset management principles. Infrastructure investments shall be based on life cycle costs, including the operation and maintenance costs over the life of the asset. Where appropriate, environmental and social costs also may be a factor in the decision making process. The Design Standards, Standard Construction Specifications (SCS), and the Standard Drawings are intended to be used to deliver new infrastructure that minimize life cycle costs, maximize public health and safety, protect the environment, and contribute to the quality of life in Salem.

(b) Applicability. This Division of the Design Standards applies to all Design Standards now in effect or adopted hereafter.

(c) Authority to Adopt. These Design Standards are authorized by SRC Chapters 20J and 70. Design Standard requirements shall be consistent with the SRC. In those cases where a conflict may exist, the SRC will take precedence.

(d) Delegation of Authority. The SRC delegates authority to adopt and implement the Design Standards for Public Facilities to the Director, or the Director's designee. The Director hereby designates the City Engineer as the City's official to create, manage, and implement the Design Standards.

(e) Scope. The City has adopted the SCS including Standard Drawings. The design, construction, and reconstruction of improvements intended for use by the public and the City, including the workmanship and materials incorporated therein, shall be in accordance with the SCS and the Standard Drawings.

The City will enforce these Standards carefully and thoughtfully. They are not intended as a substitute for competent work by design professionals. The Engineer of Record (EOR) is ultimately responsible for the final design of the project. Failure to comply with these Standards may result in the City requesting additional submissions and/or revisions which can result in the delay of approvals and permit issuance.

The Design Standards implement the requirements of the SRC; the City's Infrastructure Master Plans (Master Plans); the City's National Pollution Discharge Elimination System (NPDES) permits; Oregon Revised Statutes (ORS); and federal regulations. Design methods and materials not covered by these Standards, the SCS, or Standard Drawings, shall be designed according to accepted professional engineering practices as approved by the City.

1.2—Definitions

Terms in these Administrative Rules (Rules), Chapter 109–Public Works, that are specifically defined in the SRC, have the same meaning as in the SRC, except as otherwise provided in these Rules or as context requires. Other terms in these Rules are defined herein as set forth in Appendix 1A—Acronyms and Definitions, incorporated herein by this reference. Terms specifically defined in these Rules apply only to the application and enforcement of these Rules.

1.3—Application of Standards Required

Pursuant to the SRC, all water, wastewater, storm drainage, and streets infrastructure, either within the City's public rights-of-way (ROW) or easements or which will become part of or connected to a public system, shall be designed in accordance with the Design Standards.

1.4—Project Coordination

In designing projects for the City, the following key project coordination elements must be considered and performed through the delivery of the project, including but not limited to:

(a) Coordination and notification of property owners impacted by the design and construction of the project. Property ownerships can be obtained from the appropriate County Assessor's website. Notifications shall be in written form to the impacted property owners. Owners and tenants shall be notified at a minimum; before survey work is performed in the ROW, on their property, and before construction begins. Larger projects may necessitate more frequent updates.

(b) Obtaining all necessary permits. Natural Resource permits can take nine months or longer to obtain. Projects will not be approved without the appropriate permits.

(c) Coordination with Franchise Utilities for new or relocation of existing utilities.

(d) Existing driveway adjustment coordination with property owners, including obtaining permits of entry prior to plan approval.

(e) Obtaining any necessary ROW and/or easements, prior to approval of the project.

(f) Responding to, addressing, and resolving construction problems, as approved by the City, as they occur in a timely manner. The City will not be responsible to resolve design problems and unforeseen site conditions.

(g) Managing project close out activities, including submittal of As-Built project drawings, in conformance with Division 002–Drafting and Drawing Standards, within three months from the date the project is substantially complete.

Go To TOC Div 1

1.5—Field Investigation Required During Design

The EOR is solely responsible to perform due diligence in obtaining critical field information for the design of the project. This will include obtaining the accurate horizontal and vertical location of all existing utilities, trees and other natural features, other existing infrastructure, and key project constraints. City As-Built information shall only be used as an aid to the EOR in verifying existing facilities and must be verified in the field. Potholing, vacuum excavation, or other approved methods of field verification are required prior to starting construction of new facilities and should be performed during the design phase. City reserves the right to require potholing or vacuum excavation prior to plan approval for critical design issues. Notes documenting horizontal and vertical control of key infrastructure shall be included on construction drawings. Neglecting proper field investigation will not justify approval of a Design Exception Request.

1.6—Location of Utilities within the ROW or Public Utility Easements (PUE)

(a) <u>Franchise Utilities</u>

(1). Franchise utilities are to be located in a PUE whenever possible. Where PUEs are not available, the preferred location shall be behind the curb. Utilities shall be installed parallel or perpendicular to the ROW whenever possible. Skewed-angle locations are to be avoided. The requirements of SRC Chapter 35 must be followed.

(2). Buried Franchise utilities shall have a minimum horizontal separation of 5 feet from parallel water mains. Horizontal separation may be reduced to a minimum of 3 feet, but only if the franchise utility is placed 1.5 feet deeper than the parallel water main.

(3). Franchise utilities will comply with the minimum separation distances from City trees as provided in Division 006, Table 6-31 for all new and replaced utilities and infrastructure.

(4). No new utility meters shall be located in tree wells.

(b) <u>Water—Sewer Separation</u>

Refer to the applicable section(s) of these Standards and applicable state law for sanitary sewer and water separation.

(c) <u>Water Main Location</u>

The water main shall be located within the street and within seven feet from the curb face. If a cathodic protected gas line is already present, the water main shall be placed on the opposite side of the street. If a water main is already present, any cathodic protected gas line shall be placed on the opposite side of the street.

(d) <u>Sanitary Sewer Main Location</u>

Go To TOC Div 1

The sanitary sewer main shall be located within 5 feet of either side of the centerline. Along curved alignments, the center of the manhole shall be located not less than 6 feet from the curb face on the outside of the curve. The sewer centerline shall not be extended behind the curb face on the inside of a curve.

(e) <u>Storm Drain Location</u>

The storm drain shall be located within the street and within seven feet from the curb face. Whenever possible, the storm drain shall be located on the opposite side of the street from the sanitary sewer.

1.7—Boring, Tunneling, and Jacking

(a) General

(1). All boring, tunneling, and jacking within the ROW shall meet the requirements of this section.

(2). The horizontal design location shall meet standard setback requirements in accordance with these standards and all administrative rules. Special consideration shall be given to the size of the conduit run being installed, displacement and vibration factors, and type of utilities adjacent to the bore alignment. Soil types and existing topography need to be considered in addition to the chances of encountering rock ledges or boulders.

(3). A geotechnical evaluation shall be conducted, as appropriate.

(4). The vertical alignment of the bore is determined by reviewing survey data, the elevation of existing utilities, and geotechnical data. Choose an alignment that will ensure the greatest chance for success while minimizing the opportunity for utility conflicts, obstructions, water, and other conflicts.

(b) <u>Location of Existing Utilities</u>

(1). The location of all existing utilities in the project area shall be shown on the Plans.

(2). Pothole and/or vacuum excavation shall be completed for all existing utilities in the alignment of the bore and elevations shown on the Plans.

(3). Where gravity sewer systems are adjacent to the bore alignment and sewer laterals cross the alignment, the vertical elevation of the bore shall be one foot below the invert elevation of the mainline sewer pipeline.

(4). Where directional bore alignment transitions up to or downward from vaults and hand holes, all utilities in these areas will be located by potholing or vacuum excavation with no exceptions. Utilities that cannot be located during the design process will be required to be located by the contractor during construction.

(c) Boring, Tunneling, and Jacking within the Critical Tree Zone

(1). Boring, tunneling, and jacking in the CTZ shall be conducted in a manner which minimizes damage to tree roots.

(2). The top of the bore shall be a minimum depth of two feet below grade.

(3). Locate the receiving and inserting point outside the CTZ.

1.8—Easements

(a) General

Whenever possible, public utilities will be located in the ROW. Locating public utilities in an easement shall only be allowed due to topography or when it shall benefit the utility, such as avoiding a dead end water main. A recorded easement is required prior to permit issuance whenever a utility is located outside of the ROW and not shown on the proposed project plat. The EOR shall use the City easement forms when preparing an easement, which must be reviewed and approved by the City before it is recorded. Easement forms are available for download on the Public Works Engineering website.

(b) Pipeline Easements

(1). The width of a pipeline easement shall be determined by the type of pipe being installed (water, sanitary sewer, stormwater), the pipe size, and by the depth of bury. The minimum pipeline easement width based on type and size of pipe is provided in Table 1-1.

(2). For pipe greater than 10 feet of cover, the easement width will be increased 2 feet for each additional foot of depth.

(3). When the pipeline is transversing a slope, the depth to the pipe invert shall be measured from the top of the cut slope. Easement widths shall only be increased in 5-foot increments (i.e. 15, 20, 25, and 30).

(4). Where easements are centered along a property line, the edge of the pipe shall be offset 18 inches from either side of the property line. In all other cases, the pipe shall be centered in the easement.

(5). In those cases where a private sewer lateral is serving “second tier” uphill lots, a private pipeline easement across adjacent lots shall be required for the lateral sewer to connect to the sewer main in the ROW.

(6). Sewer main line easements will not be permitted at the back of a lot, unless approved via the Design Exception process.

(7). Buildings, patios, structures, trees, and fences shall not encroach in easements. This includes structures overhanging the easement.

Go To TOC Div 1

Water	
Nominal Pipe Diameter (in.)	**Easement Width (ft.)**
6 – 10	15
12 – 48	20
50 – 72	25
Sanitary Sewer	
Nominal Pipe Diameter (in.)	**Easement Width (ft.)**
4 – 6 Lateral	15
8 – 21 Main	20
24 – 72 Trunk	25
Greater than 72	30
Storm Drain	
Nominal Pipe Diameter (in.)	**Easement Width (ft.)**
4 – 6 Lateral	15
10 – 36 Main	20
42 – 60 Main	25
Greater than 60	30

Table 1-1. Pipeline Easement Width Based on Type and Size of Pipe.

(c) Public Utility Easements (PUE)

(1). Telephone, power, TV, gas, and other franchise utilities can be located on either or both sides of the street.

(2). Telephone, power, TV, and water shall have a minimum cover of 3 feet. Gas shall have a minimum cover of 2.5 feet, or the depth required by Northwest Natural Gas, whichever is greater. If utilities are located in a common trench in the PUE, gas shall be at least 1-foot deeper than the other franchise utilities.

(d) Open Channel Easements

Open channel easement widths shall be either the 100-year floodway, 15 feet from the channel centerline, or 10 feet from the recognized bank, whichever is greater. These requirements do not include property along the Willamette River, which are included in the Willamette Greenway (see SRC Chapter 141).

(e) Access Easements

All City-maintained flow control structures, manholes, and other significant structures requiring vehicular access, etc. located outside the ROW shall be accessible for maintenance and operation under all weather conditions. Locations for pipelines and other facilities serving a Planned Unit Development (PUD), apartment complex, or commercial/industrial development shall be located in parking lots, private drives, or similar open areas permitting unobstructed vehicle access for maintenance. All meters, hydrants, valves, and other critical appurtenances shall be protected from vehicular damage and shall be placed so they are easily accessible for maintenance, repair, or replacement.

Where structures are located in areas which are not easily accessible, an access easement shall be provided with a permanent all weather access road designed for H-20 loading (access road design details are included in Division 006–Streets). The access easement shall be a minimum 15 feet wide and will include a 12-foot travel way.

(f) Common Easements

Typically, easements shall be exclusive and limited to only one utility. In a limited number of circumstances a common easement may be allowed under the following conditions:

(1). The utility cannot be located in the ROW.

(2). The topography or other site limitations do not allow the use of two parallel exclusive easements.

(3). The common easement will include a water line and storm drain or sanitary sewer and storm drain. A water line and sanitary sewer in a common easement requires prior approval by the City Engineer.

(4). Adequate separation can be maintained between the pipelines. Separation of utilities shall meet Department of Environmental Quality (DEQ) and Health Division requirements.

(5). Access for maintenance will be provided to all structures located in the common easement.

(6). The width of the common easement will be determined by calculating the combined width of the two exclusive easements, as provided in these Design Standards, and subtracting 10 feet.

1.9—Engineer of Record Requirements

The City requires strict compliance with ORS Chapter 672 for professional engineers and SRC 77.091.

The EOR shall maintain complete responsibility for the design of the project. All engineering plans, reports, and documents shall be prepared by a registered professional civil engineer or by a subordinate employee under their direction, and shall be signed by them and stamped with their seal to indicate responsibility. Approval of plans and issuance of permits by the Director does not in any way relieve the EOR of their responsibility to meet all requirements of the City or other affected jurisdictions, or the obligation to protect the life, health, and property of the public. It is also required that at any time a revision to the design is required; the EOR shall maintain responsibility to redesign according to these Design Standards per the City's approval. It is therefore necessary for the EOR to be available during construction should timely changes be required.

1.10—Surveying Standards for Plans Submittal

All plans submitted to the City shall be referenced and controlled by the following horizontal and vertical datum:

- Horizontal Datum—North American Datum (NAD) 83, Oregon State Plan Coordinate, North Zone, current EPOCH version

- Vertical Datum—National Geodetic Vertical Datum (NGVD) 1929/47

Unless otherwise noted or specified, all topographic surveying of existing infrastructure shall be located within the field to ±0.01 feet and illustrated on the plans with this same level of precision. All improvements shall be designed within an accuracy of ±0.01 feet when compared with the approved plans. Vertical and horizontal control for the project will be described and shown on the cover sheet of the plans.

1.11—Preservation of Trees and Vegetation

Preservation of trees and vegetation is required by SRC. Tree preservation must be addressed during project design. Existing and proposed trees shall be shown on the construction plans as well as any special measures required to construct the project. This information shall include existing and proposed tree locations, varieties, sizes, and protection/removal requirements. Special attention shall be given to trees conflicting with such things as pavement, curbs, sidewalks, pipe alignments, etc. Permits are required for all development projects for tree removal and proposed tree planting within the ROW and on City property. All construction projects must meet the requirements of the Administrative Rule for City Trees 109-500-2.

1.12—Master Plan Conformance

Proposed designs shall be in conformance with each of the most recently adopted Master Plans. These plans are published on the City's website. For linking systems to be in conformance with the Master Plans, they shall be designed in a manner that is consistent with the plan's need to serve the area within the Urban Growth Boundary (UGB) (SRC 70.040).

Go To TOC Div 1

1.13—Geotechnical Evaluations

The EOR is required to perform or cause to be performed appropriate geotechnical investigation as required for design of roads, structures, deep fills, cuts, and other facilities that necessitate geotechnical evaluation. The findings of the investigation shall be included in a geotechnical report which shall be submitted to the City at the time of plan submittal.

If the proposed development is located within a landslide hazard area and designated with a low, moderate, or high susceptibility to landslides, the EOR shall submit either a geotechnical assessment or a geotechnical report as required in the SRC. The need for this type of geotechnical investigation will normally be identified during the development plan review process.

The City will make the final determination regarding the requirement to submit a geotechnical report. The City will review the report with the design drawings, and if necessary, seek a second expert review for critical geotechnical design issues.

The minimum submittal requirements for geotechnical assessments and geotechnical reports are addressed in Appendix 1B–Requirements for Geotechnical Reports of this Division and in SRC Chapter 855.

1.14—Hydraulic and Hydrology Requirements

Hydraulic and hydrology calculations and reports shall be required to size stormwater facilities and submitted during the design review process. Details and requirements are provided in Division 004–Stormwater.

1.15—Traffic Impact Analysis

The Salem Transportation System Plan (TSP) establishes the requirement for a Traffic Impact Analysis (TIA) as part of a land use development proposal. Whether or not a TIA will be required for a particular project is determined during the land use application process. Guidelines for completing the TIA are provided in Division 006—Streets, and in Appendix 1C–Traffic Impact Analysis Report Format of this Division. The EOR shall be responsible for submitting the TIA as part of the development review process, as required.

1.16—Permits

All necessary regulatory permits for the project shall be obtained, including those issued by the City and from other agencies, prior to approval of final plans. Permitting issues should be identified during the planning phase of the project to facilitate efficient schedule management.

(a) <u>Erosion Prevention and Sediment Control (EPSC) Permit</u>

EPSC permits are required for all projects beyond certain thresholds established in SRC Chapter 75, where earth disturbing activities will take place. For projects greater than one acre in size, the EPSC permit is obtained from the Oregon DEQ as a 1200-C permit. A copy of the approved 1200-C permit is required before the City will issue a development permit.

Go To TOC Div 1

For projects less than one acre, the EPSC permit is obtained from the City. Both the 1200-C and the City-issued EPSC permit must be obtained before initiating any earth disturbing activity.

Guidance on how to develop an EPSC Plan is provided in Division 007–Erosion Prevention and Sediment Control.

(b) <u>Oregon Department of State Lands & U.S. Army Corps of Engineers Permits</u>

Construction projects that involve a stream crossing, work within the normal high water zone adjacent to a stream, or work within a designated wetland; may require permits from the Oregon Department of State Lands (DSL), U.S. Army Corps of Engineers (Corps), or both. These permits can take nine months or longer to obtain. The City has mapped most jurisdictional wetlands within its boundaries and Public Works can provide that information upon request. The City requires a copy of all permits required by other agencies before a development permit can be issued for a project. The permit applicant is required to apply, coordinate, and obtain permits mandatory for construction.

(c) <u>Development Permits</u>

Construction plans for private development projects shall be submitted to the Public Works Development Services Section through the Permit Application Center (PAC). Public Works staff is responsible for checking to ensure compliance with these Design Standards and SRC. Submittal requirements for development permits can be obtained from the PAC.

(d) <u>Street Opening Permits</u>

Street Opening permits are required for any excavation in City street pavement. Open cut of streets that have been resurfaced or reconstructed during the past five years are prohibited, unless approved via the Design Exception process. Public Works maintains a current list of these streets. Exception approval will require more rigorous street and trench repair measures to ensure integrity of newly paved streets.

(e) <u>Excavation and Fill Permit</u>

If the proposed project is within a landslide hazard area, an Excavation and Fill permit will be required. These permits are also required if fill is being placed in a City easement. These conditions may also trigger the need for a geotechnical investigation (see Section 1.12–Geotechnical Evaluations).

(f) <u>Tree Permits</u>

Permits are required to prune, remove, install lights or other attachments, collect biological materials, or engage in ground disturbing activities within the Critical Tree Zone of City trees pursuant to SRC Chapter 86 and Administrative Rule 109-500-2.

1.17—As-Built Submittals

Go To TOC Div 1

(a) **As-Built Drawings**

As-built drawings for all projects are required to be submitted within three months of construction substantial completion. As-built drawings shall meet the requirements set forth in Division 002–Drafting and Drawing Standards.

(b) **EOR Responsible**

The EOR shall be responsible for supervising the As-Built surveying of the project and insuring the accuracy of the information contained in the As-Built drawings.

1.18—Design Standard Exceptions

A Design Standard Exception request shall not be granted if it would result in a violation of a requirement of the SRC. In cases where an adjustment or variance to a standard established in the SRC is needed, the EOR shall obtain approval for the adjustment or variance as provided in the SRC.

Exceptions to the Standards in undeveloped areas should rarely occur. The need for Exceptions is more likely to occur in developed areas where existing infrastructure constrains the design options.

It is the responsibility of the EOR to identify potential Exceptions, and to request an Exception, as early as possible in order to avoid impact to the project schedule. The City reserves the right to conduct thorough evaluation of an Exception request as stipulated below, untimely requests may result in delay of plan review and approval. It is also the responsibility of the EOR to conduct a thorough field evaluation, utility location, subsurface exploration, geotechnical evaluation, and hazmat analysis to minimize avoidable changes during construction.

(a) **Exception Submittal Requirements**

All Exception requests shall be in writing and include, but not necessarily be limited to:

(1). Company name and address.

(2). Key contact information, and name of professional engineer requesting the exemption.

(3). Project description.

(4). A complete summary explaining the reason and justification for the Exception citing the current standards and, as necessary, addressing the options evaluated, operational and maintenance impacts, lifecycle costs, site constraints, public safety impacts, environmental impacts, impacts to other design standards, as well as other pertinent information.

(5). Other reports, data, or calculations as necessary supporting the request.

(b) **Review Process**

(1). The City Engineer will evaluate the Exception request and coordinate with Public Works stakeholders and experts as required to make a final decision.

(2). The City is committed to timely review of Exception requests. The more complete and organized the written request, the greater the opportunity for the City to conduct a thorough analysis of the request and make an informed decision in a timely manner. The City reserves the right to request additional information, if needed, during the review process. It is anticipated that a thoroughly written Exception request will be reviewed and responded to within ten business days from the submittal.

(3). The City Engineer will issue a written decision upon completion of the evaluation of the Exception request.

(c) Appeals Process

(1). The requestor may file a written appeal of the City Engineers' decision to the Director. The written appeal must be received by the Director within ten calendar days of the City Engineer's decision.

(2). The Director may call on stakeholders and experts as needed and/or require the requestor to provide additional information.

(3). The Director shall mail a written decision to the appealing party no later than 30 calendar days after receipt of the written appeal.

(4). The Director's decision may be appealed pursuant to the Contested Case Procedures set forth in SRC 20J.240-430. The appeal must be filed within 15 business days of the date of the Director's decision. The notice of appeal shall comply with the provisions of SRC 20J.110 for contested case proceedings.

(d) Urgent Exception Request

(1). Site Conditions. During construction, an Urgent Exception to an approved design may be approved to respond to unforeseen site conditions. Not all situations encountered during construction will merit an Urgent Exception. In some circumstances a project must be constructed consistent with the Standards regardless of existing site conditions. Minor changes due to site conditions that are within the boundaries established by the Standards do not constitute an Urgent Exception. These minor changes should be processed through a change order issued by the Project Manager or EOR.

(2). Timeliness of Decision. Because decisions are needed on a timely basis during construction, an Urgent Exception may be orally granted by the City Engineer. If the City Engineer cannot be reached within one business day, an Assistant City Engineer may grant an Urgent Exception. All oral decisions shall be documented in writing within two business days of the decision.

CITY OF SALEM
DEPARTMENT OF PUBLIC WORKS
ADMINISTRATIVE RULES
CHAPTER 109
DIVISION 001 APPENDIX A
ACRONYMS AND DEFINITIONS

SECTION

A

AASHTO—American **A**ssociation of **S**tate **H**ighway and **T**ransportation **O**fficials.
AC—Asphalt **C**oncrete.
Access Walkway—Concrete or paved access route across a planting strip, more or less perpendicular to the curb and sidewalk.
ACPA—American **C**oncrete **P**aving **A**ssociation.
ADA—Americans with **D**isabilities **A**ct.
APAO—Asphalt **P**avement **A**ssociation of **O**regon.
Approved Point of Discharge—An approved location downstream from a project identified to discharge stormwater flows from all or a portion of the project.
APWA—American **P**ublic **W**orks **A**ssociation.
As-Built Drawings—Drawings signed and dated by the project engineer indicating that the construction plans have been reviewed and revised, if necessary, to accurately show all as-built construction details.
Average Maintained Footcandles—The average level or horizontal luminance on the roadway pavement when the output of the lamp and luminaire is diminished by the maintenance factors; expressed in average footcandles for the pavement area.
AWWA—American **W**ater **W**orks **A**ssociation.

B

BDDM—Bridge **D**esign and **D**rafting **M**anual.
Bike Lanes—A designated travel way for bicyclists established within the roadway directly adjacent to the outside vehicular lane or on the shoulder.
Blended Transition—Raised pedestrian street crossing, depressed corners or connections between a street and sidewalk with a running slope less than or equal to five percent.
BMP—Best **M**anagement **P**ractice: The technique, measure, or structural control that is used for a given set of conditions to manage and prevent erosion, control sediment, and improve the quality of storm water runoff.
Building Sewer—The part of the horizontal piping of the drainage system that extends from the end of the building drain. It receives the discharge of the building drain and conveys it to a public or private sewer, individual sewage disposal system, or other point of disposal.

C

CAD—Computer **A**ided **D**esign.
California Bearing Ratio (CBR)—The ratio of the bearing strength of a material with that of a well-graded, crushed stone as determined by a CBR test.
Central Business District (CBD)—That portion of downtown Salem as described in SRC Chapter 154.
Channel—A linear topographic depression that contains moving water and has a bottom and sides that serve to confine the water.
Circular Curve—A curve having uniform radius for the entire distance between adjacent tangent sections.
City—Reference to City of Salem, Oregon.

Clustered Mailboxes—Free-standing mailbox units with multiple, locked mailboxes, parcel lockers, and a slot for mail collection (also known as Centralized Mailbox Units (CMU)).
CMU—Centralized **M**ailbox **U**nit.
Collection Systems—Facilities maintained by the City of Salem and District connected thereto for the collecting, pumping, conveying, and controlling of wastewater.
Control Density Backfill (CDF)—A low strength cementitious material that requires no compactive effort.
Critical Tree Zone (CTZ)—A defined area surrounding the trunk intended to protect the tree's trunk, roots, branches, and soil to ensure tree health and stability. It is the area defined by the tree's dripline or an area measured 1-foot per 1-inch diameter at breast height, whichever is greater (SRC 86.010(d))
Cross Connection—Any connection or arrangement, physical or otherwise, between a potable water supply system and any plumbing fixture, tank, receptacle, equipment or device, through which it may be possible for non-potable, used, unclean, polluted, and/or contaminated water, or other substances, to enter into any part of such potable water system under any condition.
Chlorosulfonated Polyethelene (CSPE)—Hypolan, rubber polymer.
Curb Ramp—A pedestrian access connection between a street and sidewalk with a running slope greater than five percent and less than 8.33 percent.

D

Design Standard Exception—A one-time deviation from the Design Standards that responds to a unique project issue, extenuating circumstance, and/or site constraint that does not lend itself to adherence to the Design Standards.
Design Standards or **Standards—**Public Works Design Standards in their entirety, including supplements, addenda, or revisions thereto.
Design Storm—The distribution of rainfall intensity over time, identified to have a probability of recurrence, given in years (i.e., five-year design storm). Often, the term "design storm" is truncated when describing design storm characteristics (i.e., five-year flow).
Detention Facility—A facility designed to receive and hold stormwater and release it at a slower rate, usually over a number of hours. The full volume of stormwater that enters the facility is eventually released.
DHS—Oregon **D**epartment of **H**uman **S**ervices.
Director—Reference to Public Works Director.
Dissolved Air Flotation (DAF)—A water treatment process that clarifies water by the removal of suspended matter, such as oil or solids.
Distribution System—Distribution main pipelines, pumping stations, valves, and ancillary equipment used to transmit water from the supply source to the service line.
Domestic Sewage—The liquid and water-borne waste derived from the ordinary living processes, free from industrial wastes, and of such character to permit satisfactory disposal without special treatment into the public sewer or by means of private sewage disposal system.
DWF—Dry **W**eather **F**low.
Dynamic Cone Penetration (DCP)—A test that provides a measure of a material's in-situ resistance to penetration. The test is performed by driving a metal cone into the ground by repeated striking with a 17.6 pound (8 kilogram) weight dropped from a distance of 2.26 feet (575 millimeters).

E

EAL—Equivalent **A**xle **L**oad.
Easement—A right afforded to the City to make limited use of real property not owned by the City. As used in these Design Standards, it may also refer to (1) an area of land within which the limited use right is afforded; or (2) the legal instrument through which the limited use right is conveyed to the City.
EOR—Engineer **O**f **R**ecord**—**The registered professional engineer responsible for design of a project.
EPDM—Ethylene **P**ropylene **D**iene **M**onomer**—**Synthetic Rubber.
EPSC—Erosion **P**revention **S**ediment **C**ontrol.
EPSCP—Erosion **P**revention **S**ediment **C**ontrol **P**lan.
Exception—Reference to Design Standard Exception.

F

FAC—Facultative **W**etland **S**pecies**—**Plant species that survive in both wetland and upland environments.
FACU—Facultative **U**pland **S**pecies**—**Plant species that are best suited in an upland area but can tolerate a wet environment.
FACW—Facultative **W**et **W**etland **S**pecies**—**Plant species that are best suited in a wet environment but can tolerate occasional dry periods.
FHWA—Federal **H**igh**w**ay **A**dministration of the U.S. Department of Transportation.
Fire Hydrant Assembly—The fire hydrant.
Flow Control—The practice of limiting the release of peak flow rates and volumes from a site. Flow control is intended to protect downstream properties, infrastructure, and natural resources from the increased stormwater runoff peak flow rates and volumes resulting from development.
FWD—Falling **W**eight **D**eflectometer.

G

GPM—Gallons **P**er **M**inute.
Green Roof—A roof designed to treat storm runoff using filtration. The City of Portland Stormwater Design Manual should be referenced for the design of green roofs.
Green Stormwater Infrastructure—GSI—A stormwater facility that mimics natural surface hydrologic functions through infiltration or evapotranspiration, or that involves stormwater reuse (SRC 71.005(7)).

H

HGL—Hydraulic **G**rade **L**ine.
Hydrant Lead—The line connecting the fire hydrant assembly to the City main or private fire line with an auxiliary valve.

I

ITE—Institute of **T**ransportation **E**ngineers.
Impervious—Areas or surfaces located above ground, at the ground surface, or below ground which retard saturation of direct rainfall into the land subsurface or otherwise cause stormwater to run off the land surface at an increased rate of flow from that present under natural, undeveloped conditions.

Inlet—A structure located just below the ground surface used to collect stormwater runoff. Generally located in streets and parking lots, inlets have grated lids, allowing stormwater from the surface to pass through for collection. The term, "Inlet," is also used in reference to the point at which stormwater from impervious surfaces or conveyance piping enters a stormwater management facility.

J

Junction—A structure (i.e., catch basin or manhole) within a storm system whose purpose is combining multiple pipe inlets, facilitating changes in horizontal or vertical alignment, provide access for operation and maintenance, and/or other related functions.

K

L

Local or Residential Street—A facility not designated on one of the higher systems. It serves primarily to provide access to abutting land and offers the lowest level of traffic mobility. Through traffic movement is deliberately discouraged.
Longitudinal Joint—A joint which follows a course approximately parallel to the centerline of the roadway.
LOS—Level **O**f **S**ervice.

M

Major Partition—A partition which includes the creation of a road or street.
Master Plan—Reference to any of the City's Infrastructure Master Plans.
Maximum Extent Feasible—MEF—The extent to which a requirement or standard must be complied with as constrained by the physical limitations of the site, practical considerations of engineering design, and reasonable considerations of financial costs and environmental impacts (SRC 71.005(12)).
MR—Resilient **M**odulus.
Multiple Family Dwelling—A building or portion designed thereof for occupancy by two or more families, living independently of each other.
MUTCD—Manual on **U**niform **T**raffic **C**ontrol **D**evices.

N

NDT—Non-**D**estructive **T**esting.
NEC—National **E**lectrical **C**ode.
NI—No **I**ndicator Status.
NRCS—Natural **R**esource **C**onservation **S**ervice.
NWPL—National **W**etland **P**lant **L**ist.

O

OBL—Obligate **W**etland **S**pecies**—**Plant species that are typically found in a wetland.
ODFW—Oregon **D**epartment of **F**ish and **W**ildlife.
ODOT—Oregon **D**epartment **O**f **T**ransportation.
ODSL—**O**regon **D**epartment of **S**tate **L**ands.
One Lane Rotated—A two lane street including the median or left-turn lanes.
OPSC—Oregon **P**lumbing **S**pecialty **C**ode.
OTTCH—Oregon **T**emporary **T**raffic **C**ontrol **H**andbook.

P

PAC—Permit **A**pplication **C**enter.
PC—Point of **C**urvature.
PCC—Portland **C**ement **C**oncrete.
Peak Discharge—The maximum volumetric flow for a given design storm.
Pedestrian Access Route—A continuous and unobstructed path of travel provided for pedestrians with disabilities within or coinciding with a Pedestrian Circular Path.
Pedestrian Circular Path—A prepared exterior or interior surface provided for pedestrian travel in the public right-of-way.
PI—Point of **I**ntersection.
Plans—Construction plans, including system plans, sewer plans and profiles, cross sections, detailed drawings, etc., or reproductions thereof, approved or to be approved by the City Engineer, which show the location, character, dimensions, and details for the work to be done, in which constitute a supplement to these Standards.
Potable Water—Water satisfactory for drinking, culinary, and domestic purposes and meets the requirements of the health authority having jurisdiction.
PRC—Point of **R**everse **C**urve.
Private Distribution System—A privately owned and maintained water distribution system serving an industrial or commercial subdivision or a multi-building development on a single lot served through a master meter installed at the approved location.
Private Stormwater System—Owned and operated by a private property owner, a storm collection and conveyance system located outside the building envelope which serves one or multiple building storm drains, catch basins, area drains, or other drainage facilities. Generally synonymous with private storm sewer and private storm drain.
Project Engineer—The engineer, in responsible charge, licensed by the State of Oregon as a Civil Engineer under whose direction the Plans and details for the work are prepared and submitted to the City for review and approval.
PROWAG—Public **R**ight-**O**f-**W**ay **A**ccessibility **G**uidelines.

PSF—Pounds per **S**quare **F**oot.
PT—Point of **T**angency.
Public Stormwater System—Any portion of the storm collection and conveyance system operated and maintained by the City. Generally synonymous with public storm sewer and public storm drain.
PUD—Planned **U**nit **D**evelopment.
PUE—Public **U**tility **E**asement.
PVI—Point of **V**ertical **I**ntersection.
Pipe Types:
- **ABS—A**crylonitrile-**B**utadiene-**S**tyrene.
- **CHDPE—C**orrugated **H**igh **D**ensity **P**olyethylene.
- **CONC—**Concrete.
- **DI—D**uctile **I**ron.
- **HDPE—H**igh **D**ensity **P**oly**e**thylene.
- **PVC—P**oly**v**inyl **C**hloride.

Q

R

RDII—Rainfall **D**erived **I**nflow and **I**nfiltration.
Residential—A residential development or a mixture of residential and commercial establishments, characterized by few pedestrians and a low parking demand or turnover at night. This description includes areas with single family homes, townhouses, and/or small apartments. Regional parks, cemeteries, and vacant lands are also included.
Retention—The restriction and storage of runoff without direct release to a point of disposal.
Retention Facility—A facility designed to receive and hold stormwater runoff. Rather than storing and releasing the entire runoff volume, retention facilities permanently retain a portion of the water on site, where it infiltrates, evaporates, or is absorbed by surrounding vegetation. In this way, the full volume of stormwater that enters the facility is not released off site.
Retrofit—The creation or modification of an urban runoff management system in a previously developed area. This may include wet ponds, infiltration systems, wetland plantings, stream bank stabilization, and other BMP techniques for improving water quality and creating aquatic habitat. A retrofit can consist of the construction of a new BMP in a developed area, the enhancement of an older urban runoff management structure, or a combination of improvement and new construction.
Right(s)-Of-Way—ROW— All land or interest therein which by deed, conveyance, agreement, easement, dedication, usage, or process of law is reserved for or dedicated to the use of the general public for roadway purposes, which the City has sole responsibility to maintain.
Roadway—That entire portion of the right-of-way used, or to be used, for vehicle movement, which exists between the curbs or proposed curb lines.
Rules—Reference to Administrative Rules of City of Salem.

S

Salem—Reference to City of Salem, Oregon.
SBUH—Santa **B**arbara **U**rban **H**ydrograph.

Sector Plan—A plan developed by the City detailing how service to a specific area is to be provided.
SESWD—Suburban **E**ast **S**alem **W**ater **D**istrict.
Sewer—Reference to the sanitary sewer collection system.
SFR—Single **F**amily **R**esidential.
Shared Use Path—A multi-use path designed primarily for use by bicyclists and pedestrians, including pedestrians with disabilities, for transportation and recreation purposes. Shared use paths are not physically separated from motor vehicle traffic by an open space or barrier, and are either within the street right-of-way or within an independent right-of-way.
Source Control—Facilities and/or actions that address site activities and characteristics with the potential to generate pollutants that may not be addressed solely through the pollution reduction facilities.
SRC—Salem **R**evised **C**ode.
Standard Construction Specifications—SCS—The Standard Construction Specifications and Plans for Public Works construction in the City of Salem.
Standard Drawings—The drawings of structures or devices commonly used in the construction of the City's infrastructure and referred to on the Plans.
Stormwater Management Facilities—Pipes, catch basins, waterways, detention basins, culverts, and other related facilities, used singularly or in combination for the purpose of collecting, conveying, storing, and/or treating runoff.
Streets or **Roads—**Any public highway, road, street, avenue, alley, way, easement, or right-of-way used or to be used for vehicle movement.
Superelevation—The vertical distance between the heights of the inner and outer edges of highway pavement.
Superelevation Runoff—The length of roadway needed to transition the outside lane cross slope from zero (flat) to full superelevation, or vice versa.
Swale—A vegetated strip of land designed to attenuate stormwater runoff, clean it with natural soil and vegetation filters, and then infiltrate it into the ground.
SWMM—Storm**w**ater **M**anagement **M**odel.

T

Tangent Runout—The length of roadway needed to transition the outside lane cross slope from the normal cross slope to zero (flat), or vice versa.
Transition and Taper—Taper for acceleration or deceleration of turning vehicles is provided on high speed roads in order to improve traffic flow conditions. Tapers are so designed that an entering vehicle can accelerate to the speed of through traffic before it begins the actual merging maneuver, and that a diverging vehicle need not begin to decelerate until it has completely left the through lane.
Transverse Joint—A joint which follows a course approximately perpendicular to the centerline of the roadway.
Tree Protection Area (TPA)—The portion of the CTZ that will be protected by tree protection fencing and/or other methods as determined by the City's Urban Forester.
Trunk Sewer—A public sewer ten inches or larger which has been or is being constructed to accommodate more than one main sewer or lateral sewer. It may, in some cases, serve as a lateral sewer.
TSP—Transportation **S**ystem **P**lan.
Two Lanes Rotated—A four lane street, including median or left-turn lanes.

U

UFAS—Uniform **F**ederal **A**ccessibility **S**tandards.
UGB—Urban **G**rowth **B**oundary.
Uniform Plumbing Code—The Uniform Plumbing Code adopted by the International Association of Plumbing and Mechanical Officials, current edition. Adopted by SRC 61.001.
Uniformity Ratio—The ratio of average footcandles of luminance on the pavement area to the footcandles at the point of minimum luminance on the pavement.
UPL—Obligate Upland Species.
Urban Intermediate—That portion of the City which is outside of a downtown area, but generally within the zone of influence of a business or industrial development often characterized by moderately heavy nighttime pedestrian traffic and somewhat lower parking turnover than is found in a commercial area. This includes densely developed apartment areas, hospitals, public libraries, and neighborhood recreational centers.
Urgent Exception Request—A deviation to the Design Standards occurring during construction of a critical path task resulting in the need to change the design as reflected on approved construction plans to mitigate an unanticipated existing site condition encountered during construction.
USACE—United **S**tates **A**rmy **C**orps of **E**ngineers.
USPS—United **S**tates **P**ostal **S**ervice.

V

Volume Based Facility—A detention facility not designed to provide infiltration. Per code requirements, these facilities must be designed to manage larger storm events than non-volume based facilities.

W

WashDOE—Washington **D**epartment **O**f **E**cology

X

Y

Z

Go To TOC Div 1

CITY OF SALEM
DEPARTMENT OF PUBLIC WORKS
ADMINISTRATIVE RULES
CHAPTER 109
DIVISION 001 APPENDIX B
REQUIREMENTS FOR GEOTECHNICAL REPORTS

SECTION

Division 001 Appendix B—Requirements for Geotechnical Reports

1B.1—Introduction

The geotechnical report is intended to define the subsurface conditions and provide geotechnical conclusions and recommendations for design and construction of the project. A geological assessment or engineering geology report may be incorporated into or included as an appendix to the geotechnical report for the purpose of providing geologic information for the geotechnical engineer, explaining the implications of the subsurface conditions for appropriate project design and construction. The investigation should include the following as applicable:

1B.2—General

(a) Name, address, and phone number.

(b) Client for whom the report was prepared.

(c) A description of the proposed project and its location.

(d) Planned construction (type of structure and use, type of construction and foundation/ floor system, number of stories, estimated structural loads).

(e) A site map of the area at a scale of 1":400' or larger. Geologic conditions, topography, and location of proposed structures are to be shown. A copy of published geologic maps shall also be provided.

(f) A review of the geologic history and history of prior excavation and fills.

(g) A field reconnaissance of the site and vicinity.

(h) Discussion of geologic hazards.

(i) A discussion of the engineering aspects of the site and proposed project. The discussion should address foundation types for proposed structures, retaining systems, grading considerations, stability of cut-slopes and constructed embankments, settlement of the site and adjacent sites due to existing conditions, proposed construction, and proposed surface and subsurface drainage facilities.

(j) A bibliography of all references used.

1B.3—Field Investigations

(a) (Date of work done, investigative methods, sampling methods, logs of borings/ test pits, elevations of borings/test pits for reference of materials and samples to finished grade or footing elevations, identify real or assume elevations.

(b) Location of all samples taken, surface and subsurface.

(c) Groundwater conditions and potential (future natural and artificial seepage effects).

(d) Structural cross-sections (one or more appropriately positioned and referenced on map; especially through critical areas, slopes and slides) of suitable size and engineering scale; with labeled units, features and structures; and a legend. These sections should correlate with surface and subsurface data showing representative dip components, projections, and stratigraphic/structural relationships.

1B.4—Engineering/Material Characteristics and Testing

(a) Test methods used, type or condition of samples, applicable engineering graphics and calculations, results of all tests, and sample locations of all test samples.

(b) Unified Soil Classifications of materials.

(c) Material competency and strength of existing soils/profile.

(d) Pertinent engineering geologic attributes (clayey, weak, loose; alignments, fissility, planar boundaries; pervious or water-bearing parts; susceptibility to mass wasting, erosion, piping, or compressibility).

(e) Effects and extent of weathering (existing and relationship to project design and future site stability, material strength).

(f) Fill densities of unconsolidated field areas and moisture content.

(g) Bearing capacity and/or shear strength of areas affected by future foundation placement (drained or undrained conditions, effective stress or total stress analysis, in-situ or remolded samples must be identified).

(h) Consolidation or settlement potential.

(i) Expansion potential.

(j) Maximum density-optimum moisture parameters of proposed fill material.

1B.5—Stability Features and Conditions

(a) Adequate mapping, sections and description dimensions and type of existing downslope movement, soil/rock creep, flows, falls, slumps, slides, if any.

(b) Activity, cause or contributing factors of downslope movement features.

(c) Recent erosion, deposition, or flooding features.

(d) Subsidence/settlement, piping, solution or other void features or conditions.

(e) Groundwater and surface drainage characteristics or feature.

(f) Surface expression (past and present); permeability/porosity of near surface materials.

(g) Actual or potential aquifers or conduits, perching situations, barriers or other controls to percolation and groundwater movement and fluctuations of groundwater levels at the site.

1B.6—Foundation Design Criteria

(a) Footing depth and width.

(b) Criteria for foundation material preparation.

(c) Allowable bearing values based on testing.

(d) Lateral pressures (active, passive, or at-rest conditions) and coefficient of friction.

(e) Settlement—total, differential, and rate of settlement.

1B.7—Reference

In supplemental or grading plan review reports referencing earlier reports, supply copies of those referenced reports or applicable portions as required by the Director.

1B.8—Conclusions and Recommendations

Ground preparation (clearing, unsuitable material removal, scarification and moisturization).

1B.9—Fill support

(a) Suitability and pre-compaction of in-situ materials (describe test results and other pertinent data to be used to determine suitability).

(b) Densification and moisturization or dewatering measures (equipment, surcharge, settlement monitoring, if applicable).

1B.10—Placement of Fill

(a) Material approval (on site, imported).

(b) Methods and standards (ASTM standards or approved equivalent).

(c) Testing (ASTM standards (D1556, D1557, D2167, D2922, D2937, D3017) or equivalent) and frequency of field density testing by vertical intervals and/or volume of fill.

(d) Elimination of cut/fill or other different transitions beneath improvements.

(e) Opinion as to adequacy of site for the proposed development (this opinion should also be summarized in the first part of the report).

(f) Other pertinent geotechnical information for the safe development of the site.

1B.11—Certification

A signature, certification number, and stamp of a Professional Engineer, registered in the State of Oregon as provided by ORS 672.002 to 672.325, who by training, education and experience is qualified in the practice of geotechnical or soils engineering practices.

A signature, certification number, and stamp of a Registered Geologist who is certified in the specialty of Engineering Geology under the provisions of ORS 672.505 to 672.705 if a geological assessment or engineering geology report is incorporated into or included as an appendix to the geotechnical report.

CITY OF SALEM
DEPARTMENT OF PUBLIC WORKS
ADMINISTRATIVE RULES
CHAPTER 109
DIVISION 001 APPENDIX C
TRAFFIC IMPACT ANALYSIS REPORT FORMAT

SECTION

1C.1—Introduction and Summary

(a) Report Certification.
(b) Purpose of Report and Study Objectives.
(c) Executive Summary.
  (1). Site Location and Study Area.
  (2). Proposed Development Description.
  (3). Findings.
  (4). Recommendations and Proposed Mitigation.

1C.2—Proposed Development

(a) Description.
(b) Location and Vicinity Map, Site Plan.
(c) Existing/Proposed Land Use.
(d) Phasing and Timing of Project.

1C.3—Existing Conditions

(a) Study Area.
  (1). Limits of Traffic Study.
  (2). Anticipated Future Development in Area.
(b) Transportation System Inventory.
  (1). Area Roadway System (Travel Lanes, Traffic Control, Geometric Issues).
  (2). Traffic Volumes and Conditions.
  (3). Existing Safety and Capacity Deficiencies.
  (4). Transit Service.
  (5). Pedestrian and Bicycle Facilities.

1C.4—Projected Traffic

(a) Background Traffic.
  (1). Base Year Traffic.
  (2). Method of Traffic Volume Projection (Background Growth).
  (3). Projected Traffic Volumes.
  (4). Traffic Volumes from Other Proposed Developments.
  (5). Total Background Traffic.
(b) Site Traffic.
  (1). Trip Generation.
  (2). Trip Distribution.
(c) Total Network Traffic.

1C.5—Traffic Analysis

(a) Capacity and Level of Service of Study Area.
- **(1).** Signalized Intersections.
- **(2).** Unsignalized Intersections.
- **(3).** Site Access.
- **(4).** Design Vehicle Requirements.
- **(5).** Site Circulation and Parking.

(b) Traffic Safety.

1C.6—Improvement Analysis

(a) Analysis of Proposed Mitigation.
- **(1).** Year of Opening.
- **(2).** Each Subsequent Phase.

1C.7—Findings

(a) Traffic Impacts.
(b) Compliance with Operational Standards (LOS, v/c, etc.).
(c) Needed Improvements.

1C.8—Recommendations and Mitigation

(a) Site Access and Circulation Plan.
(b) Roadway and Intersection Improvements.
(c) Transportation System Management Actions.

1C.9—Appendices

(a) Maps.
(b) Count Data.
(c) Analysis Worksheets.
(d) Warrant Worksheets.
(e) Any Other Information Required.

Main Menu

CITY OF SALEM
DEPARTMENT OF PUBLIC WORKS
ADMINISTRATIVE RULES
CHAPTER 109
DIVISION 002
DRAFTING AND DRAWING STANDARDS

SECTION

TABLES

2.1—Introduction

(a) Objective

The objective of this Division is to ensure drawings provide clear, uniform, and consistent preliminary plans, construction plans, and As-Built drawings which will facilitate efficient drawing review, inspection, construction, and record keeping of capital improvement and permitted development improvements. The overall intent of all construction drawings is to present the design in a form that can be easily understood and constructed. Accurate drawing information is relied upon by a variety of end users. Each drawing also provides a permanent record to be retrieved and utilized for reference in maintaining and operating infrastructure, as well as reference for future project designs.

(b) Applicability

The requirements of this Division apply to drafting and drawing preparation of public improvements and certain private infrastructure required by these Design Standards or the Salem Revised Code (SRC).

2.2—Submittal Requirements

(a) Drawing Submittal Requirements

Drawings shall be prepared in either AutoCAD ".dwg" files or ".dxf" files that can be imported directly into AutoCAD. Drawings shall be submitted for plan review in a ".pdf" version of the AutoCAD drawings. As-Built drawings shall be submitted for City review in pdf format. Final construction and As-Built drawings shall be submitted in hard copy and electronically with AutoCAD ".dwg" files or ".dxf" files that can be imported directly into AutoCAD. All Computer-Aided Design (CAD) files submitted to the City must be accompanied with a file list that provides the names of all files including external drawing files.

(1). E-Transmit Command—All electronic files submitted shall be generated with the e-transmit command of AutoCAD.

(2). External References—All external references used in the drawings (X-references) shall be included with the electronic submission. This will occur automatically with use of the e-transmit command in AutoCAD.

(3). When the drawings are submitted to the City for review and comments, the drawings shall be clearly marked, "PRELIMINARY—NOT FOR CONSTRUCTION" over the engineering stamp and signature.

(b) Template Drawing Files

An AutoCAD template drawing file is available to be utilized to enhance the uniformity of construction documents. The use of the template is optional. The template drawing file and associated documentation can be found in the "CAD Standards" folder included with the electronic version of the Design Standards. The template may be converted to other CAD formats provided that the CAD files submitted to the City are capable of retaining the same appearance and functionality after being imported back into AutoCAD. The standard template drawings contain the following:

(1). City title block and attributes (in paper space).

(2). City cover sheet example.

(3). Plan and profile title block.

(4). Standard text styles.

(5). Symbols library title block.

(6). City of Salem standard layers.

2.3—General Requirements

(a) Drawing Size

The standard size drawing for all public improvement projects shall be ANSI "D", 22-inch by 34-inch sheets. Other sizes may be permitted with prior City approval.

(b) Orientation

It is preferred that drawings are orientated such that the north arrow is generally facing to the top or to the right of the sheet. All drawings that include a plan view shall include a north arrow.

(c) Title Block

At a minimum, title blocks shall include the project name, date of drawing, and a revision block.

(d) Stationing

Stationing shall be in positive numbers and increase from south to north or west to east whenever possible.

(e) Match Lines

Match lines shall be included when adjoining information is contained on multiple sheets. Each match line shall include the centerline station of the break and the adjacent sheet number to reference. Match lines shall be placed in a way to minimize the duplication of information.

(f) Lettering

Minimum plotted text height of all text must be 0.10-inch when plotted for submittal on a 22-inch by 34-inch standard drawing sheet.

Lettering and dimensioning shall be placed so they can be read from left to right as viewed from the bottom of the sheet and bottom to top when viewed from the right side of the sheet.

Text shall be placed on the sheet such that it is not obstructed by any lines contained in the drawing.

(g) Scales

The recommended scales to be used for each type of infrastructure are listed in Table 2-1.

Drawing/Scale	Horizontal	Vertical
Wastewater	1″ = 40′	1″ = 4′
	1″ = 50′	1″ = 5′
Stormwater	1″ = 40′	1″ = 4′
Water	1″ = 20′	1″ = 2′
	1″ = 40′	1″ = 4′
Streets	1″ = 20′	1″ = 2′
Signing and Striping	1″ = 20′	N/A
Traffic Signal	1″ = 10′	N/A
	1″ = 20′	N/A
Interconnect	1″ = 30′	N/A
Illumination	1″ = 40′	N/A
Grading/EPSC	1″ = 50′	N/A
Subdivisions	1″ = 50′	N/A

Table 2-1. Recommended Scales for Design Drawings

Complex and cluttered sections of a drawing may require a larger scale to show the necessary detail. An accurate bar scale shall accompany scale references.

(h) Contour Lines

Existing contour information is required for every project unless the project does not involve grading and/or construction of surface improvements where contours would not add value to the drawing such as installing utilities in an existing street. The EOR shall develop contour lines based on survey and topographic information. Contour lines shall extend beyond the project area to adequately show the surrounding topography and the impacts the improvements will have on the area. Existing contours should be screened utilizing the following contour intervals:

(1). 1-foot for slopes less than 10 percent—Label and bold the contour lines on 5-foot intervals.

(2). A maximum interval of 2 feet for slopes between 10 percent and 40 percent—Label and bold the contour lines at no greater than 10-foot intervals.

(3). A maximum interval of 5 feet for slopes greater than 40 percent—Label and bold the contour lines at no greater than 20-foot intervals.

(i) <u>Existing Utilities and Topography</u>

All existing underground, surface improvements, and topography in proximity of the project shall be shown. This information must be shown for the full width of the ROW or easement and for a sufficient distance on either side of the ROW or easement to show possible impacts on adjacent properties and/or related facilities.

Existing utilities crossing the projected alignment of streets or utilities within 250 feet of the end of the proposed alignment shall be shown. Existing utilities and topography shall be shown on property directly adjacent to all sides of the project in order to sufficiently convey information regarding adjacent topography and utilities. Show fire hydrants bordering the project to determine accurate spacing for fire hydrants.

Whenever screening is used for existing features and topography, it must provide clear differentiation between proposed and existing improvements, even when reproduced at a scale with a 50 percent reduction.

(j) <u>Street Names</u>

Label all streets with their proposed or legal street names.

(k) <u>Future Extensions</u>

If improvements will be extended in the future, include all division or phase lines. Clearly identify the limits of proposed construction of the initial phase(s). Include additional existing topography in the future extension area as necessary to assure that the proposed improvements and future improvements will be compatible.

(l) <u>Floodway and Floodplain</u>

Indicate the location of all water courses, stream and railroad crossings, and culverts that cross the alignment within 500 feet of all new infrastructure in order to prevent future grade conflicts. All water course crossings must show the 100-year floodplain and floodway channel for the design storm as specified by the SRC. This information may be shown on the site plan.

(m) **Survey Monumentation**

Existing survey monumentation shall be shown and noted as to its type. This includes, but is not limited to control monuments, street centerline monumentation, property corners, benchmarks, etc. See Division 001–General for survey requirements.

(n) **Optional Drawing Sequence**

A suggested drawing sequence is included below. It is recognized that all projects are unique and may not include all the plans shown.

(1). Title Sheet.
(2). Site Plan (if applicable).
(3). General Legend/Index of Drawings.
(4). Symbols, Abbreviations, and General Construction Notes.
(5). Composite Utility Plan.
(6). Erosion Prevention Sedimentation Control Plan (EPSCP).
(7). Grading Plan.
(8). Traffic Control Plan.
(9). Street and Stormwater Plan and Profile.
(10). Off-site Street and Stormwater Plan and Profile.
(11). Street and Stormwater Details and Notes.
(12). Water Plan and Profile.
(13). Sanitary Sewer Plan and Profile.
(14). Pavement Restoration Plan.
(15). Off-site Water Plan and Profile.
(16). Off-site Sanitary Sewer Plan and Profile.
(17). Water and Sanitary Sewer Details and Notes.
(18). Traffic Signal Plan.
(19). Traffic Signal Interconnect Plan.
(20). Streetlight Illumination Plan.
(21). Signing and Striping Plan.
(22). Signing and Striping Details and Notes.
(23). Landscaping Plan.
(24). Landscaping Details and Notes.
(25). Street Cross Sections.

2.4—Title Sheet

The amount of information contained on the Title Sheet will vary based on the size and scope of the project. For large projects, the required information may need to be separated and placed on two or more sheets. The Title Sheet(s) shall include the elements listed below.

(a) **Vicinity Map**

The Vicinity Map shall always go on the first sheet and have a scale of not less than 1"=800'. The map shall cover a large enough area to include major arterials and collector streets near the project location.

(b) Index of Drawings

The Index of Drawings shall itemize and describe all sheets in the project set of drawings. The index may be placed on the second sheet for large projects.

(c) General Legend

The General Legend will contain a list of all the standard symbols and definitions used throughout the set of drawings. The City's standard symbols are available for use as provided on the City's E-disk. When City standard symbols are not used or defined, the designer shall utilize symbols common to a particular discipline.

For large, multidisciplinary projects, the designer may choose to break up the legend and place the relevant section at the beginning of each portion of the work. For example the Traffic Signal Legend could be placed at the beginning of the Traffic Signal Sheets.

(d) Survey Information

Vertical and horizontal datums shall be identified and described.

(e) Special Instructions

(1). For permit projects, the following statement shall appear on the Title Sheet referencing the City of Salem Standard Construction Specifications (SCS):

> *All construction shall be in accordance with the City of Salem Standard Construction Specifications and any special provisions included as a part of the approved plans.*

(2). Include the following text per Oregon Administrative Rules, OAR 952-001-0020:

> *ATTENTION: Oregon law requires you to follow rules adopted by the Oregon Utility Notification Center. Those rules are set forth in OAR 952-001-0010 through 952-001-0090. You may obtain copies of the rules by calling the Center. The telephone number for the Oregon Utility Notification Center is 503-232-1987.*

2.5—Site Plan

(a) Large or complex projects shall include a Site Plan.

(b) The Site Plan shall be a composite plan showing all complete properties to be served by the improvements including the number of units to be served by the improvement. The Site Plan should also include existing and proposed contours, appurtenances, natural features, surrounding streets, the shaded area of proposed street improvements, and other pertinent information. The total acreage impacted, streets directly served, and units per acre density, shall also be shown.

2.6—Erosion Prevention Sediment Control Plan (EPSCP)

The EPSCP sheet(s) shall contain the following elements:

(a) Site Boundary and the total area of the site.

(b) Existing topography and drainage patterns.

(c) Location of EPSC measures and structures before, during, and after construction.

(d) Sequencing of ground disturbance as required.

(e) Limits and areas of total soil disturbance.

(f) Limits of areas to be used for storage of soils or waste material.

(g) Sensitive area preservation such as existing vegetation, trees, wetlands, streams, springs, etc.

(h) Location of drainage outfalls to receiving waters.

(i) Wells and underground injection controls.

(j) Details of EPSC measures and structures.

(k) Details of detention and sedimentation ponds, storm drain piping, inflow, and outflow details.

(l) Boundaries of the 100-year floodplain or floodway as applicable.

2.7—Grading Plan

The grading plan sheet(s) shall contain the following elements:

(a) Existing and proposed contours.

(b) Spot elevations of proposed surfaces as required to convey adequate data to determine drainage patterns and construct improvements.

(c) Existing utilities.

(d) Existing and proposed buildings and pavement.

(e) Stormwater facilities.

(f) Existing sensitive areas to be protected, such as streams, wetlands, and springs on or directly adjacent to the site.

(g) Sufficient topography adjacent to the site to convey existing topography and drainage patterns.

(h) Limits of proposed cuts and fill.

(i) For large projects sequencing as required for erosion prevention and sediment control.

(j) Boundaries of 100-year floodplain or floodway as applicable.

2.8—Traffic Control Plan

Traffic Control Plans may be required where work requires complex street closures or detours. All Traffic Control Plans must be in conformance with the *Oregon Temporary Traffic Control Handbook* (OTTCH) and the *Manual of Uniform Traffic Control Devices (MUTCD).*

(a) **Drawing Scale**

The drawing scale shall be in engineering units and selected to clearly convey the required information.

(b) **Required Information**

(1). ROW Centerline and Stationing.

(2). Locations of all signs.

(3). Dimensions of all tapers and spacing requirements.

(4). A legend of all signs used on the sheet.

(c) **Special Instructions**

The following special instructions shall be placed in all notes for all Traffic Control Plans.

(1). Signs placed continuously for longer than two weeks shall be post mounted.

(2). Only flexible signs may be used on portable sign supports. All flexible signs and portable sign supports shall be crashworthy (per OTTCH).

(3). Road signs may be used on barricades when appropriately crash tested.

2.9—Plan and Profile Sheets—General

Street, stormwater, sanitary sewer, water, and other improvements shall be shown on Plan and Profile Sheets. Improvements detailed for construction on separate sheets which may conflict with the other design features (i.e. traffic signal poles or street lights) shall be shown on all plan sheets for reference only. Plan and profile views shall be on the same sheet, and shall be aligned vertically by stations on the sheet to the greatest extent possible.

(a) <u>Plan View—General</u>

The Plan View shall include the following:

(1). Drawing scale (horizontal).

(2). ROW centerline and stationing.

(3). Existing and proposed ROW, easements, and existing monumentation including dimensions.

(4). Contour lines.

(5). Existing and proposed improvements.

(6). Existing topographic features.

(7). Existing trees shall be shown with type and diameter. Those trees potentially affected by the construction shall be marked for removal or protection. Plans shall show temporary fencing around all trees to be saved at the drip line. Proposed trees shall be shown on the plan view at their approximate planned location.

(8). Horizontal curve Data for centerline and curb returns.

(9). Match lines (as applicable).

> ***NOTE:*** *Numbered key notes, also known as "call outs" corresponding to a key note legend on the same sheet, shall be utilized on all Plan Views.*

(b) Profile View—General

The Profile View shall be shown in a grid directly below the corresponding Plan View and shall be aligned vertically by stations on the sheet to the greatest extent possible. Grid lines shall be established based on the plan and profile view scales. The Profile View shall include the following:

(1). Drawing scale (vertical).

(2). Centerline stationing.

(3). Existing ground profile at centerline of proposed improvements.

(4). Vertical curve data.

(5). Existing and proposed utilities, and potential crossing conflicts.

(6). Match Lines (as applicable).

> ***NOTE:*** *The designer shall gather adequate information from the current topographic survey, utility records, locates, and potholing to accurately show all existing utilities within and near the project area. Whenever there is a potential conflict, a note should be placed on the drawing requiring the contractor to pothole the utility crossing before beginning the work (see Division 001–General).*

2.10—Water Plan and Profile

(a) Plan View

(1). Pipelines shall show size, length between fittings, service level (G0, S1, S2, etc.), and type and class of material. Include distance from ROW centerline or property line.

(2). Water lines and services shall be shown and stationed. All private water lines connected to the City system shall be shown and designated as private on the drawings.

(3). All fittings and valves shall be shown on the Plan View and stationed. A detail shall be required at all locations where three or more fittings are used.

(4). Show the location of all meter boxes, thrust blocks, and all other appurtenances with the fitting and branch line stationed to facilitate coordination and locating.

(b) Profile View

(1). The water Profile View shall include new mains with a diameter of 8 inches or larger and mains installed in existing streets or across private property with stationing. Water lines in new subdivisions do not need to be profiled unless crossing existing facilities.

(2). Sanitary sewer and stormwater facilities shall be shown as dashed or screened back so they are clearly shown but faded into the background of the sheet.

(3). Utility crossings of the proposed water line installation shall be shown.

(c) Detail Sheets

Separate detailed drawings shall be included for all non-standard water system appurtenances including fire hydrants, thrust blocks, valve boxes, blow offs, service installations, etc. Appropriate references to the Standard Plans may be used for standard water system appurtenances in lieu of details actually shown on the drawings. A blank As-Built Valve Schedule shall be included on one of the water detail sheets for recording station, size, end fittings, manufacturer, type of valve (gate, butterfly, etc.), and any other specific fitting and valve information.

2.11—Sanitary Sewer Plan and Profile

(a) Plan View

(1). Show sewer main lines including manholes, size, stationing, and types of pipe. Include distance from ROW centerline or property line.

(2). Clean outs and service tees shall be shown and include the station with centerline offset, size, and depth at the property line.

(b) Profile View

(1). All structures (manhole, clean outs, etc.) shall be accurately depicted (size and elevation) on the Profile View. All sewer structures shall include and be labeled with the centerline station and offset, invert elevations, and rim elevations.

(2). All sewer lines shall be depicted and labeled with pipe size and flow line of pipe, length, slope, and type of material.

(3). Utility crossings of the proposed sewer shall be shown.

(c) Detail Sheets

Separate detailed drawings shall be included for all non-standard sanitary sewer appurtenances including manholes, pump stations, etc. Appropriate references to the

Standard Plans may be used for standard sanitary sewer appurtenances in lieu of details actually shown on the drawings.

2.12—Stormwater Plan and Profile

(a) Plan View

(1). Show location, size, and length of all pipes and other detention, water quality, or conveyance facilities, including the invert elevations of existing or any other adjacent stormwater systems which connect to the proposed development. Include distance from ROW centerline or property line.

(2). Inlet and catch basin locations shall be shown with a station, offset from centerline, flow line elevation, invert elevation, and depth.

(3). Treatment Facilities. All treatment facilities shall include the following:

A. Facility dimensions and setbacks from property lines and structures.

B. Facility wall materials and waterproofing membrane, if applicable.

C. All stormwater piping associated with the facility, including pipe materials and sizes, and inlets and catch basins shall include the same information depicted in Subsection 2.11(a)(2).

D. The total quantity of impervious surface area being treated by the facility, water quality facility sizing criteria, and associated information.

(4). Flow Control Facilities. All flow control facilities shall include the following:

A. Ground elevations at catchment locations, channel inverts, top, and toe of slope surrounding detention area.

B. Ground slopes of channel inverts and sides, parking lots, bottoms and sides of flow control basins, and adjacent surroundings.

C. Invert and top elevations (if applicable) of pipes, catch basins, manholes, or other similar structures.

D. Detention volume within each proposed basin.

E. Size and invert elevation for all control structure elements including orifices and weirs.

F. Summary of flow control calculations with total areas and flows broken down by facility.

G. When open basin surface ponding is utilized, the following statement shall be included on the plan:

> ***NOTE:*** *Final grades within the detention area are critical to the function of the detention system and must be strictly followed. Pond construction and finished volume shall be inspected by the City prior to final paving or landscaping.*

(b) Profile View

(1). Pipe location (top and flow line inside of pipe), size and type, length, slope, and hydraulic grade line (HGL) shall be shown. Private storm lines are not required to be profiled.

(2). Structures (including Flow Control and Treatment Facilities)

A. Location of catch basins, manholes, and other appurtenances with each manhole and catch basin numbered and stationed.

B. For underground flow control and conveyance systems, profile of the existing and proposed ground and/or pavement surface, stormwater invert, and HGL, if applicable.

C. Include a Profile View of each stormwater treatment facility and appurtenances including typical cross-sections with dimensions.

(3). Open Channel Conveyance Systems**—**Profile of the existing and proposed ground surface at the flow line, existing and proposed ground surface at the top of bank and the maximum water surface for the design storm.

(c) Detail Sheets

Separate detailed drawings shall be included for all non-standard stormwater appurtenances including manholes, catch basins, culvert, head walls, orifice controls, detention diversion structures, etc. Appropriate references to the Standard Plans may be used for standard stormwater appurtenances in lieu of details actually shown on the drawings. For open channels, cross sections shall be shown to adequately convey the variety of channel cross sections being constructed, generally one section at each 50-foot interval.

2.13—Street Plan and Profile

(a) Plan View

(1). Sidewalks

Sidewalks shall be shown on the drawings and labeled with width and type (curbside or setback) within the alignment. Sidewalks that will not be built as part of the project shall be shown on the plans with dashed lines and labeled as "future" with width and type.

(2). Driveways

Curb cuts and driveway approaches shall be shown on the plans and clearly depict the location and horizontal dimensions. A cross section detail or reference to a Standard Plan shall also be provided. Driveways behind the sidewalk shall be shown and labeled with the material type.

(3). Curb Ramps

Plans shall include the location and horizontal dimensions of all curb ramps, blended transitions, and turning spaces. The design running slopes and cross slopes for curb ramps, blended transitions, and turning spaces shall also be identified on the drawings.

(4). Curb and Gutter

Curb and gutter shall be shown.

(5). Pavement

Horizontal limits of pavement construction shall be shown on the Plan View. Transitions shall clearly be shown and dimensioned with a length and taper rate. For PCC pavement, include the location of dowels and contraction and expansion joints complying with the requirements set forth in the SCS.

(6). Curb Return Data

Each curb return shall be labeled with letters and/or numbers and a corresponding table shall be included on the same sheet. The data table shall include the delta angle (in degrees), radius (in feet), curve length (in feet), beginning Point of Curvature (PC) station and offset from centerline, and ending Point of Tangency (PT) station and offset from centerline.

Provide top of curb elevations corresponding to no less than the quarter deltas on curb return including a description of each point; i.e., high point, ¼ delta, etc., shall be shown in the Plan View or the Profile View.

(7). Horizontal Curve Data

Each horizontal curve shall be labeled with letters and/or numbers and a corresponding table on the same sheet. PC and PT locations shall be labeled with station on the centerline. The data table shall include the delta angle (in degrees), radius (in feet), curve length (in feet), PC station, and PT station.

(b) Profile View

(1). Finished Centerline and/or Top of Curb

The finished grade profiles for the centerline and/or top of curb shall be labeled and shall include grades along all tangents. Existing profiles at the centerline and/or curb line shall be included and shown as a dashed line.

(2). Vertical Curves

Each vertical curve along the proposed centerline and/or top of curb shall be labeled to include the PC station/elevation, point of vertical intersection station/elevation, PT station/elevation, high/low point station/elevation, length of vertical curve, and K values, based on AASHTO definition (see Division 006—Streets).

(3). Cul-de-Sac

Cul-de-sac top of curb shall be shown in profile. Label ¼ delta elevations and vertical curve data as required.

(c) Street Typical Sections

All street projects shall contain typical street sections for the project. A separate cross section shall be included for each street section used in the project. Dimensions on typical street sections shall be shown as accurately as possible. When widths vary in a typical section, width shall be labeled as “varies” and include minimum and maximum dimensions.

Typical sections shall be labeled with beginning and ending stationing and show centerline location, ROW width, easements, key pavement dimensions (type and lifts), standard aggregate base depths, geotextile fabric location and type, sidewalks, curb and gutter, maximum cut/fill slope to catch points within easements and ROW, subgrade preparation and protection requirements including construction notes to implement any geotechnical engineering recommendations.

(d) Street Cross Sections

Street cross sections are required for off-site linking and boundary streets, at existing driveways, other critical areas, and at maximum 50-foot intervals. The horizontal scale of the cross sections shall match the scale shown on the plans.

(e) <u>Detail Sheets</u>

Separate detailed drawings shall be included for all non-standard street appurtenances including curb ramps, curb extensions, retaining walls, pavement transitions, etc. Appropriate references to the Standard Plans may be used for standard street appurtenances in lieu of details actually shown on the drawings.

2.14—Traffic Signal Plans

Traffic signal modifications and installations are typically very “detail-rich” drawings requiring a significant amount of details to convey the necessary information.

(a) <u>Required Information</u>

(1). Traffic Signal Legend Plan

A. Standard traffic signal callout bubbles.

B. Standard Legend symbols for traffic signals and abbreviations.

C. Construction and general notes.

D. Traffic Signal Removal Plan. The Traffic Signal Removal Plan shall include, but is not limited to:

(i). The traffic signal intersection(s) at a scale of 1″=10′ showing original edge of pavement, curb line, lane markings, crosswalks, sidewalks, property lines, and other topographical features relevant to the removal of the existing traffic signal equipment.

(ii). Proposed equipment—shaded as background information.

(iii). Location and description of all utilities, both overhead and underground, in, and around the intersection—shaded as background information for the installation of the traffic signal poles and equipment.

(iv). Location and specification of traffic signal poles and arms, underground conduit, traffic signal wiring, junction boxes, signal heads, pedestrian heads, push buttons, traffic signal controller and service cabinet, emergency preemption equipment, existing power sources, overhead signs, and all other equipment to be removed.

(2). Traffic Signal Plan

A. Traffic signal layout for the intersection drawn at a scale of 1″=10′ showing edge of pavement, final placement of future curb line, lane markings, crosswalks, final placement of sidewalks, property lines, and other topographical features to be installed or which will remain after street construction. Also show existing traffic signal pole base locations for equipment to be removed.

B. Location and specification of traffic signal poles and arms, underground conduit, traffic signal wiring, junction boxes, signal heads, pedestrian heads, push buttons, traffic signal controller and service cabinet, emergency preemption equipment, existing power sources, overhead signs, and all other equipment needed to install the signal. Show a reference number for each pole.

C. The plan shall include the following traffic signal interconnect work, existing and proposed, within the intersection:

(i). Conduit.

(ii). Wire.

(iii). Junction Boxes.

(iv). Hand Holes.

(v). Splice Vaults.

D. Legend depicting and specifying the items to be installed shall be shown on the signal plan. Standard legend symbols and specifications as used by the City shall be used in specifying equipment or materials on the plan and legend.

E. Location and description of all utilities, both overhead and underground, in, and around the intersection. These items will be shown in a lighter color as background information for the installation of the traffic signal poles and equipment.

(3). Traffic Signal Detection Plan. This plan shall include, but is not limited to the following:

A. Intersection layout shall be drawn at a scale of 1″=20′ showing edge of pavement, final placement of future curb line, lane markings, property lines, and crosswalks. If conduit is to be installed behind curb, show driveways, sidewalks, and other topographical features located between curb and property line.

B. Show detection zones, video cameras and wiring, and all other equipment needed for proper video detection installation. Show detector wiring diagram indicating all functions and input files to be used.

C. Show normal phase rotation diagram for the intersection.

D. Emergency vehicle preemption operation diagrams for the intersection.

E. Pole orientation chart showing all attachment orientation information for each signal pole including mast arm, luminary arm, terminal cabinet, vehicle signals, signs, push buttons, pedestrian heads, and any other items shown on the plans.

F. A legend depicting and specifying the items to be installed shown on the Detector Plan. Standard legend symbols and specifications as used by the City shall be used in specifying equipment and material on the plan and legend.

(4). Additional Traffic Signal Plans

The Pole Entrance Chart, Orientation Diagrams, and Pole Location Chart shall be placed on the Legend Sheet when space permits, but can float to other pages when space limitations arise due to the complexity of the project. The following are additional sheets which may be required as part of a Traffic Signal package:

A. Service (battery backup) cabinet details.

B. Equipment mounting details.

C. Underground enclosure details.

D. Traffic signal equipment details.

(5). Traffic Signal Interconnect Plan

Traffic signal interconnect work is often performed in conjunction with traffic signal work and should be placed simultaneously in the plan set. Traffic signal interconnect modification or installation often requires multiple sheets in order to convey the necessary information. The following information is provided as a guideline for traffic signal interconnect modifications or installation projects:

A. Interconnect Legend

This sheet can be combined with the Traffic Signal Legend Sheet when space on the sheet permits. This sheet shall include, but is not limited to, the following:

(i). Standard interconnect callout bubbles.

(ii). Abbreviation and standard interconnect symbols.

(iii). Construction and general notes.

B. Interconnect Plan

(i). The plan shall include the location of all interconnect conduit, existing or proposed, drawn to 1″=30′ scale using street plan sheets for a basis of the layout.

(ii). Show location of interconnect junction boxes, existing or proposed, as well as all existing or proposed traffic signal control equipment.

(iii). Show legend depicting and specifying the items to be installed. Standard legend symbols and specifications as used by the City shall be used in specifying equipment and material on the plan and legend.

(iv). Show any details necessary to show adequate information to connect to existing installations and intersections. Details shall be drawn at a scale of 1″=10′.

C. Fiber Optic Splice and Logic Diagram Plan. This sheet shall include, but is not limited to, the following:

(i). Details of the splice closure and traffic signal controller.

(ii). Notes, legend, and fiber color code.

D. Fiber optic detail sheet. Include cable management in hand holes and splice vaults.

2.15—Streetlight Illumination Plan

(a) <u>Required Information</u>

At a minimum, the streetlight illumination plan sheet shall include the following information:

(1). ROW, street stationing, curbs or edge of pavement, sidewalks, traffic signal equipment, and trees.

(2). Location of existing and proposed street and pedestrian lights.

(3). Luminaire type, pole height, pole base design, and luminaire arm length of proposed street lights.

(4). Existing power supply system together with design details of proposed underground power system including conduit, pull boxes, and wiring.

(5). Details regarding photoelectric cells, access ports, conduits, etc.

2.16—Signing and Striping Plan

(a) Required Information

The signing and striping plan shall include the following information:

(1). ROW, street stationing, curbs or edge of pavement, sidewalks, traffic signal equipment, trees and tall vegetation, and any other site-specific feature necessary to determine acceptable sign locations.

(2). Locations of existing signs.

(3). Location, type, and size of all proposed signs.

(4). Identify which pavement markings are to be preserved and which are to be removed.

(5). Location and alignment of new pavement markings using dimensions and references to street stations, sufficiently detailed to be laid out by measuring tape.

(6). Reference all details on the Standard Plans.

(b) Detail Sheets

Separate detailed drawings shall be included for all non-standard appurtenances including graphic depiction of all signs; a Sign Table listing all signs on the project with the applicable Federal Code, type, legend, size, quantity, and additional comments as necessary; etc. Appropriate references to the Standard Plans may be used for standard appurtenances in lieu of details actually shown on the drawings.

2.17—Landscaping

(a) Required Information

(1). A schedule containing the number, types, and sizes of all plants being used on the project.

(2). Construction limits for landscaping work.

(3). The general layout and placement of all plants.

(4). The general layout and placement of all irrigation components.

(5). For Subdivision Development Projects:

a. Show all trees to be planted during construction.

b. Shall locations of all future trees in the ROW to be planted when each lot is developed.

(b) <u>Protection of Existing Trees</u>

(1). Identify all trees to be removed and all trees to be protected on the Plans.

(2). Provide reference and/or details for tree protection fencing (see Standard Plan 820).

2.18—As-Built Drawings

(a) <u>General Requirements</u>

(1). The As-Built drawing set shall be submitted in electronic format and shall conform to the standards established in this Division. The following statement shall be placed on each sheet of the As-Built drawing set and shall be signed by the EOR.

I CERTIFY THAT I AM THE ENGINEER OF RECORD FOR THIS PROJECT WHICH, TO THE BEST OF MY KNOWLEDGE, HAS BEEN CONSTRUCTED IN CONFORMANCE WITH CITY OF SALEM STANDARDS AND THE PROJECT PLANS.

(2). The words, "AS-BUILT DRAWING," shall appear as the last entry in the revision block along with the month, day, and year the As-Built drawing was prepared.

(3). The EOR shall remove their Professional Engineers' stamp from the title block and replace it with the following information:

A. The name of the engineer who sealed the original drawings.

B. Their registration number.

C. The date the drawings were signed.

D. The expiration date for the certificate at the time the drawings were signed.

NOTE: *An example Title Block with the required information is included in a folder with the electronic AutoCAD drawings available from the Public Works Department.*

(4). All sheets that were part of the original, approved design plan set shall be submitted as part of the As-Built drawings, including title and all detail sheets.

(5). As-Built drawings must include the legal names of all streets shown.

(6). As-Built drawings must include all private and public easement information.

(7). As-Built drawings shall be based on field measured final improvements.

(b) <u>Water As-Built Drawings</u>

The following minimum information shall be noted on the water system As-Built drawings:

(1). All changes altering the approved plans.

(2). All changes from standard 36-inch depth of cover; limits shall be shown on plan with annotated reason for change; actual (top of pipe) will be shown at every fitting that is not at standard cover.

(3). Show alignment changes, grade changes, and changes in construction materials; if changed alignment results in station changes; a station equation shall be shown, as appropriate.

(4). Provide updates to the inventory list on construction drawings utilizing the As-Built Valve Schedule.

(5). Provide fire service pipe size and material for private portion of the system.

(6). Provide water service station on main line.

(7). Provide station and offset to all valves, fittings, blow offs, and water meters (or end of line if a meter is not provided).

(c) <u>Sanitary Sewer As-Built Drawings</u>

The following minimum information shall be noted on sanitary sewer As-Built drawings:

(1). Any changes altering the approved plans.

(2). Show alignment changes, grade changes, and changes in construction materials; if changed alignment results in station changes, a station equation shall be shown as appropriate at manhole.

(3). Provide surveyed As-Built rim and invert elevations for each manhole noting the direction of flow at each invert.

(4). Provide station of wye or tee into the main line and station, offset and depth of pipe at lateral clean outs at the property line.

(5). If cleanout is not included in the initial phase of work, then the station offset, and depth at the end of service lateral measured from existing ground to invert of pipe, invert elevations shall be noted.

(6). Show location of backfill material changes (i.e., CDF, aggregate or native materials).

(d) <u>Stormwater As-Built Drawings</u>

The following minimum information shall be noted on stormwater As-Built drawings:

(1). Any changes altering the approved plans.

(2). Show alignment changes, grade changes, and changes in construction materials; if changed alignment results in station changes, a station equation shall be shown as appropriate at manhole.

(3). Provide surveyed As-Built rim and invert elevations for each manhole, catch basin, and inlet noting the direction of flow. Provide depth of sump for catch basins.

(4). Where stormwater service laterals are installed, provide type of pipe, station, offset, and depth to top of pipe at the end of the lateral. Indicate if lateral is private or public.

(5). Show location of backfill material changes (i.e. CDF, aggregate or native materials).

(e) <u>Street As-Built Drawings</u>

The following minimum information shall be noted on street As-Built drawings:

(1). Any changes altering the approved plans.

(2). Change in horizontal alignment, with centerline, curve data, and stationing of primary control points (e.g., PC, PI, PT, PRC).

(3). Vertical curve or grade changes; change in location of low point in sag vertical curve.

(4). Directed changes to approved thickness for street structural section components. Show station limits where changes in structural section have occurred.

(5). Change in driveway locations or widths.

(f) Traffic Signal As-Built Drawings

At a minimum, any changes from the approved plans in the type, size, or location of traffic signal equipment, interconnect system, and street lights shall be noted on the traffic signal As-Built drawings.

Main Menu

CITY OF SALEM
DEPARTMENT OF PUBLIC WORKS
ADMINISTRATIVE RULES
CHAPTER 109
DIVISION 003
SANITARY SEWER COLLECTION SYSTEM

SECTION

Top Div 3

FIGURES

TABLES

3.1—Introduction

This Division pertains to the sanitary sewer collection system (sewer) only. The design of sanitary sewer pump stations is included in the Special Facilities section of these Design Standards.

Private sanitary sewer systems are subject to the requirements of the Oregon State Plumbing Specialty Code (OPSC), SRC, and these Standards.

(a) Objectives

The objective of this Division is to develop a sanitary sewer system which will:

(1). Be consistent with the adopted Salem Wastewater Management Master Plan, and any detailed facilities plan for the area;

(2). Have adequate design capacity to carry the expected flow within the design life, and at a sufficient depth to serve adjacent properties;

(3). Have sufficient grade to maintain a minimum velocity of two feet per second when flowing half full;

(4). Have sufficient structural strength to withstand all external loads which may be imposed;

(5). Be constructed of materials resistant to both corrosion and erosion with a minimum design life of 75 years;

(6). Be economical and safe to build and maintain by minimizing operation and maintenance costs and need for future repairs; and

(7). Prevent infiltration or inflow of ground and surface waters; including at pipe joints, manholes, and sewer laterals.

(b) Applicability

These Standards shall apply to all public sewer collection system facilities and to all private sewer system facilities within the ROW and/or PUEs in the City and its service areas.

(c) Drafting and Drawing Requirements

See Division 002−Drafting and Drawing Standards for drafting and drawing requirements for sanitary sewer plans.

3.2—General Design Considerations

Sewers shall be designed to remove the domestic sewage and industrial waste from all residential, commercial, industrial, and other buildings.

Stormwater; including street, parking lot, roof, or footing drainage; shall not be discharged into the sewer system. Stormwater shall be conveyed, treated, and controlled by a system of storm facilities separate from the sanitary sewer system in accordance with the Division 004−Stormwater System.

Clean, non-contact, and untreated cooling water shall not be discharged into sewers. This does not include filter backwash lines of swimming pools or water with chlorine residue, "play" fountains and water features, fish ponds, and "hot tubs", which shall drain into a sewer.

In general, sewer systems shall be designed to accommodate future flows for the ultimate development of the specific drainage area concerned.

All developments shall be designed to provide necessary facilities and sufficient capacity to serve adjacent upstream parcels and provide for orderly development of the drainage area. This shall include the extension of sewer mains to adjoining properties.

(a) Sanitary Sewer System Capacity

The public sewer shall be sized to carry the ultimate flow for a basin in accordance with the current adopted Wastewater Management Master Plan including all applicable amendments and updates. Design capacities and pipe sizing shall be determined by the following:

(1). As detailed or identified in the adopted Wastewater Management Master Plan, and/or any detailed facilities plans. Precedence to determine pipe size shall be in the following order:

A. Detailed facilities plan

B. Wastewater Management Master Plan

(2). For service of industrial and unique commercial properties where there is an absence of information per Subsection 3.2(a)(1), above; design capacities and pipe sizing shall be determined by considering the following factors and assumptions for immediate and adjacent areas to be served:

A. The higher of either the current or projected population of the area to be served by the proposed sewer facilities within the UGB as provided by the City.

B. The maximum daily wastewater demand based upon land use (higher of either the current or projected land use) within the UGB and area to be served as identified in the most recently adopted Master Plan.

C. Special needs of commercial or industrial users to be served at specific locations within the UGB as established by the Master Plan, and/or detailed facilities plans.

(3). The following detailed design factors, consumption data, and other information to be used for design purposes, shall be obtained from the Public Works Department:

A. Maximum peak hour Dry Weather Flow (DWF) based upon the specific details of the proposed development and land use type.

B. Peak hour Rainfall Derived Inflow and Infiltration (RDII) for wet weather periods added to the peak hour DWF based upon collection basin and land use.

C. Demand for unique commercial installations, industrial users, PUDs, and multiple-family dwellings which shall be calculated on an individual basis.

(b) <u>Design Calculations</u>

Design calculations shall include estimates of average maximum and minimum hourly flows. Design calculations shall confirm pipe sizes, layout, population estimates, land use, or other design assumptions.

Design capacity of main sewers, collector sewers, trunk sewers, and interceptor sewers shall be designated on the following basis:

(1). Main sewers shall be sized to convey capacity based on sewers flowing half full with the total peak hour flow (DWF plus RDII).

(2). Collector, trunk, and interceptor sewers shall be sized to convey a design capacity based on sewers flowing full, without head (hydraulic grade line (HGL) less than or equal to the elevation of the pipe crown) conveying the peak hour flow (dry weather plus RDII). A schematic illustrating the various classifications of sewer pipes within the collection system is provided in Figure 3-1. Information on the downstream starting HGL elevation to be used for the design can be obtained from the Public Works Department. If no HGL information is available at the connection point to the existing system, the starting HGL elevation shall be assumed to be at an elevation equal to the crown of the downstream pipe unless otherwise required by the City. The HGL profile shall be calculated from the point of connection with the existing system to the upstream end of the project.

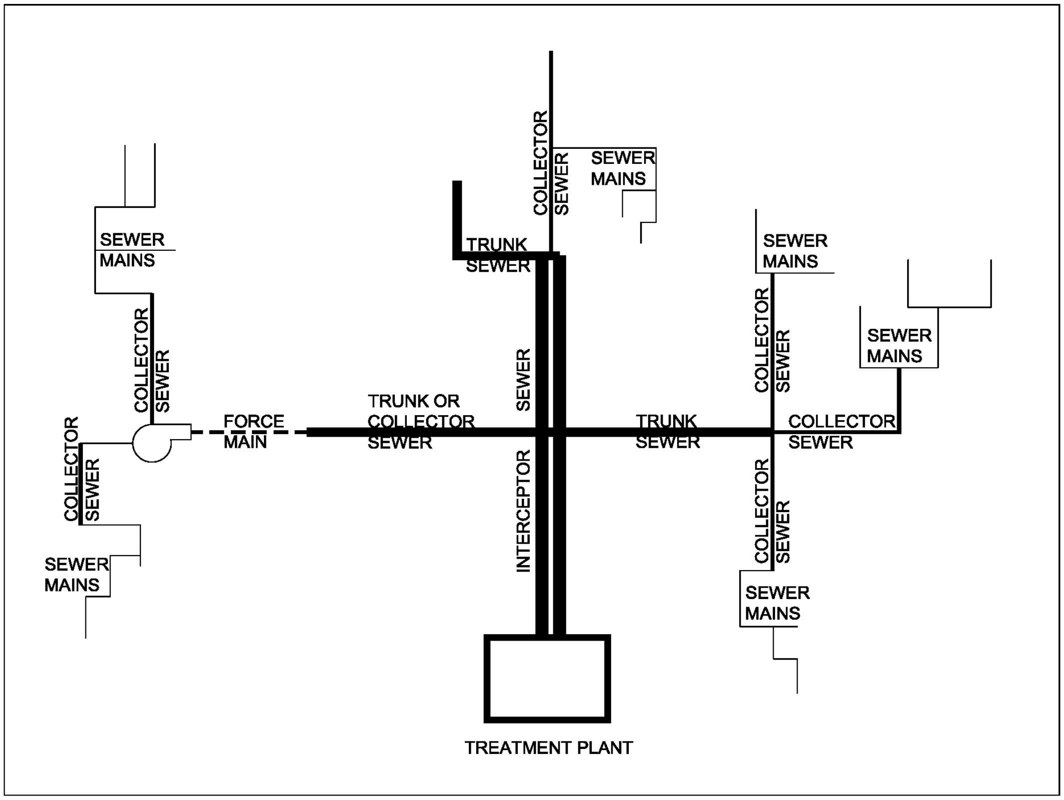


Figure 3-1. Classification of Sanitary Sewers within the Collection System

(c) Pipe Size and Materials

Sewer pipe size and materials shall conform to Table 3-1. All pipe materials shall conform to the SCS.

Classification	Inside Pipe Diameter (Inches)	Allowable Pipe Types*
Sewer Service Laterals	4 through 6	PVC, DI, HDPE
Main Sewers	8	PVC, DI, HDPE
Collector Sewers	10 through 21	PVC, DI, HDPE
Trunk Sewers	24 through 48	PVC, DI RCP (≥36" Diameter Only)
Interceptor Sewers	54 and above	RCP
*See Appendix 1A—Acronyms and Definitions for a list of acronyms defining the types of pipe		

Table 3-1. Size and Material of Sanitary Sewer Pipe

(d) Grade and Slope

(1). Uniform Slope

Sewer lines shall be designed on a uniform slope between consecutive manholes. Vertical curves in sewers are not permitted.

(2). Minimum Slope

All sewers shall be laid on a slope which will produce a mean velocity, when flowing half full of at least 2 feet per second, which is based upon Manning's pipe friction formula, using a roughness coefficient per Table 3-2 or the pipe manufacturer's recommendations, whichever is greater.

Pipe Material	Manning's "n" Value
PVC	0.010
DI	0.013
HDPE, smooth inner wall	0.010
RCP	0.013

Table 3-2. Manning's "n" Value

The minimum acceptable slope for various pipe sizes is listed in Table 3-3.

Classification	Inside Pipe Diameter (Inches)	Percent of Grade (feet per 100 feet)
Main Sewers	8	.40
Collector Sewers	10	.30
	12	.22
	15	.15
	18	.12
	21	.10
Trunk Sewers	24	.09
	27 through 48	.08
Interceptor Sewers	54 and above	.08

Table 3-3. Minimum Sanitary Sewer Slope

Specifying a larger diameter pipe at less than the minimum grade will not be approved unless documentation is provided that a velocity of 2 feet per second will be obtained with the pipe flowing half full.

(3). Pipe on Steep Slopes

Sewers on slopes of 20 percent or more shall be secured by anchor blocks in accordance with Standard Drawing 113.

Where velocities are greater than 15 feet per second, the pipe material shall be ductile iron and special provisions shall be made to protect manholes against erosion and displacement by hydraulic forces. This may be accomplished by installing one additional manhole to decrease the slope or to split a 90 degree horizontal direction change into two 45 degree incremental changes.

(e) Minimum Depth

All sewers shall be laid at a depth sufficient to drain the lowest elevation of existing, proposed, and future building sewers and to protect against damage by frost or traffic. Depth is measured from the top of pipe to finish grade at the sewer alignment.

Under normal conditions, sewers in residential areas shall be placed in the street with the following minimum cover:

(1). Main Sewers—6 feet

(2). Collector, Trunk, and Interceptor Sewers—8 feet

Deviation from the minimum depth and cover standards must be pre-approved through the Design Standard Exception process identified in Division 001General. This may require special bedding and/or backfill, load calculations, manufacturer's specifications, specific pipe materials, or other additional requirements.

(f) Sanitary Sewer Mains

(1). Alignment

Sewer mains shall be laid in a straight alignment between consecutive manholes. Horizontal and vertical curves in sewers are not permitted. Sewer mains shall begin at a manhole and shall terminate at a manhole, except as provided in Subsection 3.2(h)(1).

(2). Location

Sewer mains shall be located within the ROW whenever feasible. If the sewer main must be located outside the ROW, an easement must be provided to the City. Easements are described in Division 001—General.

(3). Relation to Water Lines and other Utilities

Sewers shall be separated from potable water pipes and other sources of domestic water in accordance with Oregon Administrative Rules (OAR) Chapter 333. The

EOR is responsible for field locating and verifying the alignment, depth, and inverts of all existing facilities that may be impacted by the project (see Division 001—General).

(g) <u>Stream and Drainage Crossings</u>

Generally, the top of all sewers entering or crossing streams shall be a minimum of three feet below the stream bed and at a sufficient depth below the streambed to protect the sewer main. Inverted siphons shall not be allowed at stream or drainage crossings. Concrete encasement may be required in other cases dependant on soil types, depth of cover, and streambed characteristics.

Sewers located parallel to streams shall be located outside of the streambed and sufficiently removed from the streambed to provide for future possible stream channel widening and in accordance with applicable City code requirements for waterway and riparian area protection.

Sewers crossing streams or drainage channels shall be designed to cross the stream as nearly perpendicular to the stream channel as possible and at a uniform grade.

Pipe material shall be DI Class 50 with an 18-foot length of pipe centered on the stream or drainage channel centerline. The DI pipe shall extend to a point where a one-to-one slope, which begins at the top of the bank and slopes down from the bank away from the channel centerline, intersects the top of the pipe.

(h) <u>Manholes and Cleanouts</u>

Manholes and cleanouts shall be designed in accordance with the applicable standard drawings.

(1). Cleanouts

Cleanouts will not be approved as substitutes for manholes.

(2). Manhole Lids

Lockdown, watertight lids shall be required on all manholes meeting one or more of the following criteria:

A. Manholes on trunk sewers or interceptor sewers.

B. Manholes located in easements.

(3). Manholes with rim elevations less than one foot above the 100-year flood elevation.

(4). Manhole Taps

When an existing manhole is tapped to install a new sewer, which will drain into the manhole, the new sewer shall enter the manhole with the invert a minimum of 0.25 feet below the shelf elevation of the manhole and a channel shall be formed in the shelf of the manhole to the invert of the existing sewer. A minimum of eight inches of wall separating the cutouts or breakouts for the individual pipe connections shall be provided in manholes. Where a connection is proposed to an existing manhole, the elevation of existing shelf, and elevations of existing inlets and outlets shall be shown on the plans.

(5). Manhole Size and Location

Manholes shall have an internal diameter based on the largest pipe diameter connected to the manhole and per Table 3-4.

Manhole Diameter (interior dia. in inches)	Maximum Pipe Size (dia. in inches) w/0° deflection	Maximum Pipe Size (dia. in inches) w/90° deflection
48	18	15
60	30	18
72	42	30
84	54	36

Table 3-4. Manhole Size

Manholes shall be placed at the following locations:

A. Every change in grade or alignment of a sewer.

B. Every point where there is a change in pipe size.

C. Each intersection or junction of a sewer.

D. Upper end of all sewer mains.

E. In front of the last property or lot being served, 10 feet past the common lot line of the adjoining parcel.

F. At intervals of 450 feet or less.

G. At any point where an 8-inch diameter or larger private sewer intersects the public sewer.

H. Manholes shall be located at street intersections whenever feasible.

Manholes shall not be located in the curb or gutter. Manholes may be allowed behind the curb where necessary to connect to an existing system or where there are no other feasible alternatives. Whenever a manhole or other structure is located in an easement, an Access Easement must be granted to the City (see Division 001−General).

Two manholes shall be required whenever the interior horizontal angle between a manhole inlet and outlet is less than 90 degrees. Where an 8-inch sewer connects to an 8-inch sewer, this interior angle can be reduced to 80 degrees. The nearest point between the two structures shall be a minimum of 10 feet separation as measured between the exterior of the two structures. The intent is to prevent one sewer from discharging into another sewer, in opposition to the flow. See Figure 3-2.

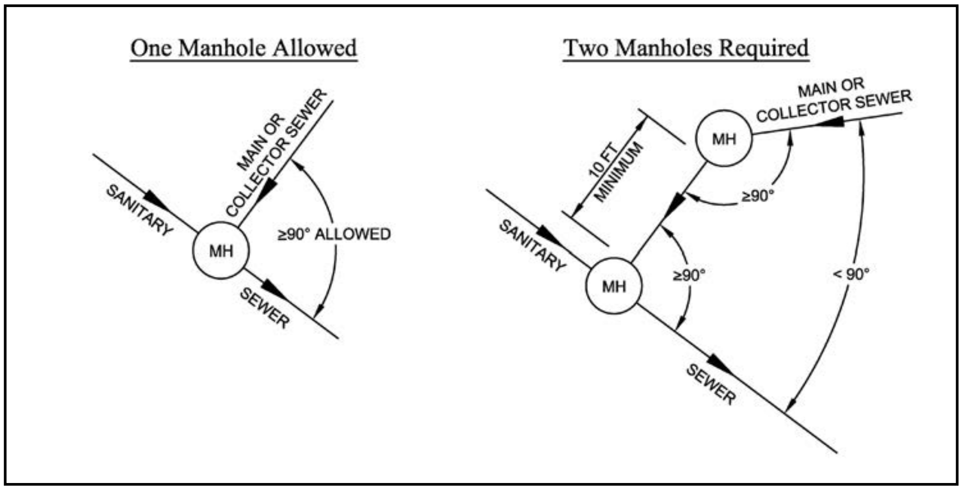


Figure 3-2. Allowable Horizontal Angle for Main and Collector Sewers

For a trunk or interceptor sewer, the interior horizontal angle between any manhole inlet and outlet shall not be less than 120 degrees. Where this is not the case, a minimum of two manholes shall be installed with a minimum of 10 feet separation as measured from the nearest point between the exterior of the two structures. See Figure 3-3.

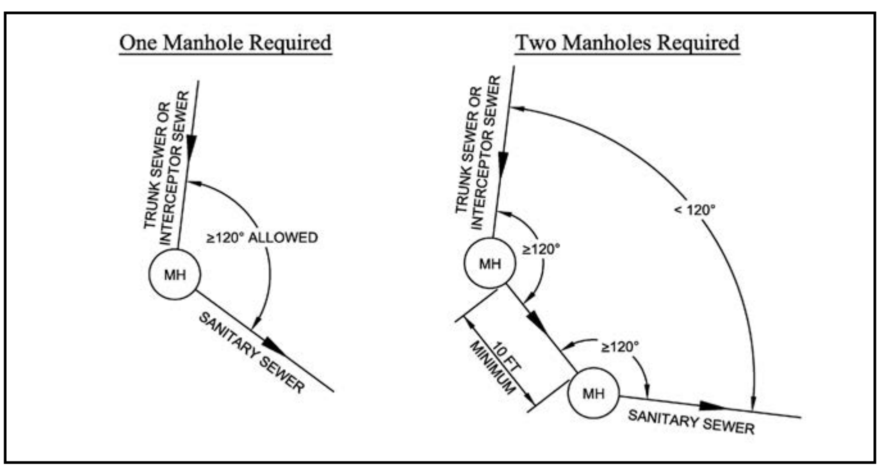


Figure 3-3. Allowable Horizontal Angle for Trunk and Interceptor Sewers

(6). Drop Across the Manhole

The drop across flow channel within the structure shall normally be 0.10-foot. Where the design requires more than a 60 degree horizontal deflection angle between any inlet and outlet of a manhole, the vertical drop shall be between 0.20 feet and 0.25 feet.

A vertical offset in grade at a manhole exceeding 0.25 feet will not be permitted except under the following conditions:

A. When a smaller diameter pipe connects to a larger diameter sewer, in which case, crown elevations should match.

B. When a grade conflict exists with an adjacent existing utility, a vertical drop up to a maximum of 2 feet is allowed.

C. When a vertical drop greater than 2 feet is requested, reviewed, and approved, an outside drop manhole shall be installed in accordance with the applicable standard drawing.

D. Where a force main connects to a gravity sewer, the invert shall be designed above the gravity sewer's HGL.

(7). Drop Manholes

Outside drop manholes will be allowed only in those cases where there are no other feasible alternatives. Drop manholes can be avoided by installing sewers deeper or by the installation of an intermediate manhole as shown in Figure 3-4. Construction of outside drop assemblies to serve future development may be allowed where sewers are located more than 20 feet deep. No inside drop manholes are allowed.

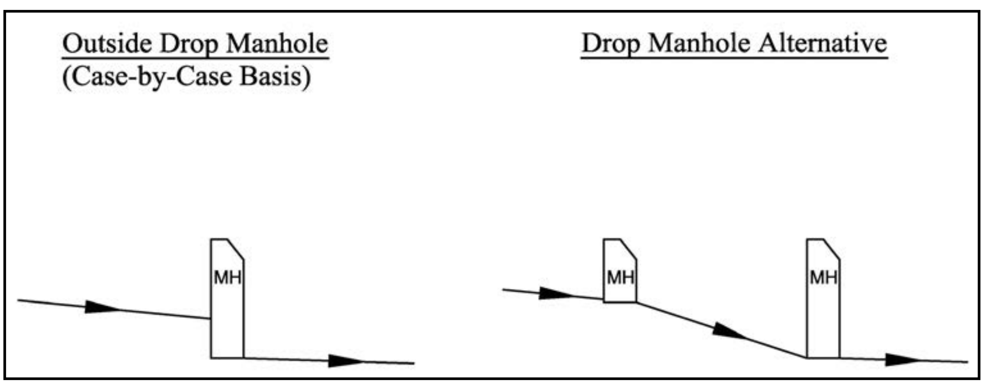


Figure 3-4. Drop Manhole Alternative

If approved, outside drop assemblies shall be provided for sewer lines less than 12 inches in diameter which enter the manhole more than 24 inches above the invert at the outlet of the structure. This vertical distance shall be measured at the inside of the manhole walls and not the centerline. An outside drop for pipes larger than 12 inches in diameter will not be allowed.

3.3—Sewer Laterals and Private Collection Systems

(a) Sewer Laterals

Sewer laterals are those portions of the sewage system between the public sewer and the structure being served, which are installed and maintained by property owners or agencies other than the City.

(1). The maximum lateral pipe size shall be 6 inches in diameter. Private sewers equal to or larger than 8 inches in diameter shall be considered private collection systems.

(2). Construction of house or building laterals shall conform to the OPSC on private property, including all requirements for water tightness. No roof, surface, foundation, or stormwater drain lines shall be connected to the public sewers.

(3). Laterals shall not tie directly into an existing or new public manhole. Laterals may be connected to private manholes or monitoring manholes. A two-way sanitary wye cleanout shall be installed at, or within five feet of, the property line on laterals. See applicable standard drawing. Laterals shall have a minimum of four feet of cover at the property line.

(4). Each individual building shall be connected by a separate lateral to the public sewer main or private collection system. Combined laterals will be permitted only when the property cannot legally be further divided. An example of this is a residential lot with a house and unattached garage or shop with plumbing facilities.

(5). Parallel laterals shall be off-set a minimum of 18 inches between the pipe centerlines within the ROW. Lateral wyes or taps shall be a minimum of 18 inches between the centers of the wyes or taps at the public sewer.

(6). The maximum distance a service lateral shall run in the ROW to a City main shall be 100 feet. Service laterals longer than 100 feet in the ROW will not be allowed. Instead, the sewer main shall be extended to provide service to the property as shown in Figure 3-5.

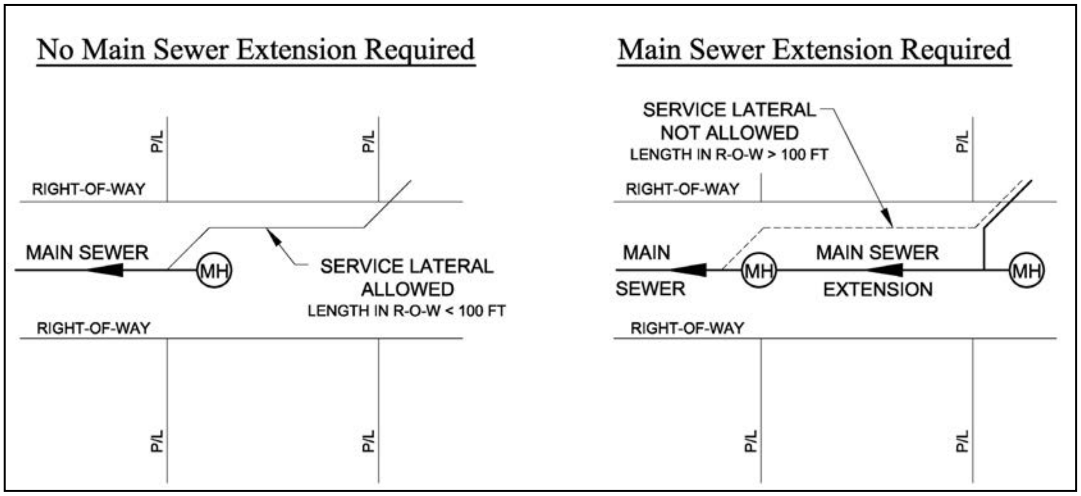


Figure 3-5. Laterals Requiring Sewer Main Extensions

(b) Private Collection Systems

Private collection systems are privately owned and maintained sewer systems with a minimum of 8-inch-diameter pipe size at the connection to the public sewer. Private collection systems are typically installed to service multi-unit structures, such as apartments, mobile home parks, schools, and commercial or industrial developments.

Private collection system sewers shall conform to the OPSC and SRC on private property, in addition to the following requirements:

(1). A manhole is required at the connection to the City public sewer collection system.

(2). A separate monitoring structure (manhole) is required at the property line upstream from the connection to the public sewer per SRC 73.070 (b), near the property line, and after the last discharge connection.

(3). A maintenance and operation agreement shall be required when a private collection system crosses multiple legal lots in a commercial or industrial development.

(c) Tracer Wire Requirements

All sewer service lateral and private collection system pipe within the ROW shall have an electrically conductive tracer wire, 18-gauge minimum size, insulated copper and green sheeting, installed in the trench for the purpose of locating pipe in the future. The tracer wire shall run the full length of the installed pipe with one end located around the private sewer line or lateral. The other end of the tracer wire shall be of sufficient length for an electrically conductive splice.

3.4—Pretreatment and Monitoring Systems

This section primarily applies to industrial, commercial, and multi-residential facilities connected to the sewer system.

(a) Applicability

Pretreatment requirements are described in SRC Chapter 74 and vary depending on the type of activities and processes occurring; types of wastewater generated and disposal methods; applicable federal, state, and local program requirements; and discharge limits. Other state and federal code requirements may also impact pretreatment.

Pretreatment may include one or more of the following:

(1). Use of best management practices, control, and/or management plans. Specific requirements will be identified during the site plan review process.

(2). Prohibiting or restricting activities or certain discharges.

(3). Required installation, operation, and maintenance of City-approved pretreatment facilities designed to remove or treat pollutants of concern prior to discharge.

(4). OPSC requires grease interceptors for specific businesses or processes.

Pretreatment facilities may include settling traps, containment structures, separators, filters, Dissolved Air Flotation (DAF), screens, solids removal, wastewater monitoring facilities (i.e. pH recording, flow recording, automatic sampling, etc.), and diversions to separate wastewater types. Pretreatment facilities are installed, operated, and maintained by the business owner or operator with pretreatment systems located and maintained on their property.

(b) Design

The type of treatment system needed is typically performance based. Businesses must ensure that discharge limitations and prohibitions are met using the City recognized methods of their choice to ensure continuous compliance. Treatment systems are required to be maintained by the owner or operator at a frequency adequate to ensure proper operation and must be accessible to City staff for inspection and/or sampling at any time of day.

(c) Monitoring and Pretreatment Structure and Facilities

Industrial users may be required per SRC Chapter 74 to construct and maintain approved flow monitoring, pH monitoring, process logging, sampling, and sample storage facilities for all waste entering the municipal wastewater system. Metering, monitoring, and sampling facilities may be required with or without pretreatment facilities.

All devices, facilities, and related equipment are the responsibility of the waste discharger, and shall be maintained in a safe and proper condition at all times of operation.

The area for installation of the measuring and sampling equipment, pH monitoring system, and sample storage shall be fully enclosed, locked, and protected from tampering with keys provided to or by the City. All measuring and sampling equipment shall be serviced and calibrated upon installation and at least twice annually by a qualified technician approved by the Director. Maintenance, repair, replacement, or additional equipment needed to accurately monitor waste discharge is the sole responsibility of the owner.

The flow measurement, pH monitoring, and sampling stations shall be located and constructed in a manner acceptable to the City. Complete plans on all phases of the proposed installation, including all equipment proposed for use, shall be submitted to the City for approval prior to construction.

There shall be sufficient room in or near the sampling station to allow accurate sampling, preparation of samples for analysis, and vehicle turnarounds.

An approved electrical outlet shall be provided near the user's sample equipment for City use. An approved hose bib and water supply shall be provided for cleaning and maintenance.

(1). Flow Monitoring Device

The flow measurement device shall be a flume, or other flow measurement device providing accurate and continuous flow indication, but in no case shall pump timers or other indirect measurement devices be used for flow measurement.

The flow meter shall indicate instantaneous GPM flows and total flow in millions of gallons per day with a minimum of seven numerical digits including four decimal points, or in gallons for low flow facilities with a minimum of seven numerical digits, and designed to obtain a system accuracy of ±2 percent. The meter shall be equipped with a set of electrical contacts arranged to momentarily close a circuit to energize the sampling. Other control variations will be acceptable if it can be demonstrated that the sampling procedure will result in a waste sample which is flow proportional.

(2). Sampling

The method of sampling used may be by direct pumping or vacuuming continuous pumping past a solenoid-operated diversion valve into the sample container; continuous pumping past a sampler dipper calibrated to remove a constant sample; by a proportionate dipper sampler operating directly in the waste flow meter; or by any other approved means. The sample collection pipe or dipper cup shall be sized according to waste characteristics and approved by the

City and the sample pump shall have a minimum capacity of 3 GPM. The sample line shall not be interconnected to any other piping system.

All samples must be continuously refrigerated at a temperature between 1°C and 4°C (34°F and 39°F).

The sampling device will take a minimum of 50 samples per operating day, and in no case shall the daily collected sample be less than two liters in volume. The sample storage facility or system shall be capable to holding three days of sample volume, for weekend or holiday storage.

All sampling hoses, devices including valves and sample splitters, holding vessels, and refrigerators used for holding or storing samples shall be cleaned and maintained so as to ensure true and accurate composite samples. The sampling area shall have a sanitary sink or other method of cleaning and sanitizing the components accessible to the users or sample collector, or an approved method/system of disposing of excessive sampled fluids.

A clean sample container should be available daily to the City sample collector to place in service.

(3). pH Monitoring

When a pH adjustment is required to meet established pH limits, a recording pH meter with flow indicator shall be installed and maintained by the user.

The pH monitoring and control equipment shall be approved by the City and be equipped with a circular strip chart recorder or electronic data logger transmittable and readable by City staff. The recording for pH monitoring shall show a minimum of 24 hours of data indicating the presence or absence of flows.

(4). Other Industrial Pretreatment Systems

Where industrial wastewater contains settable solid particles, the flow shall pass through up to an approved 20-mesh screen (0.85mm sieve opening).

Treatment systems for other prohibited discharges, limited contaminates, and/or materials (metals, oils, greases, flammables, etc.), shall be appropriate for the material being removed.

(5). Records

The user discharging the waste shall keep flow, pH, and other records as required by the City and shall provide qualified personnel to properly maintain and operate the facilities.

Maintenance schedules shall be made available to City inspectors including, but not limited to, schedules for:

A. Cleaning sample collection tubes and containers;
B. Operating the sample refrigeration system;
C. Cleaning screening equipment; and
D. Calibrating pH probes and chemical feed equipment.

Historical metering and monitoring data shall be maintained by the discharger and available to City staff for a period of five years.

(d) **Standards and Prohibitions**

Discharge standards and local wastewater pretreatment limits are set forth by SRC Chapter 74.

(1). Local Limits

Limits for discharges to the sanitary sewer are reviewed and updated on a five-year cycle, as required by Oregon DEQ.

(2). Sanitary sewer prohibited discharges are found in SRC Chapter 74.

(3). Stormwater and surface water prohibited discharges are found in SRC Chapters 71 and 73.

(e) **Additional Pretreatment Materials**

The following local wastewater permit application forms, policies, checklists, and user-specific information can be found on the City Environmental Services website:

(1). Management/Treatment Methods to meet Pretreatment Program Standards.

(2). Pretreatment System Forms and Policies.

(3). Pretreatment Considerations Checklist.

(4). Salem's Pretreatment Manual.

(5). A web link to Code of Federal Regulations; Title 40: Protection of Environment.

(6). Oregon Plumbing Specialty Code (OPSC).

Main Menu

CITY OF SALEM
DEPARTMENT OF PUBLIC WORKS
ADMINISTRATIVE RULES
CHAPTER 109
DIVISION 004
STORMWATER SYSTEM

SECTION

FIGURES

TABLES

APPENDICES

4.1—Introduction

(a) Objectives

The objectives of these Standards are to provide an effective stormwater system that will:

(1). Safely convey all stormwater from sources upslope to approved storm system facilities downslope, thus preventing the uncontrolled discharge of stormwater onto adjoining public or private property and protecting the safety and security of persons and property.

(2). Maintain and improve the water quality in, and the beneficial uses of, Salem's waterways, lakes, ponds, wetlands, and other natural drainage resources.

(3). Implement a stormwater treatment program reflecting the requirements associated with the National Pollution Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Permit, Oregon Department of Environmental Quality (DEQ) Total Maximum Daily Load Program (TMDL), and the water quality needs of Salem's urban waterways.

(4). Protect Salem's natural resources by preserving stormwater quality and preventing erosion.

(5). Reduce surface runoff volumes by prioritizing stormwater interception, evapotranspiration, and infiltration.

(6). Construct facilities which are safe and economical to maintain, meet the service levels intended, and minimize the life cycle cost.

(7). Provide for orderly development by routing and controlling the discharge of stormwater and providing adequate capacity for future development.

(8). Substantially maintain the runoff characteristics of the original undeveloped drainage basin.

(9). Achieve stormwater pollutant efficiency removal goals through the application of Green Stormwater Infrastructure (GSI) to the Maximum Extent Feasible (MEF).

(b) Applicability

These Standards shall govern all construction and upgrades to the City public stormwater system and privately owned stormwater systems and include the collection, flow control, treatment, and conveyance of stormwater from both private property and from within the ROW.

(c) How to Use These Standards

The stormwater Design Standards provide the requirements for the design of stormwater infrastructure consisting of conveyance, treatment, and flow control systems. SRC Chapter 71 establishes specific requirements for stormwater discharges to receiving waters, and requirements for the use of GSI necessary to comply with the City's NPDES Municipal stormwater permit. The Stormwater Standards not only provide for design of stormwater facilities but also provide the frame work to comply with key elements of SRC Chapter 71. The designer; however, should become familiar with SRC Chapter 71 since these Standards do not address all of the requirements of SRC Chapter 71.

When designing a stormwater system and using these Standards the following key elements should be addressed and/or performed:

(1). Determine the type of project and threshold requirements: Project types include Single Family Residential (impervious area 1,300 to 10,000 square feet), Large Projects (impervious area greater than 10,000 square feet) and Non Single Family Residential less than 10,000 square feet of impervious area. Subsection 4.2(a)—Project Type Thresholds and Discharge Requirements defines the requirements for each type of project. Impervious area requiring flow control can be reduced by a number of techniques such as preserving trees and native vegetation, planting trees, utilizing pervious pavement, etc. Subsection 4.2(g)—Impervious Area Reduction Techniques defines these techniques. Projects less than 10,000 square feet can be sized using a simplified methodology as described in Subsection 4.2(n)—Design Sizing Methodologies. Large projects require the Engineered Method per Subsection 4.2(n)—Design Sizing Methodologies.

(2). Discharge Requirements: Special attention needs to be given to points of discharge and the capacity of the downstream public conveyance systems. SRC Chapter 71contains specific requirements related to these items and Subsections 4.2(a)—Project Type Thresholds and Discharge Requirements, (j)—Approved Point of Discharge, and (k)—Downstream Capacity Analysis of these standards provides general design requirements.

(3). Site Assessment: It is critical to perform a site assessment to determine soil types, infiltration rates, topography, existing trees, and vegetation, etc. Infiltration rates are required in order to determine types and sizes of facilities required. Subsection 4.2(c)—Site Assessment defines the site assessment requirements.

(4). Hydrologic Analysis: Projects greater than 10,000 square feet require a hydrologic analysis to be performed to size facilities. See Subsections 4.2(o)—Hydrologic Analysis, (p)—Stormwater Treatment and Flow Control Design Storm Events and Appendix 4D—Hydraulic Analysis for requirements, criteria and information for hydrologic analysis.

(5). Green Stormwater Infrastructure: SRC requires Green Stormwater Infrastructure to be used to the Maximum Extent Feasible (GSI/MEF). These Standards include options for GSI and their design requirements. Additionally Subsection 4.2(b)—Green Stormwater Infrastructure to the Maximum Extent Feasible and Appendix 4E—Green Stormwater Infrastructure to the Maximum Extent Feasible for Large Projects provide information and criteria to determine if the MEF requirement has been met. Adequate site design, including necessary horizontal and vertical elevation design data will be necessary to determine if the MEF requirement has been met.

(6). Selection and Design of Treatment, Flow Control or Combined Facilities: The designer is encouraged to utilize combined treatment and flow control facilities. Section 4.3—Combined Stormwater Flow Control and Treatment Facilities includes options and design criteria for combined treatment and flow control facilities. Section 4.4—Stormwater Treatment Facilities consists of treatment only facilities and Section 4.5—Flow Control Facilities consists of volume based flow control facilities. Subsection 4.2(p)—Stormwater Treatment and Flow Control Design Storm Events defines the design storms utilized to size facilities. If the project involves a Land Division Subsection 4.2(m)—Land Division Alternative presents options for utilizing multiple dispersed facilities or single larger facilities to provide for treatment and flow control.

(7). Conveyance System Design: The conveyance system must be designed to carry offsite and onsite stormwater to the approved point of discharge. Conveyance systems must be designed to the meet the requirements of the Stormwater Master Plan, provide for the future development of up gradient property, and extend to the upslope boundaries. In some cases, stormwater conveyance may need to extend through an easement to reach the downstream point of discharge. See Section 4.8—Conveyance Systems for design of Conveyance Systems.

4.2—General Design Requirements

This section provides the thresholds, sizing methodologies, hydrologic analysis, infiltration testing, and other general requirements common to all projects.

Design requirements for combined stormwater facilities are located in Section 4.3—Combined Stormwater Flow Control and Treatment Facilities, stormwater treatment facilities are described in Section 4.4—Stormwater Treatment Facilities, and flow control requirements can be found in Section 4.5—Flow Control Facilities. All projects must also meet the applicable requirements in Administrative Rules 109 Division 011—Operation and Maintenance of Stormwater Facilities and Administrative Rule 109 Division 012—Stormwater Source Control.

Top Div 4

(a) Project Type Thresholds and Discharge requirements

Threshold requirements for stormwater treatment and flow control standards are established in SRC Chapter 71 and include the following:

(1). Single Family Residential (SFR) Projects: All SFR projects where the total impervious surface is between 1,300 and 10,000 square feet shall be designed and constructed with GSI to the MEF except where flow control facilities and treatment facilities have already been constructed per SRC Chapter 71 to serve the lot or parcel. The GSI presented in this division and sized using these Design Standards; fulfill the requirements for MEF. SFR projects greater than 10,000 square feet will be considered a large project.

(2). Non-SFR < 10,000 Square Feet: SRC does not require Non-SFR projects consisting of less than 10,000 square feet of new or replaced impervious surface to provide stormwater flow control or general stormwater treatment. However, reducing impervious surface area may reduce SDC fees and stormwater utility rates.

(3). Large Projects: Large projects are required to provide both flow control and treatment facilities using GSI to the MEF and conforming to these Design Standards. Large projects are defined in SRC Chapter 71 as projects where the individually or combined new and replaced impervious surface is 10,000 square feet or more. This includes all projects with 10,000 square feet or more of ground disturbing activities. See SRC Chapter 71 for the definition of replaced impervious area.

(4). All Projects: See SRC Chapter 71 for other requirements for all projects regardless of size, such as source control, discharge to wetlands, preserving trees, providing landscaping, etc. Projects that are adjacent to an existing open channel waterway or within the 100-year floodplain of any waterway must meet the requirements of SRC Chapter 140.

(b) Green Stormwater Infrastructure to the Maximum Extent Feasible (GSI/MEF)

Green Stormwater Infrastructure (GSI) means a stormwater facility that mimics natural surface hydrologic functions through infiltration or evapotranspiration, or that involves stormwater reuse (SRC Chapter 71.005(7)).

Maximum Extent Feasible (MEF) means the extent to which a requirement or Standard must be complied with as constrained by the physical limitations of the site, practical considerations of engineering design, and reasonable considerations of financial costs and environmental impacts (SRC Chapter 71.005(12)).

SRC Chapter 71 requires the use of GSI/MEF for SFR projects and for large projects.

To fully meet the requirements for large projects, both treatment and flow control facilities must meet the standards for GSI/MEF. Although site constraints, limitations in engineering design, and financial costs should rarely completely restrict the use of GSI, the City recognizes that some projects will be unable to exclusively provide GSI. Appendix 4E—Implementing GSI to the MEF establishes the criteria for meeting the requirements to meet MEF for GSI (MEF/GSI).

Alternatives qualifying as a green stormwater facility are identified with a parenthetical (GSI) (for example: Rain Garden (GSI)).

(c) Site Assessment

Defining the following elements in the initial site assessment phase provides critical data, and identifies opportunities and constraints for designing stormwater infrastructure. Early identification of these items will provide for more efficient selection and sizing of stormwater treatment and flow control facilities, will assist in providing GSI/MEF, and assist in meeting regulatory requirements.

(1). Site topography, boundaries, and existing improvements.

(2). Existing soil types and infiltration capacity.

(3). Geologic hazards such as landslides.

(4). On-site contamination and hazardous materials.

(5). Ground water elevations.

(6). Existing trees and native vegetation.

(7). Existing and proposed impervious areas.

(8). Floodplains and floodways.

(9). Sensitive natural areas (waterways, streams, wetlands, wildlife habitat, etc.).

(10). Identify natural resource agency regulatory requirements.

(d) Preserve Existing Trees and Vegetation

Existing trees and native vegetation must be preserved per SRC Chapter 68—Preservation of Trees and Vegetation. The plans must identify all trees and native vegetation that are being retained. Protecting existing trees and planting new trees on the site can reduce the amount of treatment that is needed (See Subsection 4.2(g)—Impervious Area Reduction Techniques).

(e) Ground Disturbing Activity

Site design and construction should minimize ground disturbing activities and retain the undisturbed state of the duff layer, topsoil, and native vegetation where feasible. Impervious development areas should be minimized, preserving natural features. Reducing the amount of imperviousness will reduce the development's impact on the site and the size of required stormwater facilities. See Division 007—Erosion Prevention and Sediment Control Plan for more construction site runoff requirements.

(f) Other Design Considerations

The following are items which are not required per SRC Chapter 71, but may be considered when designing stormwater facilities.

(1). Incorporate the stormwater facilities into the site's landscaping features as practical and feasible to minimize the impact on the available green space.

(2). Utilize construction techniques and landscape designs that minimize soil compaction and preserve the existing soil permeability.

(3). Use pervious, porous, or permeable pavement in parking lots and on private property where practicable, to minimize surface runoff and reduce the amount of impervious area.

(4). Provide stormwater facilities that are non-operator dependent, are reliable, minimize operation and maintenance, and address the range of potential impacts resulting from multiple site uses and properties.

(g) Impervious Area Reduction Techniques

This section defines the impervious area reduction techniques, authorized in SRC Chapter 71 that can be applied to reduce the amount of impervious area requiring stormwater treatment and flow control.

(1). Using trees to reduce the amount of impervious area that requires treatment.

A. Preserved Trees

The amount of impervious area that requires treatment may be reduced by 50 square feet for every existing tree preserved within the project area. Existing trees must be within ten feet of the ground level impervious surface, as measured from the edge of the drip line.

B. New Trees

The amount of impervious area that requires treatment may be reduced by 20 square feet for every new tree planted within the project area. New trees must be planted within ten feet of the ground level impervious surface, as measured from the trunk of the tree.

C. New and preserved deciduous trees must be at least two caliper inches. New and preserved evergreen trees must be at least eight feet tall.

D. Trees can only reduce the amount of impervious area that requires treatment by a maximum of ten percent.

E. Trees planted to meet stormwater facility planting requirements cannot also be used toward impervious area reduction.

F. Stormwater trees shall be maintained and protected on the site after construction and for the life of the development.

G. Trees being used for impervious surface mitigation must be clearly shown on the plans.

H. During construction, the area beneath the drip line must be fenced and protected from construction equipment.

(2). Pervious Pavement

No additional stormwater treatment is required for pervious pavement areas. Pervious pavement is considered pervious for flow control purposes.

(3). Green Roofs

No additional stormwater treatment is required for green roof areas. For flow control purposes, 50 percent of the green roof surface area may be subtracted from the total impervious areas used in hydrologic calculations. Design details for Green Roofs are contained in Subsection 4.3(d)–Green Roofs (GSI).

(4). Rainwater Harvesting

No additional stormwater treatment and flow control is required for the quantity of rainwater that is reused. Rainwater harvesting can be used to reduce the size of stormwater treatment and flow control facilities needed for a project. Excess rainwater which cannot be reused and stormwater from other impervious areas may be mixed and directed to on-site stormwater treatment and flow control facilities. Rainwater may be collected and reused for non-potable water uses within a house or building, or for landscape irrigation purposes, as allowed by the Oregon Plumbing Specialty Code (OPSC). A water use budget shall be submitted with the plans for a rainwater harvesting system to illustrate the amount of stormwater used each year. Developments which use a rainwater harvesting system must still meet all other stormwater code requirements.

Rainwater Harvesting design requirements include:

A. All locations of water reuse must have permanent signage that notifies users of non-potable water.

B. All rainwater harvesting systems must follow OPSC requirements and receive plumbing approval from the City prior to construction.

C. If the property is connected to City water, the system must have City approved and inspected backflow protection in the form of a reduced-pressure (RP) type of backflow assembly. System containment RPs must be located on private property at the property line, immediately adjacent to the point of water service connection.

(5). Amending Soils in Disturbed Areas

Amending soils in areas where they have been disturbed will reduce the amount of runoff volume as calculated through the hydrologic analysis. For unamended disturbed areas, the curve numbers in Table 4D-6 for "impervious soil" shall be used in the hydrologic calculations. If the soils in the area have been amended, the curve numbers for "Open Space—Good Condition" can be used. The three alternatives for amending soils in disturbed areas include:

A. Scrape off the topsoil to a depth of eight inches minimum, stockpile on site, and replace after construction without compaction. The stockpile area must meet all the requirements for erosion prevention and sediment control.

B. Import a topsoil mix for the disturbed areas with silt, clay, sand and compost in equal proportions. Topsoil specifications are included in Appendix 4G—Key Material Specifications. Place this mixture over the disturbed area to a depth of eight inches uncompacted. For large projects, the disturbed area shall be scarified for a minimum depth of six-inches prior to placing the top soil mix.

C. Amend the top eight inches of native top soil which has been disturbed by tilling in three inches of compost that meets the requirements in Appendix 4G—Key Material Specifications. If surface ponding is occurring after tilling in compost, add sand and re-till until infiltration performance is improved and ponding no longer occurs.

(h) <u>Source Control</u>

All development and redevelopment projects, regardless of size, which have a potential for pollution-generating activities as defined in SRC Chapter 71, need source control in addition to any required stormwater facilities. Project sites where pollution generating activities (listed in SRC Chapter 71.005(15)) are planned, or may occur, shall follow the requirements of these Design Standards in addition to the requirements provided in Administrative Rule 109-012—Stormwater Source Control.

(i) Underground Injection Control Structures

Subsurface discharge infiltration facilities that are defined by DEQ as Underground Injection Control Structures (UICs) (e.g. private soakage trenches, manufactured chamber systems, or drywells) shall be designed with the approved pretreatment devices and registered with DEQ as required. New UIC devices which accept stormwater runoff from the ROW or for public ownership are not allowed.

(j) Approved Point of Discharge

The point of discharge for all stormwater generated within a development may be a storm drain pipe, open channel, waterway, wetland, or other approved facility. In addition to the point of discharge, all projects must identify an overflow route for stormwater in the event the treatment and/or flow control facility fails or rainfall exceeds the facility's design capacity. This overflow route must be shown on the site plan. The City shall approve all points of discharge.

(k) Downstream Capacity Analysis

SRC Chapter 71 requires large projects to provide additional stormwater facilities or improve the public stormwater system if insufficient capacity exists in the public stormwater system to carry the anticipated discharges. When downstream capacity issues are identified through operational knowledge, flood complaint calls, or the Stormwater Master Plan, the developer will be responsible for performing an analysis of the downstream stormwater system, and either making the needed capacity improvements, providing additional on-site detention, or provide other means to mitigate the downstream impacts.

A downstream capacity analysis shall:

(1). Be based on peak flows at the point of discharge as listed in Table 4-3.

(2). Evaluate the system's conveyance capacity from the point of discharge, ¼ mile downstream or to a distance where the project site contributes less than 15 percent of the upstream drainage basin area, whichever is greater.

(3). Use the Manning's Formula for evaluating the capacity of pipes, ditches, and waterways. Backwater effect shall be included in determining capacity for waterways with drainage areas greater than 250 acres, using HEC-RAS or an equivalent computer modeling software.

If the downstream analysis crosses the jurisdictional boundary of another agency with the authority to manage surface water, that agency shall be notified by the EOR and given an opportunity to review and comment on the analysis.

Reporting requirements for the downstream capacity analysis are included in Appendix 4A—Stormwater Submittal Requirements.

(l) Infiltration Testing

To accurately determine the location, size and capacity of stormwater treatment facilities, it is necessary to know the infiltration rate of the soil at the facility location. Natural Resource Conservation Service (NRCS) Soil Survey data may be used to obtain an approximate infiltration rate; however, actual site conditions may be significantly different. Infiltration testing data, in accordance with the requirements listed in Appendix 4C—Infiltration Testing, must be submitted for all proposed stormwater treatment infiltration facilities. The City has approved two types of infiltration testing; the Basic and Professional Infiltration Tests (details provided in Appendix 4C—Infiltration Testing). Infiltration testing requirements vary depending on the type of project:

(1). SFR and projects with less than 10,000 square feet of new plus replaced impervious area: On-site infiltration testing is required for infiltration stormwater facilities. For these facilities the Basic Method Infiltration Test may be used as described in Appendix 4C—Infiltration Testing. This testing method does not require a licensed professional.

(2). Large Projects: Professional Infiltration testing is required in the general location of the proposed stormwater treatment facility. Testing methods and reporting requirements are provided in Appendix 4C—Infiltration Testing.

(m) Land Division Alternative

Land Division shall be designed with stormwater facilities suitable to serve the entire development under full build out conditions. Stormwater facilities may be either dispersed or unified as described below, or in some combination thereof. Dispersed facilities in the ROW are preferred where feasible.

Dispersed Facilities in ROW consist of multiple, smaller stormwater facilities designed to accept stormwater from private property and from the ROW and are located in the ROW. After final approval and acceptance of these facilities, the City will assume Operation and Maintenance (O&M). Alternatives and design requirements for dispersed facilities in the ROW are discussed in Section 4.7–Right-of-Way Facilities.

Unified Facilities consist of single (or several), large facilities designed for the total contribution of stormwater from both the ROW and private property. After final approval and acceptance of these facilities, the City will assume Operation and Maintenance (O&M). An access easement shall be granted to the City where needed to maintain the facilities. Public stormwater facilities must be located in the public ROW or on property deeded to the City.

(n) <u>Design Sizing Methodologies</u>

There are two methods for sizing stormwater facilities: the Simplified Method and the Engineered Method.

(1). Simplified Method

The Simplified Method uses a surface area ratio calculation to size the stormwater facilities. The amount of new or replaced impervious area is calculated, and multiplied by a sizing factor that varies by facility type.

The Simplified Method **is allowed** in the design of private stormwater facilities for projects with less than 10,000 square feet (0.23 acre) of new/or replaced impervious area, including but not limited to roofs, patios, parking areas, and driveways. This method is most appropriate for private, small-scale commercial or residential development. Stormwater facilities designed using the Simplified Method are not required to be stamped by an engineer as long as the total impervious area is less than 10,000 square feet.

The Simplified Method is not allowed for the design of public stormwater facilities.

The Simplified Method form is shown in Figure 4-1. This form along with the information required in Appendix 4A—Stormwater Submittal Requirements, must be submitted to the City with the construction plans when applying for a building permit.

Simplified Approach for Stormwater Management		
The City has produced this form to assist with a quick and simple approach to manage stormwater on-site. Facilities sized with this form are presumed to comply with basic treatment and flow control requirements.		
INSTRUCTIONS	SITE INFORMATION	
1. Enter Square footage of new and/or replaced impervious site area.	(1) Total Impervious Area	sf
2. Enter amount of area reduction. This includes pervious pavement, green roofs, and areas with rainwater harvesting.	(2) Total Impervious Area Reduction	sf
3. Subtract (2) from (1) to calculate total impervious area requiring stormwater facilities (3) = (1) – (2)	(3) Required Mitigation Area	sf
4. Select desired stormwater facilities from rows (b) through (f) in Column 1, below. Enter the square footage of impervious area that will flow into each facility type in Column 2.		
5. Multiply each impervious area from Column 2 by the corresponding sizing factor in Column 3, and enter the result in Column 4. This is the facility surface area required.		
6. Total Column 2 (Rows b - f) and enter the resulting "Impervious Area Managed" on line (6).	(6) Total Impervious Area Managed	sf
7. Subtract (6) from (3) and enter the result on line (7). This must be zero or less. Submit this form with the application for permit. (7) = (3) - (6)	(7) Remaining Area	sf

Column 1	Column 2	Column 3		Column 4
Stormwater Management Facility	Impervious Area Managed	Infiltration Rate	Sizing Factor	Facility Surface Area
b. Infiltration Planter	_____ sf	0.5-0.75	0.11	= _____ sf
		0.75-1.25	0.09	= _____ sf
		1.25-1.75	0.07	= _____ sf
		>1.75	0.06	= _____ sf
c. Filtration Planter	_____ sf		0.06	= _____ sf
d. Infiltration Rain Garden	_____ sf	0.5-0.75	0.11	= _____ sf
		0.75-1.25	0.09	= _____ sf
		1.25-1.75	0.07	= _____ sf
		>1.75	0.06	= _____ sf
e. Filtration Rain Garden	_____ sf		0.06	= _____ sf
f. Vegetated Filter Strip	_____ sf		0.20	= _____ sf

Figure 4-1. Simplified Method Sizing Tool

Top Div 4

(2). Engineered Method

The Engineered Method **shall be used** to design residential, commercial, industrial, and institutional projects with 10,000 square feet (0.23 acres) or greater of new and/or replaced impervious surface and for all public stormwater facilities. It can be applied to size facilities on smaller projects where the more detailed hydrologic calculations allow the facility to be sized more accurately than with the Simplified Method. This methodology shall be performed by a licensed Professional Engineer.

The Engineered method consists of sizing stormwater facilities by applying hydraulic and hydrologic engineering calculations to determine runoff, flow, volume, storage, conveyance capacity, etc. These standards provide requirements for the various hydrologic and hydraulic calculations necessary. Impervious area utilized in calculations may be reduced per the guidelines in subsection 4.2(g)—Impervious Area Reduction Techniques. Hydrologic analysis requirements can be found in subsection 4.2(o)—Hydrologic Analysis. Subsection 4.2(p)—Stormwater Treatment and Flow Control Design Storm Events provide design storm requirements for hydrologic calculations. See the table of contents for other applicable sections required to design and size facilities.

The Engineered Method analysis shall be submitted as part of the Stormwater Management Report (See Appendix 4A—Stormwater Submittal Requirements).

(o) <u>Hydrologic Analysis</u>

To meet Design Standard requirements according to the Engineered Method, stormwater facility design flows and volumes shall be determined using the methods described in this section. Additional information and supporting documentation for these methods can be found in Appendix 4D—Hydrologic Analysis.

(1). For every project, the impervious area shall include the total proposed impervious area, including all streets, driveways, redeveloped areas, and tentative building footprints based on the allowed building coverage and setbacks per the zoning code.

A. Drainage Areas

All hydrologic analyzes must include the drainage area of the site being evaluated and all of the upstream contributing basin area including those areas outside the proposed development site. Drainage calculations for flow control analysis shall include both the pre-developed and the post-developed drainage conditions.

B. Acceptable Analytical Methods

Calculation of stormwater runoff for stormwater treatment and flow control shall be analyzed using the Santa Barbara Urban Hydrograph (SBUH)

Method, Natural Resource Conservation Service (NRCS) TR 55, or the Stormwater Management Model SWMM.

C. Rational Method

The Rational Method may only be used to determine the peak flow for conveyance systems in conformance with these Standards. The Rational Method shall be used for sizing conveyance facilities and for determining the peak flow capacity of conveyance facilities with contributing drainage areas less than ten acres. The minimum time of concentration shall be five minutes.

D. Hydrograph Methods

The following conditions shall be met when evaluating the basin area characteristics using a hydrograph method.

(i). Pre-development Conditions

A homogeneous basin area will be assumed, regardless of the current conditions, when determining the peak runoff for pre-development conditions. The runoff characteristics for calculating allowable outflow are based on the combination of woods and grassland. These curve numbers have been calculated and provided in Appendix 4D—Hydrologic Analysis, Table 4D-6, "City of Salem Pre-development." These curve numbers shall always be used for determining pre-development flow condition selected for the predominate soil type where the project is located.

(ii). Post-development Conditions

A runoff hydrograph shall be created from an accurate characterization of the post-development site conditions. The runoff hydrograph shall include the contributing pervious and impervious areas along with their associated runoff curve numbers. Sub-basins shall be delineated and routed together when appropriate. A separate analysis of just the impervious area shall also be performed. The larger of the two hydrographs shall be used for design.

(p) <u>Stormwater Treatment and Flow Control Design Storm Events</u>

As specified in SRC Chapter 71, where stormwater treatment facilities are required, they must be designed to treat 80 percent of the annual rainfall. Properly designing a treatment facility utilizing the following storm event meets this requirement:

(1). The physical characteristics of the site and the design storm shall be used to determine the magnitude, volume, and duration of the runoff hydrographs. Either the Santa Barbara Urban Hydrograph (SBUH), Natural Resource Conservation Service (NRCS) TR-55 method, or Stormwater Management

Model (SWMM) may be used to generate the hydrograph. The Soil Conservation Service Type 1-A, 24-hour rainfall distribution, shall be used in all applications. A more detailed description of the hydrologic methods and parameters to be used to fulfill these Standards is provided in Appendix 4D—Hydrologic Analysis.

(2). Water Quality

The water quality design storm event shall be 1.38 inches per 24-hour period.

(3). Flow Control

A. One-half of the post-development peak runoff rate of the two-year storm must be equal to or less than one-half of the peak runoff rate of the pre-developed two-year, 24-hour storm; and the peak runoff rate of the post-development ten-year, 24-hour storm must be equal to or less than the peak runoff rate of the pre-developed ten-year, 24-hour storm event.

B. All volume-based facilities shall be sized to detain the post-developed 100-year design storm with a release rate no greater than the pre-developed, 100-year design storm.

C. Runoff volumes and flow rates shall be determined in accordance with the hydrologic calculation methods contained in Appendix 4D—Hydrologic Analysis.

(q) Site Disturbance

Soil compaction where the footprint of facilities designed for full or partial infiltration are to be located shall be avoided during construction. The location of these facilities shall be clearly marked on the plans. These areas must be protected with barriers or other means during construction. No vehicle traffic, except that specifically used to construct the facility, shall be allowed within ten feet of infiltration area.

(r) As-Builts

All facilities shall be field verified after construction to demonstrate they meet all design parameters including, but not limited to, storage volume, slope, overflow elevation, etc. As-built drawings shall be submitted in accordance with the requirements in Division 002—Drafting and Drawing Standards.

(s) Operations and Maintenance Requirements

Operations and Maintenance (O&M) requirements apply to all private stormwater treatment facilities and related facility components. Owners are required to provide access to the City and check their facilities regularly to determine maintenance needs.

In addition, privately owned and maintained stormwater facilities require the submittal of a “Private Facility Agreement” and a “Facility Maintenance Form”. See Administrative Rule 109-011—Operations and Maintenance of Stormwater Facilities.

(t) All Weather Access

All weather vehicle access shall be provided to all stormwater facilities maintained by the City, as approved by the City. The type of surface treatment (i.e., asphalt, concrete or gravel) will be determined as appropriate for the location, slope and expected operation and maintenance traffic. Access easements are required per Division 001—General.

(u) Plant Material Landscaping Requirements

Green stormwater facilities and other facilities as required in this Division shall be landscaped with approved plant selection, soil amendments, fertilizers, etc., per Appendix 4B—Plant Material and Landscaping Requirements for Stormwater Facilities. Plans shall include complete landscape design per Appendix 4B—Plant Material and Landscaping Requirements for Stormwater Facilities.

4.3—Combined Stormwater Flow Control and Treatment Facilities

This section of the Stormwater Design Standards specifies the requirements for designing stormwater facilities that provide both flow control and treatment.

(a) Stormwater Planters, Rain Gardens, and Combination Swales (GSI)

Stormwater planters, rain gardens, and combination swales have many similar design features. All three can be designed as combined stormwater flow control and treatment facilities. These facilities are designed as infiltration, partial infiltration, or filtration systems. The type of facility chosen is site specific and based on the measured infiltration rates, geological conditions, and physical site limitations.

(1). Description

A. Stormwater Planters (GSI) (See Standard Plans 215 and 216)

Stormwater planters are smaller structural landscaped reservoirs used to collect, filter, and (where feasible) infiltrate stormwater runoff, allowing pollutants to settle and filter out as the water percolates through the planter growing medium before infiltrating into the ground below or piped to an approved point of discharge.

B. Rain Gardens (GSI) (See Standard Plan 217)

Rain gardens are landscaped reservoirs or depressions in the ground surface used to collect, filter, and/or infiltrate stormwater runoff. In rain gardens, pollutants settle and filter out as the water percolates through the growing medium, then infiltrates into the ground below or piped to an approved point of discharge. Numerous design variations of shape and planting scheme can be used to fit the design to a particular site.

C. Combination Swales (See Standard Plan 219)

Combination swales have very similar design features as rain gardens and planters but are more linear and narrow in shape and can be adapted to steeper slopes. As with the other two alternatives, pollutants settle and filter out as the water percolates through the growing medium, then infiltrates into the ground. Combination swales are different than the flow through vegetated swales that provide treatment only described in Subsection 4.4(b)–Vegetated Swales (GSI).

(2). Infiltration Requirements

A. Infiltration Facilities

If on-site testing demonstrates the infiltration rate is 0.5 inch/hour or greater, the stormwater facility shall be designed as an infiltration facility. Infiltration testing requirements are included in Subsection 4.2(l)–Infiltration Testing and in Appendix 4C—Infiltration Testing.

A partial infiltration facility will be allowed if:

(i). The size of the infiltration facility is greater than ten percent of the total impervious area it serves and;

(ii). The rock storage area used in the sizing calculation has reached the maximum depth of 48-inches.

(3). Partial Infiltration Facilities

If the measured infiltration rate is less than 0.5 inches/hour, the treatment facility shall be designed as a partial infiltration facility. These facilities are similar to an infiltration facility with the addition of a perforated collection pipe running the length of the facility. The perforated pipe collects the flow passing through the growing medium to an approved point of discharge. See Standard Plan 221 for piping configuration details.

(4). Filtration Facilities

For private facilities only, the rock reservoir may extend under the pavement as designed by the EOR. Filtration facilities have an impermeable liner to prevent any flow leaving the facility and infiltrating into the ground and provide water treatment by filtering through soil and plants. Stormwater is then collected in a perforated pipe for conveyance.

Filtration facilities are required whenever the following site conditions are encountered regardless of the measured infiltration rate:

A. Sites with slope stability concerns. These sites require a Geotechnical Engineering or geologist report to determine the suitability for infiltration and facility recommendations.

B. Sites with a high groundwater table. A Geotechnical Engineering or geologist investigation and a report is required to determine the seasonally high groundwater level which must be more than three feet below the lowest elevation of the stormwater infiltration facilities.

C. Sites with contaminated soils. See Administrative Rule 109-112—Stormwater Source Control.

D. Where physical limitations of the site do not allow for the setback from building foundations required for infiltration facilities.

(5). General Design Requirements for Planters, Rain Gardens, and Combination Swales.

A. General Sizing Requirements

Large projects shall be designed using the engineered method as defined in Subsection 4.2(n)(2)—Engineered Method:

B. Sizing Infiltration Facilities

(i). Inflow to the facility shall consist of the design storm per Subsection 4.2(p)–Stormwater Treatment and Flow Control Design Storm Events, post-development runoff rate.

(ii). The outflow equals the infiltration rate times the wetted bottom (invert) surface area of the facility.

(iii). The storage volume consists of the rock storage beneath the growing medium, assuming a 40 percent void ratio and the volume above the growing medium to the overflow. The storage volume shall contain the design storm hydrograph inflow less outflow.

(iv). All stormwater treated by the facility has to drain from the surface within 24 hours after a storm event ends and the storage reservoir must be drained within 30 hours after a storm event ends.

(v). The size of the infiltration facility is determined by the wetted bottom surface area associated with the peak water surface elevation prior to overflow.

C. Sizing partial infiltration and filtration facilities:

Post-development runoff rates and pre-development runoff rates shall be determined utilizing the design storms described in Subsection 4.2(p)–Stormwater Treatment and Flow Control Design Storm Events. These storm events shall not overflow the facility.

(i). The outflow through the growing medium is controlled by the infiltration rate of the growing medium at two-inches per hour times the bottom (invert) wetted surface area of the facility. Additional flow control may be provided by an orifice outlet if needed.

(ii). The facility may be sized based on the flow rate through the facility as determined by the Darcy equation. This equation cannot be used for facilities without underdrains.

$$\boldsymbol{Q = kiA = k\left(\frac{d + D}{D}\right) \times A \times 43200}$$

Where:

Q = Outflow (cfs)

k = Infiltration of growing medium (2-inches per hour)

d = Depth of water above growing medium (inches)

D = Depth of growing medium (inches)

A = Bottom wetted surface area (square feet)

(6). Piping Requirements

A. In streets or parking lots, stormwater may flow directly into the stormwater treatment facility via curb openings.

B. An overflow to an approved point of discharge is required for all stormwater treatment facilities.

C. On private property, the overflow drain and piping must meet OPSC requirements and shall direct excess stormwater to an approved point of discharge as identified on the subdivision's Public Works Permit drawings.

D. Within the ROW, this overflow drain and piping must meet City Public Works Standards and shall direct excess stormwater to an approved point of discharge.

(7). Setbacks

A. Infiltration facilities shall be located at least ten feet from building foundations and shall not be located immediately upslope of building structures.

B. Filtration facilities can be located within ten feet of a building foundation.

C. All stormwater treatment facilities shall be set back a minimum of five feet from side lot property lines and easements where the adjoining property is downslope. Where the adjoining property is at the same grade or upslope from the facility, there are no set back requirements from the property lines.

(b) **<u>Flow Dispersion (GSI)</u>**

(1). Description

Full dispersion is a combined flow control and treatment strategy that utilizes the natural capacity of vegetated surfaces to mitigate runoff quantity and quality impacts associated with impervious surfaces, such as driveways, parking areas, and roofs. Fully dispersed surface runoff must be discharged using one of the methods summarized in Table 4-1.

Flow Dispersion Method	Flow Path Length	Maximum Impervious Surface
Splash Block	100 feet	700 sq ft
Rock Pad	100 feet	700 sq ft
10-foot Gravel Trench	100 feet	1,400 sq ft
50-foot Gravel Trench	100 feet	5,000 sq ft
Sheet Flow Dispersion	100 feet	25-ft strip width
	200 feet	50-ft strip width
Paved Walkways and Recreational Trails	25 feet	Up to 15 feet wide

Table 4-1. Summary of Approved Dispersion Methods.

(2). General Design Requirements

A. The total area of the impervious surface being dispersed must not exceed 15 percent of the total post construction vegetated area. The dispersion area being utilized must be delineated on the site plan and designated as the approved point of discharge.

B. A vegetated flow path at least 100 feet in length must be available along the flow path that runoff will follow upon discharge from a dispersion device. The vegetated flow path must meet all of the following criteria:

(i). The flow path must be a vegetated surface.

(ii). The flow path must be onsite or in an offsite easement area reserved for dispersion.

(iii). The slope of the flow path must be at least one percent but no steeper than 15 percent.

(iv). The flow path must be located between the dispersion device and any downstream drainage feature such as a pipe, ditch, stream, river, pond, lake, or wetland.

(v). For sites with septic systems, the flow path must be located downslope of any primary and reserve drain field areas.

(vi). Dispersion devices are not allowed within 50 feet of a steep slope hazard area (greater than 30 percent) or landslide hazard area.

C. Delineation of Vegetated Areas: The area of vegetated surface used for full dispersion must be delineated as a flow dispersion area on the site plan. The flow dispersion area is subject to the following limitations:

(i). All trees within the dispersion area at the time of permit application shall be retained, aside from the removal of dangerous and diseased trees.

(ii). The area may include previously cleared areas replanted by the proposed project.

(iii). The dispersion area may be used for passive recreation and related facilities.

(3). Splash Block Design

Splash blocks may be used to disperse the runoff collected from small amounts of roof area and discharged via a downspout. Typical design details are shown in Standard Plan 252.

A. No more than 700 square feet of roof area may be drained to a single splash block.

B. The splash block must have at least 50 feet of separation between adjacent flow paths for the entire 100-ft.

C. The splash block must be located ten feet from the foundation for homes with basements.

(4). Crushed Rock Pad Design

Rock pads may be used to disperse the runoff collected from up to 1,400 square feet of impervious area and discharged via a vegetated flow path. Typical design details are shown Standard Plan 253.

A. Pads shall consist of crushed rock, two feet wide (perpendicular to flow) by three feet long by six inches deep.

B. Rock shall be crushed, open-graded 3” to 1½”, washed, open-graded rock.

C. No more than 700 square feet of impervious surface may be drained to a single rock pad dispersing to a vegetated flow path of 100 feet.

D. When multiple rock pads are used, there must be at least 50 feet of separation between rock pads and adjacent flow paths for the entire length of the flow path.

(5). Gravel Filled Dispersion Trenches

There are two types of gravel filled trench designs that can be used to disperse flows, the Small Gravel Trench and the Large Gravel Trench with Notch Board (Standard Plans 254 and 255).

A. General Design Requirements

(i). All trenches are filled with ¾-inch to 1½-inch open-graded washed rock.

(ii). All trenches must be placed at least ten feet from any building and must be as parallel as possible to the contour of the ground.

(iii). The uphill grade to the trench must be no more than 20 percent and downhill flow path must be no more than 15 percent. The minimum grade of the flow path must be greater than one percent.

(iv). Trench (and grade board, if required) must be level.

B. Design Requirements for Small Gravel Trench

(i). The trench shall be ten feet long and at least two feet wide by 18-inches deep (Standard Plan 254).

(ii). The four-inch pipe must be buried at least six inches beneath the trench surface.

(iii). The ten-foot trench length is the maximum allowed without a notch grade board as shown in Standard Plan 254.

(iv). No more than 1,400 square feet of impervious area may be drained to a single ten-foot trench dispersing to a vegetated flow path of 100 feet.

(v). No more than 2,800 square feet of impervious surface may be drained to a single ten-foot trench dispersing to a vegetated flow path of 200 feet.

(vi). The trench must be lined with filter fabric.

C. Design Requirements for Large Gravel Trench with Notch Board

(i). The trench shall be 10 to 50 feet long with a notch grade board, and be at least 28-inches wide by 24-inches deep (Standard Plan 255).

(ii). The notched pressure-treated grade board is two inches wide by a minimum of 12-inches deep, with "v" notches placed 18-inches on center that are two-inches wide by two-inches deep.

(iii). At least four, 4-inch by 4-inch support posts must be secured to the notched grade board with two galvanized bolts and spaced evenly along the length of the trench.

(iv). Pipe must be four to six inches in diameter, placed at a minimum of six inches from the bottom and one foot from either side of the trench.

(v). The influent pipe shall be connected to a catch basin with a solid cover that locks.

(vi). The maximum in-flow is 0.5 CFS per trench.

(vii). The pipes must have at least two clean out wyes (one in either direction from catch basin) and end caps.

(viii). The trench must be lined with filter fabric.

(ix). The 50-foot trench length is the longest allowed.

(x). No more than 5,000 square feet of impervious area may be drained to a single ten-foot trench dispersing to a vegetated flow path of 100 feet.

(xi). No more than 10,000 square feet of impervious surface may be drained to a single 50-foot trench dispersing to a vegetated flow path of 200 feet.

(6). Sheet Flow Dispersion Design Requirements.

A. Concentrated runoff from the impervious surface is not permitted. Runoff must consist of uniform sheet flow.

B. The edge of the impervious surface and the ground adjacent to or immediately below the edge must be level or sloped no more than five percent along the edge as shown in Standard Plan 256.

C. A two-foot-wide, six-inch-deep, strip of crushed rock or the extended base course of a road or driveway must be provided at or below the edge of the impervious strip to facilitate dispersal of runoff.

D. No more than a 25-foot-wide strip of impervious surface may be sheet flowed in this manner when dispersing to a vegetated flow path of 100 feet.

E. No more than a 50-foot-wide strip of impervious surface may be sheet flowed in this manner when dispersing to a vegetated flow path of 200 feet.

(c) Pervious Pavement (GSI)

(1). Pervious pavement can be used for private streets, driveways, and parking lots. Pervious pavement has not yet been approved for use in the ROW, and will only be reviewed on a case-by-case application when proposed in ROW areas outside the travel lanes.

(2). Must meet all applicable State and City building codes.

(3). Pervious pavement systems shall be designed and constructed in accordance with City of Portland Pervious Street Standards.

(4). Shall not be used in areas within the 100-year floodplain, or at slopes that exceed six percent.

(5). An underdrain system shall be employed to direct excess water to an approved disposal point when:

A. The native soil is not capable of infiltrating at a rate adequate to prevent water from the 25-year, 24-hour storm from filling the gravel layer and backing up into the pavement layer.

B. An underdrain is required where the native soils infiltrate at 0.5 inches per hour or less, or where the slope of the paving surface and gravel base layer may cause water to accumulate and fill the gravel layer quickly in the lower area.

(6). A safety overflow mechanism, such as an inlet drain, catch basin, curb opening, or other approved method, shall be provided to prevent ponding in the event that the surface is clogged with sediment or debris.

(7). Other paving systems may be reviewed on a case-by-case basis for pervious designation and appropriate use, and must show the ability to pass water quickly through the pavement layer.

(d) Green Roofs (GSI)

(1). Description (See Standard Plan 224)

A green roof system is comprised of waterproof material covered with a soil and vegetative layer. A green roof is utilized in place of a traditional roofing system as a way to limit impervious site area by capturing, and depending on the season, evapotranspirating 10 to 100 percent of the precipitation. Green roofs attempt to mimic pre-developed ground cover hydrology, reducing post-developed peak runoff rates to near pre-developed rates. Additionally, green roofs help mitigate runoff temperatures by keeping roofs cool and retaining most of the runoff during the warm months of the year.

Green roofs fulfill 100 percent of the requirement for treatment, and provide a 50 percent reduction in impervious area, equivalent to half the area of the green roof, for the purpose of flow control.

(2). General Design Requirements

A. Structural Roof Support

The structural roof support must be sufficient to hold the additional weight of the green roof. Generally, the building structure must be adequate to hold an additional 10 to 25 pounds per square foot (psf) saturated weight, depending on the vegetation and growth medium that will be used. This weight is in addition to snow load requirements. The project architects and/or structural engineers shall address the structural requirements of the green roof and submit their calculations with the design drawings for review. Review and approval of the structural components of the building is the responsibility of the City's Building and Safety Division.

B. Waterproof Membrane

Waterproof membranes shall be constructed of modified asphalts, synthetic rubber (EPDM), hypolan (CPSE), or reinforced PVC. These materials have different strengths and functional characteristics. Some of these materials require root barriers and other protective materials.

C. Root Barrier

Root barriers are constructed of dense materials that inhibit root penetration. The need for a root barrier depends on the waterproof membrane selected. Most modified asphalts require a root barrier, while EPDM and reinforced PVC do not. The EOR shall follow the manufacturer's recommendations regarding root barriers for the specific waterproof membrane selected for the project.

D. Underdrain System

An underdrain system and overflow to an approved point of discharge are required. Though a method of drainage must be provided, a manufactured product is not required. The drainage layer may include filter fabric, manufactured perforated plastic sheets, gravel, or be the growing medium itself. An approved discharge location must be identified for every green roof and a drain(s) provided.

E. Growing Medium (Soil)

The growing medium is generally two- to six-inches thick and well drained. It weighs from 10 to 25 pounds per square-foot when saturated. A simple mix of one-fourth topsoil, on-fourth compost, and one-half pumice perlite is sufficient for most applications. Some manufacturer's have their own growing medium specifications.

F. Vegetation (See Appendix 4B–Landscape Requirements and Plant List for Stormwater Facilities)

Green roof vegetation should have the following attributes:

(i). Drought-tolerant plants, requiring little or no irrigation after establishment.

(ii). Plants and plant spacing that allow the growth to thoroughly cover the soil. At least 90 percent of the surface area shall be covered after two years.

(iii). Self-sustaining, without the need for fertilizers, pesticides, or herbicides.

(iv). Very low-maintenance, needing little or no mowing or trimming.

(v). Perennial or self-sowing.

(vi). Fire resistant.

A mix of sedum and succulent plant communities possess many of these attributes. Herbs, forbs, grasses, and other low groundcovers also can be used to provide additional benefits and aesthetics; however, these plants need more watering and maintenance to survive and keep their appearance.

G. Gravel Ballast

Gravel ballast may be placed along the perimeter of the roof and at air vents or other vertical elements. The need for ballast will depend on operational and structural design issues. In most cases, very little, if any, ballast is needed. Gravel ballast can also be used to provide periodic maintenance. If a

Top Div 4

root barrier is used, it must extend under the gravel ballast and growth medium, and up the side of the vertical elements.

H. Drain

As with a conventional roof, a green roof must safely drain runoff from the roof to an approved point of discharge.

(e) <u>Constructed Wetland Treatment Systems (GSI)</u>

This section describes two types of constructed wetland systems: Treatment Wetland and Subsurface Gravel Wetland. Treatment Wetlands are limited to larger drainage areas, at least ten acres in size. A Subsurface Gravel Wetland can be used for a project containing one acre or more of impervious area. These systems can be designed to meet the requirements of both treatment and flow control.

(1). General Design Requirements

A. To meet the flow control requirements, a detailed hydraulic analysis must be performed by a Professional Engineer, showing compliance with flow control standards.

B. A design team with experience in hydrology, wetland plants, and engineering shall be used to design a subsurface gravel wetland.

C. A water budget analysis shall be performed with the design of the facility.

D. Two staff gauges shall be installed at opposite ends of the bottom of the wetland to enable maintenance staff to measure the depth of accumulated sediment.

E. Access routes to the wetland for maintenance purposes must be shown on the plans. See access easement requirements in Division 001—General.

F. Flow through the facility shall be distributed as uniformly as possible across the wetland and ponded section.

G. An overflow mechanism to an approved point of discharge is required.

H. An emergency overflow shall be provided. The emergency overflow shall be designed for the 100 year, 24-hour storm and be capable of conveying the stormwater without causing damage to the facility or surrounding property.

(2). Treatment Wetland (GSI)

A. Description (See Standard Plan 222)

A wetland is an area inundated or saturated by surface or groundwater at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands remove pollutants through several processes including sedimentation, filtration, and biological uptake. The USACE and DSL regulate natural wetlands. Natural wetlands must be protected and cannot be used as stormwater treatment facilities.

Treatment Wetlands are wetlands designed and constructed for the specific purpose of providing a stormwater treatment facility. When adequate volume and a control structure are provided, Treatment Wetlands can also provide flow control.

B. Specific design requirements of a Treatment Wetland

(i). The minimum drainage area to be served by a Treatment Wetland is ten acres. The configuration of the wetland can be configured to a specific site.

(ii). For stormwater treatment, the wet portion or permanent pool of the wetland shall have a residence time of at least 36 hours, calculated as the treatment design storm volume divided by the average facility outflow rate.

(iii). The geometry, surface area, and volume of the Treatment Wetland shall be designed to match the components listed in Table 4-2. Component values may vary by up to two percent (plus or minus) of the listed values.

Treatment Wetland Design Requirements		
Design Component	**Percent of Design Volume (approx.)**	**Percent of the Facility Surface Area (approx.)**
Forebay	10	5
Micropool	10	5
Deep Water (> 18”)	50	40
Deep Wetland (6” – 18”)	20	25
Shallow Wetland (<6”)	10	25

Table 4-2. Design Requirements for Treatment Wetland Components

(iv). Forebay: A relatively deep zone placed where influent water discharges to a stormwater wetland. It traps coarse sediments, reduces incoming velocity, and helps distribute runoff evenly over the wetland.

(v). Micropool: A deep (four to six feet) pool placed at the outlet of a stormwater wetland forebay.

(vi). Dead zone storage: The additional storage volume provided to allow for sediment accumulation. For a Treatment Wetland, the additional storage is provided in the Forebay.

(vii). Deep-water: The area within a stormwater wetland that has a water depth greater than 18 inches.

(viii). Deep wetland: The area within a stormwater wetland that has a water depth between six and 18 inches.

(ix). Shallow wetland: The area within a stormwater wetland that has a water depth less than six inches.

See Standard Plan 222 for more specific details and sizing requirements for Treatment Wetlands.

C. Soil Suitability

(i). Treatment Wetlands are appropriate for NRCS type C and D soils.

(ii). Topsoil shall be used within the top 12 inches of the facility, or the soil shall be amended to support plant growth.

(iii). A certified soil scientist, or a person with suitable wetland design training and expertise, shall evaluate the soils at the bottom of the facility to confirm that they are suitable for wetland vegetation planting.

(3). Subsurface Gravel Wetland (GSI)

A. Description (See Standard Plan 223)

The Subsurface Gravel Wetland is a horizontal-flow filtration system that relies on a dense root mat, crushed stone, and an anaerobic, microbe rich environment to provide stormwater treatment. It approximates the look and function of a natural wetland, effectively removing sediments and other stormwater pollutants. This facility can be designed to provide both treatment and flow control.

B. Specific design requirements of a Subsurface Gravel Wetland

(i). Subsurface Gravel Wetlands are suitable for projects with a minimum of one acre of impervious surfaces. The shape of the wetland can be configured to match the specific site conditions.

(ii). The subsurface gravel storage shall have a residence time based on the stormwater volume (calculated as the treatment design storm volume divided by the average facility outflow rate) of no less than 24 hours.

(iii). The Subsurface Gravel Wetland shall be designed so that ponded water is drained within 48 hours.

(iv). Forebay: Shallow area used to trap any coarse sediment which escaped the upstream pretreatment manhole, reduces incoming velocity, and helps distribute runoff evenly over the wetland. Runoff exits the forebay through a perforated standpipe and flows into the vegetated treatment basin.

(v). Vegetated treatment basins: Water flows evenly over the vegetated treatment basins, where it is treated through a variety of physical, chemical, and biological processes.

(vi). Perforated riser pipes: Water in the vegetated treatment basins is conveyed to the subsurface gravel layer through perforated riser pipes. This ensures the gravel subsurface area fills quickly.

(vii). Subsurface gravel layer: Biological processes with anaerobic microbes take place in this layer along with the uptake of pollutants by the vegetative root system. Physical and chemical treatment, through the trapping of contaminants, occurs on and within the gravel filter media and root mat.

(viii). Outlet Structure: The outlet structure is used for flow control and also to regulate the level of water within the wetland. The outlet elevation shall be set to ensure the soil stays wet but water is not ponded on the surface of the wetland.

See Standard Plan 223 for more specific details and sizing requirements for Subsurface Gravel Wetlands.

C. Soil Suitability

(i). Subsurface Gravel Wetlands are appropriate for NRCS type C and D soils. Infiltration rates should be 0.5 inches per hour or less.

(ii). Topsoil shall be used within the top 12 inches of the facility, or the soil shall be amended to support plant growth.

4.4–Stormwater Treatment Facilities

Facilities described in this section provide design requirements for stormwater treatment only. Utilizing these facilities for a project site requires additional detention or retention facilities to meet flow control requirements defined in Section 4.5–Flow Control Facilities. Stormwater treatment facilities are sized to treat the water quality design storm defined in Subsection 4.2(p)–Stormwater Treatment and Flow Control Design Storm Events. These facilities must be situated off line and treat the volume of water generated by the water quality design storm utilizing a flow splitter or bypass.

(a) Stormwater Planters and Rain Gardens (GSI)

Stormwater planters and rain gardens described in Section 4.3–Combined Stormwater Flow Control and Treatment Facilities can be designed as stormwater treatment only facilities for a stormwater inflow volume generated by the water quality design storm from the impervious areas served by the facility.

(b) Vegetated Swales (GSI)

(1). Description

Vegetated swales are long, narrow landscaped depressions used to collect and convey stormwater runoff, allowing pollutants to settle and filter out as the water flows through the facility. A collection/overflow system is required at the end of the swale. Swales can be used to treat stormwater from parking lots, driveways, and other impervious surfaces on private property.

Swales intended to provide both water quality and conveyance must be designed to treat or infiltrate the water quality design storm under all flow conditions and convey the design event without erosion consistent with Table 4-3.

(2). Specific Design Requirements

A. The swale width and profile shall be designed to convey runoff from the stormwater treatment design storm intensity based on the following design criteria:

(i). The maximum design velocity is 0.9 feet per second using the water quality design storm.

(ii). The minimum hydraulic residence time (time for flow to pass through the swale) is nine minutes.

(iii). Manning's "n" value of 0.25 for treatment and Manning's "n" value of 0.030 for conveyance.

B. Maximum Depth for the water quality storm event is four inches. The maximum conveyance depth is 12 inches.

(i). For facilities not protected by a high-flow storm diversion device, provide a minimum of one foot of freeboard above the water surface elevation for the conveyance design storm.

(ii). Velocities shall not exceed three feet per second (fps) for the conveyance design storm.

C. Debris and Sediment Collection

A sedimentation basin or a pretreatment structure shall be provided prior to the inlet of the facility to collect debris and sediment that enter the vegetated swale. Pretreatment structures are listed in Appendix 4F—List of Accepted Manufactured Stormwater Facilities.

D. Soil Suitability

Growing medium shall be used within the top 12 inches of the facility as specified in Appendix 4G—Key Material Specifications.

E. Geometry/Slopes

(i). The swale shall incorporate a flow-spreading device at the inlet. The flow spreader shall provide a uniform flow distribution across the swale bottom. In swales with a bottom width greater than six feet, a flow spreader shall be installed at least every 50 feet. The flow spreading device can be integrated into the sedimentation basin.

(ii). The minimum swale length is 100 feet. This requirement can be met with a segmented swale which is linked together so that the total length is 100 feet.

(iii). To minimize flow channelization, the swale bottom shall be level, with uniform longitudinal slope.

(c) <u>Vegetated Filter Strips (GSI)</u>

(1). Description (See Standard Plan 218)

Vegetated filter strips are gently sloping areas used to filter, slow, and infiltrate sheet flow runoff used to receive the runoff from walkways and driveways. Stormwater enters the filter as sheet flow from an impervious surface or is converted to sheet flow using a flow spreader. Sheet flow is maintained using the relatively large surface area. Pollutants are removed through filtration and sedimentation.

(2). Specific Design Requirements

A. Vegetated filter strips are appropriate for all soil types. Unless existing vegetated areas are approved for infiltration, amended soils shall be used for the top 12 inches of the facility.

B. Filter strips shall have a minimum slope of one percent and a maximum slope of ten percent. Filter strips shall have a uniform cross slope to ensure that flows are distributed evenly.

C. Stormwater shall enter the filter as sheet flow from an impervious surface.

D. Vegetated filter strips shall have on average a minimum width of five feet and a maximum width of 15 feet, measured in the direction of the flow.

E. Filter strips shall be sized using a factor of 0.2 times the impervious area which sheet flows to the filter strip.

F. Sod may only be used for single-family residential sites and for filter strips along sidewalks per Appendix 4B—Landscape Requirements and Plants Lists for Stormwater Facilities. Filter Strips shall be planted with a variety of trees, shrubs, and ground covers, including grasses per Appendix 4B—Landscape Requirements and Plant Lists for Stormwater Facilities.

G. Unless the filter strip is designed for stormwater disposal via infiltration, an approved conveyance and disposal method will be required at the end of the filter.

H. Slopes greater than five percent, a series of check dams or terraces.

(d) Manufactured Treatment Technology

(1). Description

There are many types of Manufactured Treatment Technology available for use today. Some of these alternative systems are stand alone and meet the requirements for stormwater treatment. Other systems must be used in conjunction with pre-treatment structures to meet stormwater quality standards.

A list of accepted Manufactured Treatment Technologies is provided in Appendix 4F—List of Accepted Manufactured Stormwater Facilities.

(2). Design Requirements

In addition to design calculations, the following must be submitted with each manufactured stormwater treatment technology project:

A. The pollution reduction capacity of the facility.

B. The flow-through conveyance capacity (i.e., maximum flow through the facility that will not agitate and release trapped pollutants).

C. An Operations and Maintenance plan must also be submitted to the City in accordance with the manufacturer's recommendations for private facilities and an Operations and Maintenance plan must be submitted in accordance with Administrative Rule 109-011—Operations and Maintenance of Stormwater Facilities.

D. Manufactured stormwater treatment technologies must be designed and constructed in accordance with the manufacturer's recommendations.

E. The maximum depth of any sump pump for a stormwater facility is 20 feet.

(3). Alternative Treatment Technologies

A. Will be treated as Design Standard Exceptions per Division 1—General.

B. Have been approved by Washington Department of Ecology (WashDOE).

C. Regardless of WashDOE approval, the City reserves the right to deny or approve Alternative Treatment Technologies.

4.5—Flow Control Facilities

This section will present methods for sizing and designing flow control only facilities. However, the design of multi-functional facilities that provide stormwater treatment and flow control is encouraged. Combined stormwater facilities are described in Section 4.3—Combined Stormwater Flow Control and Treatment Facilities.

(a) <u>General Requirements</u>

(1). Flow control only facilities will require additional treatment facilities per Section 4.2–General Design Requirements.

(2). All stormwater runoff originating from and/or draining to any proposed large project shall be detained, controlled, and/or conveyed in accordance with these Standards. When existing conditions make stormwater flow control impractical for all or a portion of a proposed development, the City may permit compensatory storage volume to be provided in another location within the drainage basin, or require payment of a Fee-in-Lieu for such facilities per SRC Chapter 71.

Top Div 4

(3). When on-site stormwater facilities are not designed to detain the off-site runoff, the on-site stormwater facilities (including conveyance, flow control, treatment, and emergency overflow elements) must be properly designed to address conveyance of off-site runoff through the site. If flow from the off-site areas cannot be separated or bypassed then the stormwater facilities must be designed for the total on-site and off-site flow.

(4). All aspects of public health, safety, maintenance, nuisance abatement, and vector control must be considered in every stormwater facility plan.

(5). The impact of a potential system failure should be analyzed for effects to the proposed development, adjacent properties, elements of on-site and off-site private stormwater systems, and elements of the public drainage system.

(6). Multiple-use flow control facilities (i.e., parks, fields, parking lots) are encouraged if such a design complies with all other requirements in these Standards.

(b) Flow Control Facility Sizing Criteria

Most of the flow control facilities provided in this section of the Design Standards are volume based facilities and are required to provide adequate storage for the 100-year design storm. Retention systems (Section 4.6—Retention Systems (GSI)(Private Only)) are not volume-based facilities. This subsection describes the sizing criteria for volume based flow control facilities.

(1). Runoff Calculations

A. Drainage Areas

All designs shall identify drainage areas within and upstream of the project. In undeveloped drainage areas, drainage calculations shall separately consider existing drainage patterns and post-developed drainage patterns, consistent with the applicable Comprehensive Land Use Plans.

B. Analytical Methods

Storm runoff shall be calculated per Subsection 4.2(o)—Hydrologic Analysis and Appendix 4D—Hydrologic Analysis.

For projects using the Simplified Method, no flow control calculations will be required. It is assumed the facilities sized with the Simplified Method provide sufficient flow control.

(2). Flow Control Volume Calculations

A. Total Detained Volume

The flow control facility shall be sized to detain a 100-year 24-hour design storm per the requirements of Subsection 4.2(p)—Stormwater Treatment and Flow Control Design Storm Events. The total flow control volume is determined by calculating the difference in volume of the total cumulative runoff of the post-development design storm minus the total cumulative runoff from the pre-developed design storm. This standard does not apply to retention facilities (see Section 4.6—Retention Systems (GSI) (Private Only)).

B. Peak Discharge Rate

(i). Discharge Rate. The discharge rate shall be equal to or less than the pre-developed 100-year design storm per Subsection 4.2(p)—Stormwater Treatment and Flow Control Design Storm Events.

(ii). Curve Numbers–Pre-Development. Regardless of the existing pre-developed surface condition, the runoff characteristics for calculating allowable outflow will be based on a woods and grassland combination. Curve numbers for this combination have been calculated and listed in Appendix 4D—Hydrologic Analysis, Table C-6, and "City of Salem Pre-development". All developments shall use these curve numbers for determining the pre-development runoff conditions using the predominate soil type for the project area.

(iii). Off Site Stormwater Flow. The flow of stormwater from off-site of the development must be considered. If this water cannot be separated or bypassed, then the flow control facility shall be designed for the total flow on and off-site (SRC Chapter 71).

(iv). Retrofit Existing Site. When retrofitting, improving, or redeveloping an existing site that contains existing parking lots, streets, or other impervious areas, there may be small drainage areas within the site that cannot be detained and must flow undetained from the site. Flows from impervious areas having undetained runoff shall be calculated and subtracted from the allowable total outflow. These areas shall not exceed ten percent of the total impervious surface areas. All new impervious areas must have stormwater treatment.

C. Reduction to Flow Control Area

The total surface area requiring flow control may be reduced for areas retained in a natural, undisturbed state and for any of the impervious area reduction techniques identified in Subsection 4.2(g)—Impervious Area Reduction Techniques.

D. Outlet Control

Outflow is typically restricted through multiple orifices, usually located within a manhole or other junction structure (see Standard Plan 251).

(i). Orifices shall be ¼-inch or greater in size. Whenever an orifice is less than two inches in size it shall be contained in a section of well screen or slotted pipe to prevent clogging (see Standard Plan 251). The size of the orifice shall be established based on the following equation:

$$\mathbf{D} = \sqrt{\frac{\mathbf{36.88\ Q}}{\sqrt{\mathbf{H}}}}$$

Where:

D = Orifice Diameter (inches)
Q = Allowable Outflow (cfs)
H = hydraulic head, feet

(ii). If a weir is required, sizing for a Rectangular Notched Sharp Crested Weir is based on the following equation:

$$\mathbf{Q = C(L - 0.2H) * H^{1.5}}$$

Where:

Q = Weir Discharge (cfs)
C = 3.27 + 0.40 x H/P, feet
P = Height of weir bottom above downstream water surface, feet
H = Height from weir bottom to crest, feet
L = Length of weir, feet

(iii). Sizing for a V-Notched Sharp Crested Weir is based on the following equation:

$$\mathbf{Q = C_d \left(Tan\ \frac{\theta}{2}\right)\ H^{\frac{5}{2}}}$$

Where:

Q = Weir Discharge (cfs)
C_d = Contraction coefficient (feet) (use 2.5 for 90° weir)
θ = Internal angle of notch (degrees)
H = Height from weir bottom to crest (feet)

NOTE: *For weirs notched out of circular risers, length is the portion of the riser circumference. The length of the weir shall not exceed 50 percent of the pipe's circumference.*

(3). Dry Detention Ponds

A. Description

Dry detention ponds are vegetated basins designed to fill during storm events and slowly release the water over a number of hours. Wet ponds containing standing water for an extended period of time are not allowed.

B. General Design Requirements

(i). The design of dry detention ponds to function as multi-purpose facilities is encouraged, such as open space or parks, provided that any alternative uses are compatible with the basic stormwater functions and operations and maintenance standards. In-stream ponds are not allowed.

(ii). All flow control ponds shall have a minimum of one foot of freeboard above the maximum design water surface.

(iii). The top 12-inch layer of soil must be amended or topsoil imported before the site can be planted. Suitable topsoil from the site can be stripped, amended, and reused for the growing media.

(iv). An overflow to an approved point of discharge is required for these facilities.

C. Location and Ownership

(i). All dry detention ponds to be maintained by the City shall be located on land dedicated to the City, within the ROW, or on a public stormwater easement dedicated to the City.

(ii). Dry detention ponds serving more than one tax lot, or designed to function as multi-use/recreational facilities, shall be located in a separate tract (e.g., Tract A), defined easement, or designated open space.

D. Setbacks

Ponds shall be constructed to maintain the following setback distances from structures and other facilities.

(i). Minimum distance from the edge of the maximum water surface elevation to side lot property lines and structures: 20 feet, unless an easement with the adjacent property owner is provided. Unless a Geotechnical Engineer confirms that a smaller setback is acceptable as approved by the City, the distance from the outside toe of the pond berm embankment to the nearest property line: one-half of the berm height (minimum distance of five feet).

(ii). Minimum distance from the edge of the pond water surface to septic tank, distribution box, or septic tank drain field: 50 feet.

(iii). Surrounding slopes shall not exceed ten percent. Minimum distance from the edge of the pond water surface to the top of a slope greater than 15 percent shall be 200 feet, unless a geotechnical report is submitted to and approved by the City.

(iv). Minimum distance from the edge of the pond water surface to a well shall be 100 feet.

E. Geometry/Design Requirements

(i). Slopes within the pond shall not exceed 3H:1V.

(ii). The distance between all inlets and the outlet shall be maximized to facilitate sedimentation.

(iii). The maximum depth of the pond shall not exceed six feet. The first two feet of depth shall be distributed evenly around the perimeter of the pond.

(iv). Minimum freeboard shall be one foot above the highest potential water surface elevation (one foot above the emergency overflow structure or spillway elevation).

(v). Dry detention ponds are applicable for use in NRCS type B, C, and D soils (the pond should be designed as an infiltration basin in type A soils).

(vi). Ponds shall be designed with an upstream sedimentation manhole having a down-turned elbow or tee riser outflow pipe to trap oils, sediments, and floatables.

F. Outlet and Overflow Requirements

(i). If a riser pipe outlet is used, it shall be protected by a trash rack and anti-vortex plate. If an orifice plate is used, it shall be protected with a trash rack with at least ten square feet of open surface area. The rack must be hinged or easily removable to allow for cleaning. The rack shall be adequately secured to prevent it from being removed or opened when maintenance is not occurring.

(ii). All ponds shall have an emergency overflow spillway or structure designed to convey the 100-year, 24-hour design storm for post-development site conditions, assuming the pond is full to the crest of the structure. The emergency overflow shall be designed to convey extreme event peak flows around the berm structure for discharge into the downstream conveyance system and sited to protect the structural integrity of the berm. The emergency overflow is in addition to the overflow provided in the control structure.

The sub grade of the emergency overflow spillway shall be set at or above the 100-year overflow elevation of the control structure. It shall be armored with riprap or other flow-resistant material that will protect the embankment and minimize erosion. Riprap shall be designed in conformance with these Design Standards and extend to the toe of each face of the berm embankment.

The emergency overflow spillway weir section shall be designed for the maximum design storm event for post-development conditions, using the following formula:

$$\boldsymbol{L = \frac{Q_{100}}{3.21H^{1.5}} - 2.4H}$$

Where:

L = Length of bottom of weir (feet)
Q_{100} = 100-year pre-development flow rate (cfs)
H = Height of emergency overflow water surface (feet)

(iii). The outlet orifice shall be designed to minimize clogging.

(iv). Inlet/outlet structures of all surface ponds shall be designed with suitable debris barriers and erosion control measures to adequately protect the outlet from sedimentation or other debris.

G. Embankment and Soil Stabilization

(i). Pond embankments greater than four feet in height shall be designed by a Geotechnical Engineer to ensure stability during pond full conditions.

(ii). Native soil on which the embankment is placed shall be evaluated by a Geotechnical Engineer to determine compaction requirements and/or special measures required prior to placing embankment on native soil.

(iii). All pond embankments shall be constructed by excavating a key equal to 50 percent of the embankment height above the bottom of the pond, or as recommended by a Geotechnical Engineer.

(iv). Pond embankment slopes shall be a maximum (i.e. steepest) slope of 3H:1V on the upstream and downstream face. The use of retaining walls in ponds is prohibited.

(v). Pond embankments six feet or less in height including freeboard, measured through the center of the berm, shall have a minimum top width of six feet, or as recommended by a Geotechnical Engineer.

(vi). Where maintenance access is provided along the top of berm, the minimum width of the top of berm shall be at least 15 feet and designed for all weather access.

(c) **<u>Parking Lot Detention Basin</u>**

(1). Treatment

NOTE: *The full detention volume from a parking lot detention basin must be treated by one of the methods described in Section 4.4—Stormwater Treatment Facilities before it is released to an approved point of discharge.*

(2). Location

Parking lot detention facilities shall only be located on private property and function in accordance with requirements for Dry Detention Ponds. They should be located in a portion of the parking lot that receives a minimal amount of use. Parking lot surface detention shall not be permitted in underground parking structures.

(3). Design Requirements

A. Maximum depth of water surface on all parking lot surface detention facilities shall be one foot.

B. The slope on all parking lot surface detention basin shall be no less than one percent and no greater than five percent in areas designed for vehicular traffic.

C. An oil/water separator or other water quality treatment technology shall be required as specified in Administrative Rule 109-112—Stormwater Source Control.

D. The maximum water surface elevation of the parking lot pond shall be at least one foot below either of the following, whichever is lower:

(i). The lowest habitable floor elevation; or

(ii). The lowest elevation of mechanical, electrical, or other equipment subject to damage by flooding.

(01). The one-foot minimum clearance may be reduced if the detention overflow provides adequate protection from flood damage and approved by the City.

(02). Where curbing is used for detention, the maximum water surface shall be no higher than 0.25 feet below the top of curb, and type "C" curbing shall be used as shown in the Standard Plans.

(03). Parking lot detention basins shall utilize the same type of outlet structure used with a Dry Detention basin.

(d) Structural Flow Control Facilities

(1). Description (See Standard Plan 248)

Structural detention facilities such as tanks, vaults, and oversized pipes provide underground storage of stormwater as part of a flow control system. They must be designed not only for their function as flow control facilities, but to withstand an environment of periodic inundation, potentially corrosive chemicals or electrochemical soil conditions, and heavy ground and surface loadings. They must also be accessible for maintenance. Facilities in this section must be designed using acceptable hydrologic analysis to meet applicable flow control requirements. Additional facilities will be required to meet applicable stormwater treatment standards.

(2). Design Requirements

A. Either a surface containment pond or a sedimentation manhole is required upstream of the structural detention facility. In addition, a minimum 0.5 feet of dead storage shall be provided. The bottom shall slope 0.2 percent.

B. Structural detention facilities can be used in conjunction with other detention storage facilities, such as ponds or parking lot ponds, to provide initial or supplemental storage.

C. Two accessways to a public structural detention facility shall be required per Standard Plan 248 and shall consist of a minimum 36-inch diameter access entry cover. All access openings shall have round, solid locking lids.

D. Publicly owned structural detention facilities are permitted within the ROW. Publicly maintained structural detention facilities that are not located within the ROW, shall be located in separate open space tracts with public sewer access easements that are dedicated to the City. All facilities shall be located to allow easy maintenance access. When located outside the ROW, access ports will be accessible by an all weather access road conforming to the requirements in Division 001—General.

E. The minimum size for a detention pipe shall be 36 inches in diameter.

F. If the public collection system piping is also designed to provide storage, the resulting maximum water surface elevation shall maintain a minimum one foot of freeboard in any catch basin below the catch basin grate.

G. The minimum internal height of a structural detention facility shall be three feet, and the minimum width shall be three feet. The maximum depth of the vault or tank invert shall be 20 feet.

H. The placement of large diameter flow control pipes must allow for the required separation from all other utilities. The installation shall not pose any crossing conflicts for other utilities, including services to individual properties.

I. The flow control structure and sedimentation manholes for linear facilities must be provided as shown on Standard Plan 248 and be within 15 feet of service truck access, with a minimum manhole diameter of 48 inches. All manholes that are part of the structural flow control facility shall include sump pumps.

J. Pipes, fittings, and manholes for closed flow control systems shall be built with material having a minimum 75-year design life regardless of on-site soil types. The constructed facilities shall be successfully tested for water tightness before being accepted by the City.

K. In soils where groundwater may induce flotation and buoyancy, measures are required to counteract these forces. Measures that may be required include ballasting with concrete or earth backfill, providing concrete anchors or other counteractive measures. Calculations shall be provided which demonstrate the required stability.

L. Structural detention facilities shall be placed on stable, consolidated native soil with suitable bedding. Tanks and vaults shall not be allowed in fill slopes unless recommended by a Geotechnical Engineer.

M. All structural flow control facilities will have an outlet structure and be documented in the Geotechnical Report.

N. All flow control systems shall have positive gravity flow to the downstream gravity conveyance system.

4.6—Retention Systems (GSI) (Private Only)

Underground retention and infiltration systems can be used to provide an approved point of discharge by collecting and recharging stormwater runoff into the ground. These systems may be approved for either partial or full retention of stormwater onsite. The use of soakage trenches, manufactured chambers, and drywells is highly dependent on soil type, infiltration rates, and height of the groundwater table. These facilities will only be approved for use on private property where there is no stormwater runoff from the public ROW. To qualify as GSI, the following shall be met:

(a) <u>General Design Requirements</u>

(1). Soil Suitability

A. The measured infiltration rate must be 0.5 inches per hour or greater.

B. Infiltration testing in the immediate vicinity of the facility is required. Infiltration testing and reporting requirements are included in Appendix 4C—Infiltration Testing.

C. Retention systems shall not be installed in fill material. They may only be installed in native soils.

Top Div 4

Note: *DEQ has identified soakage trenches and drywells as "Class V Injection Wells" under the Federal Underground Injection Control (UIC) Program. These facilities must be classified as exempt, authorized by rule, or authorized by permit by the DEQ. Since the UIC Program states that these types of facilities can have a direct impact on groundwater, stormwater treatment is required before discharging stormwater into them (unless they are used exclusively for residential roof runoff from three units or less).*

For more information about the UIC requirement visit DEQ's website: http:// www.deq.state.or.us/wq/uic/uic.htm. For technical questions call the DEQ-UIC Program at 503-229-5886. For copies of applications or forms, call 503-229-5189. Any modification to a soakage trench or drywell that functions as a UIC must have prior approval from DEQ before modifications are made.

(2). Setbacks:

Underground retention and infiltration systems require a five-foot setback from property lines and a minimum ten-foot setback from building foundations. A 100-foot setback is required for any slope 20 percent or greater. It is recommended that a Geotechnical Engineer evaluate a setback for specific design to ensure foundation is not imported by water infiltration.

(3). Sizing Criteria

Hydrology calculations shall be performed using either the Rational Method or the hydrograph method described in Appendix 4D—Hydrologic Analysis.

A. The required storage capacity of the facility shall be determined by subtracting the volume of water that can infiltrate out of the facility within the required drawdown period from the volume of runoff from the contributing basin for each facility design.

B. If the measured infiltration rate for the project site is at least two inches per hour, then the 100-year storm event may be used as the design storm for the selected hydrograph method and the system can be designed to retain 100 percent of the stormwater on site.

If the infiltration rate is less than two inches but greater than 0.5-inches per hour, the site shall be designed to retain at least the ten-year storm event without overflow. An overflow will be provided to an approved point of discharge.

(4). Pre-treatment

A. A pretreatment structure is highly recommended and may be required by DEQ, depending on the impervious area being served, prior to discharging into these types of facilities.

(5). Refer to OAR 340, Division 44—Construction and Use of Waste Disposal Wells or Other Underground Injection Activities, for additional design and regulatory requirements.

(b) Soakage Trench (GSI)

(1). Description (See Standard Plan 249)

A soakage trench is a shallow trench in permeable soil that is backfilled with washed drain rock and lined with filter fabric. The trench surface may be covered with grass, rock, or plantings. Private soakage trenches can be used to provide stormwater discharge by collecting and recharging stormwater runoff into the ground.

(2). Design Requirements

A. The maximum impervious area to be served by a soakage trench is 10,000 square feet.

B. Trenches shall not be constructed under current or future impervious surfaces.

C. All trenches shall be constructed in native soil and shall not be subject to vehicular traffic or construction work that will compact the soil and reduce the permeability.

D. Minimum drawdown time for a soakage trench is ten hours.

E. A minimum of five feet is required between the bottom of the soakage trench and the seasonal high groundwater elevation.

F. The bottom of the soakage trench shall be level, or clay check dams may be used to prevent water from collecting near the downstream end.

G. The pipe must have minimum cover of 12 inches measured from the top of pipe to finished grade.

(c) Manufactured Chamber Technologies

(1). Description (See Standard Plan 249)

Chamber systems function similarly to the soakage trench, but provide more storage and can be used in locations with limited infiltration. Corrugated plastic stormwater chambers are typically constructed of high-density polypropylene or polyethylene. They are arched systems that can be rated for H-10 or H-20 loading, depending on the manufacturer, amount of cover, and type of cover. Chamber systems can be installed and covered by an impervious surface layer.

(2). Design Requirements

A. Six inches of washed drain rock is required below the chamber.

B. A manufactured chamber can be used to serve an impervious area of any size.

C. The manufacturer's requirements shall be followed regarding the design and construction of these facilities.

D. All other requirements of a soakage trench shall also apply to a manufactured chamber system.

(d) **<u>Drywells</u>**

(1). Description (See Standard Plan 250)

The typical drywell is a precast concrete ring in five-foot-tall sections perforated to allow for infiltration. These facilities are vertical in nature, which prevents their use in areas that have limited infiltration because of seasonal high groundwater or a shallow infiltration barrier such as dense clay, or fragipan layer.

(2). Design Requirements

A. The drywell must be a minimum ten feet from all foundations and five feet from property lines. The top of the drywell shall be located downgrade from foundations and at a lower elevation than local basements.

B. Drywells are prohibited where permanent or seasonally high groundwater will exist within ten feet of the bottom of the drywell, based on DEQ requirements.

C. The drawdown time for drywell design when full shall not exceed 12 hours.

D. A drywell can be sized to serve up to 12,000 square feet of impervious surface.

4.7—Right-of-Way Facilities

This section provides details specific to stormwater facilities located in the ROW. These facilities have the same design requirements as for any other large project and can provide flow control and treatment. Standard Plans 225 through 247 contain design details for stormwater facilities constructed in the ROW. ROW facilities can be designed as combined facilities including planters and combination swales (Section 4.3—Combined Stormwater Flow Control and Treatment Facilities) or as separate stormwater treatment (Section 4.4—Stormwater Treatment Facilities) and flow control facilities (Section 4.5—Flow Control Facilities).

(a) <u>**General Design Considerations**</u>

(1). The Engineered Method must be used for sizing stormwater facilities in the ROW.

(2). Stormwater facilities can be located behind the curb or designed as a curb extension.

(3). Facilities can be designed for areas where on street parking is allowed or where it is prohibited.

(4). Fire hydrants must be located at least five feet away from the nearest point of any stormwater facility.

(5). Other utilities must be located outside the boundaries of the stormwater facility. Water services that cross under the stormwater facility must be sleeved (see Standard Plan 247).

(6). Elevations must be shown on the plans for all inlets, check dams, overflow, and sidewalks to insure stormwater flows through the facility, cannot back up or flood, and will fill and operate as designed.

(7). The minimum width of a planter in the ROW shall be increased to four feet if street trees are placed in the planter as part of the landscaping requirements.

4.8—Conveyance Systems

(a) <u>**General Design Considerations**</u>

(1). Waterway conveyance systems shall be designed to accommodate fish passage.

(2). Existing waterways shall be retained except where culverts, bridges, or other closed systems are proposed and approved by the City.

(3). To help mitigate water temperature, the design shall provide shade trees along all open waterways.

(4). Conveyance systems shall be designed and constructed in compliance with requirements of all applicable Federal, State, and local agencies. Work within open waterways will normally require permit authorization from other agencies (See Division 001—General).

(5). The stormwater conveyance system shall be designed and constructed in accordance with floodplain management policies and regulations in accordance with SRC Chapter 140.

(b) Capacity

(1). A given conveyance system shall be sized to carry the design storm flowing full as described in Table 4-3. The design storm selected shall be based on either the size of the drainage area or the street classification, whichever is larger.

Conveyance System Design Capacity		
System Element		**Design Storm Recurrence Interval**
Local Streets	Streets, curbs, gutters, inlets, catch basins, collector drains	10 years
Local Storm Drains	Drainage area <50 acres	10 years
Collector Streets	Streets, curbs, gutters, inlets, catch basins, collector drains	25 years
Collector Sewers	Drainage area 50—250 acres	25 years
Arterials	Streets, curbs, gutters, inlets, catch basins, collector drains	50 years
Trunk Sewer	Drainage area > 250 acres	50 years
Ditches and Culverts	Local Streets	25 years
	Arterials and Collector	50 years
Waterways	Without designated floodplain	50 years
	With designated floodplain	100 years
Bridges		100 years

Table 4-3. Conveyance System Design Capacity for System Elements

(c) Piped Systems

(1). Design Requirements

A. Size

Mainline and connecting storm drains shall be not less than ten inches inside diameter.

(2). Slope Requirements

All storm drains shall be laid on a grade which will produce a mean velocity (when flowing full) of at least 2.5 feet per second, and designed using Manning's pipe friction formula with a roughness coefficient of 0.013 as described in Table 4-5, Manning's Roughness Coefficient for Existing Pipes.

The minimum acceptable grade for various pipe sizes with a Manning's Roughness Coefficient of 0.013 is shown in Table 4-4.

Inside Pipe Diameter (inches)	Grade (feet per 100 feet)
8 (private)	0.52
10	0.39
12	0.30
15	0.23
18	0.18
21	0.14
24	0.12
27	0.10
30 (and larger)	0.09

Table 4-4. Minimum Pipe Grade for 2.5 feet/second

The minimum grade may be reduced from the above table as long as an absolute minimum velocity of 2.0 fps can be demonstrated. The maximum grade is 20 percent.

Engineers may specify a storm drain pipe size that is no more than one size category larger than needed for the carrying capacity in order to meet grade requirements, i.e., a 12-inch pipe for a ten-inch pipe to achieve a decrease in slope.

(3). Manning's Roughness Coefficient

The "n" value for existing pipes varies based on material, condition, interior wall configuration, and other related factors as shown in Table 4-5. The values in the table below shall be used on existing pipes unless a lower value can be justified by inspection.

Manning's Roughness Coefficients	
Pipe Material	**Range of "n" Values ***
Plastic (PVC, HDPE)	0.009 – 0.013
Concrete	0.013 – 0.015
Ductile Iron	0.013 – 0.015
Cast Iron	0.013 – 0.015
Corrugated Metal	0.032
**The lower range represents new pipe and pipe in good condition and the upper range represents pipe in fair condition. Pipe in poor condition will require greater "n" values as approved by the City.*	

Table 4-5. Roughness Coefficients for Various Types of Pipe

Top Div 4

(4). Pipe Materials

Pipe materials for public storm drains shall conform to the City's SCS. Acceptable pipe materials and abbreviations are as follows:

A. CHDPE—Corrugated High Density Polyethylene
B. CONC—Concrete
C. DI—Ductile Iron
D. HDPE—High Density Polyethylene
E. PVC—Polyvinyl Chloride
F. ABS – Acrylonitrile-Butadiene-Styrene

(5). Alignment/Location

A. Storm drains shall be located in the ROW within seven feet from curb face.

B. Storm drains shall be laid on a straight alignment between junctions.

C. Utility crossings shall be 90 degree angles and in no case, less than 70 degrees. Utility crossings with less than six inches of vertical separation shall be backfilled with controlled density backfill or other approved material.

D. Where storm drains parallel other utility pipe or conduit lines, the vertical and horizontal alignment shall permit future side connections of storm drains and avoid conflicts with parallel utilities without abrupt changes in vertical grade of main or connecting storm drains.

E. Storm drain alignments shall accommodate future planned projects such as street widening, changes in horizontal or vertical street alignment, and master plan water, sewer or other stormwater facilities.

(6). Cover Requirements

A. All storm drains shall be laid at a depth sufficient to protect against damage by traffic and to drain building footings and under floors where practical. Depth is measured from top of pipe to finish grade at the storm drain alignment.

B. Minimum cover for all storm drainage pipes shall be 30 inches above the top of the pipe. Ductile iron pipes shall be used where 30 inches of cover cannot be achieved.

C. It must be demonstrated that the storm drain is at sufficient depth to properly drain the remainder of the upstream contributing basin.

(7). Junctions

A. Junctions are required for the stormwater conveyance system wherever there is a change in grade, direction, or pipe size.

B. Storm drain pipe junctions shall be cleanouts, catch basins, manholes, or other approved junctions as shown on the Standard Plans.

C. Catch basins and cleanouts shall be used as junctions only with pipes less than 18 inches in diameter for depths up to five feet from rim to invert.

D. Piped storm drain systems shall have junctions located at intervals which do not exceed 500 feet.

E. Catch basin may connect to a storm drain without a junction when the connecting pipe is less than 20 feet long and a minimum of 12 inches in diameter and when the storm drain is not less than 18 inches in diameter.

F. Where an outlet pipe is larger than the inlet pipe, the elevations of the pipe crowns shall match. For all junctions with a sump pump, the outlet invert(s) shall be between 0.1 foot and one foot below the lowest inlet invert. All channelized manholes shall have a minimum drop across the manhole of 0.2 foot and meet the requirements of Standard Plan 101.

G. Junctions located outside the ROW shall be a minimum 48-inch diameter manhole. All junctions located outside of the ROW shall be provided with an access easement meeting the requirements provided in Division 001—General.

(8). Catch Basins

A. Inlets shall be designed to accept the appropriate size design storm flow (as defined in Table 4-3).

B. Inlet spread and capture calculations are required for all arterial and collector streets. Either the ODOT Hydraulics Manual, Chapter 13, Appendix D—Hydrologic Analysis, or the FHWA HEC-22 Urban Drainage Design Manual may be used for inlet spread and capture design criteria.

C. Where inlet spread and capture calculations are not required, inlets may be spaced at no greater than 400 feet.

D. No more than 0.1 cfs of non-captured flow is allowed downstream of the project limits.

E. Flow paths shall not cross intersections.

F. Type 4 catch basins are required on curbed streets that are less than five percent in running slope and shall be generally located along the ROW at private property boundaries (lot lines) in order to avoid driveways. Type 2 catch basins shall be used on curbed streets greater than five percent or where Type 4 catch basins cannot be used. Inlets shall not be located at driveways or pedestrian ramps.

G. Inlets shall be located along the gutter line or open channel flow-line. When streets are widened or otherwise modified, causing an inlet to be located outside a flow-line, the inlet shall be removed entirely and reconstructed with a cleanout, manhole, or other acceptable junction.

H. Type A inlets shall be required at sag locations. An overflow must be designed for an escape route to account for flows exceeding design capacity or inlet failure. Escape route must be designed to approved point of discharge.

(9). Subsurface Drainage

Subsurface drains shall be constructed with adequate erosion protection and shall discharge into the public storm drain system at a catch basin or manhole. Subsurface drains are required for all excavations and fills, with or without retaining walls, which exceed four feet vertically.

(d) <u>Culverts</u>

Criteria provided in this section for culvert design for open channel flow shall also apply to culverts placed in drainage ways and road side ditches.

(1). Culverts in Waterways

A. New culverts shall be sized in conformance with the capacity requirements found in Subsection 4.8(b)–Capacity.

B. Culverts placed in streams or creeks determined to be "waters of the State" require approval from DSL and the USACE.

C. All culverts shall be designed for fish passage in accordance with ODFW guidance unless otherwise exempted by ODFW.

D. Crossing structures shall be designed with a foundation and three sides or oversized and buried in the open channel to maintain the natural channel bottom.

(2). Culverts in Ditches

A. Headwater

(i). For new culverts 18 inches in diameter or less, the maximum allowable design storm headwater elevation (measured from the inlet invert) shall not exceed 2.0 times the pipe diameter or three times the pipe diameter with a seepage collar.

(ii). For new culverts larger than 18 inches in diameter, the maximum allowable design storm headwater elevation (measured from the inlet invert) shall not exceed 1.5 times the pipe diameter.

B. Inlet

(i). All street crossing culverts are required to be designed with a head wall.

(ii). For culverts 18 inches through 42 inches in diameter, the embankment around the culvert inlet shall be protected from erosion by armoring around the inlet with rock or other protection. The armoring shall extend upstream from the culvert a minimum of five feet and shall be as high as the designed headwater elevation.

C. Headwalls and Endwalls

Pipe headwalls, endwalls, or other approved end protection shall be required where pipe material, other than concrete or ductile iron, is exposed at an outlet or inlet or where required to provide slope stability. Details for the headwalls, endwalls, and other end protection shall be included in the construction drawings.

D. Outlets

(i). For culverts 12-inches in diameter and larger, the receiving channel of the outlet shall be protected from erosion by a rock lining, bioengineering, or by some other type of energy dissipater.

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

E. Inlet and Outlet Control Analysis

The headwater depth for pipes under inlet or outlet control shall be determined using hydraulics software such as the FHWA program HY-8 or the nomographs contained in the ODOT Hydraulics Manual.

(e) **<u>Open Channel Drainageways</u>**

(1). Design Requirements

A. Open Channel Drainageways shall be designed with a natural curvilinear alignment, a 100-foot-minimum flow-line radius, and a low-flow channel designed to convey a minimum two-year design storm.

B. Banks shall be designed with a minimum one foot of freeboard above the capacity design storm specified in Table 4-3.

NOTE: *The surface configuration at the top of bank should provide adequate accessibility for maintenance.*

(2). Slope Requirements

A. Bank slopes shall generally be no steeper than 3H:1V (three horizontal to one vertical). In a reach where 3H:1V side slopes are not feasible due to existing site conditions or other obstructions in the channel, the bank slope may steepen to 2H:1V and will require erosion protection. If the top of bank is a berm, the back slope shall generally be no steeper than 2H:1V and shall be graded to prevent localized ponding. In areas of potential instability, the City reserves the right to require grading to be designed by a Geotechnical Engineer.

NOTE: *The flow-line slope is generally dictated by the natural contours. The minimum flow-line slope shall be three percent where feasible, but in no case shall the minimum flow velocity be less than two feet per second.*

(3). Manning's Roughness Coefficient

Manning's Roughness Coefficient ("n") shall generally comply with the ODOT Hydraulic Manual. Typical "n" value ranges are shown in Table 4-5. For new systems, use the design value listed in Table 4-5.

Manning's Roughness Coefficients for Open Channels		
Type of Open Channel	**Range of "n" Values**	**Design "n" Values**
Concrete lined	0.012—0.018	0.015
Rock lined	0.025—0.045	0.040
Vegetated swale flowing full	0.025—0.035	0.030
Earth Ditch	0.022—0.033	0.0225
Natural waterway (surface width <100 feet)	0.025—0.06	0.035
Vegetated Floodplains	0.05—0.15	0.07

Table 4-5. Manning's Roughness Coefficients for Open Channels.

(4). Bank Stabilization

Open channel waterways shall be designed and constructed with temporary and permanent naturally vegetated bank stabilization measures in all locations. Specialized bank stabilization shall be considered as follows:

A. In waterways, natural bank stabilization measures (i.e., slope pull-back, willow mats, rock barbs, or re-vegetation with localized native plant species) shall be used.

B. Areas of extreme curvature, changes in channel cross-section, or low-flow channels with flow velocities exceeding three feet per second shall be designed and constructed with bank stabilization to allow for potential scouring from turbulent flows.

C. Post-construction bank stabilization shall minimize the potential for erosion or sedimentation in accordance with SRC Chapter 71.

(f) <u>Outfalls to Ditches and Waterways</u>

Outfalls to waterways may require DSL and USACE permits. The EOR is responsible for obtaining necessary State and Federal permits and providing proof of approval to the City.

(1). Outfalls shall be constructed to minimize the potential for erosion and other potential damage to the banks of the receiving open channel. Outfall designs shall prevent erosion and scouring upstream and downstream of the outfall structure.

(2). Bank stabilization shall conform to Subsection 4.8.(e)(4)—Bank Stabilization, and shall not reduce the carrying capacity of the water course. Bank stabilization designs shall consider the flow velocities of pipe outlets and the open channel for the design storm event. Where stones are placed within existing bank slopes, the bank shall typically be excavated a minimum of 18 inches or 1.5 times the size of the largest stone being used, whichever is greater.

(3). Flow from the outfall structure shall be directed downstream, typically no less than 30 degrees from perpendicular to the waterway flow.

(4). Outfalls shall be located at the ordinary high water elevation. The area between the ordinary high water level and the stream bed shall be stabilized with material to dissipate energy.

(5). Engineered energy dissipaters, including stilling basins, drop pools, hydraulic jump basins, baffled aprons, and bucket aprons, are required for outfalls with velocity at design flow greater than ten fps. These shall be designed in accordance with the current edition of the *ODOT Hydraulics Manual*.

(6). Outfalls may be inter-planted with willow stakes or other approved plantings every two feet on-center, to increase stability, reduce erosion, provide shading, and improve aesthetics. The direct flow path between the natural water body and the outfall shall be clear of trees.

(7). Riprap protection, when required, shall be designed in accordance with the current edition of the *ODOT Hydraulics Manual.*

CITY OF SALEM
DEPARTMENT OF PUBLIC WORKS
ADMINISTRATIVE RULES
CHAPTER 109
DIVISION 004 APPENDIX A
STORMWATER SUBMITTAL REQUIREMENTS

SECTION

TABLES

4A.1—Simplified Method Submittal Guide

The Simplified Method may be used to design stormwater facilities for SFR project and for other projects where the total impervious area is less than 10,000 ft^2.

When using the Simplified Method, the minimum submittal requirements are as follows:

(a) <u>Site Plans</u>

Site plans with a scale of 1″= 10′ (large projects may use a scale of 1″= 50′). Information on the site plan shall include:

(1). North arrow.

(2). Elevations and topography.

(3). Property lines.

(4). Lot area and setbacks.

(5). Footprints of structures.

(6). Easements and driveways.

(7). Any wells and/or on-site septic systems.

(8). All existing and proposed utility services (buried and overhead).

(9). Width of ROW and curb height.

(10). Impervious areas.

(11). Type, location, and size of stormwater facility.

(12). Existing and proposed surface drainage.

(13). Sidewalks.

(14). Surface materials (concrete, asphalt, grass, bark mulch, etc.).

(15). Appropriate Dimensions.

(16). Proposed stormwater discharge point.

(b) Cross Section and Details of the Proposed Facilities

Cross sections and details of the proposed stormwater facilities will be included with the plan set for the development. The plans shall show the elevations of inlets, outlets, and discharge points on the cross section(s) with arrows showing the direction of flow.

(c) Infiltration Test Results

Infiltration test results will be submitted using the appropriate forms found in Appendix 4B—Landscape Requirements and Plant Lists for Stormwater Facilities.

(d) Landscaping Plans

The Landscaping Plan shall contain the following information:

(1). Standard drawing information identified under Subsection 4A.1(a)—Site Plans, above.

(2). Planting plan and cross section for stormwater facility, including planting zones, plant layout, and distribution.

(3). Plant legend including botanical name, common name, quantity, condition, size, spacing, and appropriate planting zone for each plant.

(4). Soil preparation and planting details and notes.

(5). Mulch, compost, soil amendment, and topsoil specifications and quantities.

(6). Seed mixes, method, rates, and areas of application, if used.

(e) Irrigation Plans

The irrigation plan shall contain the irrigation layout, material legend, details and notes, if used.

(f) Simplified Method Form

The Simplified Method Form must be filled out and is used to size the stormwater facilities. The square footage for each facility, as computed on the form, shall be shown on the plans.

(g) Private Stormwater Facilities Agreement

The builder must complete the Private Stormwater Facilities Agreement and sign and record the document in the appropriate County. This form can be found in Administrative Rule 109 Division 011—Operation and Maintenance of Stormwater Facilities

Top Div 4A

(h) Operation and Maintenance Plan

The Operation and Maintenance Plan shall be completed and submitted with the plan set. Operations and Maintenance requirements for Basic Stormwater Facilities are included in Administrative Rule 109 Division 011—Operation and Maintenance of Stormwater Facilities.

4A.2—Engineered Method Submittal Guide

For projects where the impervious surface area is 10,000 ft^2 or more, the Engineered Method must be used to design the stormwater facilities. For these projects, the applicant will submit all the items listed in Subsection 4A.1—Simplified Method Submittal Guide in addition to a Stormwater Management Report.

The Stormwater Management Report is required for every site improvement where the Engineering Method is used and the minimum submittal requirements are as follows. All reports shall be paginated and securely fastened (including maps and exhibits).

(a) Cover Sheet

The cover shall contain the following information:

(1). Project name and owner.

(2). Site address.

(3). Associated permit numbers.

(4). Submittal date.

(5). Engineer of Record.

(6). Firm Name and Address.

(7). Contact information including phone numbers and email addresses.

(b) Engineer's Certification and Statement

The EOR shall properly seal the document with their Oregon professional engineer stamp on the cover sheet or the following page.

(c) Project Overview and Description

The Project Overview shall include and/or address the following information, as applicable:

(1). Size and location of project site (vicinity map).

(2). Brief description of the project scope and proposed improvements.

(3). Description and size of the watershed draining to the site.

(4). Description of the existing site conditions, constraints, sensitive areas, and waterways.

(5). Summary of the manner in which existing trees and native vegetation are impacted and/or preserved.

(6). Summary of the extent to which green stormwater infrastructure is being used, and if the MEF criteria is met per Appendix 4E—Implementing Green Stormwater Infrastructure to the Maximum Extent Feasible.

(7). Regulatory permits required.

(8). Identification of the escape route through or from the site for the 100-year storm.

(d) Methodology

This section of the report shall contain the following information:

(1). Depth to Groundwater—attach any test results or other applicable data.

(2). Delineation of existing trees and native vegetation.

(3). Demonstration of maximized infiltration and vegetative treatment—attached infiltration testing results.

(4). Description of soil types and any other geologic features impacting stormwater infrastructure design.

(5). Identification of any hazardous materials based on past use of the project site.

(e) Analysis

This section shall contain the following information:

(1). Computational Methods Utilized and Software utilized.

(2). Design assumptions and critical variables and inputs including, but not limited to, curve numbers, coefficients, infiltration rates, grades, design storms, etc.

(3). Hydrology Calculations (pre- and post-development).

(4). Conveyance capacity calculations.

(5). Treatment and flow control sizing calculations.

(6). Provide separate tables of pre- and post-construction catchment areas (differentiate public vs. private, roof vs. pavement, and pervious vs. impervious). See example Table 4A-1 below.

(7). Maps shall be provided illustrating the pre- and post-construction catchment areas as identified in the following tables.

Catchment and Facility Table *(shows each catchment on proposed site as well as proposed facility)*							
Catchment/ Facility ID	**Source (roof/road/other)**	**Impervious Area (sf/ac)**	**Pervious Area (sf/ac)**	**Ownership (private/public)**	**Facility Type**	**Facility Size (sf/ac)**	**Curve #**
AA							
BB							

Table 4A-1. Catchment and Facility Table Example

(8). Comparison table of the flow rates for pre- and post-construction. Table must show that the project meets the flow control requirements set forth in Administrative Rule 109 Division 004—Stormwater System, see example Table 4A-2, below.

Pre vs. Post Construction Flow Rates						
Facility ID	**Peak Flow Rate (cfs)**					
	Half of the 2 Year Storm		**10 Year Storm**		**100 Year Storm**	
Project Site	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
AA						
BB						

Table 4A-2. Pre vs. Post Construction Flow Rates Table Example

(9). Determination of the escape route and inundation level for the 24-hour, 100-year event. Results of this analysis shall be illustrated on a site map.

4A.3—GSI Analysis

(a) Provide submittal requirements per Appendix 4E—Implementing Green Stormwater Infrastructure to the Maximum Extent Feasible as required to demonstrate GSI will be used to the MEF.

4A.4—Stormwater Facility Details/Exhibits

Items included in this section shall include:

(a) Contour maps of pre and post-development.

(1). Impervious area identification.

(2). Watershed delineation.

(3). Existing and new drainage ways.

(4). Point(s) of discharge.

(b) Delineation of each catchment area and the associated stormwater facilities.

(c) Landscape plans.

4A.5—Source Control

This section shall provide any site information for potential pollution generating activity at the site, as identified in SRC Chapter 71, and the required response plans identified in Administrative Rule 109 Division 012—Stormwater Source Control.

4A.6—Downstream Analysis Report

If a downstream analysis is required, the report shall identify any capacity issues that may result from the project/development runoff, and provide the supporting data and analysis as required and identified in this appendix. The report shall provide recommendations for mitigation downstream capacity issues identified.

4A.7—Open Channel Hydraulic Modeling

Where open channel hydraulic modeling is used in the downstream analysis, the following information shall be included in the report:

(a) A site map showing the location of the project and the surrounding drainage basin.

(b) A description of all calculations, references, and modeling used in the analysis.

(c) A discussion of how Manning's n-values were determined, including photos of typical cross sections used in determining the n-values.

(d) A description of the storm events used in the study and where the information was obtained.

(e) A brief description of the physical condition and the estimated capacity of all existing drainage structures analyzed.

(f) A list of any previous hydraulic analysis and references relied on for the current study.

(g) Cross section plots for all cross sections, plotted at no more than two per 8½ x 11 sheet. Each cross section shall be scaled consistently and properly labeled with the cross section number. Cross sections shall be perpendicular to the flow and waterway centerline. Sections shall be oriented left to right facing downstream and show the two-year, ten-year, and 100-year water surface elevations.

(h) A CD-ROM with the model input and output files shall be included in the report package.

(i) Additional information may be required by the City as appropriate, based on the size and complexity of the project.

4A.8—Floodway and Floodplain Analysis

If a Floodway/Floodplain Analysis is required as a condition of development, the following information shall be submitted in addition to the requirements listed in Section 4A.7—Open Channel Hydraulic Modeling:

(a) A description of how the upstream and downstream boundary conditions were established.

(b) All proposed grading, culverts, bridges, drop structures, access ramps, etc., that are in the floodplain must be shown and included in the modeling.

(c) Describe the floodway analysis.

(d) Photographs of the existing study reach shall be included.

(e) A table with existing and proposed water surface elevations and velocities at each cross section.

(f) The 100-year floodplain and floodway lines shall be clearly shown on the map based on the modeling results and tied to the appropriate contour lines.

CITY OF SALEM
DEPARTMENT OF PUBLIC WORKS
ADMINISTRATIVE RULES
CHAPTER 109
DIVISION 004 APPENDIX B
LANDSCAPE REQUIREMENTS AND PLANT LISTS FOR STORMWATER FACILITIES

SECTION

TABLES

4B.1—General

The City encourages the use of native plants in stormwater drainage facilities, since they are best suited to long-term survival in the local climate. Because all landscaping needs may not be met by native plants, some ornamental non-native plants may be acceptable for use. This appendix provides a list of native plants for use in stormwater facilities constructed in the City.

Vegetation on the City's Non-Native, Nuisance, and Noxious weed list is strictly prohibited in drainage control facilities.

Contact the City of Salem Parks Department Urban Forester for approved stormwater trees for planting in ROW stormwater facilities.

4B.2—Planting Zones

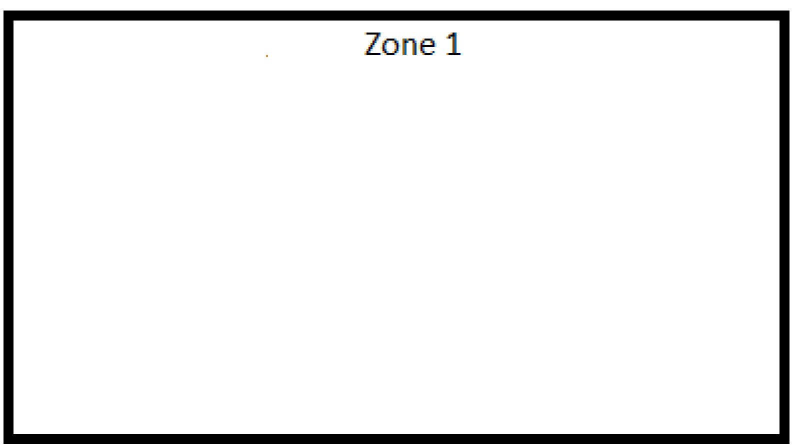
Zone 1: The area of the stormwater facility from the bottom of the facility to the designed high water mark. This area has moist to wet soils and plants located in this zone must be moisture tolerant. [USACE National Wetland Plant List (NWPL), OBL/FACW]

Zone 2: The area of the stormwater facility from the designed high water line to a point three feet up slope from the base. This area typically has dry to moist soils, with the moist soils being located further down the side slopes. Plants in this zone shall be drought tolerant and help stabilize the slopes. [USACE NWPL, FAC]

Zone 3: The area of the stormwater facility from a point three feet from the base of the slope to the top of the slope including the upland area. This zone is typified by dry soils. Plants in this zone shall be drought tolerant. [USACE NWPL, FACU/ UPL/ NI]

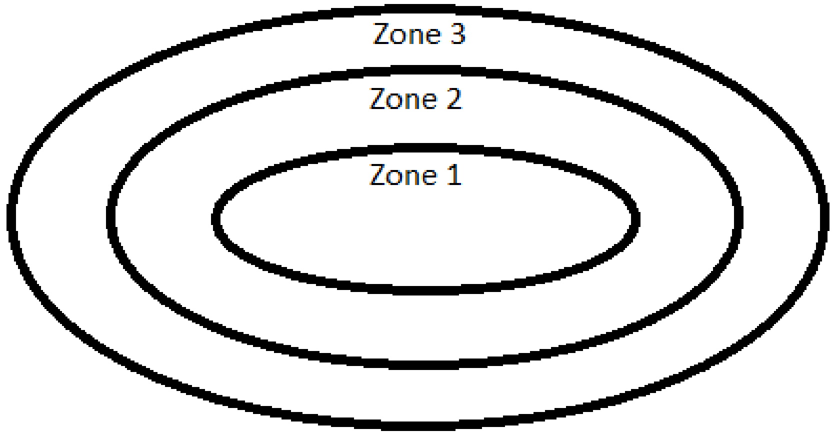
4B.3—Planting Zone Diagrams

Planter Planting Zone

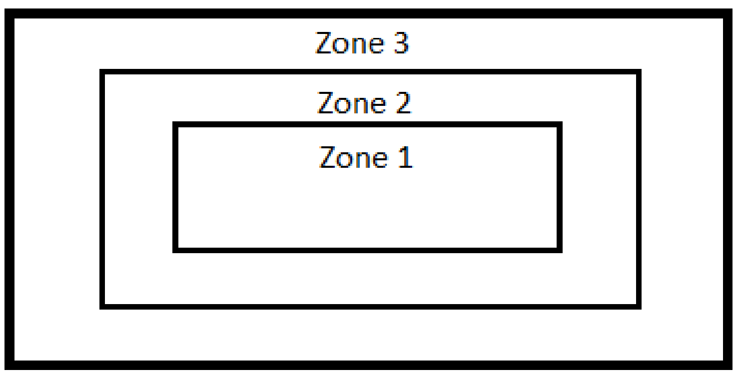


Top Div 4B

Rain Garden Planting Zones



Swale Planting Zones



4B.4—Planting, Landscape, and Irrigation Requirements

The vegetation used in GSI facilities may also be used to meet other landscape requirements of the project. Stormwater facilities with vegetative plantings must meet the following requirements:

(a) For all facilities located in riparian corridors and Public Stormwater Facilities, all plants shall be appropriate native species from the plant list contained in this appendix. For private stormwater facilities, non-native plant varieties may be used which are suitable for the planting zone where located in the facility.

(b) Plants will be inspected and accepted or rejected at the end of construction when the project is substantially complete.

(c) Establishment maintenance procedures, such as control of invasive weeds, animal and vandal damage, mulching, re-staking, watering, and mesh or tube protection replacement, shall be noted on the plans as needed to ensure plant survival.

(d) Stormwater facilities located in the ROW are not permitted to use evergreen trees to meet landscaping requirements. Street trees in the ROW shall be located outside of planters whenever possible. If street trees are placed in planters, the minimum width of the facility is four feet.

(e) Selected plant materials should be appropriate for soil, hydrologic, and other facility and site conditions. The density of plantings shall be consistent with the requirements listed in this appendix. The intent is for the plants to be dense enough when mature to minimize the growth of weeds and invasive species and reduce the amount of needed maintenance.

(f) The planting design shall minimize the need for herbicides, fertilizers, or pesticides at any time before, during, after construction, and on a long-term basis.

(g) Plants shall be selected and planted to minimize the need for mowing, pruning, and irrigation.

(h) Certified weed-free native grass or native wildflower seed shall be applied at the rates specified by the supplier. If plant establishment cannot be achieved with seeding by the time construction of the stormwater facility has been completed, the design shall provide for planting the area with wildflower sod, plugs, container plants, or other methods to establish the vegetation and protect the facility against erosion before water is allowed to enter the facility.

(i) A temporary irrigation system must be included in the design of each facility to be used until the plants are fully established, generally two to three years. Public stormwater facilities shall be designed so permanent, long-term irrigation systems are not needed.

(j) All plantings in and adjacent to the ROW shall be appropriate for the area and not interfere with vision and sight clearance requirements. Plants that will not become a nuisance by growing over the public sidewalks shall be selected.

(k) Growing medium shall be placed at a minimum depth of 12 inches over native soil, unless otherwise noted in the Standard Plans. See Appendix 4G–Key Material Specifications for details on topsoil, organic soil amendment, and growing medium requirements.

(l) A two-inch layer of pea gravel (not bark dust or bark chips) shall be specified over the growing medium between the plantings in Planting Zone 1. Organic mulch such as straw, bark, sawdust, or compost shall be placed at a depth of two to three inches above the high water mark, in Planting Zones 2 or 3. Organic mulch shall not be placed such that it may enter waterways or clog inlets/outlets.

4B.5—Stormwater Planters

(a) <u>Planting Zones</u>

Stormwater Planters have only one plant zone. Native plants for planters are listed in Table 4B-1.

(b) Planting Requirements

(1). Plants shall be spaced evenly. Use the spacing identified in Table 4B-1 for the plants selected.

(2). Perennial plants and bulbs may be planted throughout planters to add seasonal color and variability.

(3). The following plant quantities and sizes shall be installed per 100 square feet of surface area:

A. Woody Plants

(i). Four large shrubs/small trees: 3-gallon container or equivalent.

(ii). Six shrubs: 1-gallon container or equivalent.

B. Grasses, Herbs and Ground Cover

Container Size	Spacing
Plug (9 cubic inch) 50 cell tray, deep	9-inch on center, tri-space
4-inch pot	9-inch on center, tri-space
1-gallon container	12-inch on center, tri-space

Table 4B-1. Plant Spacing

C. At least 75 percent of the facility shall be planted with grasses, sedges, or rushes. Herbs and forbs may cover the balance of the facility.

4B.6—Rain Gardens, Vegetated Filter Strip, and Vegetated Swales

(a) Planting Zones

These facilities have three planting zones (1–3). Native plants approved for use in these facilities are included in Table 4B-1.

(b) Planting Requirements

(1). Minimum plant material quantities per 100 square feet of facility area are as follows:

A. Woody Plants

One evergreen or deciduous tree planted on the perimeter

(i). Evergreen trees: Minimum height: six feet.

(ii). Deciduous trees: Minimum caliper: 1½-inches at six inches above base.

(iii). Four large shrubs/small trees: three-gallon container or equivalent.

(iv). Six shrubs: one gallon container or equivalent.

B. Grasses, Herbs and Ground Cover

See Table 4B-1.

At least 75 percent of the facility shall be planted with grasses, sedges, or rushes. Herbs and forbs may cover the balance of the facility.

4B.7—Dry Detention Basins

(a) Planting zones

These facilities have three planting zones (⊢ 3). Native plants approved for use in these facilities are included in Table 4B-1.

(b) Planting Requirements

For soils with slow infiltration rates (less than two inches per hour) moist to wet plants are preferable; for soils with higher infiltration rates moist to dry plants are preferable. At least 50 percent of the facility shall be planted with grasses or grass-like plants. If a vegetated swale is utilized in conjunction with the detention basin, the swale portion of the facility shall be planted in accordance with Section 4B.5—Stormwater Planters.

(1). Minimum plant material quantities per 250 square feet of basin area shall be as follows:

A. Woody Plants

One evergreen or deciduous tree planted on the perimeter:

(i). Evergreen trees: Minimum height: Six feet.

(ii). Deciduous trees: Minimum caliper: 1½ inches at 6 inches above base.

(iii). Four large shrubs/small trees: three-gallon container or equivalent.

(iv). Six shrubs: one gallon container or equivalent.

B. Grasses, Herbs and Ground Cover

See Table 4B-1.

At least 75 percent of the facility shall be planted with grasses, sedges, or rushes. Herbs and forbs may cover the balance of the facility.

Plant Name		Proposed Facility Type					Characteristics	
Botanic Name, Common Name	Zone	Planters	Rain Garden	Filter Strip	Swale	Dry Detention Basin	Potential Height	O.C. Spacing
Grasses and Groundcover (1)								
Agrostis exarata Spike Bentgrass	1, 2	•	•	•	•	•	3′	1′
Arctostaphylos uva-ursi Kinnick-kinnick	3		•	•	•	•	1′+	1′
Beckmannia syzigachne American Slough Grass	1	•	•	•	•		3′	1′
Bromus carinatus California Brome Grass	3		•	•	•	•	2′	1′
Bromus sitchensis Alaska Brome	3		•	•	•	•	5′	1′
Bromus vulgaris Columbia Brome Grass	3		•	•	•	•	2′	1′
Carex densa Dense Sedge	1	•	•	•	•		2′	1′
Carex deweyana Dewey Sedge	2		•	•	•	•	2′	1′
Carex hendersonii Henderson Sedge	2				•	•	3′	1′
Carex obnupta Slough Sedge	1	•	•	•	•		4′	2′
Carex stipata Sawbeak Sedge	1	•	•	•	•		3′	1′
Carex tumulicola Foothill Sedge	2, 3				•	•	2′	1′
Danthonia californica California Oatgrass	2		•	•	•		3′	1′
Deschampsia caespitosa Tufted Hairgrass	1, 2	•	•	•	•	•	4′	2′
Deschampsia elongata Slender Hairgrass	1, 2	•	•	•	•	•	1′	1′
Eleocharis acicularis Needle Spike-Rush	1	•	•	•	•		1′	1′
Eleocharis ovata Ovate Spike-Rush	1	•	•	•	•		1.5′	1′
Eleocharis palustris Creeping Spike-Rush	1	•	•	•	•		3′	1′
Elymus glaucus Blue Wildrye	2, 3		•	•	•	•	3′	1′
Elymus trachycaulus Slender Wheatgrass	2, 3						3′	1′
Festuca occidentalis Western Fescue Grass	3		•	•	•	•	3′	1′
Festuca roemeri* var. *roemeri Roemer's Fescue	3		•	•	•		2′	1′
Festuca rubra* var. *commutata Western Red Fescue	2, 3						3′	1′

Division 004, Appendix B—Planting List for Stormwater Facilities

Plant Name		Proposed Facility Type					Characteristics	
Botanic Name, Common Name	Zone	Planters	Rain Garden	Filter Strip	Swale	Dry Detention Basin	Potential Height	O.C. Spacing
Fragaria vesca Woodland strawberry	2, 3		•	•	•	•	1′+	1′
Fragaria virginiana Wild strawberry	2, 3		•	•	•	•	1′+	1′
Glyceria occidentalis Western Mannagrass	1	•	•	•	•		5′	1′
Hordeum brachyantherum Meadow Barley	1, 2		•	•	•	•	3′	1′
Juncus acuminatus Tapertip Rush	1	•	•	•	•		3′	1′
Juncus effusus* var. *gracilis Common or Lamp Rush	1	•	•	•	•		3′	1′
Juncus effusus* var. *pacificus Common or Pacific Rush	1	•	•	•	•		3′	1′
Juncus ensifolius Dagger-leaf Rush	1	•	•	•	•	•	2′	1′
Juncus oxymeris Pointed Rush	1	•	•	•	•		3′	1′
Juncus patens Grooved Rush, Spreading Rush	1	•	•	•	•	•	2′	1′
Juncus tenuis, Slender Rush	1, 2	•	•	•	•	•	2′	1′
Juncus unilateralis One-sided Rush	1	•	•	•	•		2′	1′
Koeleria (Aira) macrantha Junegrass	2, 3		•	•	•	•	2′	1′
Scirpus acutus, Hardstem Bulrush	1	•	•	•	•		5′	4′
Scirpus americanus Three-square or American Bulrush	1	•	•	•	•		3′	1′
Scirpus microcarpus Small Fruited Bulrush	1	•	•	•	•		3′	1′
Forbs (Herbaceous Plants) (1)								
Achillea millefolium Western Yarrow	2, 3				•	•	3′	1′
Alisma plantago-aquatica Water Plantain	1	•	•	•	•		1′	1′
Allium acuminatum Hooker's Onion	2, 3		•			•	1′	1′
Allium amplectens Slim Leaf Onion	2, 3		•			•	1′	1′
Aquilegia formosa Western Columbine	2, 3		•		•	•	3′	1′
Aster subspicatus Douglas' Aster	1, 2	•	•	•	•	•	3′	1′
Bidens cernua Nodding Beggartick	1	•	•	•	•	•	3′+	1′
Brodiaea coronaria Harvest Brodiaea	1, 2	•	•			•	1′	1′

Division 004, Appendix B—Planting List for Stormwater Facilities

Plant Name		Proposed Facility Type					Characteristics	
Botanic Name, Common Name	Zone	Planters	Rain Garden	Filter Strip	Swale	Dry Detention Basin	Potential Height	O.C. Spacing
Camassia leichtlinii Great Camas	1, 2	•	•	•	•	•	3′	1′
Camassia quamash Common Camas	1, 2	•	•	•	•	•	3′	1′
Clarkia amoena Farewell to Spring [A]	2, 3					•	3′	1′
Clarkia purpurea Four Spot Godetia [A]	2, 3					•	2′	1′
Collinsia rattanii Blue-eyed Mary [A]	2, 3					•	2′	1′
Collomia grandiflora Large-flowered Collomia [A]	2, 3					•	2′	1′
Dichelostemma congestum Ookow	2, 3					•	2′	1′
Downingia elegans Calico Flower [A]	1	•	•	•	•	•	1′	1′
Epilobium densiflorum Denseflower Willow-herb	1	•				•	2′	1′
Eriophyllum lanatum Woolly Sunflower	3					•	2′	1′
Geum macrophyllum Large-leaf Avens	2		•	•	•		2′	1′
Gilia capitata Bluefield Gilia	3		•	•	•	•	2′	1′
Grindelia integrifolia Gumweed	1, 2	•				•	3′	1′
Iris tenax Oregon Iris	2, 3		•	•	•	•	2′	1′
Lotus purshiana Spanish Clover	1	•					2′	1′
Lupinus albicaulis Sickle-keeled Lupine	2, 3					•	5′	3′
Lupinus micranthus Small-flowered Lupine [A]	2, 3					•	1′	1′
Lupinus polyphyllus Large Leaf Lupine	2		•	•	•		3′	1′
Lupinus rivularis Stream Lupine	2						3′	1′
Madia elegans Common Madia [A]	2, 3					•	3′	1′
Plagiobothrys figuratus Fragrant Popcorn-flower [A]	1	•	•	•	•	•	1′	1′
Plagiobothrys scouleri Scouler's Popcorn flower [A]	1	•	•	•	•	•	1′	1′
Potentilla gracilis Slender Cinquefoil	2		•		•	•	2′	1′
Prunella vulgaris* var. *lanceolata Lance Selfheal	3					•	1′	1′
Ranaunculus occidentalis Western Buttercup	1	•					2′	1′
Ranunculus orthorhyncus Straightbeak Buttercup	1	•					3′	1′
Sanguisorba annua (occidentalis) Prairie Burnet [A]	3					•	2′	1′

Plant Name		Proposed Facility Type					Characteristics	
Botanic Name, Common Name	Zone	Planters	Rain Garden	Filter Strip	Swale	Dry Detention Basin	Potential Height	O.C. Spacing
Saxifraga occidentalis Western Rockbreaker	3					•	1′	1′
Sidalcea campestris Meadow Checker-mallow	3					•	4′	1′
Sisyrinchium douglasii Purple-Eyed Grass	2, 3		•	•	•	•	1′	1′
Sisyrinchium calfornicum Golden-eyed Grass	1	•	•	•	•		1′	1′
Sisyrinchium idahoense Idaho Blue-eyed Grass	1	•	•	•	•		1′	1′
Solidago canadensis Canadian Goldenrod	3					•	5′	1′
Symphyotrichum (Aster) hallii Hall's Aster	2, 3		•	•	•	•	2′	1′
Ferns								
Athyrium filix-femina Lady Fern	2	•				•	3′	2′
Blechnum spicant Deer Fern	2	•	•	•	•	•	3′	4′
Polypodium glycyrrhiza Licorice Fern	2	•	•	•	•	•	1′	1′
Polystichum munitum Sword Fern	2, 3	•	•	•	•	•	5′	4′
Pteridium aquilinum Bracken Fern	2, 3	•					3′	2′
Shrubs								
Ceanothus cuneatus Buckbrush	3		•	•	•	•	9′	12′
Ceanothus integerrimus Deerbrush	2, 3		•	•	•	•	12′	12′
Ceanothus sanguineous Oregon Redstem Ceanothus	3		•	•	•	•	12′	10′
Ceanothus velutinus Snowbrush	2, 3		•	•	•	•	10′	10′
Cornus sericea Red-osier or Redtwig Dogwood	1, 2	•	•	•	•	•	14′	12′
Gaultheria shallon Salal	2, 3		•	•	•	•	5′	2′
Mahonia aquifolium Tall Oregon Grape	2, 3		•	•	•	•	6′	4′
Mahonia nervosa Dull Oregon Grape	2, 3		•	•	•	•	2′	2′
Philadelphus lewisii Mock Orange	1, 2	•	•	•	•	•	10′	4′
Physocarpus capitatus Pacific Ninebark	1	•	•	•	•	•	12′	6′
Ribes sanguineum Red-flowering Currant	2, 3		•	•	•	•	10′	4′
Rosa gymnocarpa Baldhip Rose	2, 3		•	•	•	•	5′	3′

Plant Name		Proposed Facility Type					Characteristics	
Botanic Name, Common Name	Zone	Planters	Rain Garden	Filter Strip	Swale	Dry Detention Basin	Potential Height	O.C. Spacing
Rosa nutkana Nootka Rose	2		•	•	•	•	8′	4′
Rosa pisocarpa Swamp Rose	2		•	•	•	•	8′	4′
Rubus parviflorus Thimbleberry	2, 3		•	•	•	•	7′	4′
Rubus spectabilis Salmonberry	1, 2	•	•	•	•	•	10′	6′
Spiraea douglasii Douglas Spiraea	1, 2		•	•	•	•	6′	4′
Symphoricarpos albus Common Snowberry	2, 3	•	•	•	•	•	5′	2′
Viburnum edule Highbush Cranberry, Squashberry	1, 2	•	•	•	•	•	9′	6′
Large Shrubs/ Small Trees								
Acer circinatum Vine Maple	2	•	•	•	•		20′	12′
Amelanchier alnifolia Western Saskatoon Serviceberry	2, 3		•	•	•		9′	12′
Corylus cornuta Western Beaked Hazelnut	3		•	•	•		13′	12′
Crataegus douglasii (or C. suksdorfii) Douglas Black Hawthorn	2		•	•	•		30′	20′
Holodiscus discolor Oceanspray	3		•	•	•		15′	6′
Malus fusca Pacific Crab Apple	1, 2	•	•	•	•		40′	12′
Oemleria cerasiformis Indian Plum; Osoberry	1, 2	•	•	•	•		15′	6′
Prunus emarginata or P.Virginiana, Bitter or Choke Cherry	1	•	•	•	•		50′	12′
Rhamnus purshiana Cascara	1, 2	•	•	•	•		30′	12′
Salix fluviatilis Columbia Willow	1		•	•	•		18′	12′
Salix hookeriana Piper's Willow	1	•	•	•	•		18′	12′
Salix lucida (or S. lasiandra) Pacific Willow	1		•	•	•		60′	12′
Salix scouleriana Scouler's Willow	1	•	•	•	•		30′	12′
Salix sessilifolia Soft leafed Willow	1	•	•	•	•		24′	12′
Salix sitchensis Sitka Willow	1	•	•	•	•		25′	12′
Sambucus cerulea Blue Elderberry	2, 3		•	•	•		13′	12′
Sambucus racemosa Red Elderberry	2, 3		•	•	•		15′	12′

Plant Name		Proposed Facility Type					Characteristics	
Botanic Name, Common Name	Zone	Planters	Rain Garden	Filter Strip	Swale	Dry Detention Basin	Potential Height	O.C. Spacing
Conifer and Evergreen Trees								
Abies grandis Grand Fir	3		•	•	•	•	100′+	12′
Arbutus menziesii Madrone	3		•	•	•	•	100′+	12′
Calocedrus decurrens Incense cedar	3		•	•	•	•	100′+	12′
Castanopsis chrysophylla Chinquapin	3					•	100′+	12′
Pinus monticola Western White Pine	3		•	•	•	•	100′+	12′
Pinus ponderosa Ponderosa Pine	3		•	•	•	•	100′+	12′
Pseudotsuga menziesii Douglas Fir	2,3		•	•	•	•	100′+	12′
Thuja plicata Western Red Cedar	2, 3		•	•	•	•	200′+	12′
Tsuga heterophylla Western hemlock	2, 3		•	•	•	•	100′+	12′
Deciduous Trees								
Acer macrophyllum Big leaf Maple	2, 3		•	•	•	•	100′	12′
Alnus rhombifolia White Alder	1		•	•	•	•	80′	12′
Alnus rubra Red Alder	1, 2		•	•	•	•	120′	12′
Cornus nuttallii Western Flowering Dogwood	2		•	•	•	•	60′	12′
Fraxinus latifolia Oregon Ash	1		•	•	•	•	80′	12′
Populus balsamifera Black Cottonwood	2		•	•	•	•	100′+	12′
Quercus garryana Oregon White Oak	3		•	•	•	•	80′	12′
Quercus kelloggii California Black Oak	3		•	•	•	•	80′	12′

[A] Annual Plant. Limit use in Planting Zone 1 and 2, due to minimal soil retention capabilities.

(1) *On Center Spacing assumes the use of mature plants in one-gallon containers. If less mature plants are used, spacing between plants will be reduced in accordance with Table 4B-1.*

4B.8—Constructed Treatment and Subsurface Gravel Wetlands

(a) Planting Requirements

(1). Shrubs and wetland plantings shall be designed to minimize solar exposure of open water areas. Trees or other appropriate vegetation shall be located around the east, south, and west sides of a facility to maximize shading.

(2). Facility area is equivalent to the area of the wetland, including bottom and side slopes, plus a ten-foot buffer around the wetland.

(3). City maintained facilities shall be designed not to require mowing. Where mowing cannot be avoided, facilities shall be designed to require mowing no more than once or twice annually. Turf and lawn areas are not allowed for City maintained facilities.

(4). Minimum plant material quantities per 200 square feet of the facility area are as follows:

A. Woody Plants

One evergreen or deciduous tree:

(i). Evergreen trees: Minimum height: Six feet.

(ii). Deciduous trees: Minimum caliper: 1½ inches at Six inches above base.

(iii). Four large shrubs/small trees: Three-gallon container or equivalent.

(iv). Six shrubs: One-gallon container or equivalent.

B. Grasses, Herbs and Ground covers

(i). One plant per 12 inches on center, triangular spacing.

(ii). Minimum container size: four-inch pot.

At least 75 percent of the facility shall be planted with grasses or grass-like plants. Herbs and forbs may cover the balance of the facility.

C. Aquatic and Emergent Wetland Plants

One plant per two square feet of a pond emergent plant zone. The emergent plant zone is closest to the shore, where grasses, sedges and rushes provide shelter for frogs, birds, mammals, algae, protozoan, worms, insects, snails and small fish.

Top Div 4B

The emergent plant zone shall be at least 25 percent of the total pond water surface area.

Wetlands Plant List	
Herbaceous Plants (Aquatic and Emergent): Zone 1- Emergent Wet to Saturated	
Alisma plantago-aquatica Water Plantain	****Potamogeton natans*** Floating-leaf Pondweed
Carex obnupta Slough Sedge	****Sagittaria latifolia*** Broadleaf Arrowhead, Wapato
Eleocharis ovata Ovate Spike rush	***Scirpus acutus*** Hardstem Bulrush
Eleocharis palustris Creeping Spike rush	***Sparganium emersum*** Narrowleaf Bur-reed
****Lemna minor*** Common Lesser Duckweed*	***Veronica americana*** American Speedwell
Myosotis laxa Small-flowered Forget-me-not	
Zone 1- Moist to Wet Zone	
Alopecurus geniculatus Water foxtail	***Juncus effusus* var. *pacificus*** Common Rush or Pacific Rush
Beckmannia syzigachne American Slough Grass	***Juncus ensifolius*** Dagger-leaf Rush
Carex densa Dense Sedge	***Juncus oxymeris*** Pointed Rush
Carex deweyana Dewey Sedge	***Juncus tenuis*** Slender Rush
Carex hendersonii Henderson Sedge	***Juncus patens*** Grooved Rush; Spreading Rush
Carex obnupta Slough Sedge	***Juncus unilateralis*** One-sided Rush
Carex stipata Sawbeak Sedge	***Lupinus polyphyllus*** Large-leaved Lupine
Juncus acuminatus Tapertip Rush	***Scirpus microcarpus*** Small flowered (or fruited) Bulrush
Juncus effusus* var. *gracilis Common Rush or Lamp Rush	
Grasses and Groundcovers: Varying Zones. See Seed and Sowing Rates for Stormwater Facilities (Section 4B.10—Forbs and Section 4B.11—Grasses) or use plant spacing in Table 4B-1.	
Arctostaphylos uva-ursi Kinnick-Kinnick; dry	***Festuca roemeri*** var. ***roemeri*** Roemer's Fescue; dry
Aster hallii Hall's Aster; moist-dry	***Glyceria occidentalis*** Western Mannagrass; moist-wet
Aster subspicatus Douglas' Aster; moist-dry	***Iris tenax*** Oregon Iris; moist-dry
Bidens cernua, Nodding Beggartick; moist-wet	***Koeleria macrantha*** Junegrass; moist-dry
Bromus carinatus California Brome Grass; moist-dry	***Lupinus micranthus*** Small Flowered Lupine; moist-dry
Bromus sitchensis Alaska Brome; moist-dry	***Lupinus polyphyllus*** Large Leaf Lupine;

Wetlands Plant List	
	moist-dry
Bromus vulgaris Columbia Brome Grass; moist-dry	***Lupinus rivularis*** Riverbank Lupine; moist-dry
Danthonia californica California Oatgrass; moist-dry	***Potentilla gracilis* var. *gracilis*** Graceful Cinquefoil; moist-dry
	Sisyrinchium idahoense Blue-eyed Grass; moist-dry
Shrubs: Moist to Saturated Zones 1, 2	
Acer circinatum Vine Maple	***Rosa pisocarpa*** Swamp Rose
Blechnum spicant Deer Fern	***Rubus spectabilis*** Salmonberry
Cornus sericea Red-stemmed dogwood	***Salix fluviatilis*** Columbia Willow
Physocarpus capitatus Pacific Ninebark	***Salix hookeriana*** Hookers Willow
Polystichum munitum Sword fern	***Salix sitchensis*** Sitka Willow
Rhamnus purshiana Cascara	***Viburnum edule*** Highbush Cranberry; Squashberry
Spiraea douglasii Douglas Spiraea	
Shrubs: Moist to Dry Zones 2, 3	
Crateagus douglasii Black Hawthorn	***Rosa gymnocarpa*** Baldhip Rose
Lonicera involucrata Black twinberry	***Rosa nutkana*** Nootka Rose
Mahonia aquifolium Tall Oregon Grape	***Rubus parviflorus*** Thimbleberry
Mahonia nervosa Dull Oregon Grape	***Sambucus racemosa*** Red Elderberry
Oemlaria cerasiformis Indian Plum	***Spiraea betulifolia*** Shiny-leaf Spiraea
Prunus emarginata Bitter Cherry	***Symphoricarpus albus***, Snowberry
Shrubs: Dry Zone 3	
Ceanothus cuneatus Buckbrush	***Philadelphus lewisii*** Mock Orange
Ceanothus integerrimus Deerbrush	***Ribes sanguineum*** Red Flowering Currant
Corylus cornuta Western Beaked Hazelnut	***Salix scouleriana*** Scouler's Willow
Holodiscus discolor Oceanspray	
Trees: Conifer and Evergreen Trees: Varying Zones	
Abies grandis Grand Fir; moist-dry	***Pinus ponderosa*** Ponderosa Pine; dry
Arbutus menziesii Madrone; dry	***Pseudotsuga menziesii*** Douglas Fir; moist-dry
Calocedrus decurrens Incense Cedar; dry	***Sequoia sempervirens*** Coast Redwood; moist
Pinus monticola Western White Pine; dry-moist	***Thuja plicata*** Western Red Cedar; moist-wet

Deciduous Trees: Varying Zones	
Acer macrophyllum, Big leaf Maple; moist-dry	***Malus fusca*** Pacific Crabapple; moist-wet
Alnus rhombifolia White Alder; moist-wet	***Oemleria cerasiformis*** Indian Plum; moist-dry
Alnus rubra Red Alder; moist-wet	***Populus balsamifera*** Black Cottonwood-; moist-wet
Amelanchier alnifolia Serviceberry; dry	***Quercus garryana*** Oregon White Oak; moist-dry
Cornus nuttalii Western Flowering Dogwood; moist-dry	***Quercus kelloggii*** California Black Oak; dry
Fraxinus latifolia Oregon Ash; moist-wet	***Salix lucida* var. *lasiandra*** Pacific Willow; moist-wet

4B.9—Green Roofs Plants List

Plant Name	Characteristics					
Botanic name, Common Dam	NW Native	Evergreen	Potential Height	O.C. Spacing	Full Sun	Partial Shade
Sedums and Succulents						
Delosperma ssp., Ice Plant	N	Y	4”		•	
Malephora crocea* var. *purpureo crocea 'TequilaSunrise'	N	Y	10”		•	
Sedum ‘Autumn Joy’	N	N	24”		•	
Sedum acre, Biting Stonecrop	N	Y	2”		•	
Sedum album, White Stonecrop	N	Y	3”		•	
Sedum divergens, Pacific Stonecrop	N	Y	3”		•	
Sedum hispanicum, Spanish Stonecrop	N	Y	3”		•	
Sedum kamtschaticum, Kirinso	N	N	6”		•	
Sedum oreganum, Oregon Stonecrop	Y	Y	4”		•	•
Sedum sexangular, Tasteless Stonecrop	N	Y	4”		•	
Sedum spathulifolium, Stonecrop	Y	Y	4”		•	
Sedum spurium, Two-row Stonecrop	N	Y	6”		•	•
Sempervivum tectorum, Hens and Chicks	N	Y	6”		•	
Herbaceous Plants						
Achillea millefolium, Common Yarrow	N	N	36”		•	

Plant Name	**Characteristics**					
Botanic name, Common Dam	**NW Native**	**Evergreen**	**Potential Height**	**O.C. Spacing**	**Full Sun**	**Partial Shade**
Achillea tomentosa, Wooly Yarrow	N	N	8″		•	
Arenaria Montana, Sandwort	N	N	4″		•	
Artemesia 'Silver Mound', Artemesia	N	N	12″		•	
Aurinia saxatilis, Compacta	N	N	6″		•	
Castilleja foliosa, Indian Paintbrush	Y	N	10″		•	
Dianthus ssp.	N	N	12″		•	•
Erigeron discoideus, Fleabane	N	N	12″		•	•
Festuca glauca, Blue Fescue	N	Y	12″		•	•
Fragaria chiloensis, Coastal Strawberry	Y	Y	10″		•	•
Fragaria virginiana, Wild Strawberry	Y	Y	10″		•	•
Gaillardia aristata, Birds-eye gilia	N	N	20″		•	•
Gazania linearis 'CO Gold', Gazania	N	N	6″		•	
Gilia capitata, Blue Thimble Flower	Y	N	12″		•	
Koelaria macrantha, June Grass	N	N	24″		•	•
Linaria reticulate, Purplenet Toadflax	N	N	20″		•	
Lobularia maritime, Sweet Alyssum	N	N	12″		•	
Polypodium glycrrhiza, Licorice Fern	Y	Y	12″		•	•
Polystichum munitum, Sword Fern	Y	Y	24″		•	•
Potentilla napalensis, Nepal Cinquefoil	N	N	14″		•	•
Potentilla neumanniana, Cinquefoil	N	N	14″		•	
Thymus serphyllum, Creeping Thyme	N	N	3″		•	
Veronica liwanensis, Speedwell	N	N	2″		•	•

4B.10—Seed and Sowing Rates for Stormwater Facilities: Forbs

Scientific Name	**Common Name**	**Sowing Season**	**Sow Rate (hand)**	**Zone**
Achillea millefolium	Western yarrow	Fall	0.25 lbs/ac	1, 2
Alisma media	Water plantain	Fall/Spring	1.0 lb/ac	1
Aquilegia formosa	Western columbine	Fall	1.0 lb/ac	1, 2
Camassia leichtlinii	Great camas	Fall	1 lb/ac	1, 2

Scientific Name	**Common Name**	**Sowing Season**	**Sow Rate (hand)**	**Zone**
Camassia quamash	Common camas	Fall	1 lb/ac	1, 2
Clarkia amoena	Farewell to Spring	Fall-early Spring	0.25-1 lb/ac	2, 3
Clarkia purpurea	Four Spot godetia	Fall-early Spring	0.25-1 lb/ac	2, 3
Collinsia rattanii	Blue-eyed mary	Fall/Spring	0.25 lbs/ac	2, 3
Collomia grandiflora	Large-flowered collomia	Fall/Spring	0.5 lbs/ac	2, 3
Epilobium densiflorum	Denseflower willow-herb	Fall	1.0 lb/ac	1, 2
Eriophyllum lanatum	Woolly sunflower	Fall	1.0 lb/ac	1, 2
Geum macrophyllum	Large-leaf avens	Fall-early Spring	0.25-1 lb/ac	1, 2
Gilia capitata	Bluefield gilia	Fall-early Spring	2 lbs/ac	2, 3
Grindelia integrifolia	Gumweed	Fall-early Spring	0.25-1 lb/ac	2, 3
Iris tenax	Oregon iris	Fall	2 lbs/ac	2, 3
Lotus purshiana	Spanish clover	Fall	2 lbs/ac	2, 3
Lupinus albicaulis	Sickle-keeled lupine	Fall	1 lb/ac	2, 3
Lupinus micranthus	Small-flowered lupine	Fall	1 lb/ac	2, 3
Lupinus rivularis	Stream lupine	Fall	1 lb/ac	2, 3
Madia elegans	Common madia	Fall-early Spring	0.25-1 lb/ac	2, 3
Plagiobothrys figuratus	Fragrant popcorn-flower	Fall-early Spring	1 lb/ac	1
Plagiobothrys scouleri	Scouler's popcorn flower	Fall-early Spring	0.25-1 lb/ac	1
Potentilla gracilis	Slender cinquefoil	Fall-early Spring	0.25-1 lb/ac	1, 2
Prunella vulgaris var. lanceolata	Lance selfheal	Fall-early Spring	2 lbs/ac	1, 2
Ranaunculus occidentalis	Western buttercup	Fall	1 lb/ac	2, 3
Ranunculus orthorhyncus	Straightbeak buttercup	Fall-early Spring	0.25-1 lb/ac	1, 2
Sanguisorba annua (occidentalis)	Praire burnet	Fall-early Spring	0.25-1 lb/ac	1, 2
Saxifraga occidentalis	Western Rockbreaker	Fall-early Spring	0.25-1 lb/ac	1, 2

Scientific Name	Common Name	Sowing Season	Sow Rate (hand)	Zone
Sidalcea campestris	Meadow checker-mallow	Fall	1 lb/ac	2, 3
Sisyrinchium calfornicum	Golden-eyed grass	Fall	0.25-1 lb/ac	2, 3
Sisyrinchium idahoense	Blue-eyed grass	Fall	0.25-1 lb/ac	2, 3
Solidago canadensis	Canada goldenrod	Fall	0.50 lbs/ac	2, 3
Symphyotrichum (Aster) hallii	Hall's aster	Fall-early Spring	1 lb/ac	2, 3

4B.11—Seed and Sowing Rates for Stormwater Facilities: Grasses

Scientific Name	Common Name	Sowing Season	Sow Rate (hand)
Agrostis exarata	Spike bentgrass	early fall/spring	5 lbs/ac
Alopecurus geniculatus	Water foxtail	fall/spring	25 lbs/ac
Beckmannia syzigachne	American sloughgrass	fall/spring	2 lbs/ac
Bromus carinatus	California brome	early fall/spring	25 lbs/ac
Bromus sitchensis	Alaska brome	early fall/spring	25 lbs/ac
Bromus vulgaris	Columbia brome	fall/spring	5 lbs/ac
Danthonia californica	California oatgrass	fall/spring	30 lbs/ac
Deschampsia cespitosa	Tufted hairgrass	fall/spring	2 lbs/ac
Deschampsia elongata	Slender hairgrass	early fall/spring	20 lbs/ac
Elymus glaucus	Blue Wildrye	early fall/spring	25 lbs/ac
Elymus trachycaulus	Slender wheatgrass	early fall/spring	25 lbs/ac
Festuca occidentalis	Western fescue	fall/spring	20 lbs/ac
Festuca roemeri	Roemer's fescue	fall/spring	2 lbs/ac
Glyceria elata	Tall mannagrass	fall/spring	2 lbs/ac
Glyceria occidentalis	Western mannagrass	fall/spring	25 lbs/ac
Hordeum brachyantherum	Meadow barley	early fall/spring	25 lbs/ac
Koeleria macrantha	Prairie Junegrass	fall/spring	20 lbs/ac
Leersia oryzoides	Rice cutgrass	fall/spring	5 lbs/ac
Poa secunda	Pine Bluegrass	fall/spring	2lbs/ac

CITY OF SALEM
DEPARTMENT OF PUBLIC WORKS
ADMINISTRATIVE RULES
CHAPTER 109
DIVISION 004 APPENDIX C
INFILTRATION TESTING

SECTION

FIGURES

Top Div 4C

4C.1—General

To properly size and locate a stormwater treatment facility, it is necessary to characterize the soil infiltration rate at the specific location of the proposed facility. All projects that require a stormwater treatment facility must evaluate existing site conditions and determine if the infiltration rate is adequate to support the proposed stormwater treatment facility.

There are two alternatives for meeting the infiltration testing requirements depending on the size and type of project. These include:

(a) **The Basic Method—Open Pit Infiltration Test**

The Basic Method open pit test is only allowed for SFR projects on private property with less than 10,000 square feet of new plus replaced impervious surface. The methodology for the basic method infiltration testing can be found in Section 4C.2—Basic Method—Open Pit Infiltration Test.

(b) **Professional Method Infiltration Testing**

The professional method infiltration testing is applicable for large projects with more than 10,000 square feet of new plus replaced impervious surface. Alternative testing methodologies for large projects are described in Section 4C.3—Professional Method Infiltration Testing.

The City reserves the right to require additional testing, if needed.

4C.2—Basic Method—Open Pit Infiltration Test

The purpose of the Basic Method infiltration test is to provide a simple method for the non-professional design of stormwater treatment systems on small projects. The results of infiltration testing must be documented on the Basic Method Report Form (see Figure 4C-3). For projects with over 10,000 square feet of new plus replaced impervious surface, the Professional Method infiltration testing will be used and is found in Section 4C.3—Professional Method Infiltration Testing.

The intent of the open pit test is to determine whether or not the local infiltration rate is adequate (0.5 inches/hour or greater) to meet the requirements for an infiltration stormwater treatment facility. A licensed professional is not required when conducting the Basic Method infiltration test.

(a) **Basic Method Instructions**

(1). A simple open pit infiltration test is required for each facility designed through the Simplified Method. The test should be in the location where the facility is proposed or within the direct vicinity.

(2). Excavate a test hole to the depth where the bottom of the stormwater treatment facility will be located or otherwise to four feet. The test hole can be excavated with small excavation equipment or by hand using a shovel, auger, or post hole digger.

(3). If a layer hard enough to prevent further excavation is encountered, or if noticeable moisture/water is encountered in the soil, stop and measure this depth from the surface and record it on the Simplified Method Form. Proceed with the test at this depth.

(4). Fill the hole with water to a height of about six inches from the bottom of the hole (or to one-half the maximum depth of the proposed facility), and record the exact time. Check the water level at regular intervals (every one minute for fast-draining soils to every ten minutes for slower-draining soils) for a minimum of one hour or until all of the water has infiltrated. Record the distance the water has dropped from the top edge of the hole.

(5). Repeat this process two more times, for a total of three rounds of testing. These tests should be performed as close together as possible to portray the soil's ability to infiltrate at different levels of saturation accurately. The third test provides the best measure of the saturated infiltration rate.

(6). For each test pit required, submit all three testing results with the date, duration, drop in water height, and conversion into inches per hour.

Infiltration facilities shall be used for infiltration rates greater than 0.5 inches. Filtration facilities shall be used for infiltration rates less than 0.5 inches per hour. Facilities can be sized using the simplified method per Subsection 4.2(n)—Design Sizing Methodologies and infiltration rate results from the basic test.

4C.3—Professional Method Infiltration Testing

The Professional Method must be used for all large projects. A qualified professional must exercise judgment in the selection of the infiltration test method based on the site conditions. The three acceptable infiltration methods used to determine a design infiltration rate are:

- ♦ Encased Falling Head.
- ♦ Double-Ring Infiltrometer.
- ♦ Open Pit Falling Head.

(a) **General Criteria**

(1). Testing must be conducted or observed by a qualified professional. A qualified professional may be either a Professional Engineer (PE), Registered Geologist (RG), or Certified Engineering Geologist (CEG) licensed in the State of Oregon.

(2). The location and depth of the test shall be performed at the proposed facility location and depth.

(3). Boring logs should be provided as supporting information with the infiltration and depth to groundwater tests.

(b) **Depth and Location of Required Tests**

Infiltration tests shall be performed at the base elevation of the proposed facility.

If a confining layer, or soil with a greater percentage of fines, is observed during the subsurface investigation to be within four feet of the bottom of the planned infiltration system, the testing shall be conducted within that confining layer.

Tests must be performed in the immediate vicinity of the proposed facility. Exceptions can be made to the test location provided the qualified professional can support that the strata are consistent from the proposed facility to the test location.

For relatively deep stormwater facilities, a hollow stem auger with an electronic measuring tape can be used, provided there is an adequate seal between the auger and the native soil.

(c) **Minimum Number of Infiltration Tests**

At least one infiltration test is required for any potential location where a public or private stormwater treatment facility will be sited. For large and/or linear facilities, an additional infiltration test shall be conducted every 100 feet. The City will accept a recommended infiltration rate from a Geotechnical Engineer for a large facility where more than three infiltration tests are required.

(d) **Encased Falling Head Test**

The encased falling head procedure is based on a modification of the EPA Falling Head Percolation Test Procedure (*Onsite Wastewater Treatment and Disposal Systems Design Manual,* EPA/625/1-80-012, 1980). The most significant modification is that this test is performed with a six-inch casing that is embedded approximately six inches into the native soil. The goal of this field test is to evaluate the vertical infiltration rate through a six-inch plug of soil, without allowing any lateral infiltration. The test is not appropriate in gravelly soils or in other soils where a good seal with the casing cannot be established.

(1). Embed a solid six-inch-diameter casing into the native soil at the elevation of the proposed facility bottom (see Figure 4C-1). Ensure that the embedment provides a good seal around the pipe casing so that percolation will be limited to the six-inch plug of the material within the casing. This method can also be applied to testing within hollow stem augers, provided the driller and tester are reasonably certain that a good seal has been achieved between the soil and auger. If an adequate seal cannot be obtained, the open pit falling head procedure shall be used (see Subsection 4C.3(f)—Open Pit Falling Head Procedure).

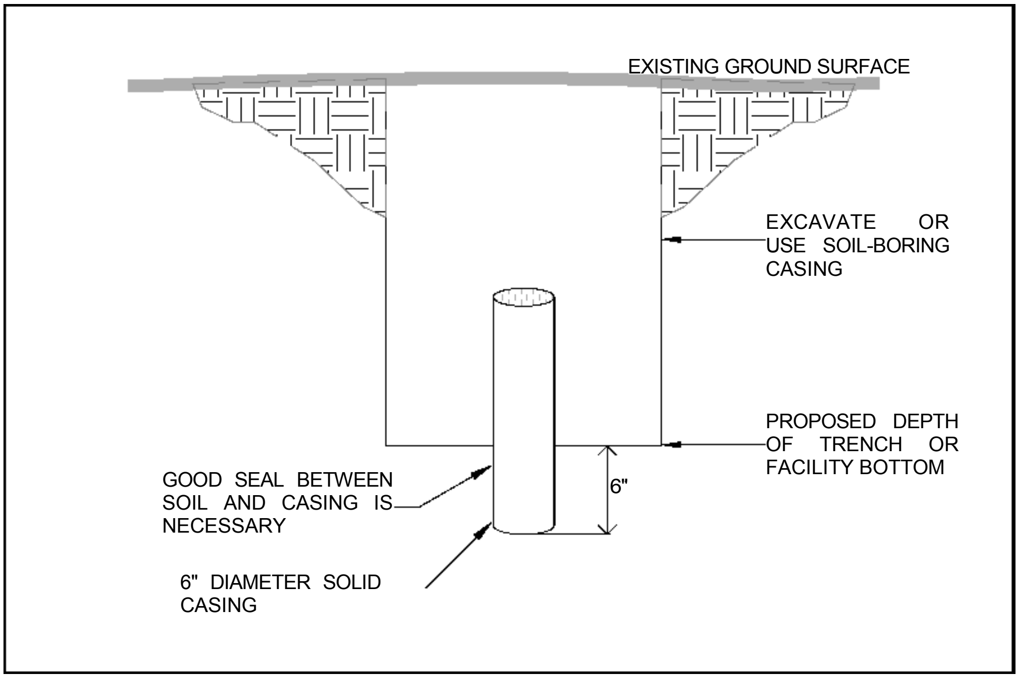


Figure 4C-1. Encased Falling Head Procedure

(2). A two-inch layer of coarse sand or fine gravel may be placed to protect the bottom from scour and sloughing.

(3). Fill the pipe with clean water a minimum of one foot above the soil to be tested, and maintain this depth for at least four hours (or overnight if clay soils are present) to presoak the native material.

Percolation rate measurements must be made after 15 hours and no more than 30 hours after the soaking period begins. It is important that the soil be allowed to soak for a sufficiently long period of time to allow the soil to swell if accurate results are to be obtained. Any soil that sloughed into the hole during the soaking period must be removed and the water level shall be adjusted to six inches above the added gravel (or eight inches above the bottom of the hole).

In sandy soils with little or no clay, soaking is not necessary. If after filling the hole twice with 12 inches of water, the water seeps completely away in less than ten minutes, the test can proceed immediately.

(4). To conduct the first trial of the test, fill the pipe to approximately six inches above the soil and measure the water level to the nearest 0.01 foot (⅛ inch). The level should be measured with a tape or other device with reference to a fixed point. The top of the pipe is often a convenient reference point. Record the exact time.

(5). Measure the water level to the nearest 0.01 foot (⅛ inch) at ten-minute intervals for a total period of one hour (or 20-minute intervals for two hours in

Top Div 4C

slower soils) or until all of the water has drained. The infiltration test is continued until the measured infiltration rate between two successive trials does not vary by more than five percent. At least three trials must be conducted. After each trial, the water level is readjusted to the six inch level. Enter results into the Data Table (see Figure 4C-2). At no time during the test is the water level allowed to rise more than six inches above the gravel.

(6). The result of the last water level drop is used to calculate the tested infiltration rate. The final rate must be reported in inches per hour.

(7). Upon completion of the testing, the casings must be immediately pulled, and the test pit must be backfilled.

(e) **Double Ring Infiltrometer Test**

The double-ring infiltrometer test procedure must conform to ASTM 3385-94. The test is performed within two concentric casings embedded and sealed to the native soils. The outer ring maintains a volume of water to diminish the potential of lateral infiltration through the center casing. The volume of water added to the center ring to maintain a static water level is used to calculate the infiltration rate. The double-ring infiltrometer is appropriate only in soils where an adequate seal can be established.

This test may be difficult to perform where the tested soil strata are in a pit, since careful regulation of the static volumes is necessary.

(f) **Open Pit Falling Head Procedure**

The Open Pit Falling Head test is applicable where site conditions prevent a good seal between the native soil and the infiltration equipment used in the other professional methods. The procedure is based on the Environmental Protection Agency (EPA) Falling Head Percolation Test Procedure (*Onsite Wastewater Treatment and Disposal Systems Design Manual,* EPA/625/1-80-012, 1980). The test is performed in an open excavation and therefore is a test of the combination of vertical and lateral infiltration.

(1). Excavate an approximately two-foot by two-foot-wide hole into the native soil to the bottom elevation of the proposed facility. The test can be conducted in a machine-excavated pit or a hand-dug pit using a shovel, posthole digger, or hand auger. If smooth augering tools or a smooth excavation bucket is used, scratch the sides and bottom of the hole with a sharp-pointed instrument, and remove the loose material from the bottom of the test hole.

(2). A two-inch layer of coarse sand or fine gravel may be placed to protect the bottom from scour and sloughing.

(3). Fill the hole with clean water a minimum of one foot above the soil to be tested, and maintain this depth of water for at least four hours (or overnight if clay soils are present) to presoak the native material.

(4). Percolation rate measurements must be made after 15 hours and no more than 30 hours after the soaking period begins. It is important that the soil be allowed to soak for a sufficiently long period of time to allow the soil to swell if accurate results are to be obtained. Any soil that sloughed into the hole during the soaking period must be removed and the water level shall be adjusted to six inches above the added gravel (or eight inches above the bottom of the hole).

(5). In sandy soils with little or no clay, soaking is not necessary. If after filling the hole twice with 12 inches of water, the water seeps completely away in less than ten minutes, the test can proceed immediately.

(6). The measurements should be made with reference to a fixed point. A lath placed in the test pit prior to filling or a sturdy beam across the top of the pit are convenient reference points. The tester and excavator should conduct all testing in accordance with OSHA regulations.

(7). Measure the water level to the nearest 0.01 foot (⅛ inch) at ten-minute intervals for a total period of one hour (or 20-minute intervals for two hours in slower soils) or until all of the water has drained. At no time during the test is the water level allowed to rise more than six inches above the gravel.

(8). Successive trials must be run until the measured infiltration rate between two successive trials does not vary by more than five percent. At least three trials must be conducted. After each trial, the water level is readjusted to the 12-inch level. Enter results into the data table (See Figure 4C-2).

(9). The results of the last water level drop are used to calculate the tested infiltration rate. The final rate must be reported in inches per hour. See the calculation following Figure 4C-2.

(10). For very rapidly draining soils, it may not be possible to maintain a water head above the bottom of the test pit. If the infiltration rate meets or exceeds the flow of water into the test pit, conduct the test in the following manner:

A. Approximate the area over which the water is infiltrating.

B. Using a water meter, bucket, or other device, measure the rate of water discharging into the test pit.

C. Calculate the infiltration rate by dividing the rate of discharge (cubic inches per hour) by the area over which it is infiltrating (square inches).

(11). Upon completion of the testing, the excavation must be backfilled.

4C.4—Reporting Requirements

(a) **Basic Method Reporting Requirements**

For the basic method the following information shall be submitted with the project's submittals.

(1). Site plan showing the location of each test performed.

(2). Infiltration test data table (see Figure 4C-3).

(3). Infiltration test results in inches per hour.

(b) **Professional Method Reporting Requirements**

For large projects where the professional method is used, the following information shall be submitted with the project's submittals.

(1). Location and depth of excavation. The excavation should be deep enough to verify that there is a three-foot separation between the final depth of the facility (rock gallery) and the seasonal high groundwater or soil layer that could reduce the infiltration rate.

(2). Summary and discussion of infiltration testing procedure, including number of tests, amounts of water used in each test (inches, gallons, etc.), and time of each test. Testing is required to show that an accurate rate was achieved.

(3). A discussion of how the test was performed including (based on the test performed):

A. Encased falling head.

(i). Pipe type.

(ii). Embedment depth.

(iii). Size of pipe.

B. Double ring infiltrometer.

(i). Pipe type.

(ii). Embedment depth.

(iii). Size of pipe.

Top Div 4C

C. Open pit (size of area).

D. Soil types with depth.

E. Groundwater observations–seasonal high groundwater level estimation.

F. Infiltration results in inches per hour.

G. Test results for each location recorded on a form similar to that shown in Figure 4C-3.

H. The stamp of the qualified professional who is submitting the report.

<table>
<tr><td colspan="3">Location: Lot 105,
Low Point Heights Subdivision</td><td>Date: 6/28/2010</td><td colspan="2">Test Hole Number: 3</td></tr>
<tr><td colspan="3">Depth to bottom of hole: 57 inches</td><td>Diameter of hole: 0.5 feet</td><td colspan="2">Test Method: Encased Falling Head</td></tr>
<tr><td colspan="6">Tester's Name: C.J. Tester
Tester's Company: Tester Company Tester's Contact Number: 555-1212</td></tr>
<tr><td colspan="3">Depth, feet</td><td colspan="3">Soil Texture</td></tr>
<tr><td colspan="3">0-0.5</td><td colspan="3">Black Top Soil</td></tr>
<tr><td colspan="3">0.5-1.0</td><td colspan="3">Brown SM</td></tr>
<tr><td colspan="3">1.0-2.2</td><td colspan="3">Brown ML</td></tr>
<tr><td colspan="3">2.2-5.1</td><td colspan="3">Brown CL</td></tr>
<tr><td>Time</td><td>Time interval, minutes</td><td>Measurement, feet</td><td>Drop in water level, feet</td><td>Percolation rate, inches per hour</td><td>Remarks</td></tr>
<tr><td>9:00</td><td>0</td><td>3.75</td><td>-</td><td></td><td>Filled with 6”</td></tr>
<tr><td>9:20</td><td>20</td><td>3.83</td><td>0.08</td><td></td><td></td></tr>
<tr><td>9:40</td><td>20</td><td>3.91</td><td>0.08</td><td>2.88</td><td></td></tr>
<tr><td>10:00</td><td>20</td><td>3.98</td><td>0.07</td><td>2.52</td><td></td></tr>
<tr><td>10:20</td><td>20</td><td>4.04</td><td>0.06</td><td>2.16</td><td></td></tr>
<tr><td>10:40</td><td>20</td><td>4.11</td><td>0.07</td><td>2.52</td><td></td></tr>
<tr><td>11:00</td><td>20</td><td>4.17</td><td>0.06</td><td>2.16</td><td></td></tr>
<tr><td>11:20</td><td>20</td><td>4.225</td><td>0.055</td><td>1.98</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>Adjusted to 6” level for Trial #2</td></tr>
</table>

Figure 4C-2. Infiltration Test Data Table Example

Calculation is performed for each water level drop

= (Drop in water level/Time interval) x conversion

= 0.055 feet/20 minutes x (12 inches/foot) x (60 minutes/hour)

= 1.98 inches per hour

For the professional method the design infiltration rate of two successive trials must have a difference of five percent or less.

Location:			**Date:**	**Test Hole Number:**	
Depth to bottom of hole:			**Diameter of hole:**	**Test Method:**	
Tester's Name: **Tester's Company:** **Tester's Contact Number:**					
Depth, feet			**Soil Texture**		
Time	**Time interval, minutes**	**Measurement, feet**	**Drop in water level, feet**	**Percolation rate, inches per hour**	**Remarks**

Figure 4C-3. Infiltration Test Data Table

CITY OF SALEM
DEPARTMENT OF PUBLIC WORKS
ADMINISTRATIVE RULES
CHAPTER 109
DIVISION 004 APPENDIX D
STORMWATER SYSTEM—HYDROLOGIC ANALYSIS

SECTION

FIGURES

TABLES

4D.1—General

Stormwater facilities design flows and volumes required in accordance with these Design Standards shall be determined using the methods described in this appendix.

4D.2—Rational Method

(a) Application

The rational method may be used for analyzing small drainage basins, ten acres or less in size, with the following restrictions:

(1). May only be used for determining the peak flow for determining the required capacity of conveyance elements.

(2). The time of concentration shall be a minimum of five minutes.

(3). For areas larger than ten acres in size, one of the hydrograph methods listed in the next section shall be used to determine the peak flow conditions.

(b) Rational Method Equation

The rational method calculation shall be made as follows:

$$Q = C_y \; x \; C \; x \; I \; x \; A$$

Q	=	Peak flow (cubic feet/second)
C_y	=	Runoff Coefficient adjustment factor (see Subsection 4D.2(d)—Runoff Coefficient Adjustment Factor)
C	=	Runoff Coefficient
I	=	Rainfall Intensity (inches/hour)
A	=	Drainage Area (acres)

(c) Runoff Coefficient "C"

The runoff coefficient is difficult to estimate because it represents the interaction of many complex factors including surface ponding, infiltration, antecedent moisture, ground cover conditions, ground slopes, and soil type. The actual runoff coefficient for a given drainage basin can best be approximated by calculating a weighted average of all distinct surface types:

$$C_{av} = \frac{\sum C_x A_x}{A_{total}}$$

Top Div 4D

Developed Surface Types	Flat 0% to 2%	Rolling 2% to 10%	Hilly Over 10%
Impervious Areas	0.9	0.9	0.9
Gravel Pavement	0.5	0.55	0.6
Landscape Areas (Except Lawns)	0.3	0.35	0.4
Lawns	0.17	0.22	0.35
Pre-developed Surface Types			
Meadow, Pasture, or Farm	0.25	0.3	0.35
Mixed	0.15	0.2	0.25
Woodland and Forest	0.1	0.15	0.2
Development Types			
Commercial Development	0.8	0.85	0.9
Industrial Development, Heavy	0.7	0.8	0.9
Dense Residential (over 6 units/acre)	0.7	0.75	0.8
Industrial Development, Light	0.6	0.7	0.8
Normal Residential (3 to 6 units/acre)	0.5	0.55	0.6
Light Residential (1 to 3 units/acre)	0.35	0.4	0.45
Parks	0.15	0.2	0.25

Table 4D-1. Runoff Coefficients "C"

(d) Runoff Coefficient Adjustment Factor

The runoff coefficients listed in Table 4D-1, above, are applicable for a storm with a recurrence interval of ten years or less. Less frequent, higher intensity storms require adjusted runoff coefficients because infiltration and other losses have a proportionally smaller effect on runoff. Runoff coefficient adjustment factors (C_y) for storms of different recurrence intervals are listed in Table 4D-2.

Recurrence Interval	Runoff Coefficient Adjustment Factor (C_y)
10 years or less	1.0
25 years	1.1
50 years	1.2
100 years	1.25

Table 4D-2. Runoff Coefficient Adjustment Factor

(e) Rainfall Intensity "I"

The cumulative rainfall intensity shall be derived from Figure 4D-1. The design storm interval is typically based on the longest time of concentration for the drainage area.

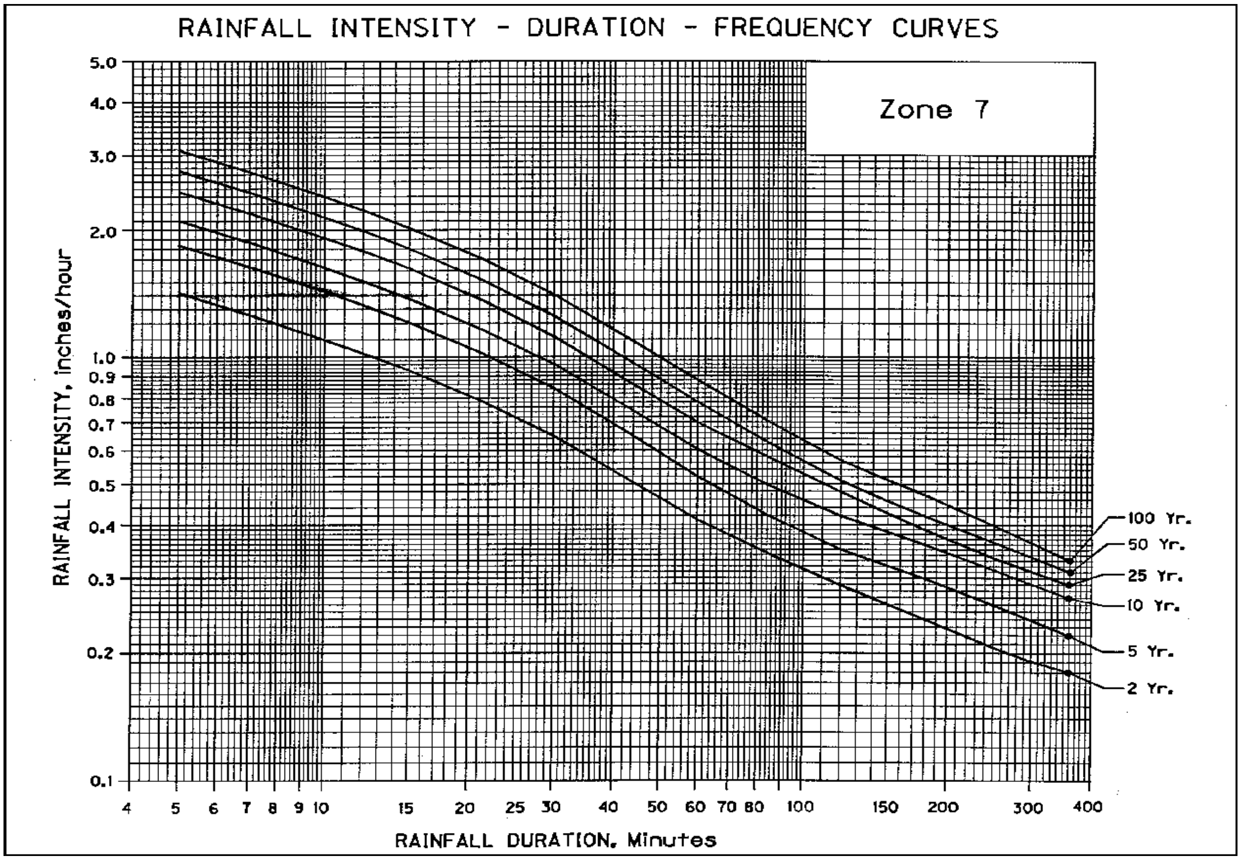


Figure 4D-1. Rainfall Intensity—Duration—Frequency Curves

4D.3—Hydrograph Methods

(a) Application

Hydrograph methods shall be used to determine the design flows and volumes for all stormwater facilities when using the Engineered Method.

(b) General

The physical characteristics of the site and the design storm shall be used to determine the magnitude, volume, and duration of the runoff hydrograph. The SBUH, NRCS TR-55 method, or SWMM may be used. If a software package is utilized, documentation of the software's processing and methodology shall be submitted with the results, along with all assumptions and input values. The typical input information needed for one of these hydrograph methods is:

(1). 24-hour type 1-A rainfall distribution.

(2). Total 24-hour rainfall amount.

(3). Basin area characteristics.

(4). Curve Number (CN).

(5). Time of Concentration.

(c) Rainfall Distribution

The rainfall distribution to use within the City is the design storm for a 24-hour duration based on the standard NRCS Type 1A rainfall distribution. This distribution is contained in Table 4D-5.

(d) Rainfall Depth

Table 4D-3 contains the 24-hour rainfall totals that shall be used in determining the runoff hydrograph for various sized storm events.

24-Hour Rainfall Depths for Salem, OR						
Recurrence Interval, Years	2	5	10	25	50	100
24-Hour Depths, Inches	2.2	2.7	3.2	3.6	4.1	4.4

Table 4D-3. Salem Rainfall Amount Based on the Storm Size.

(e) Basin Area Characteristics

For the highest degree of accuracy in hydrograph analysis, proper selection of homogeneous basin areas is needed. Significant differences in land use within a given basin must be addressed by dividing the basin area into sub-basins with similar land use and/or runoff characteristics. Hydrographs should be computed for each sub-basin area and superimposed to form the total runoff hydrograph for the basin.

All pervious and impervious areas within a given basin or sub-basin shall be analyzed separately. By analyzing pervious and impervious areas separately, the cumulative errors associated with averaging these areas are avoided, resulting in a more accurate runoff hydrograph.

(f) Runoff Curve Numbers

Runoff curve numbers were developed by the Natural Resources Conservation Service after studying the runoff characteristics of various types of land. Curve numbers (CN) were developed to consolidate diverse characteristics such as soil type, land usage, and vegetation into a single variable for computing runoff. Runoff CNs to be used in the hydrograph methods are included in Table 4D-6 at the end of this appendix.

Top Div 4D

The following factors shall be considered when choosing a CN:

(1). Many factors can affect the CN value for a given land use. For example, the movement of heavy equipment over bare ground may compact the soil so that it has a lower infiltration rate and greater runoff potential.

(2). CN values may be weighted by area when they apply to similar pervious areas (within 20 CN points). High CN areas shall not be combined with low CN areas, unless the low CN areas constitute less than 15 percent of the sub-basin.

(3). Normal antecedent soil moisture values shall be assumed for design.

4D.4—Time of Concentration (T_C)

Calculations for time of concentration should be divided into three segments: sheet flow, shallow concentrated flow, and channel/pipe flow. For the first 300 feet of overland flow, the sheet flow time of concentration can be calculated with the kinematic wave equation:

$$\boldsymbol{Sheet\ Flow\ T_c = \frac{0.93L^{0.6}n^{0.6}}{I^{0.4}S^{0.3}}}$$

T_c = Flow Time (minutes)

L = Overland Flow Length (feet)

N = Manning's Roughness Coefficient (See Table 4D-6)

I = Rainfall Intensity (inches/hour) (See Figure 4D-1)

S = Average Slope of Overland Area (foot/foot)

For overland flow distances greater than 300 feet, sheet flow typically becomes shallow concentrated flow. The average velocity for this flow can be determined from Figure III-2 (source: *1972 Soil Conservation Service Handbook),* in which the average velocity is a function of watercourse slope and surface type.

$$\boldsymbol{Shallow\ Concentrated\ Flow\ T_c = \frac{L}{60(ks)(so)^\wedge 0.5}}$$

L = Flow Length (feet)

ks = Velocity Factor Coefficient

so = Slope of Land Segment (feet/feet)

For open channels, Manning's equation should be used to estimate average flow velocity.

$$\textit{Open Channel Flow } T_c = \frac{L}{V}$$

T_c = Flow Time (seconds)

L = Flow Length (feet)

V = Flow Velocity (feet/second)

Once velocity is calculated, time of concentration can be calculated as follows:

$$T_c = \frac{L}{V}$$

T_c = Flow Time (seconds)

L = Flow Length (feet)

V = Flow Velocity (feet/second) (See Figure 4D-2)

Manning's Roughness Coefficients for Overland Sheet Flow	
Surface Types:	**n**
Impervious Areas	0.014
Gravel Pavement	0.02
Developed: Landscape Areas (Except Lawns)	0.08
Undeveloped: Meadow, Pasture, or Farm	0.15
Developed: Lawns	0.24
Pre-developed: Mixed	0.30
Pre-developed: Woodland and Forest	0.40
Development Types:	**n**
Commercial Development	0.015
Industrial Development, Heavy	0.04
Industrial Development, Light	0.05
Dense Residential (over 6 units/acre)	0.08
Normal Residential (3 to 6 units/acre)	0.20
Light Residential (1 to 3 units/acre)	0.30
Parks	0.40

Table 4D-4. Manning's Roughness Coefficients for Overland Sheet Flow

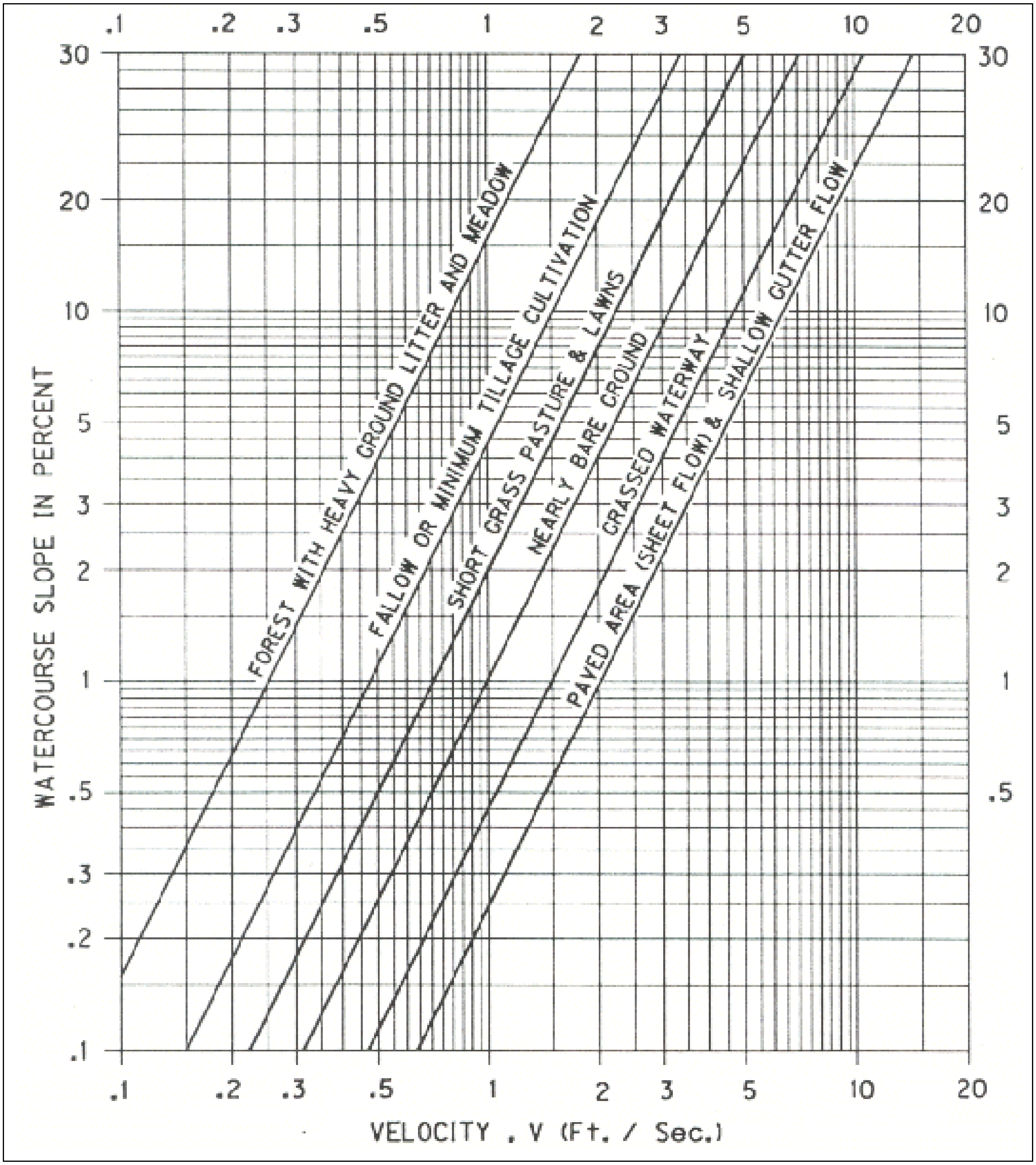


Figure 4D-2. Average Velocity of Shallow Concentrated Flow

Time from Start of Storm Minutes	% Rainfall	Cumulative % Rainfall	Time from Start of Storm Minutes	% Rainfall	Cumulative % Rainfall	Time from Start of Storm Minutes	% Rainfall	Cumulative % Rainfall	Time from Start of Storm Minutes	% Rainfall	Cumulative % Rainfall
10	0.40	0.40	370	0.95	22.57	730	0.72	67.40	1090	0.40	86.00
20	0.40	0.80	380	0.95	23.52	740	0.72	68.12	1100	0.40	86.40
30	0.40	1.20	390	0.95	24.47	750	0.72	68.84	1110	0.40	86.80
40	0.40	1.60	400	0.95	25.42	760	0.72	69.56	1120	0.40	87.20
50	0.40	2.00	410	1.34	26.76	770	0.57	70.13	1130	0.40	87.60
60	0.40	2.40	420	1.34	28.10	780	0.57	70.70	1140	0.40	88.00
70	0.40	2.80	430	1.34	29.44	790	0.57	71.27	1150	0.40	88.40
80	0.40	3.20	440	1.80	31.24	800	0.57	71.84	1160	0.40	88.80
90	0.40	3.60	450	1.80	33.04	810	0.57	72.41	1170	0.40	89.20
100	0.40	4.00	460	3.40	36.44	820	0.57	72.98	1180	0.40	89.60
110	0.50	4.50	470	5.40	41.84	830	0.57	73.55	1190	0.40	90.00
120	0.50	5.00	480	2.70	44.54	840	0.57	74.12	1200	0.40	90.40
130	0.50	5.50	490	1.80	46.34	850	0.57	74.69	1210	0.40	90.80
140	0.50	6.00	500	1.34	47.68	860	0.57	75.26	1220	0.40	91.20
150	0.50	6.50	510	1.34	49.02	870	0.57	75.83	1230	0.40	91.60
160	0.50	7.00	520	1.34	50.36	880	0.57	76.40	1240	0.40	92.00
170	0.60	7.60	530	0.88	51.24	890	0.50	76.90	1250	0.40	92.40
180	0.60	8.20	540	0.88	52.12	900	0.50	77.40	1260	0.40	92.80
190	0.60	8.80	550	0.88	53.00	910	0.50	77.90	1270	0.40	93.20
200	0.60	9.40	560	0.88	53.88	920	0.50	78.40	1280	0.40	93.60
210	0.60	10.00	570	0.88	54.76	930	0.50	78.90	1290	0.40	94.00
220	0.60	10.60	580	0.88	55.64	940	0.50	79.40	1300	0.40	94.40
230	0.70	11.30	590	0.88	56.52	950	0.50	79.90	1310	0.40	94.80
240	0.70	12.00	600	0.88	57.40	960	0.50	80.40	1320	0.40	95.20
250	0.70	12.70	610	0.88	58.28	970	0.50	80.90	1330	0.40	95.60
260	0.70	13.40	620	0.88	59.16	980	0.50	81.40	1340	0.40	96.00
270	0.70	14.10	630	0.88	60.04	990	0.50	81.90	1350	0.40	96.40
280	0.70	14.80	640	0.88	60.92	1000	0.50	82.40	1360	0.40	96.80
290	0.82	15.62	650	0.72	61.64	1010	0.40	82.80	1370	0.40	97.20
300	0.82	16.44	660	0.72	62.36	1020	0.40	83.20	1380	0.40	97.60
310	0.82	17.26	670	0.72	63.08	1030	0.40	83.60	1390	0.40	98.00
320	0.82	18.08	680	0.72	36.80	1040	0.40	84.00	1400	0.40	98.40
330	0.82	18.90	690	0.72	64.52	1050	0.40	84.40	1410	0.40	98.80
340	0.82	19.72	700	0.72	65.24	1060	0.40	84.80	1420	0.40	99.20
350	0.95	20.67	710	0.72	65.96	1070	0.40	85.20	1430	0.40	99.60
360	0.95	21.62	720	0.72	66.68	1080	0.40	85.60	1440	0.40	100.00

Table 4D -5. NRCS 24-Hour Type 1A Rainfall Distribution

Cover Description		CN For Hydrologic Soil Group A	B	C	D
Urban Areas	**Source: NRCS TR55 Table 2-2a (1986)**				
	% Impervious				
Open Space					
Poor condition (grass cover <50%		68	79	86	89
Fair condition (grass cover 50% to 70%)		49	69	79	84
Good condition (grass cover >75%) **Amended Soils**		39	61	74	80
City of Salem Pre-development		35	58	72	79
Impervious Areas					
Paved parking lots, roofs, driveways (excluding right-of-way)		98	98	98	98
Streets and roads					
Paved: curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved: open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way) **Un-amended Soils**		72	82	87	89
Urban districts					
Commercial and Business	85	89	92	94	92
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acres or less (town houses)	65	77	85	90	92
¼ acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
½ acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Agricultural Lands	**Source: NRCS TR55 Table 2-2c (1986)**				
	Hydrologic Condition				
Pasture, grassland, or range- combined forage for grazing					
<50% ground cover or heavily grazed with no mulch	Poor	68	79	86	89
50 to 75% ground cover and not heavily grazed	Fair	49	69	79	84
>75% ground cover and lightly or only occasionally grazed	Good	39	61	74	80
Meadow- continuous grass, protected from grazing and generally mowed for hay		30	58	71	78
Brush- weed/ grass mixture with brush as the major element					

Top Div 4D

Cover Description		CN For Hydrologic Soil Group A	B	C	D
<50% Ground cover	Poor	48	67	77	83
50 to 75% ground cover	Fair	35	56	70	77
>75% ground cover	Good	30	48	65	73
Woods/ grass combination (orchard or tree farm)	Poor	57	73	82	86
	Fair	43	65	76	80
	Good	32	58	72	79
Woods					
Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning	Poor	45	66	77	83
Woods are grazed but not burned, and some forest litter covers the soil	Fair	36	60	73	79
Woods are protected from grazing and litter and brush adequately covers the soil	Good	30	55	70	77
Impervious Surface Reduction Facilities	**Source: Portland Stormwater Management Manual (2008)**				
Type	**Hydrologic Condition**				
Pervious Pavement		76	85	89	n/a
Trees					
New and/or existing evergreen		36	60	73	79
New and/or existing deciduous		36	60	73	79
Green Roof	Good	n/a	61	n/a	n/a
Roof Garden	Good	n/a	48	n/a	n/a
Infiltration and Filtration Planter Box	Good	n/a	48	n/a	n/a
n/a = Not Applicable					

Table 4D-6. Runoff Curve Numbers

4D.5—Santa Barbara Urban Hydrograph (SBUH) Method

The SBUH method is an acceptable hydrograph method for flow control design. It involves a five step process. Methodology for steps one through four is described in Subsection 4D.3—Hydrograph Methods and Subsection 4D.4—Time of Concentration.

Determining runoff using the SBUH method requires the use of a computer model. Inputs to the model include:

(1). Basins Areas in acres.

(2). Precipitation for 24 hour storm events in inches.

(3). Soil Characteristics for CN.

(4). Travel time for basin in minutes.

(a) Application

The SBUH method may be used for analyzing urban drainage basins up to 100 acres or less in size:

(b) SBUH Method Equations

Abstract Runoff Value $$S = \left(\frac{1000}{CN}\right) - 10$$

Runoff Depth $$D(t) = \frac{\left(pt - 0.2(S)\right)^2}{(pt + 0.8(S))}$$

Total Runoff $$R(t) = D(t) - D(t-1)$$

Instantaneous Hydrograph $$I(t) = \frac{60.5\left(R(t)\right)A}{dt}$$

Design Flow Rate $$Q(t+1) = Q(t) + w(I(t) = I(t+1) - 2Q(t))$$

Where:

CN = Curve Number
Pt = Precipitation for the Time Increment—24 hour MRI
A = Basin Area in acres
Dt = Time Interval in Ten Minutes
W = $Dt/(2T_C+dt)$
T_C = Time of Concentration for the Drainage Basin
D(t) = Depth of Runoff at Time (t)

(c) Storage Determination

Inflow–Outflow=Change in Storage $$[(I_1+I_2)/2]-[(O_1+O_2)/2] = S_1-S_2$$

Where:

I = Inflow at Time 1 and Time 2
O = Outflow at Time 1 and Time 2
S = Storage at Time 1 and Time 2

Top Div 4D

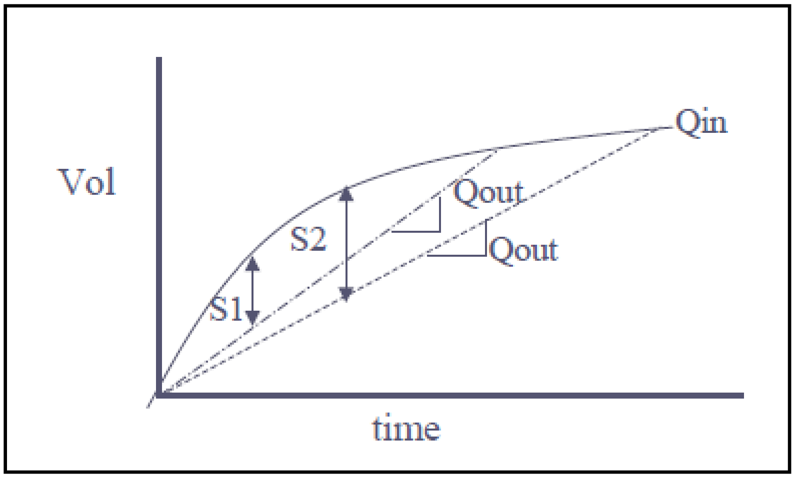


Figure 4D-3. Increased Storage Volume (S) Due to Increased Time

The time interval,Δt, must be consistent with the time interval used in developing the inflow hydrograph. The time interval used for a 24-hour storm is ten minutes. The terms I1, I2, O1, and S1 are known from the inflow hydrograph and from the storage and outflow values of the previous time step. The unknowns O2 and S2 can be solved interactively from the given stage- storage and stage-discharge curves.

NRCS Hydrologic Soil Group	Description
Group A	Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist chiefly of deep, well drained to excessively drained sands or gravels. These soils have a high rate of water transmission.
Group B	Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.
Group C	Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils that have a layer that impedes the downward movement of water or soils that have a moderately fine texture or fine texture. These soils have a slow rate of water transmission.
Group D	Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clay soils that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a fragipan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Table 4D-7. NRCS Hydrologic Soil Group Descriptions

Top Div 4

CITY OF SALEM
DEPARTMENT OF PUBLIC WORKS
ADMINISTRATIVE RULES
CHAPTER 109
DIVISION 004 APPENDIX E
IMPLEMENTING GREEN STORMWATER INFRASTRUCTURE
TO THE MAXIMUM EXTENT FEASIBLE

SECTION

Division 004 Appendix E—
Implementing Green Stormwater Infrastructure to the Maximum Extent Feasible

4E.1—Purpose

The purpose of this appendix is to establish criteria for determining whether an applicant for a development project is meeting the requirements contained in SRC Chapter 71 to implement GSI to the MEF.

4E.2—Authority

The authority to prescribe requirements for implementing the provisions of SRC Chapter 71 is granted in SRC 71.010 and SRC 20J.030 and is vested in the City Manager and Public Works Director.

4E.3—Applicability

This appendix is applicable to large projects and is to be used as approval criteria for Site Plan Review, land divisions, and other land use application and decision processes where conformance to stormwater requirements must be demonstrated as a condition of approval.

4E.4—Background

SRC Chapter 71 requires projects exceeding specified thresholds to use GSI/MEF to mitigate the impacts of stormwater runoff from the new and replaced impervious surfaces. In summary:

(a) GSI is the term used for facilities that control flow rates, flow volumes, or flow durations of drainage water, or that remove pollutants from drainage water by means of infiltration or evapotranspiration.[1]

(b) Large projects are required to use GSI/MEF to meet flow control and treatment performance standards.

(c) Large projects must meet the performance standards for flow control and treatment as specified in SRC Chapter 71, regardless of the degree to which GSI is used.

(d) Implementing GSI/MEF means that flow control and treatment requirements are to be met using these facilities unless doing so is not possible because of site limitations, considerations in engineering design, or considerations of financial costs and environmental impacts.

Because of the unique characteristics of each project site, there will be cases in which not all stormwater runoff impacts can be mitigated using exclusively GSI. In such cases, compliance with this appendix is required.

---

[1] The term GSI also applies to facilities that involve stormwater reuse. This appendix is not applicable to these types of facilities.

During land use application and decision processes, conformance with the MEF requirement can be demonstrated by one of three means:

(a) Runoff from the new and replaced impervious surfaces flows into one or more locations that have been set aside for installation of GSI and the locations have a total area of at least ten percent of the total new plus replaced impervious surface area; or

(b) GSI is used to mitigate the impacts of stormwater runoff from at least 80 percent, but less than 100 percent, of the total new plus replaced impervious surfaces; or

(c) GSI is used to mitigate the impacts of stormwater runoff from less than 80 percent of the total new plus replaced impervious surfaces and the factor(s) limiting implementation are documented per this appendix and approved Per Subsection 4E.10—Approval Process.

4E.5—Definitions

Definitions or terms in this appendix will have the same meaning as codified under the SRC and in the Design Standards. Definitions relevant to this appendix are primarily provided in SRC Chapter 71.

4E.6—Non-discretionary Approach for Achieving MEF

A large project will be considered to have met the MEF requirement when the stormwater runoff from the total amount of new plus replaced impervious surface flows into an area set aside for GSI that is at least ten percent of the total area of new plus replaced impervious surfaces. For example, a project that includes 20,000 square feet of new and replaced impervious surface shall provide a minimum of 2,000 square feet of area for GSI in a location downstream of the impervious surfaces. Regardless of the degree to which GSI is used, large projects must still meet flow control and treatment performance standards specified in SRC Chapter 71.

The submittal requirement to demonstrate compliance with the non-discretionary approach is a site plan showing the following:

(a) Boundary of the drainage area or, if present, drainage boundaries of subareas;

(b) Total square footage of all new and replaced impervious surface for each area or subarea;

(c) The direction of runoff flow for each area or subarea;

(d) The location and square footage of each area to contain GSI.

4E.7—Discretionary Approach for Achieving MEF

A large project that uses GSI to mitigate the impacts of stormwater runoff from at least 80 percent, but less than 100 percent, of the total new plus replaced impervious surfaces shall be considered to have met the MEF requirement. Regardless of the degree to which GSI is used, large projects must still meet flow control and treatment performance standards specified in SRC Chapter 71.

The submittal requirement to demonstrate compliance with the discretionary approach is a preliminary stormwater report that describes the quantity and nature of impervious surfaces, the type and location of stormwater facilities being proposed, and the basis used for determining the proposed location and size of the stormwater facility. If the proposed stormwater facility mitigates the impacts of runoff from 80 percent or more of the total new plus replaced impervious surfaces using GSI, then no additional documentation is required related to achieving MEF.

4E.8—Non-Financial Factors Limiting Implementation of GSI

One or more of the following non-financial considerations must be documented to substantiate GSI cannot be used to mitigate the impacts of runoff from 80 percent or more of the total new plus replaced impervious surfaces.

(a) Surface slopes cannot be graded to meet the design criteria required for GSI.

(b) The minimum dimensions of the facility cannot be met due to mandatory setbacks.

(c) Downspout configuration cannot be reasonably modified to convey roof runoff to the facility.

(d) Minimum vertical or horizontal clearance from utilities cannot be achieved as required by the utility owner, or as prescribed in the SRC or administrative rules.

(e) The presence of sensitive areas, including wetlands, riparian corridors, and receiving waters, precludes using GSI.

(f) Implementing GSI will unreasonably restrict pedestrian, bicycle, or vehicular access.

(g) Implementing GSI is limited by SRC Chapter 230 (Historical Preservation).

(h) In conjunction with one or more other limiting factors, GSI cannot be reasonably incorporated into the landscaping requirements as prescribed in SRC Chapter 132—Landscaping.

4E.9—Financial Factors Limiting Implementation of GSI

One or both of the following considerations must be documented to substantiate GSI cannot be used to mitigate the impacts of runoff from 80 percent or more of the total new plus replaced impervious surfaces owing to financial considerations, even when non-financial considerations would allow greater use.

(a) Using GSI represents an unreasonably disproportionate increase in total project costs when compared to meeting the requirements of SRC Chapter 71 using other types of stormwater facilities. *Life-cycle* costs[2] shall be used when comparing costs of stormwater facilities.

(b) Implementing GSI will unreasonably and adversely impact planned business practices or other intended use of the property when compared to meeting the requirements of SRC Chapter 71 using other types of stormwater facilities. Factors to be considered include building footprint requirements, parking needs, and traffic circulation considerations (for example, the need for a drive-thru window).

In addition to submittal requirements in Subsection 4E.6—Non-discretionary Approach for Achieving MEF and Subsection 4E.8—Non-Financial Factors Limiting Implementation of GSI, the following must be provided if financial considerations are used as a factor limiting implementation of GSI:

(1). A narrative description and rationale with documentation sufficient to explain and justify the applicant's conclusion that the proposed use of GSI represents the MEF and that additional GSI represents an unreasonable financial hardship.

(2). A detailed cost estimate of the storm drainage facilities as proposed, including the level of GSI that is considered feasible. The cost estimate shall include the cost for constructing the storm drainage facilities and an estimate of the costs to operate and maintain the facilities for 25 years.

(3). A detailed cost estimate if GSI is to be used to mitigate the impacts of stormwater runoff from 80 percent or more of the total new plus replaced impervious surfaces. The cost estimate shall include the cost for constructing the storm drainage facilities and an estimate of the costs to operate and maintain the facilities for 25 years.

(4). A detailed total project estimate, including but not limited to the following costs: construction; architectural and engineering; land acquisition if applicable; and project management.

[2] Determining life-cycle costs shall include, at a minimum, quantification of capital construction costs and the net present value of 25 years of maintenance and operation costs.

4E.10—Approval Process

(a) An applicant for a development project unable to demonstrate compliance per Section 4E.6—Non-discretionary Approach for Achieving MEF or unable to mitigate the impacts of runoff from 80 percent or more of the total new plus replaced impervious surface using GSI per Section 4E.7—Discretionary Approach for Achieving MEF, shall:

(1). Apply for a Design Standard Exception in accordance with the Design Standards; or
(2). Apply for a variance in accordance with SRC Chapter 245.

(b) The Director may require an applicant to apply for a variance in accordance with SRC Chapter 245.

(c) The Director may require an applicant to provide an engineering report, signed and stamped by a licensed professional.

CITY OF SALEM
DEPARTMENT OF PUBLIC WORKS
ADMINISTRATIVE RULES
CHAPTER 109
DIVISION 004 APPENDIX F
LIST OF ACCEPTED MANUFACTURED STORMWATER FACILITIES

SECTION

TABLES

4F.1—General

This appendix contains the list of accepted manufactured stormwater facilities which can be used in the City. Please refer to the Design Standards regarding when these facilities can be used and the process for adding new facilities to the list.

Devices listed in Table 4F-1 for **Basic Treatment** may be used to satisfy the requirements for stormwater treatment when sized in accordance with the manufacturer's recommendations and the Design Standards.

Devices listed in Table 4F-1 for **Pre-treatment** may be used to remove sediment and debris from stormwater prior to entering a treatment or combined facility. These structures do not meet the requirements for a stormwater treatment only and must be used as part of a treatment train.

Product	Stormwater Treatment	Pre-Treatment Only	Private Facilities	Public Facilities
CONTECH Stormwater Solutions Inc. Media Filtration System (MFS)	√		√	
CONTECH Stormwater Solutions Inc. Stormfilter Using ZPG Media	√		√	√
Kristar Upflo Filter*	√	√	√	√
Kristar FloGard Perk Filter	√		√	
Americast Filterra	√		√	√
Aqua Shield Aqua-Swirl Concentrator		√	√	√
CONTECH Stormwater Solutions Inc. CDS Stormwater Treatment System		√	√	√
CONTECH Stormwater Solutions Inc. Vortechs System		√	√	√
Hydo International Downstream Defender		√	√	√
Stormceptor		√	√	√
*Kristar Upflo Filter is only allowed for a Public Facility if specifying perlite filter media.				

Table 4F-1. Approved Manufactured Stormwater Products

CITY OF SALEM
DEPARTMENT OF PUBLIC WORKS
ADMINISTRATIVE RULES
CHAPTER 109
DIVISION 004 APPENDIX G
KEY MATERIAL SPECIFICATIONS

TABLE OF CONTENTS

SECTION

TABLES

4G.1—General

This appendix contains a number of specifications to be used for key materials used in stormwater facilities.

4G.2—Topsoil

Imported topsoil shall be used that is fertile, friable, and representative of local (Willamette Valley) productive soil furnished from part of a soil profile commonly referred to as the “A” horizon, typically ranging in depth from 3 to 12 inches, free of clods or other inorganic matter larger than three inches in any dimension, not frozen or muddy, with pH 5.8 to 7.0. Gravel portion (particles larger than 2 mm) shall not exceed 15 percent of total volume.

Topsoil shall be amended to correct nutrient deficiencies in accordance with the soil analysis report provided by the City.

Topsoil, when tested according to AASHTO T 88, shall meet the following limits:

Particle Size Range	Percent Retained (by Weight)
Larger than 2"	0
2"– ¾"	0-5
¾"–No. 4	0-20
No. 4 or less	0-100

Table 4G-1. Standard Sieve Analysis

Of the fraction passing the No. 4 sieve, excluding organic material, furnish topsoil that conforms to the following limits:

Particle Size Range	Percent (by Weight)
No. 4 – No. 200	5–70% (Retained)
No. 200 – 2 µm	20–80% (Retained)
Less than 2 µm	5–30% (Passing)

Table 4G-2. Hydrometer Analysis

4G.3—Organic Soil Amendment

Furnish soil amendments that are derived from plant material and provided by a member of the US Composting Council Seal of Testing Assurances (STA) program. See www.compostingcouncil.org for a list of providers in Oregon.

The organic soil amendment shall be the by-product of the biological degradation and transformation of plant-derived material under conditions designed to promote aerobic decomposition. The material shall be well composted, free of viable weed seeds, and stable with regard to oxygen consumption and carbon dioxide generation. The compost shall have no visible free water and produce no dust when handled. It shall meet the following criteria, as reported by the US Composting Council STA Compost Technical Data Sheet to be provided by the supplier.

- 100 percent of the soil amendment material must pass through a ½-inch screen.
- The pH of the soil amendment material must be between six and eight.
- Manufactured inert material (plastic, concrete, ceramics, metal, etc.) must be less than 1.0 percent by weight.
- The organic matter content must be between 35 and 65 percent.
- Soluble salt content must be less than 6.0 mmhos/cm.
- Germination (an indicator of maturity) must be greater than 80 percent.
- Stability must be between classes six and seven.
- Carbon/nitrogen ratio must be less than 25:1.
- Trace metals test result must be "pass."

A particle gradation analysis of the soil amendment shall be conducted in conformance with ASTM C117/C136 (AASHTO T11/T27) and documented for City approval, before delivery to the Site. The analysis shall include the following sieve sizes and the material shall meet the following gradation criteria:

Sieve Size	Percent Passing
1-inch	100
#4	75–100
#10	40–100
#40	15–40
#100	5–25
#200	5–15

Table 4G-3. Gradation Criteria

Documentation for the three analyses of the organic soil amendment material as described in Subsection 207.2.10 of the Contract Document. Planting Mixture with calculated coefficient of uniformity; organic matter content; and pH, must be provided to the City prior to blending the planting mixture. The analysis shall be performed by an accredited laboratory with certification maintained current. The date of the analysis shall be no more than 90 calendar days prior to the date of the submittal. The report shall include the name/address of the laboratory, laboratory phone and email contact information; and test data, including the date and name of the test procedure.

A Compost Technical Data Sheet from the supplier of the soil amendment shall be provided. The analysis and report must be consistent with the sampling and reporting requirements of the US Composting Council Seal of Testing Assurance (STA) program. The analysis shall be performed and reported by an approved independent STA program laboratory. The STA laboratory report must also include compost end use instructions, as a means to better inform the City.

4G.4—Growing Medium

Furnish imported growing medium for vegetated stormwater facilities conforming to the following:

(a) General Composition

The medium shall be a mix of loamy soil, sand, and compost, 30-40 percent compost (by volume) and the following:

(1). The material shall be loose and friable.

(2). It shall be well mixed and homogenous.

(3). It shall be free of wood pieces, plastic, and other foreign matter.

(4). It shall have no visible free water.

(b) Analysis Requirements for the Blended Material

(1). Particle Gradation—A particle gradation analysis of the blended material, including compost, shall be conducted in conformance with ASTM C117/C136 (AASHTO T11/T27). The analysis shall include the following sieve sizes: 1-inch, ⅜-inch, #4, #10, #20, #40, #60, #100, #200. The gradation of the blend shall meet the following gradation criteria.

Sieve Size	Percent Passing
1-inch	100
#4	75-100
#10	40-100
#40	15-50
#100	5-25
#200	5-15

Table 4G-4. Particle Gradation

The blend shall have a Coefficient of Uniformity (D60/D10) equal to or greater than six to ensure that it is well graded (has a broad range of particle sizes). The coefficient is the ratio of two particle diameters on a grain-size distribution curve; it is the particle diameter at 60 percent passing divided by the particle diameter at ten percent passing.

(2). Organic Matter Content—An analysis of soil organic matter content shall be conducted in conformance with ASTM D2974 (loss on ignition test). The soil organic matter content shall be a minimum of ten percent, as reported by that test.

(3). Power of Hydrogen (pH)—The pH of the blended material shall be tested and have a pH of five to eight**.**

(c) <u>General Requirements for the Blended Material</u>

(1). The material shall be loose and friable.

(2). It shall be well mixed and homogenous.

(3). It shall be free of wood pieces, plastic, and other foreign matter.

(4). It shall have no visible free water.

(d) <u>Compost</u>

The compost shall be derived from plant material and provided by a member of the STA program. See www.compostingcouncil.org for a list of providers in Salem. The compost shall be the result of the biological degradation and transformation of plant derived materials under conditions designed to promote aerobic decomposition. The material shall be well composted, free of viable weed seeds, and stable with regard to oxygen consumption and carbon dioxide generation. The compost shall have no visible free water and produce no dust when handled. It shall meet the following criteria, as reported by the US Composting Council STA Compost Technical Data Sheet provided by the vendor.

(1). 100 percent of the material must pass through a ½-inch screen.

(2). The pH of the material shall be between six and eight.

(3). Manufactured inert material (plastic, concrete, ceramics, metal, etc.) shall be less than 1.0 percent by weight.

(4). The organic matter content shall be between 35 and 65 percent.

(5). Soluble salt content shall be less than 6.0 mmhos/cm.

(6). Germination (an indicator of maturity) shall be greater than 80 percent.

(7). Stability shall be between classes five and seven.

(8). Carbon/nitrogen ratio shall be less than 25:1.

(9). Trace metals test result = “pass.”

4G.5—Ballast Aggregates

Furnish ballast aggregates of four inches to two inches as shown. Use clean, hard, durable aggregates, reasonably well graded from the maximum to minimum size.

4G.6—Drain Rock

Drain rock shall meet the requirements of the *Standard Specifications for Highway Construction (2008)* by the Oregon Department of Transportation for 1½-inch to ¾-inch Granular Drain Backfill Material 00430.11.

4G.7—Filter Rock

Filter rock shall meet the requirements of the *Standard Specifications for Highway Construction (2008)* by the Oregon Department of Transportation for ¾"-½" Granular Drain Backfill Material 00430.11.

4G.8—Drainage Geotextile

Drainage Geotextile shall be Type 1, Certification Level B, meeting the requirements of the *Standard Specifications for Highway Construction (2008)* by the Oregon Department of Transportation 02320.

4G.9—Impermeable Liner

Material shall be 30 mil High Density Polyethylene (HDPE) geomembrane, textured on both sides or approved equal. An experienced firm regularly engaged in manufacturing textured HDPE shall manufacture the geomembrane.

Main Menu

CITY OF SALEM
DEPARTMENT OF PUBLIC WORKS
ADMINISTRATIVE RULES
CHAPTER 109
DIVISION 005
WATER DISTRIBUTION SYSTEM

SECTION

FIGURES

TABLES

5.1—Introduction

This Division pertains to water distribution systems only. Water reservoirs and water pump stations are included in the Special Facilities section of the Design Standards.

(a) Objectives

The objectives of these Standards are to provide a water distribution system that is:

(1). Consistent with the adopted Water System Master Plan and with all City, State, and Federal rules and regulations.

(2). Provides sufficient capacity to maintain minimum pressure during periods of maximum use and to provide sufficient volumes of water at adequate pressures to provide the expected maximum daily consumption plus fire flows at a minimum energy loss.

(3). Constructed of materials strong enough to resist all expected loads, both internal and external, and be able to preserve the potability of the water supply.

(4). Economical and safe to build and maintain.

(b) Applicability

These Design Standards shall govern all construction and upgrades to the public water distribution system within the ROW and easements in the City and applicable work within its service areas. The EOR should refer to the *City of Salem Fire Code Application Guide* for site-specific fire flow and access requirements for private property.

Permanent water distribution facilities shall be provided to all properties (legal lots of record created by a partitioning or subdivision per SRC Chapter 802) within the City in accordance with these Design Standards.

(c) Drafting and Drawing Requirements

See Division 002—Drafting and Drawing Standards for drafting and drawing requirements for water distribution improvement plans.

5.2—General Design Considerations

Water distribution systems shall be designed for maximum development of the service area with recognition of possible urban renewal, industrial expansion, etc. All developments will be required to provide public water mains of sufficient size for fire protection to adjacent parcels. This shall include the extension of water mains in easements across the property to adjoining properties and across the street frontage of the property to adjoining properties when the main is located in the ROW.

Top Div 5

(a) Pressure Requirements

Normal working pressure in the distribution system should be approximately 60 psi with a range of 40 psi to 100 psi.

(1). Single Family and Duplexes

The system shall have sufficient capacity to maintain a minimum of 40 psi at the building entrance for single family and duplex dwellings, at all times except under fire flow conditions (See 5.2(a)(1), below).

(2). All Other Developments

For all other developments, except single family and duplexes, provide a minimum pressure of 35 psi at the building side of the meter during periods of maximum use. A sufficient volume of water at adequate pressures shall be provided to satisfy the expected daily consumption plus fire flows.

(3). Fire Flow

A minimum 20 psi residual pressure under fire flow conditions shall be maintained throughout the distribution system.

(b) Head Loss Factors

Head loss shall be determined by the Darcy Weisbach equation based upon the pipe type and age per factors detailed in the Water System Master Plan or by the Hazen-Williams equation. Head loss shall be calculated using the C-values listed in Table 5-1.

Pipe Diameter	C-Value
8 Inches and Less	100
10 to 12 Inches	110
Greater than 12 Inches	120

Table 5-1. C-values for Pipes of Various Diameters

(c) Maximum Flow Velocities within Pipelines

Flow velocities within the distribution system shall normally range from three to five feet per second for average demand to a maximum velocity of 10[1] feet per second for combined average demand plus fire flow. For projects located near the higher elevation boundary of a service level, the minimal residual pressure will normally control the pipe size to meet fire flow demands rather than the maximum velocity. The EOR needs to insure their design meets the requirements for both maximum velocity and minimum residual pressure under fire flow conditions.

[1] *Private systems shall limit velocities as required by the OPSC, Installation Standards.*

(d) <u>Water System Capacity</u>

(1). Capacity and Sizing

Design capacities and pipe sizing shall be determined by the following as listed in order of priority:

A. As detailed or identified in the Water System Master Plan.

B. Minimum pipe size as identified in Subsection 5.3(d)(2).

C. For service of industrial and unique commercial properties and where there is an absence of detailed design information per paragraph 5.2(d)(1)(B) above, design capacities and pipe sizing shall be determined by considering the following factors and assumptions for areas to be served, both immediate and adjacent.

D. The higher of the current or projected population within the UGB and area to be served.

E. The maximum daily water demand based upon land use (the higher of current and projected land use) within the UGB.

(i). Special needs of commercial, industrial, or institutional users to be served at specific locations within the UGB as established by the Water System Master Plan, USA Plan, and Sector Plan.

F. Detailed design factors, consumption data, and other information for specific service areas to assist with the design can be obtained from the City Public Works Department. This includes:

(i). Maximum day demand based upon factors by pressure zone and land use.

(ii). Peak hour demand based upon peaking factors by pressure zone and land use.

(iii). Demand for unique commercial installations, industrial users, PUDs, multiple family dwellings, and institutional concerns will be calculated on an individual basis.

G. Fire flows listed in Table 5-2 shall be added to the maximum day demand. The City reserves the right to require a greater volume of flow in order to comply with the applicable provisions of the adopted Oregon Fire Code.

Top Div 5

Land Use	Fire Flows (GPM)	Duration (Hr.)
Industrial	5,500	4
Downtown	5,000	4
Commercial	4,000	3
Multiple Family	3,500	2
Residential	2,000	2
All Others	1,000	2

Table 5-2. Fire Flow Requirements

(e) <u>Main Classification</u>

(1). Transmission Mains

Per Table 5-3, transmission mains are 24-inch diameter and larger, and used for transporting water from the source of supply and pump stations to reservoirs. Service connections to individual residences are not allowed on transmission mains.

(2). Distribution Mains

Per Table 5-3, distribution mains are smaller than 24-inch diameter. Distribution mains comprise the majority of the system and are used to supply water to the individual consumer.

5.3—Water System Requirements

The following subsections contain the physical design requirements for public water systems in the City. These design requirements may be used for private systems, provided the system is designed by a registered Professional Civil Engineer. Pipe designs and installations shall be in compliance with all pipe manufacturers' recommendations. The City may require a higher classification of pipe if an engineering analysis indicates abnormal loading conditions or stresses on the pipe which could exceed the manufacturer's recommendations. All water system materials which come in contact with potable water must be in compliance with NSF 61.

(a) <u>Pipe Materials</u>

(1). 4-inch to 36-inch Diameter

Pipe ranging in size from 4-inch to 36-inch shall be DI pipe conforming to AWWA C151, thickness Class 52, and shall be cement mortar lined conforming to AWWA C104.

(2). Greater than 36-inch Diameter

Pipes larger than 36 inches in diameter, the EOR may use either steel pipe, mortar lined and coated, meeting the requirements of AWWA C200/205 or DI pipe conforming to AWWA C151, thickness Class 52, and shall be cement mortar lined conforming to AWWA C104.

(b) Pipe Joints

Joints shall be push-on, mechanical, or flange. Rubber gaskets shall conform to AWWA C111.

Changes in direction and branching of mains shall utilize mechanical joint thrust restraint. PCC thrust blocks shall be utilized when tying into existing mains in cases where sufficient lateral restraint cannot be developed on the existing main.

(c) Pipe Fittings

Pipe fittings shall be DI and conform to AWWA C110 or AWWA C153. Fittings 24-inch and smaller shall be rated at 350 psi. Fittings larger than 24 inches shall be rated at 250 psi.

(d) Main Size

(1). Grid System

The distribution system mains shall be looped at all possible locations to provide redundancy, optimize capacity, and maintain water quality. Dead end mains will only be allowed on a case-by-case basis as determined by the City. Factors that will be evaluated in this determination include demand, system pressure, water quality, special uses, redundancy, and public safety.

(2). Size of Pipe

Diameter	Function
2-inch	shall not be used as part of the distribution system, but for services only.
3-inch	shall not be used as part of the distribution system, but for services only downstream of the meter.
4-inch	may only be used on dead-end streets with service to not more than 12 residences and shall be connected to a 6-inch main, which is looped, or a 8-inch main which supplies a fire hydrant assembly.
6-inch	minimum size for looped mains not supplying fire hydrant assemblies. Looped connections shall not be greater than at 600-foot intervals.
8-inch	minimum size for mains supplying fire hydrant assemblies.
12- to 21-inch	Mains on a minimum of a half-mile grid within the distribution system and mains in industrial subdivisions, depending on demand.
24-inch	and larger for transmission mains. Individual service connections are not allowed on transmission mains.

Table 5-3. Allowed Use for Various Pipe Sizes

(e) Termination of Mains

All dead end mains shall terminate with a blow off assembly. Mains which can conceivably be extended at some later date shall have a blow off assembly, which includes a main line valve per the applicable Standard Plan.

Top Div 5

(f) Minimum Depth

The standard minimum cover over buried water mains within the ROW except the paved area shall be 36 inches from the finish grade referenced from the existing top of curb or proposed top of curve elevation. The paved area of the ROW shall have a minimum cover of 30 inches.

The minimum cover for mains across private property shall be 36 inches.

Finish grade shall normally mean the existing or proposed top of curb elevation. Where the main is located in the cut or fill slope or where mains are located in easements, finish grade shall mean at the water main alignment. The intent is to provide a minimum cover over the pipe of 30 inches in the paved travel way of the ROW and 36 inches in all other areas.

Transmission mains shall have a minimum cover of 48 inches in order to protect the pipe from damage.

(g) Location

(1). Relation to Sanitary Sewer Lines and other utilities

The vertical and horizontal separation between water and sewer lines shall be in accordance with OAR 333.

(2). Water Mains within ROW and Easements

The location of water mains within the ROW and in easements is described in Division 001—General.

(h) Stream and Drainage Crossings

Surface water crossings of mains shall be in accordance with OAR 333 and the following:

(1). Mains crossing stream or drainage channels shall be designed to cross as nearly perpendicular to the channel as possible and at a uniform grade.

(2). The following water surface crossings will be treated on a case-by-case basis:

A. Stream or drainage channel crossing for pipes of 12-inch inside diameter or greater.

B. River or creek crossings requiring special permits from DSL and the USACE.

(3). The minimum cover from the bottom of the stream bed or drainage channel to the top of pipe shall be three feet.

(4). A concrete scour pad centered on the water line will be required for mains less than 12-inch inside diameter when the cover from the top of the pipe to the bottom of the stream or drainage channel is three feet or less. A concrete scour pad may be required in other cases dependant on soil types, depth of cover, and stream bed characteristics.

(i) <u>Valves</u>

(1). Sizes

Valves shall be the same size as the mains in which they are installed. Valve types and materials shall conform to the SCS. Valves 12-inches and smaller shall be resilient wedge gate valves and conform to ANSI/AWWA C509. Valves greater than 12 inches shall be butterfly valves and conform to ANSI/AWWA C504.

(2). Location

Distribution system valves shall be located as close as possible to the tee or cross fitting. There shall be a sufficient number of valves so located that preferably three, but not more than four valves must be operated to affect any one particular shutdown. The spacing of valves shall be such that the length of any one shutdown in commercial and industrial areas shall not exceed 500 feet or 800 feet in other areas.

A tee intersection shall be valved on two branches and a cross intersection shall be valved on three branches. Transmission water mains shall have valves at a maximum of 2,000 feet spacing or as required by the City for specific applications. Creek, railroad, arterial street and wider, and freeway crossings shall be valved on each side.

Distribution taps on transmission mains shall be spaced not less than 1,300 feet apart, or as required by the City, where practical and shall be valved and plugged.

(j) <u>Phased Construction</u>

Water mains installed by phased construction which will be extended in the future, shall terminate with a blow off assembly as depicted on the applicable Standard Plan.

Developments will be required to extend mains across and/or along existing or proposed streets for future extensions by the City to serve other developments. Terminations shall be planned and located to minimize the amount of new or existing pavement to be cut when the main is extended.

5.4—Backflow Prevention

(a) General

An approved backflow prevention assembly with an approved metering system shall be required per the requirements of OAR 333, the SRC, and the following instances:

(1). When a private line must be looped between two or more City mains in order to obtain the required flow and the resultant loop will not benefit the City grid system.

(2). On all private fire lines attached to the City's distribution system.

(3). On all private waterlines or distribution systems attached to the City grid system at the master meter on the detector check assembly.

(4). When an auxiliary water supply exists on the property being served.

(5). As determined by the City Cross-Connection Control Inspector.

(6). On the domestic water service of all new or remodeled commercial or industrial buildings which meet the requirements or thresholds of this subsection.

The assembly must meet the requirements of the SRC and the City-approved assembly standards, taken from the current approved list of assemblies from the State of Oregon Department of Human Services (DHS) Public Health Division.

(b) Location and Installation

The approved backflow prevention assembly shall be located as follows:

(1). On the property being served in a place accessible for City inspection and testing;

(2). Before any branch, immediately downstream of the meter in an approved vault or structure; or

(3). If no meter, at the property line in an approved vault or structure; or

(4). Before the first branch or hazard being controlled within the structure, only with prior approval from the Public Works Director; or

The approved backflow prevention assembly shall be installed as follows:

(1). Reduced pressure and double check assemblies up to two inches may be installed in standard meter boxes.

(2). Reduced pressure and double check assemblies, two-inches and larger, must be installed in vaults.

(3). Vaults shall conform to Standard Plans.

(4). Vaults shall be water tight and shall have adequate drainage provided, except that the drain shall not be directly connected to a sanitary sewer or stormwater drain, conforming to OAR Chapter 333.

5.5—Fire Hydrants

(a) <u>Coverage</u>

Distribution of hydrants shall be based upon the required fire flow as described in Subsection 5.2(a)(3). Preferred coverage shall result in hydrant spacing not greater than 500 feet in residential areas, or greater than 300 feet in industrial and commercial areas.

(b) <u>Location</u>

Fire hydrant assemblies shall be not installed on a main less than eight inches in diameter. The hydrant lead shall be a minimum of six-inch diameter.

Fire Hydrants shall be located along streets at a minimum of 500-foot intervals, in conformance with the applicable provisions of Oregon Fire Code and as near as possible to street intersections. A single fire hydrant is allowed at the intersection of a cul-de-sac provided the cul-de-sac does not exceed 200 feet in length. For a longer cul-de-sac, locate the fire hydrant a minimum of 200 feet from the apex of the radius.

For streets with median dividers or arterial streets with four or more lanes, hydrant spacing shall be 500 feet on each side of the street or 400 feet for higher fire-flow areas (4,000 gpm or more) arranged in an alternating basis.

No hydrant shall be installed less than five feet from an existing utility pole or guy wire nor shall a utility pole or guy wire be placed less than five feet from an existing hydrant.

Approved hydrant types and installation shall conform to the SCS.

(c) <u>Hydrant Valves</u>

Each fire hydrant shall have a hydrant valve and valve box at the main line tee, which will permit repair of the hydrant without shutting down the main supplying the hydrant. Such hydrant valves shall conform to the SCS. The hydrant valve shall be a restrained mechanical joint by flange joint ends. The valve shall be connected directly to the water main using a flange joint tee adjacent to the valve. The entire assembly from main line tee to the hydrant shall be restrained with mechanical joint restraints. No thrust blocks are allowed for restraint. Refer to the Standard Plans for illustration.

5.6—Combination Air Valves

A combination air valve shall be permanently installed at high points on water mains greater than 12 inches in diameter where air can accumulate, except for residential development where combination air valves are not required. An automatic combination air valve shall be installed in an enclosure off the roadway where flooding of the enclosure will not occur. In all cases, the air outlet or inlet shall be piped to a point of free discharge not causing a cross connection. Sizing of the combination air valve for each application must meet the manufacturer's recommendation. For details see the Standard Plans.

(a) Piping for Combination Valves

The open end of the pipe from an automatic valve shall extend upward to an elevation of at least 12 inches above grade and shall be screened. Grade shall mean the existing ground elevation adjoining the enclosure. An opening twice the size of the vent pipe shall exist at grade to prevent flooding of the vault.

5.7—Chamber Drainage

Chambers, vaults, or manholes containing valves, blow offs, meters, or other appurtenances to a water distribution system shall not be connected directly to any storm drain or sanitary sewer. Such chambers shall be drained to the surface of the ground where they are not subject to flooding by surface water.

5.8—Service Lines

The term "service line" is meant to be used only for the waterline extending from the distribution main to the using meter, backflow prevention device, or private fire system double check valve.

NOTE: *1) Private customer lines are under the jurisdiction of the City Building and Safety Division; and 2) No pump shall be used on a service line to provide increased pressure without a separate permit as required by SRC 72.103.*

(a) Sizes

The size of service lines which may be used are in inches: 1, 1½, 2, 4, 6, 8, 10, and 12. Service lines will be reviewed for effects on the distribution system and shall not be greater in size than the distribution main.

Service piping size shall be in conformance with Table 5-4.

Diameter of Service Piping	Meter Size
1-inch	⅝-inch, ¾-inch, and 1-inch
1½-inch	1½-inch
2-inch	1½-inch and 2-inch
4-inch	3-inch and 4-inch
Greater than 4-inch	Service piping diameter shall match meter size

Table 5-4. Water Service Line Sizes

For four-inch and greater services, a design drawing shall be submitted showing the meter vault and fitting requirements (see Standard Plans) along with data which quantifies the expected flow requirements and proposed usage. Four inch and greater services shall contain a shut-off valve and meter bypass as shown on the Standard Plans.

(b) Location

(1). Domestic and Residential

In general, individual service connections shall terminate in front of the property to be served and shall be located two feet each side of a common-side property line. These shall be located in the sidewalk per the applicable Standard Plan. The domestic service shall not be connected to fire protection service.

(2). Fire Service

The public portion of the service line shall extend from the main line connection tee and valve to the isolation valve at the property line, upstream from the double-detector check assembly.

A backflow prevention assembly for fire services shall conform to the requirements of Section 5.4–Backflow Prevention.

Plans for fire services shall include a vicinity map, adjoining street name, width of curb, property line, location of existing waterline referenced to property line, existing hydrant locations, and the distance to property pins where the service crosses the property line. Plans shall include a profile of fire service and note all utilities in trench alignment and the surrounding surface topography including but not limited to ditches, fences, retaining walls, trees, etc.

(c) Materials

Pipe materials shall be designated on the plans and shall conform to the SCS.

Galvanized pipe is not an approved material for underground service on the public portion of the system.

5.9—Meters

All water meters and/or service lines scheduled for installation inside the City will be furnished and installed by City forces at the request and expense of the customer.

EXCEPTIONS:

(a) The service line and meter box must be placed with water mains installed by the developer (see applicable Standard Plan) and the service line installed as part of a detector backflow prevention assembly. All meters shall be installed by the City.

(b) All water meters scheduled for services inside the Suburban East Salem Water District (SESWD) will be furnished and installed by SESWD.

(a) <u>Meter Boxes</u>

Meter boxes shall be sized in accordance with dimensions required in the SCS and on the Standard Plans.

(b) <u>Location</u>

The meter, with approval by the City, may be located in the same vault with a backflow prevention device provided a completed dimensional design is submitted with a request for an Exception.

Meters shall be located at the end of each service line.

(1). Meters ¾-inch through 2-inch

Install in the ROW in a location that allows for easy reading and maintenance, centered in the sidewalk as depicted in the applicable Standard Plan.

(2). Meters 3-inch and Larger

Install near the curb or within the ROW to allow ease of reading and maintenance without entering private property. The meter location must be accessible with a crane truck to within ten feet of the installation with a minimum of ten feet of vertical clearance. If installed in a public sidewalk, the vault lid must be complaint with ADA requirements.

The meter, vault, and piping are to be protected from freezing, vandals, and vehicles. The area surrounding the vault must be sloped in such a manner to prevent stormwater from ponding over or running into the vault.

A minimum three-foot clear space must be provided around the vault to provide ample working space for servicing and maintenance activities.

5.10—Mobile Home Parks

The review of plans and the inspection of mobile home parks are under the jurisdiction of the City Building and Safety Division. Private distribution systems shall be designated in accordance with the OPSC and the applicable OARs.

All public water mains within mobile home parks shall be in the ROW or exclusive easements to the City and shall conform to these Design Standards. Each connection of the mobile home park private water system to the City system shall be through the appropriate backflow prevention assembly and meter (see Section 5.4–Backflow Prevention).

5.11—Planned Unit Developments (PUD)

General design consideration shall conform to requirements set forth by Oregon DHS, Public Health Division; OPSC; and these Design Standards.

Previously introduced requirements for capacity, materials, grid, valves, fire protection, service lines, and meters shall also be applicable for design within PUD areas.

5.12—Pressure Level Separation

When water systems of different pressure levels are interconnected, the design shall provide for a valve to remain closed and shall be marked "red cap" on the plans with clear notation requiring the valve to remain closed. Additionally, the design shall provide for flushing of each system independently through a hydrant as depicted in Figure 5-1.

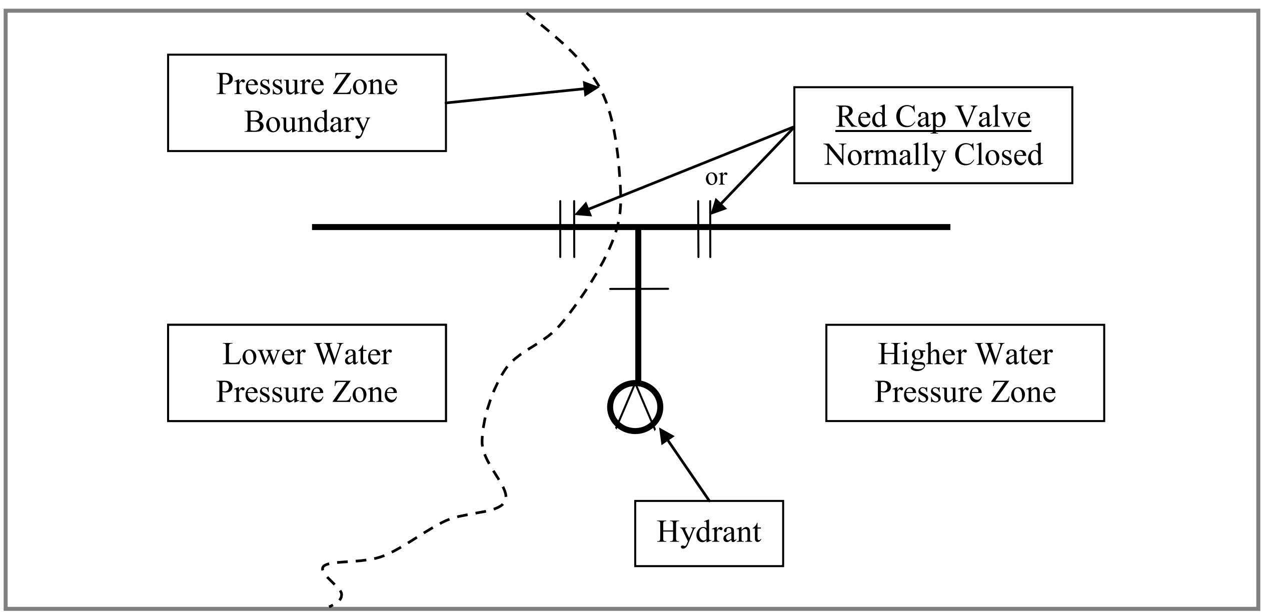


Figure 5-1. Water Pressure Level Separation Assembly

CITY OF SALEM
DEPARTMENT OF PUBLIC WORKS
ADMINISTRATIVE RULES
CHAPTER 109
DIVISION 006
STREET DESIGN STANDARDS

SECTION

Top Div 6

FIGURES

TABLES

6.1—Introduction

The requirements in this Division shall apply where required by the SRC or where referenced by a requirement in these Standards. All newly constructed streets, altered portions of existing streets, and elements added to existing streets shall comply with the requirements of this Division.

(a) Objectives

The objectives of the street design standards include, but are not limited to:

(1). Provide standards which are consistent with the SRC and Salem TSP.

(2). Provide designs that meet the traffic needs of the City.

(3). Provide design guidance criteria to City staff and the private sector regarding the design of streets within the City.

(4). Implement right-of-way (ROW) widths and improvement requirements as established in the SRC and Salem TSP, consistent with the City street classification system.

(5). Provide streets which are designed in a manner which allows economical future maintenance.

(6). Use materials and a design which ensures a minimum street design life of 20 years for arterial and collector streets, and 25 years for local streets.

(b) Americans with Disabilities Act

All pedestrian and transportation facilities shall comply with the Americans with Disabilities Act of 1990 (ADA), including any amendments thereto, and all applicable federal rules and regulations implementing the ADA, including, but not limited to, the ADA Standards for Accessible Design and the Uniform Federal Accessibility Standards (UFAS).

Certain facilities such as bus shelters, pedestrian loading zones, and protruding objects, etc., are not addressed in this Division and shall comply with the above-mentioned standards.

Additionally, the United States Access Board has issued Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right of Way (PROWAG). At the time of the adoption of these Design Standards, PROWAG has not been adopted as an official Standard. The PROWAG can be considered as recommended best practices and can be used for areas not fully addressed by the current standards.

(c) Reference Standards

The following are standards, manuals, and guidelines that are either referenced within this Division, or provide useful reference material:

(1). Manual on Uniform Traffic Control Devices for Streets and Highways, 2009 Edition (MUTCD)

(2). Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way, July 26, 2011 (PROWAG)

(3). National Electrical Code (NEC)

(4). Institute of Transportation Engineers (ITE) Trip Generation Manual

(5). ODOT Bridge Design and Drafting Manual (BDDM)

(6). ODOT Geotechnical Design Manual

(7). ODOT Hydraulics Manual

(8). A Policy on Geometric Design of Highways and Streets, AASHTO

(9). Roadside Design Guide, AASHTO

(10). Guide For Design of Pavement Structures, AASHTO

(11). Pavement Design Guide, FHWA

(12). Asphalt Pavement Design Guide, Asphalt Pavement Association of Oregon (APAO)

(13). Standard Specifications For Highway Bridges, AASHTO

(14). Institute of Traffic Engineers, Trip Generation

(15). Highway Design Manual, ODOT

(16). Signal Design Manual, ODOT

(17). Traffic Lighting Design Manual, ODOT

(18). American National Standard Practice for Roadway Lighting, ANSI/IESNA

(19). Striping Design Guidelines, ODOT

(20). Traffic Line Manual, ODOT

Top Div 6

(21). Traffic Sign Design Manual, ODOT

(22). Oregon Bicycle And Pedestrian Plan, ODOT

(23). Oregon Standard Specifications For Construction, ODOT and Oregon APWA

(d) Drafting and Drawing Requirements

See Division 002—Drafting and Drawing Standards for drafting and drawing requirements for street improvement plans.

6.2—Street Classifications and Cross Sections

(a) Classified Street Sections

SRC Chapter 803 sets forth minimum pavement widths and minimum ROW widths for various classified streets. These requirements are repeated below. In the event of an apparent conflict between the requirements in the SRC and requirements in this Standard, the requirements in the SRC shall govern. Except where turn lanes are required by Section 6.3–Lanes and Transitions or where additional lanes are required by a City approved Traffic Impact Analysis, street sections for various classified streets shall conform to the following:

(1). Local streets shall be a curbed improvement, 30 feet wide, measured between the curb faces. The Local street improvement shall be centered within the ROW (see Figure 6-1).

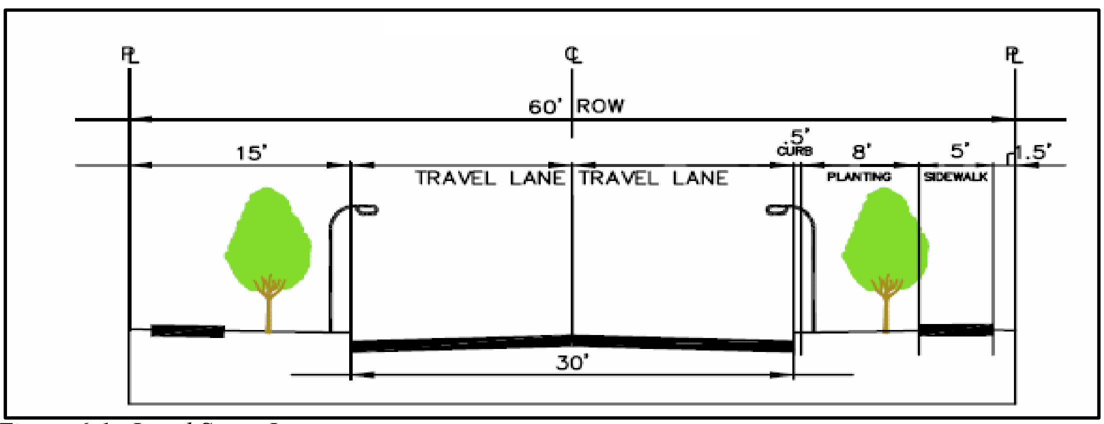


Figure 6-1. Local Street Improvements

(2). Collector "A" streets shall be a 34-foot-wide, curbed improvement and shall have striped lanes conforming to these standards. The Collector "A" street improvement shall be centered within the ROW (see Figure 6-2).

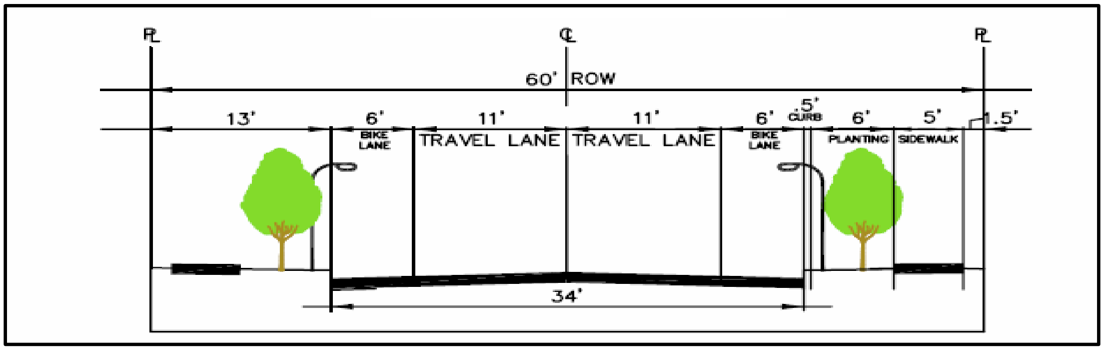


Figure 6-2. Collector "A" Street Improvements

(3). Collector "B" streets shall be a 40-foot-wide, curbed improvement, except at intersections with local streets where, in those cases, a curb extension shall be provided to reduce the pedestrian crossing distance to 34 feet. Collector "B" shall provide striped centerline, parking on one side, and striped bike lanes conforming to these standards (see Figure 6-3).

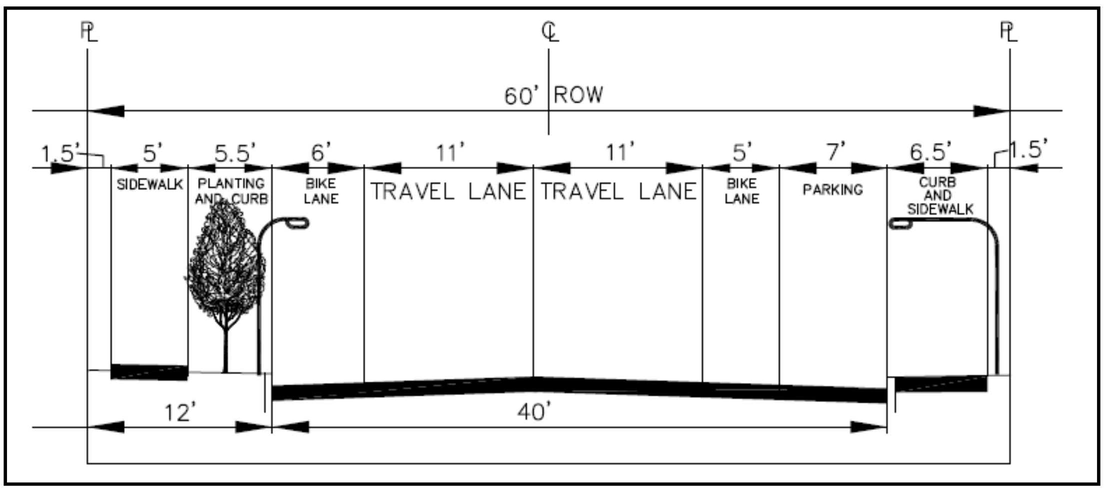


Figure 6-3. Collector "B" Street Improvements

(4). Collector "C" streets shall be a 34 feet wide, curbed improvement. Provide striped centerline and parking lane on one side located seven feet from curb face (see Figure 6-4).

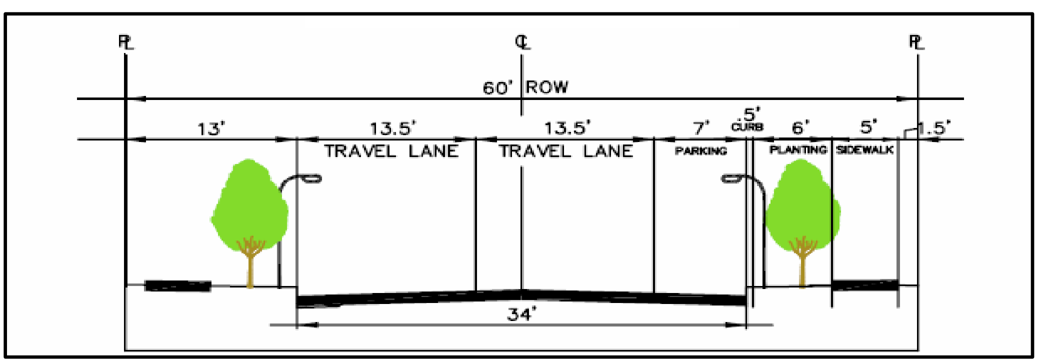


Figure 6-4. Collection "C" Street Improvements

(5). Minor Arterial streets shall be a 46-foot-wide, curbed improvement, centered within the ROW. There shall be one through lane in each direction with a median or left turn lane and bike lanes. All lanes shall be striped in conformance with these standards (see Figure 6-5).

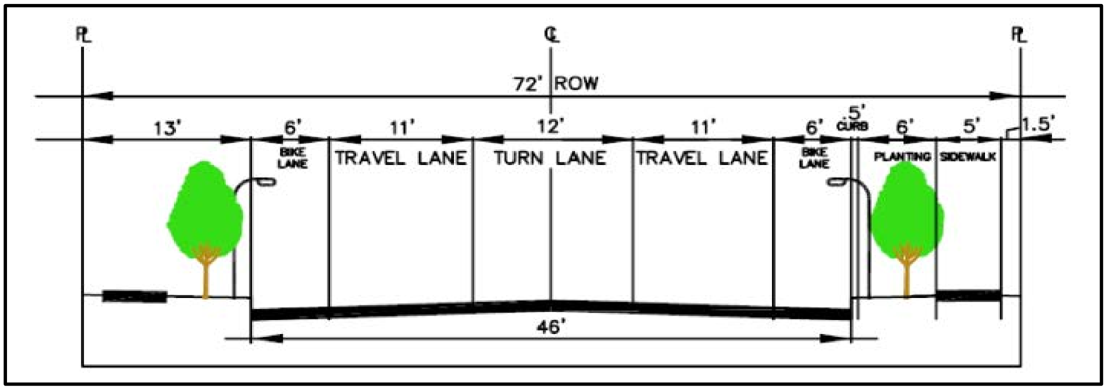


Figure 6-5. Minor Arterial Street Improvements

(6). Major Arterial streets shall be a 68-foot-wide, curbed improvement, centered within the ROW. There shall be two through lanes in each direction with a median or left turn lanes and bike lanes. All lanes shall be striped in conformance with these standards (see Figure 6-6).

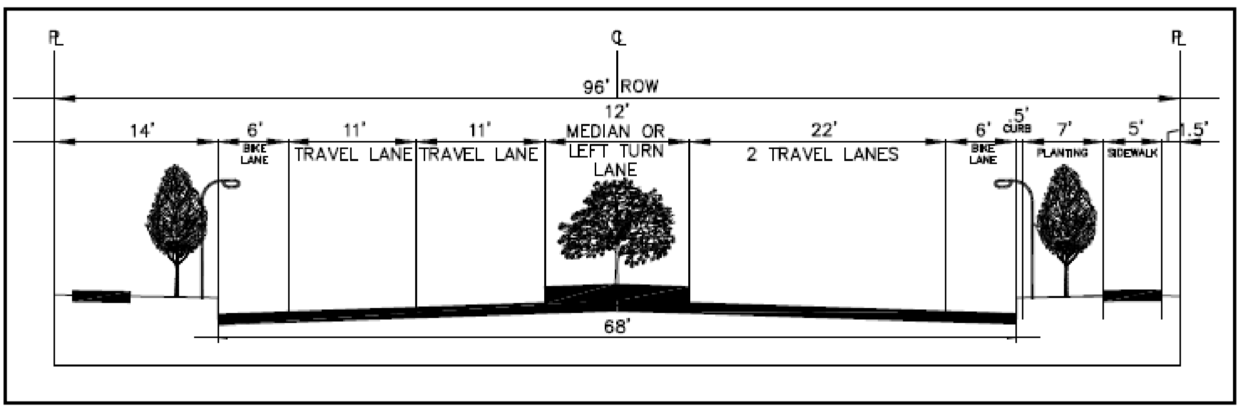


Figure 6-6. Major Arterial Street Improvements

(7). Parkway streets shall be an 80-foot-wide, curbed improvement, centered within the ROW. There shall be two through lanes in each direction with a median or left turn lane and bike lanes on each side. All lanes shall be striped in conformance with these standards (see Figure 6-7).

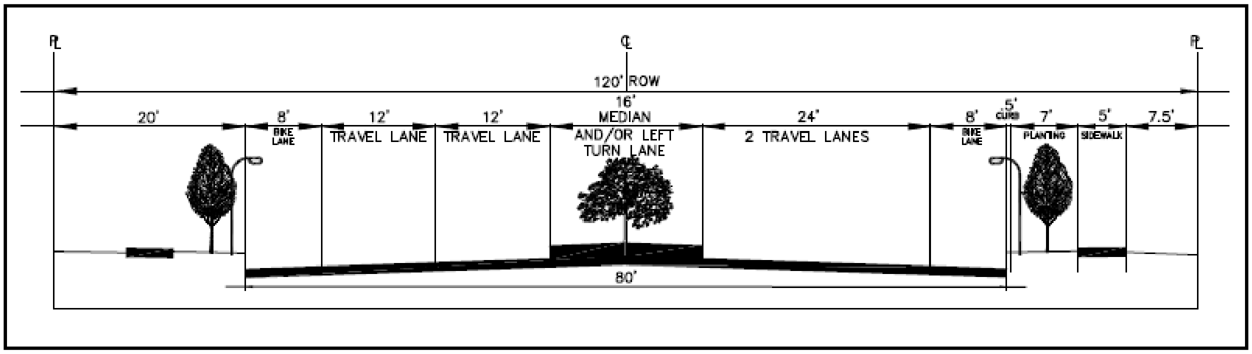


Figure 6-7. Parkway Street Improvements

(8). Alternative Cross Sections

Alternative cross sections required by design constraints may be approved by Design Exception, subject to limitations per SRC.

(b) <u>Crown Location and Cross Slope</u>

Pavement crown location and cross slope shall conform to the following:

(1). Cross Slope

Except as provided in superelevated curves and transitions (Subsection 6.8(c)—Superelevation and Subsection 6.8(f)—Superelevation Transition) pavement cross slopes, measured perpendicular to the direction of vehicular travel, shall be two percent minimum and three percent maximum.

(2). Crown Location

Except as provided in Subsection 6.2(c)—Shed Section (see Figure 6-8), street cross sections shall be designed such that the pavement surface slopes from a crown point towards the curb or edge of pavement. [Normal crown cross sections shall be designed with the crown in the center of the road.]

Crown location may be offset to match existing infrastructure or site conditions and must not be less than 12 feet from face of curb.

(c) <u>Shed Section</u>

Street cross sections with pavement surfaces sloping across the full width of the street improvement as shown in Figure 6-8 are permitted in the following cases:

(1). Within street intersections.

(2). On streets 34 feet wide or less, but only on the condition that concentrated drainage sources are prevented from flowing across the pavement surface. Cross slope shall be two percent minimum and three percent maximum per Subsection 6.2(b)(1)—Cross Slope.

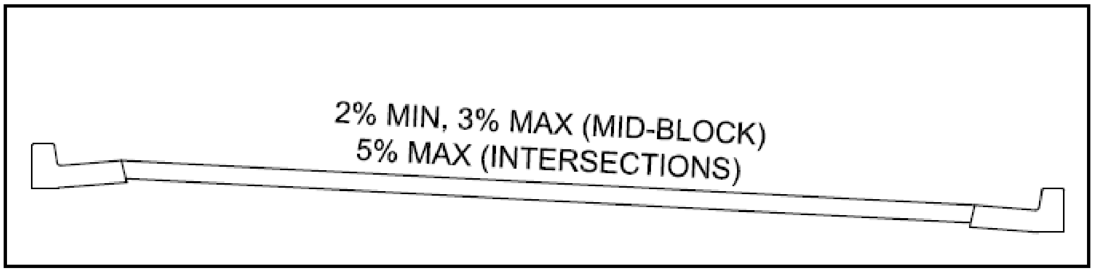


Figure 6-8. Shed Street Cross Section

NOTE: *Public storm systems providing piped storm service (rain drain) connections will prevent concentrated drainage sources from flowing across pavement.*

6.3—Lanes and Transitions

(a) Lane Widths

Striped lane widths, as measured from the centerline of a lane stripe, shall comply with widths indicated in Table 6-1. The only exception to this requirement is bicycle lanes on the parking side of Collector "B" streets, which shall be five feet wide.

Street Classification	Lane Type		
	Turn	Through	Bicycle
Parkway	14	12	8
All Other Classes	12	11	6

Table 6-1. Lane Widths (feet) for Various Street Classifications

(b) Left Turn Lanes

Left turn lanes are required on arterial streets where they intersect with arterial streets or collector streets. Left turn lanes are required on collector streets where they intersect with arterials or other collectors. Left turn lane lengths shall be determined in accordance with Traffic Impact Analysis.

(c) Widening Transition

Street widening transitions for right turn lanes and through lanes shall comply with Figure 6-9.

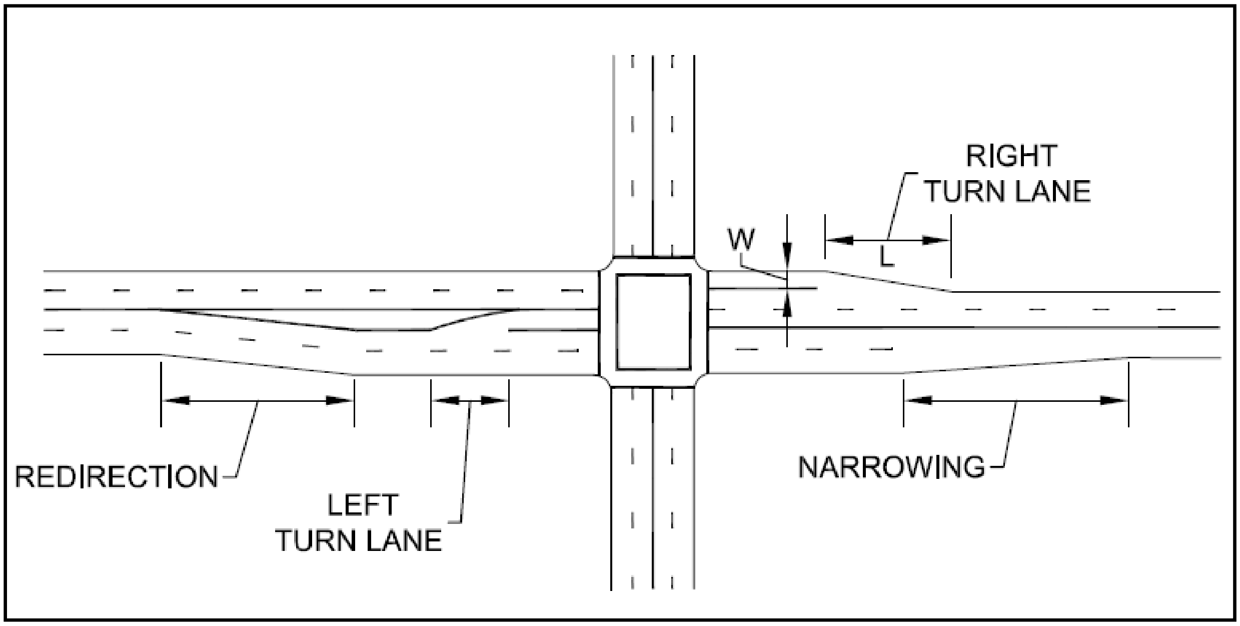


Figure 6-9. Right Turn Lanes and Through Lanes at Intersections

(1). Transition Ratio

Minimum transition ratio (*R*) for computing widening transition taper lengths shall be as shown on Table 6-2. The transition ratio (*R*) is the ratio of the length (*L*) to the width (*W*) of the offset *L/W*.

Application	**Transition Ratio *R* (Minimum)**
Right Turn Lane	5:1 or (5/1)
Through Lane Addition	10:1 or (10/1)

Table 6-2. Minimum taper transition ratio

(2). Taper Lengths

The taper lengths shall be not less than the length computed using the formula ***L=RxW*** where:

L=length of taper; ***R***=transition ratio; ***W***=width of offset

(d) Narrowing Transition

Minimum transition taper lengths for dropping a travel lane shall be computed from the formulas shown in Table 6-3 where:

L=length of taper; ***S***=design speed; ***W***=offset distance

Design Speed	Minimum Length
Less than 45 mph	$L=WS^2/60$
45 mph or Greater	$L=WS$

Table 6-3. Minimum taper for lane drop

(e) <u>Redirection</u>

Minimum transition lengths for redirecting travel lanes shall be computed from the formula ***L=WxS*** where:

L=length of taper; ***S***=design speed; ***W***=offset distance

6.4—Pedestrian Access Routes

Accessible routes are defined as a continuous, unobstructed walking surface that connects all accessible elements.

(a) <u>Components</u>

Pedestrian access routes shall consist of one or more of the following components:

(1). Sidewalks and other pedestrian circulation paths, or a portion of sidewalks and other pedestrian circulation paths.

(2). Pedestrian street crossings and at-grade rail crossings.

(3). Pedestrian overpasses and underpasses and similar structures.

(4). Curb ramps and blended transitions.

(b) <u>Continuous Width</u>

The continuous width of pedestrian access routes shall be a minimum of four feet, exclusive of the width of the curb, except, if within a median or pedestrian refuge island, in which case, the width shall be a minimum of five feet by five feet. Passing spaces are permitted to overlap pedestrian access routes.

(c) <u>Grade</u>

Except as provided below, where pedestrian access routes are contained within ROW, the grade of pedestrian access routes shall not exceed the general grade established for the adjacent street. Where pedestrian routes are not contained within the ROW, the grade of pedestrian access routes shall be five percent maximum.

(1). Pedestrian Street Crossings

Where pedestrian access routes are contained within pedestrian street crossings, the grade of the pedestrian access route shall be five percent maximum.

(d) Cross Slope

Except as provided in Subsections 1 and 2 below, the cross slope of pedestrian access routes shall be two percent maximum.

(1). Pedestrian Street Crossings Without Yield or Stop Control

Where pedestrian access routes are contained within pedestrian street crossings without or stop control, the cross lope of the pedestrian access route shall be five percent maximum.

(2). Midblock Pedestrian Street Crossings

Where pedestrian access routes are contained within midblock pedestrian street crossings, the cross slope of the pedestrian access route shall be permitted to equal the street or highway grade.

(e) Surfaces

The surfaces of pedestrian access routes, elements, and spaces that connect to pedestrian access routes shall be firm, stable, and slip resistant and shall comply with the following:

(1). Vertical Alignment

Vertical alignment shall be generally planar within pedestrian access routes (including curb ramp runs, blended transitions, turning spaces, and gutter areas within pedestrian access routes) and surfaces within other elements and spaces required to connect to pedestrian access routes. Grade breaks shall be flush. Where pedestrian access routes cross rails at grade, the pedestrian access route surface shall be level and flush with the top of rail at the outer edges of the rails and the surface between the rails shall be aligned with the top of rail.

(2). Vertical Surface Discontinuities

Vertical surface discontinuities shall be 0.5 inch maximum. Vertical surface discontinuities between 0.25 inch and 0.5 inch shall be beveled with a slope not steeper than 50 percent. The bevel shall be applied across the entire vertical surface discontinuity.

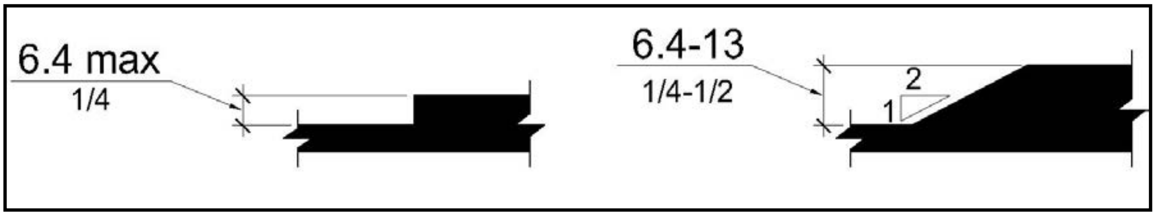


Figure 6-10. Vertical Surface Discontinuities

(3). Horizontal Openings

Horizontal openings in gratings and joints shall not permit passage of a sphere more than 0.5 inches in diameter. Elongated openings in gratings shall be placed so that the long dimension is perpendicular to the dominant direction of travel.

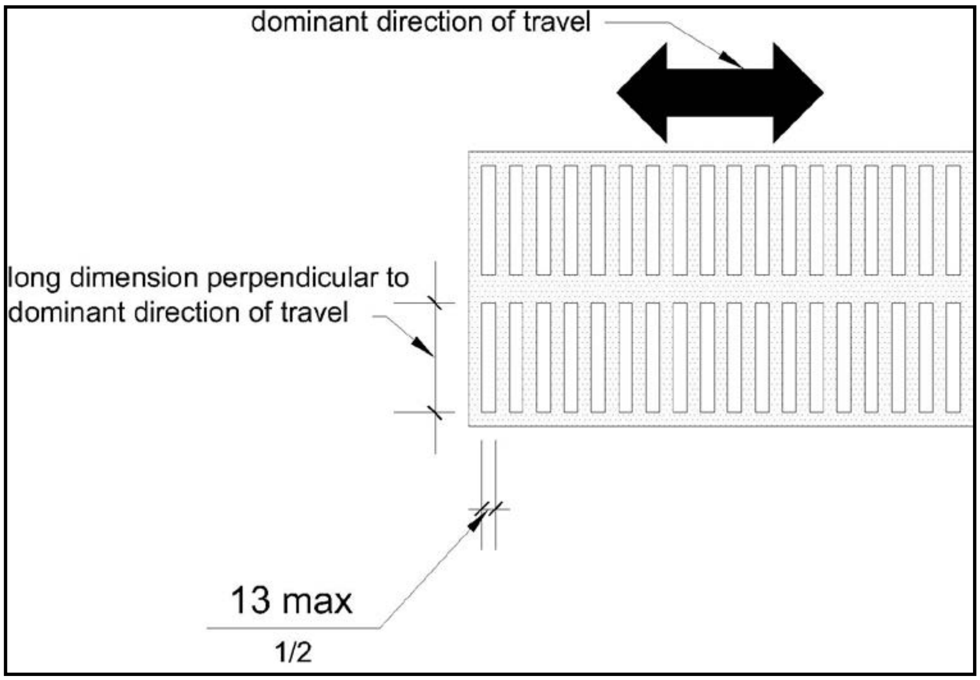


Figure 6-11. Horizontal Openings in Gratings and Joints

(4). Flangeway Gaps

Flangeway gaps at pedestrian at-grade rail crossings shall be 2.5 inch maximum on non-freight rail track and three inch maximum on freight rail track.

6.5—Intersections

(a) Intersection Angle

The angle of intersections, measured at the improvement centerlines, shall be not less than 85 degrees.

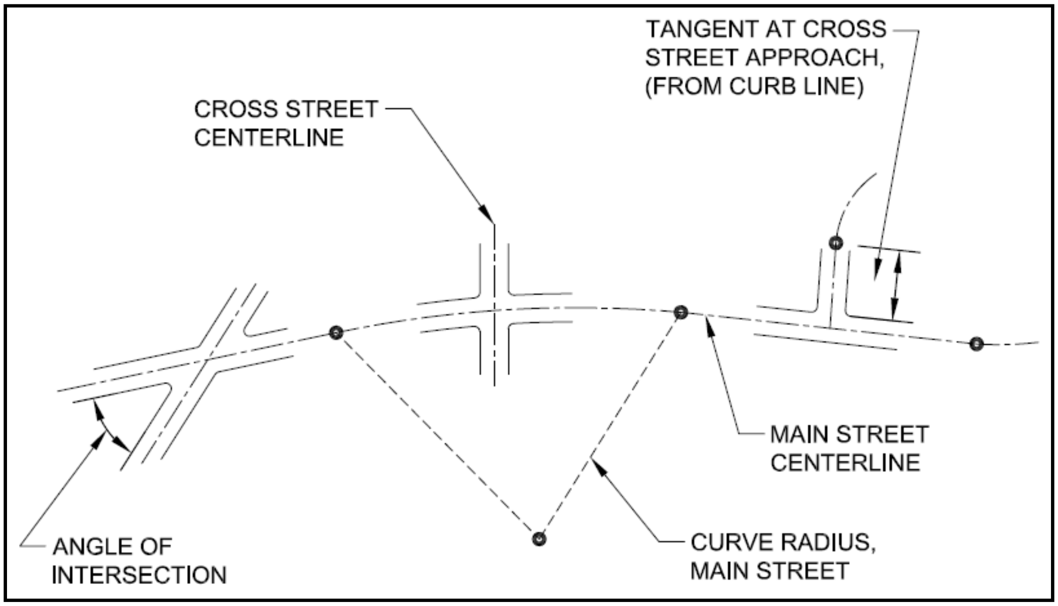


Figure 6-12. Intersection Components

(b) Tangents

There shall be a straight tangent section on each leg of an intersection having a length not less than as shown in Table 6-4. The length of the tangent is to be measured beginning at an extension of the cross street curb line.

Street Classification	Minimum Tangent Length (Feet)
Arterial	100
Collector	75
Residential	50

Table 6-4. Minimum Tangent Lengths for Various Street Classifications

(c) Intersection Approach

An intersection approach conforming to this sub-section shall be provided adjacent to intersections.

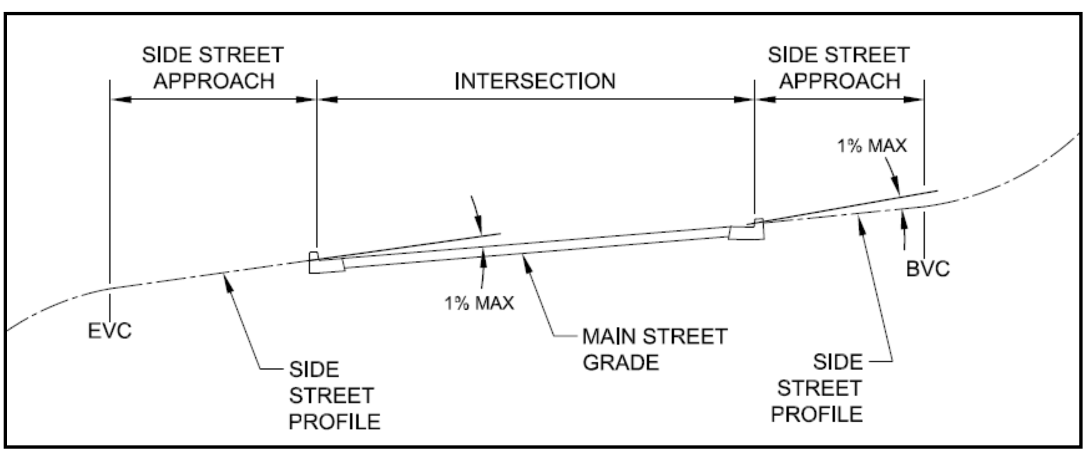


Figure 6-13. Profile of Street Intersection on Hill

Top Div 6

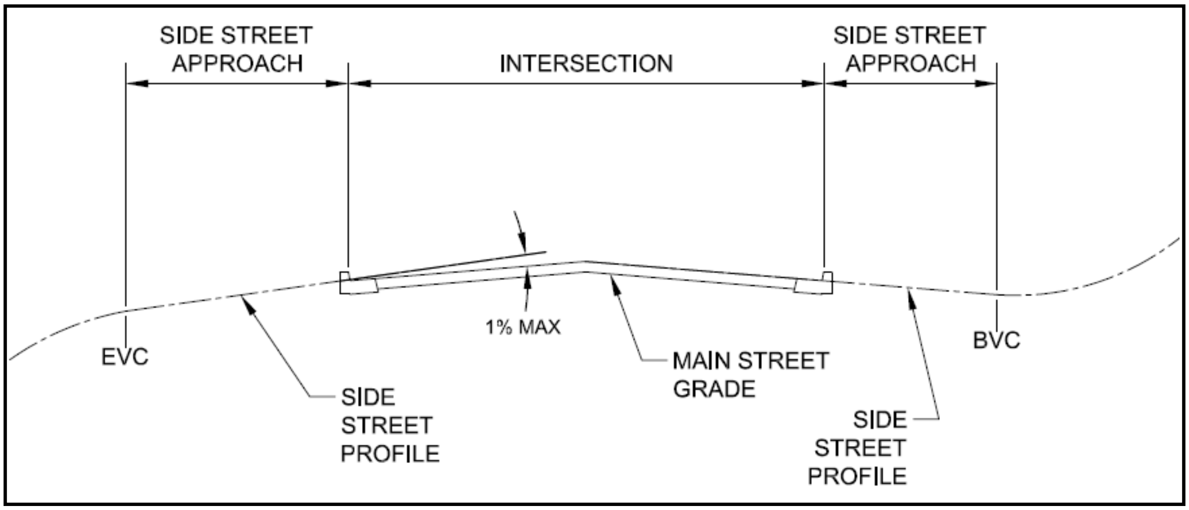


Figure 6-14. Profile of Crown Street Intersection

(1). Approach Length

The lengths of intersection approaches shall be not less than the lengths shown in Table 6-5. The approach is to be measured beginning at an extension of the cross street curb line.

Street Classification	Intersection Approach Length (Feet)
Arterial	30
Collector	25
Residential	20

Table 6-5. Minimum Approach Lengths for Various Street Classifications

(2). Approach Grade

Intersection approaches shall have straight grades not varying from the adjacent intersection grade by more than one percent.

(d) <u>Intersection Grades</u>

The maximum street grade through intersections shall be five percent unless a two percent cross slope pedestrian street crossing is required by Section 6.4—Pedestrain Access Routes.

NOTE: *Maximum grades through intersections are limited in order to comply with maximum allowable running and cross slopes for pedestrian street crossings.*

(e) **Pedestrian Street Crossing**

A pedestrian street crossing shall be provided for all legal crossing locations as required by state law, unless the City Engineer determines a crossing should not be provided in consideration of safety and traffic issues. Pedestrian street crossings shall contain a pedestrian access route that complies with Section 6.4–Pedestrian Access Routes.

6.6—Cul-de-sac and Knuckles

SRC Chapter 803 sets forth minimum ROW and street widths, including radius dimensions for culs-de-sac. These requirements are repeated below. In the event of an apparent conflict between the requirements in the SRC and requirements in this Standard, the requirements in the SRC shall govern.

(a) **Horizontal Alignment**

(1). Minimum curb radius reversing curve transitions to culs-de-sac and knuckles shall be 25 feet.

(2). Minimum ROW radius of the cul-de-sac or knuckle shall be 45 feet.

(3). Minimum curb radius of the cul-de-sac or knuckle shall be 38 feet.

(4). Culs-de-sac in industrial developments shall provide adequate turnarounds for the type of vehicles served by the streets, as approved by the City.

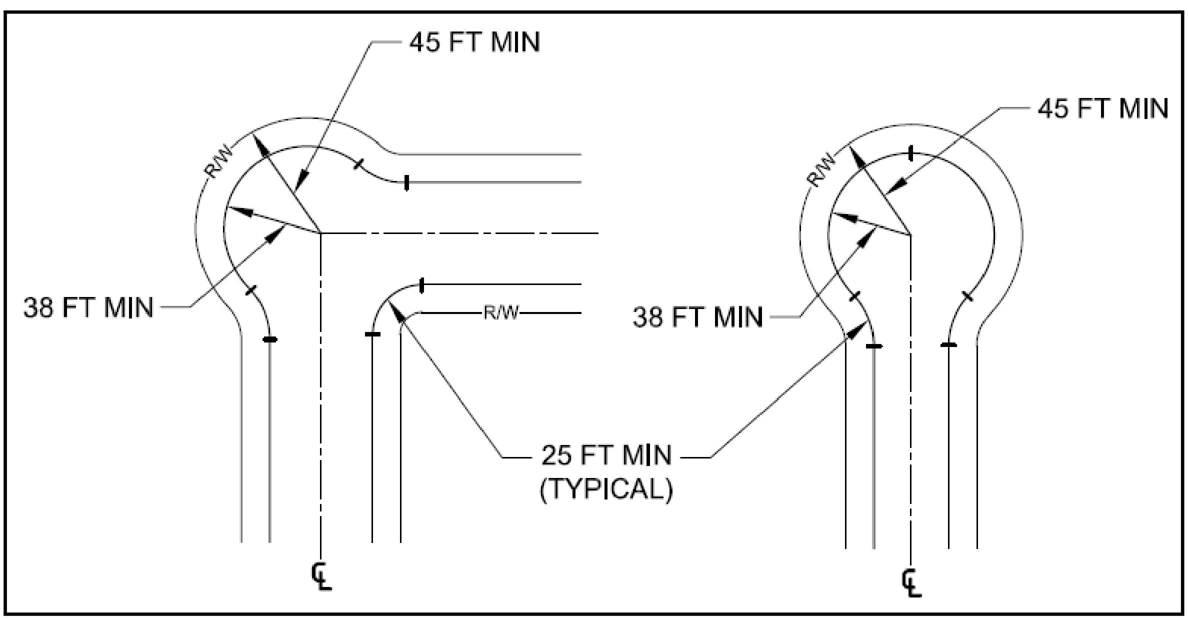


Figure 6-15. Cul-de-sac Layout

Top Div 6

(b) **Vertical Alignment**

(1). Maximum Curb Grade

Maximum curb grade shall be ten percent.

(2). Vertical Alignments

Cul-de-sac curb profiles shall be designed to provide smooth vertical alignment. Curb grade changes in excess of one percent shall conform to the requirements of a vertical curve (Section 6.9–Vertical Curves), with a K-value not less than 3.0.

6.7—Design Speeds

A major local street is the intersecting street with greater traffic volume, larger cross section, and higher functional class

A minor local street is the intersection street which, in the judgment of the City Engineer, is likely to have less traffic volume and lower functional classification than the major street.

(a) **Classified Streets**

Except as provided in Subsection 6.7(b)—Existing Posted Speed and Subsection 6.7(c)—Local Street Intersections, the minimum design speeds for streets shall be as shown in Table 6-6.

Street Classification	Design Speed
Alleys	15 mph
Local Streets	25 mph
Collectors, and Arterials in CB District	35 mph
Arterials	45 mph
Parkway	55 mph

Table 6-6. Street Classification Design Speeds

(b) **Existing Posted Speed**

Where the City Traffic Engineer determines that a street will have a posted speed less than the speeds in Table 6-6, the design speed is permitted to equal:

Classification	Design Speed
Local Streets	Posted Speed
Collectors	Posted Speed +5 mph
Arterials	Posted Speed +10 mph
Parkway	Posted Speed +10 mph

Table 6-7. Design Speeds Exceptions

(c) <u>Local Street Intersections</u>

(1). The design speed may be 15 mph for that portion of a local minor street within 100 feet upstream of an intersection with a major local street.

(2). The design speed may be 15 mph for that portion of a local street within 100 feet of a stop sign.

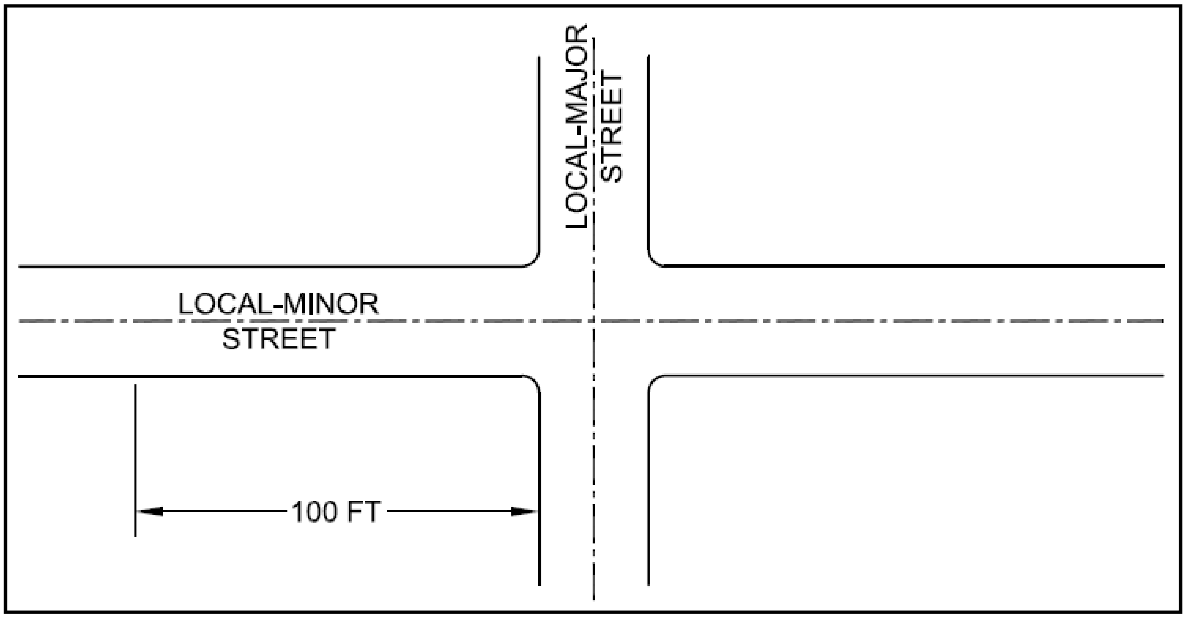


Figure 6-16. Reduced Speed Section on a Local Street

6.8—Horizontal Curves and Superelevation

(a) <u>General</u>

Horizontal direction changes shall be designed with circular curves. When physical constraints or adjacent roadway alignments do not allow for radii to accommodate curves with normal crowns, superelevation shall be required.

> ***NOTE:*** *Sharp horizontal curvature should not be introduced at or near the top of a pronounced crest vertical curve. Similarly, sharp horizontal curvature should not be introduced at or near the low point of a pronounced sag vertical curve.*

(b) <u>Centerline Radius—Normal Crown</u>

Streets with normal crowns shall be designed in accordance with Table 6-8.

Minimum Centerline Radius (feet) for Normal Crown Streets		
Design Speed (mph)	-2%	-3%
15	50	55
20	110	115
25	200	210
30	335	355
35	510	545
40	765	825
45	1040	1125

Table 6-8. Centerline Radius for Normal Crown Streets

(c) Superelevation

Streets that cannot be designed to accommodate circular curves with a normal crown shall be designed with superelevation. The maximum superelevation rates for various streets classifications are shown in Table 6-9. Superelevation shall not exceed five percent at intersections with pedestrian crossings.

Street Classification	Maximum Superelevation Rate
Local	3%
Collector	4%
Arterial and Parkway	6%

Table 6-9. Maximum Superelevation Rates

(d) Centerline Radius—Superelevation

Street centerline radii for various superelevation rates shall not be less than the lengths shown in Table 6-10. Columns with a dash indicate that superelevation is not permitted.

Minimum Centerline Radius (feet) for Superelevated Streets					
Design Speed	2%	3%	4%	5%	6%
15	–	–	–	–	–
20	95	90	–	–	–
25	170	160	–	–	–
30	275	265	250	–	–
35	410	390	375	355	–
40	595	565	535	510	485
45	795	750	715	675	645

Table 6-10. Minimum Centerline Radius for Superelevated Streets

Top Div 6

(e) Pedestrian Street Crossings in Superelevation

Superelevations shall comply with Subsection 6.4(c)—Grade where pedestrian crossings are required.

(f) Superelevation Transition

Elements of superelevation transitions are shown in Figure 6-17.

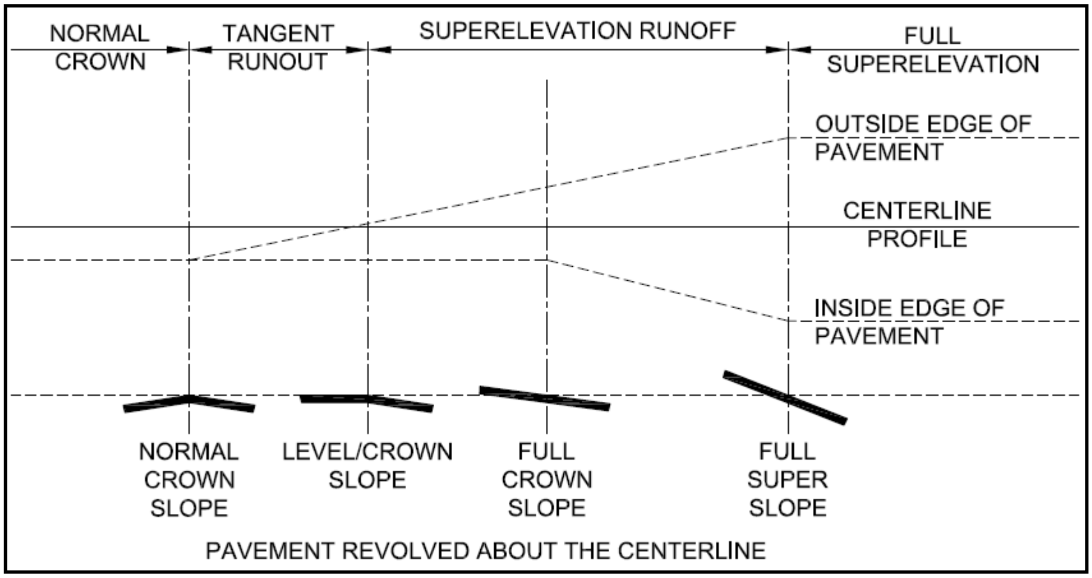


Figure 6-17. Superelevation Transition

(1). One Lane Rotated: One lane rotated is defined as a two lane street, including the median or left-turn lanes. Superelevation runoff and tangent runout lengths for one lane rotation shall be not less than the lengths shown in Table 6-11.

Design Speed (mph)	Superelevation Runoff (ft)					Tangent Runout (ft)
	Superelevation Rate					
	2%	3%	4%	5%	6%	Any
25	34	51	—	—	—	34
30	36	55	73	91	—	36
35	39	58	77	97	116	39
40	41	62	83	103	124	41
45	44	67	89	111	133	44
50	48	72	96	120	144	48
55	51	77	102	128	153	51
Runoff and runout lengths shown are based on AASHTO 2011. Designers are advised to refer to AASHTO for intermediate superelevation rates not included in this table.						

Table 6-11. Minimum Runout and Runoff Lengths (one lane)

(2). Two Lanes Rotated: Two lanes rotated is defined as a four lane street, including median or left-turn lanes. Superelevation runoff and tangent runout lengths for two lanes rotation shall be not less than the lengths shown in Table 6-12.

Design Speed (mph)	Superelevation Runoff (ft)					Tangent Runout (ft)
	Superelevation Rate					
	2%	3%	4%	5%	6%	Any
25	51	77	—	—	—	51
30	55	82	109	136	—	55
35	58	87	116	145	174	58
40	62	93	124	155	186	62
45	67	100	133	167	200	67
50	72	108	144	180	216	72
55	77	115	153	191	230	77
Runoff and runout lengths shown are based on AASHTO 2011. Designers are advised to refer to AASHTO for intermediate superelevation rates not included in this table.						

Table 6-12. Minimum Runout and Runoff Lengths (two lanes)

(3). Runoff Location

A. Alternate 1—Apply superelevation runoff in accordance with location shown in Table 6-13.

Design Speed (mph)	Portion of Runoff Located on Tangent (%)		
	Number of Lanes Rotated		
	1.0	1.5	2.0-2.5
15-45	80	85	90
>45	70	75	80

Table 6-13. Superelevation Runoff Location

B. Alternate 2—Apply the superelevation runoff with one-third on the curve itself and two-thirds on the tangent adjacent to the curve as shown in Figure 6-18.

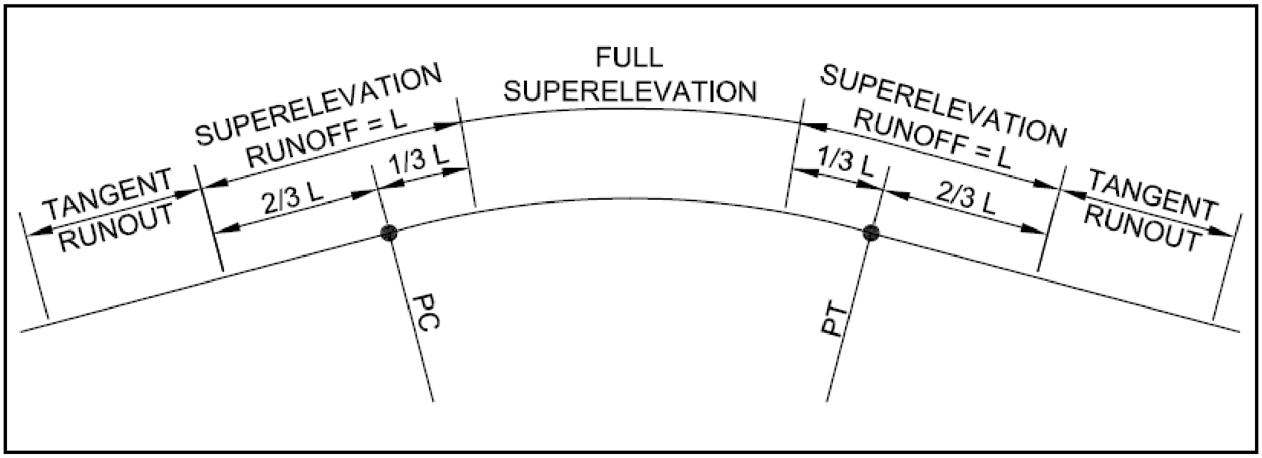


Figure 6-18. Superelevation Runoff Alternate 2

> ***NOTE:*** *To maintain drainage, vertical and horizontal curves should be designed so that the flat profile of a vertical curve will not be located near the flat cross slope of the tangent runout.*

6.9—Vertical Curves

(a) General

Grade changes in excess of one percent require a vertical curve that is parabolic and complies with this section.

(b) Length

Vertical curve length shall be not less than the length computed from the formula ***L=KxA*** where:

L = length of vertical curve in feet
K = design constant (rate of vertical curvature)
A = Algebraic differences of the grades (G_1-G_2)

(c) Design Constant (*K*)

Minimum K-Values for computing minimum lengths of vertical curves are shown on Table 6-14.

Minimum K VALUES		
Design Speed MPH	Crest Vertical Curve	Sag Vertical Curve
15	3	(8*) 10
20	7	17
25	12	26
30	19	37
35	29	49
40	44	64
45	61	79
50	84	96
55	114	115
* An exception to the minimum K value for sag curves is permitted only for 15 MPH design speeds and only under the condition that the street is fully illuminated in accordance with Section 6.28–Street Lighting.		

Table 6-14. Minimum Design Constant (K-Value) for various design speeds

6.10—Grades

(a) Maximum Street Grade

SRC Chapter 803 sets forth maximum street grades. These requirements are repeated below in Table 6-15. In the event of an apparent conflict between the requirements in the SRC and requirements in this Standard, the requirements in the SRC shall govern.

Street Classification	Maximum Grade
Arterial	6%
Collector	8%
Local	12%

Table 6-15. Maximum street grade for various street classifications

(1). Alternative

Notwithstanding whether an alternative to maximum street grade has been approved by the Director, street grades through intersections and approaches shall comply with Section 6.4–Pedestrian Access Routes or Section 6.5–Intersections.

Top Div 6

(b) Grade Changes

Except as provided in Subsection 6.10(b)(1)—Grade Change Execptions below, grade changes in excess of one percent shall comply with Section 6.9–Vertical Curves.

(1). Grade Change Exceptions

Grade change within an intersection is permitted to equal the grades established by the typical cross section of the intersected street.

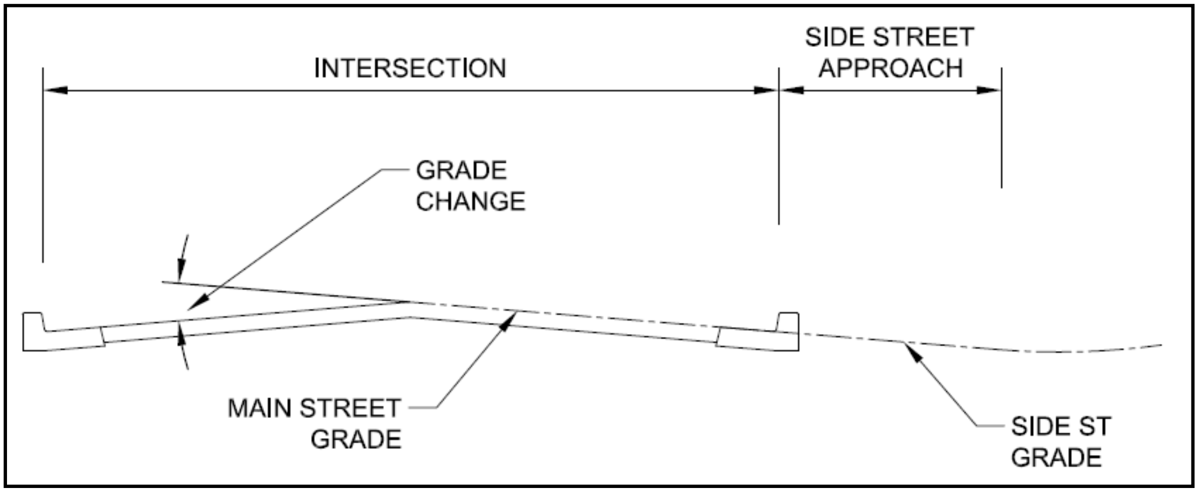


Figure 6-19. Grades at Intersections

6.11—Curbs

(a) General

See Standard Plan 303 for additional information.

(b) Types

Type A combined curb and gutter is required for both new construction and reconstruction of existing curbs. Type C curb may be permitted as approved by the City, and is required, as shown in Table 6-16.

Standard Application	Type C Curb	
	Required	Permitted
Replacement of Existing Type C Curb		X
Required Curb Exposure > 6 inches		X
At Raised Pedestrian Crossings		X
Per City Standard Drawings	X	
Per ODOT Crossing Order at Railroads	X	

Table 6-16. Type C Curbs

Top Div 6

(c) Minimum Grade

Curb grade shall be not less than 0.25 percent for Type A and 0.4 percent for Type C.

(d) Exposure

Except as described below, the nominal curb exposure shall be six inches as shown in Figure 6-20.

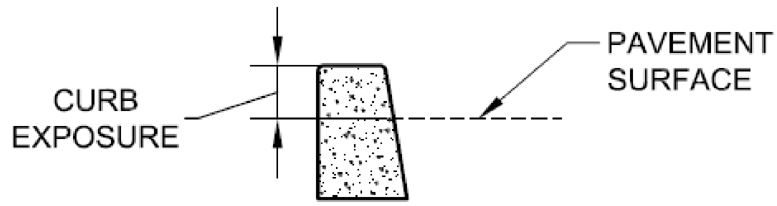


Figure 6-20. Curb Exposure

(1). Reduced Curb Exposure

Reduced curb exposure is required in those locations shown on the Standard Plans and the SCS.

NOTE: *Reduced curb exposure may be necessary in areas of reconstruction in order to resolve sidewalk drainage and ADA requirements.*

(2). Increased Curb Exposure

An increased curb exposure is required at railroad crossings for a distance prescribed by the applicable ODOT crossing order.

(e) Curb Returns at Intersection

The standard curb radii at intersections vary with the street classification. Except as noted below, curb radii shall be as shown in Table 6-17.

Intersecting Streets Classification	Local	Collector	Arterial
Local	20 ft	25 ft	25 ft
Collector	25 ft	30 ft	30 ft
Arterial	25 ft	30 ft	30 ft

Table 6-17. Standard Curb Radii

(1). Reduced Curb Radius

Curb radius may be reduced to five feet less than standard radius in any of the following circumstances:

A. To prevent conflict with immovable obstructions,

B. To fit required improvements within available ROW,

C. At intersections of one-way streets where vehicle turning movements are prohibited.

(2). Increased Curb Radius

Curb radius shall be increased above the standard radii when directed by City Traffic Engineer in order to accommodate truck turning movements.

(3). Curb Return Vertical Alignment

Curb returns shall be designed to provide smooth vertical profiles. Grade changes shall not exceed one percent. Grade changes exceeding one percent shall require a vertical curve. Profile shall be designed to provide adequate drainage. Low points shall not be located in curb ramps.

(f) Alignment Changes

Horizontal alignment changes in curbs shall be designed as a circular curve having a radius not less than 15 feet.

(g) Cross Slope at Curb Ramps and Blended Transitions

The gutter cross slope of Type A curb shall not exceed five percent at curb ramps and blended transitions.

6.12—Sidewalks

(a) Accessible Routes

All sidewalks shall contain a pedestrian access route per the requirements of Section 6.4–Pedestrian Access Routes.

(b) Sidewalk Width & Location

SRC Chapter 803 sets forth minimum sidewalk widths and locations. These standards are repeated and expanded in this section. All sidewalks shall be a minimum of five feet in width. Sidewalks that provide a direct access to a school shall be a minimum of eight feet in width for a distance of 600 feet from the point of connection. Curbline sidewalks on the striped parking side of Collector "B" Streets shall be a minimum of 6.5 feet in width. In the event of an apparent conflict between the requirements in the SRC and requirements in this Standard, the requirements in the SRC shall govern.

(c) <u>Sidewalk Slope</u>

Sidewalk cross slopes shall be a minimum of 0.5 percent and a maximum of two percent. The running slope of sidewalks shall remain as flat as possible, up to a maximum of five percent. A sidewalk may follow the slope of the adjacent roadway when achieving less than five percent is not practicable.

(d) <u>Sidewalk Thickness</u>

The minimum sidewalk thickness is four inches except in the following locations:

Location	Minimum Thickness
Driveway approaches	Six inches
Curb Ramps and turning areas (see Curb Ramp Standard Plans)	Six inches

(e) <u>Construction Timing</u>

Sidewalks shall be constructed prior to City acceptance of street improvements, except as provided below.

(1). Exception

Sidewalk construction adjacent to the full frontage portion of a residential building lot designated for driveway access may be deferred until it is required by the SRC or until a building permit is issued, whichever occurs sooner.

(f) <u>Temporary Transitions</u>

Temporary transitions conforming to Standard Plans and the SRC are required where sidewalks terminate.

6.13—Driveways

(a) <u>General</u>

SRC Chapter 804 sets forth locations, widths, and slopes for driveways. These requirements are repeated below. In addition, Standard Plan Nos. 301, 302, and 315 provide detailed layout information.

(b) <u>Angle</u>

The angle between a driveway centerline and the parallel vehicle travel lane shall not be less than 75 degrees.

(c) Driveway Width

The width of the driveway shall be consistent with Table 6-18.

Width of Driveway Approaches		
Type of Use and Parking Served	**Minimum Width**	**Maximum Width**
Residential		
Single Parking Space	10 feet	15 feet
Two Parking Spaces	14 feet	24 feet
Three or More Parking Spaces	18 feet	36 feet
All Other Uses		
One-way Driveway	12 feet	20 feet
Two-way Driveway	22 feet	40 feet

Table 6-18. Allowable Widths for Driveway Approaches

(d) Grade

For driveways connecting to a street that has not been improved to the width specified in the Salem TSP for that street, the driveway profile shall be designed to allow for future street widening.

(e) Driveway Approaches

Driveway approaches shall conform to Standard Plan Nos. 301, 302, and 320, unless one or more of the criteria set forth in Table 6-19 is met, in which case, Standard Plan No. 315 may be permitted. If Standard Plan No. 315 is permitted and driveway reconstruction is required on private property, the affected property owner shall sign a permit of entry prior to plan approval. The permit of entry shall include a map or a clearly defined description of the limits of work.

The City reserves the right to deny the use of Standard Plan No. 315 if traffic safety concerns are anticipated.

Commercial Driveway Criteria	
Driveway ADT	Greater than 8,000 ADT
Truck Volume	Minimum of 200 trucks per day of WB 40 or larger
Street Posted Speed	For streets with posted speeds of 45 mph or greater, commercial-type driveways can be used with either an ADT greater than 4,000 and/or a minimum of 100 trucks per day

Table 6-19. Commercial Driveway Criteria

(f) Pedestrian Crossing

A pedestrian access route per Section 6.4–Pedestrian Access Routes shall be provided across driveways.

(g) Driveway Closure

Where an existing driveway is to be closed, the curb (if any) shall be replaced with a new section of curb and the parking strip and sidewalk shall be made to conform to adjoining sidewalk and parking strip.

6.14—Curb Bulb-Outs

(a) General

Curb extensions shall be provided per Section 6.2—Street Classifications and Cross Sections or as required by the City. Intersection bulb-outs are generally required whenever pedestrian visibility or reduced crossing time or distance is a concern or to comply with pedestrian access route requirements.

(b) Curb

(1). Radii

Curb radii for bulb-outs shall be designed in accordance with Table 6-16. Inside radii where the curb extension ties back into the existing curb alignment shall be a minimum of 15 feet to provide for street sweeping capabilities. Compound radii are acceptable.

(2). Elevation

Curb low points shall not fall within a curb ramp throat, blended transition, or ADA access point. Curb elevations shall be provided at the beginning, ¼ point, ½ point, ¾ point, and end of each radius.

(c) Sidewalk

(1). Slope and Drainage

Sidewalk slopes shall comply with Section 6.12–Sidewalks for accessible routes. Sidewalks shall slope away from buildings and to the adjacent street unless restricted by the difference between street elevations and building elevations, or where required to slope to green stormwater infrastructure. In situations where the sidewalk cannot slope to the street for this reason, drainage can be accommodated within the bulb-out or pull-out through the use of ADA compliant grates over standard catch basins.

(2). Thickness

Sidewalk thickness shall comply with Section 6.12–Sidewalks. Bulb-outs and pull-outs that are subject to heavy traffic shall be six inches thick and shall be reinforced with either wire mesh or reinforcing bar.

(3). Joints and Texture

The panel sizes and surface textures shall be in accordance with Section 6.33—Streetscape.

6.15—Traffic Calming

(a) General

Traffic Calming structures are not permitted unless they are warranted as determined by Neighborhood Traffic Management Program criteria.

(b) Speed Humps

Speed Humps shall be located only where all of the following criteria are met:

(1). On a street designated as a local street.

(2). Where the street grade does not exceed eight percent for a distance of 75 feet upstream and 75 feet downstream of the speed hump.

(3). Speed humps shall not be installed in front of driveways, over utility manholes, or valves.

(4). Where speed humps are employed for traffic calming, two speed humps minimum are required and shall have a spacing 300 feet minimum and 500 feet maximum between any two speed humps.

6.16—Medians

(a) Raised Medians

Raised medians may be required on arterial streets where it is necessary to regulate left turn movements. Raised median widths vary in width as shown in Section 6.2–Street Classifications and Cross Sections and Standard Plan Nos. 319, 320, and 321.

(1). Turning Radius

Raised medians shall be designed to allow for the proper turning radius of all vehicles at intersections.

Top Div 6

(2). Accessibility

When a pedestrian crossing intersects with a raised median, the median shall be designed in accordance with Figure 6-21.

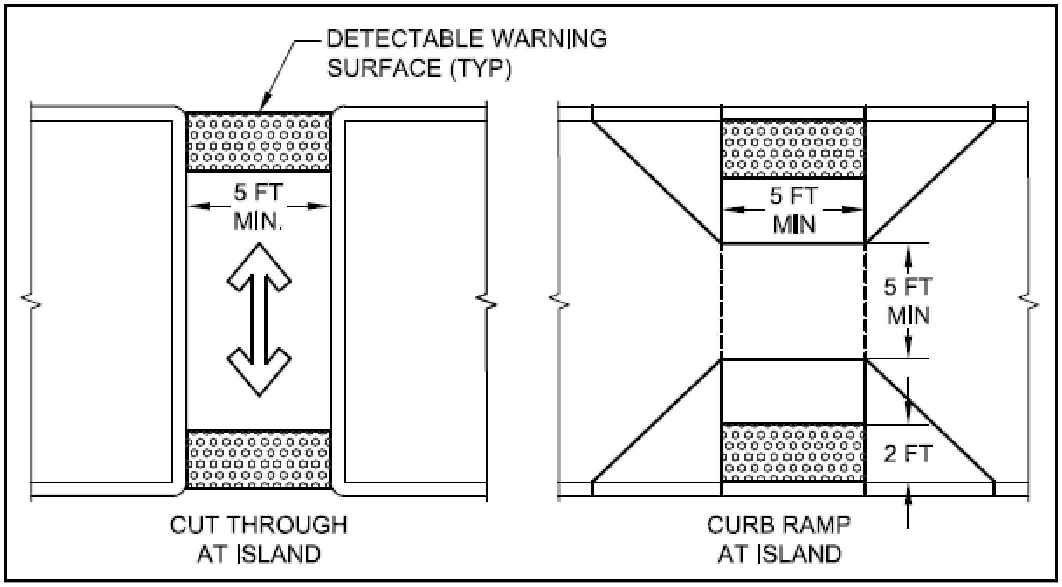


Figure 6-21. Pedestrian Crossings in Raised Median Islands

(3). Landscaping

Raised medians five feet and wider shall be planted, and careful consideration should be given to the location and type of plantings to avoid visual obstructions for turning motorists and accommodate maintenance activities. Trees shall only be allowed where the raised median is at least 8 feet in width from curb to curb.

(4). Length

When Medians are designed to provide Pedestrian refuges, the designer shall attempt to maximize the visual profile of the median by setting the length to provide for adequate space to plant two trees within one portion of the split median. Consideration needs to be given to impact to driveways, alleys, turning movements or other negative impacts to the alignment and geometry of the street.

6.17—Shoulders

(a) <u>Position</u>

Shoulders shall be flush with the roadway surface and abut the edge of the traffic lane.

(b) <u>Cross Slope</u>

Shoulders shall slope to drain away from the roadway surface. Minimum cross slope shall be two percent for paved shoulders and four percent for unpaved shoulders. Maximum cross slope for paved and unpaved shoulders shall be six percent. The outside (high side) cross slope break at the pavement edge of a superelevated curve shall not exceed eight percent.

6.18—Roadside Ditches

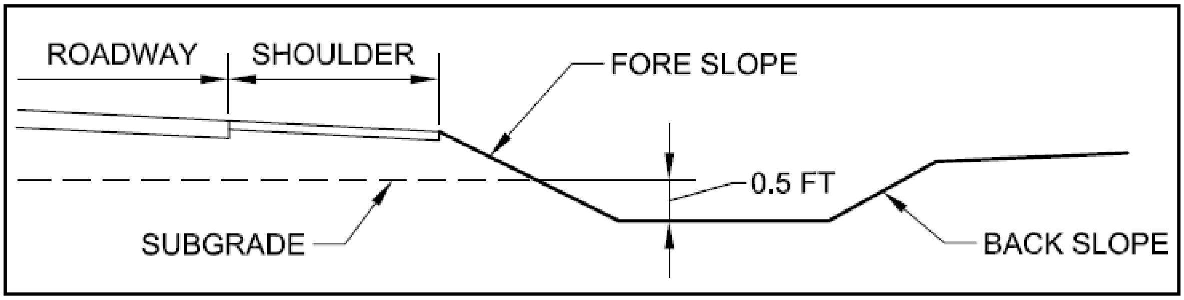


Figure 6-22. Roadside Ditches

(a) Cross Slopes

Roadside ditch slopes shall be designed to convey necessary stormwater volumes without jeopardizing the safety of the traveling public. AASHTO has compiled clear zone criteria to enhance roadway stability and provide reasonable opportunities for recovery of out-of-control vehicles. Clear zone distance is based on the design speed, expected traffic volume, and slope of ground adjacent to the roadway. Fore slopes shall not exceed 3H/1V and back slopes shall not exceed 2H/1V.

(b) Invert

Roadside ditch invert shall be a minimum of 0.5 feet below adjacent street subgrade.

6.19—Curb Ramps and Blended Transitions

(a) General

For the purposes of these Standards, Curb Ramps and Blended Transitions are defined as follows:

Curb Ramp—A pedestrian access connection between a street and sidewalk with a running slope greater than five percent and less than 8.33 percent.

Blended Transition—Raised pedestrian street crossing, depressed corners or connections between a street and sidewalk with a running slope less than or equal to five percent.

Curb Ramps and Blended Transitions shall comply with Standard Plan Nos. 307.A-D and this section.

(b) Construction Timing

Construction plans shall require curb ramps and blended transitions to be constructed prior to city acceptance of street improvements.

Top Div 6

(c) Separate Curb Ramp

Except as noted below, a separate curb ramp, blended transition, or a combination of curb ramps and blended transitions shall connect the pedestrian access routes at each pedestrian street crossing.

(1). Alterations

In alterations where existing physical constraints prevent construction of a separate curb ramp or blended transition for each pedestrian street crossing, a single diagonal curb ramp may be permitted to serve both pedestrian street crossings.

(2). Location

Curb ramps and blended transitions shall be located such that a minimum four foot by four foot clear space is provided within the width of the pedestrian street crossing and wholly outside the parallel vehicle travel lane. The curb ramp (excluding any flared sides) or blended transition shall be contained wholly within the width of the pedestrian street crossing served (see Figure 6-23).

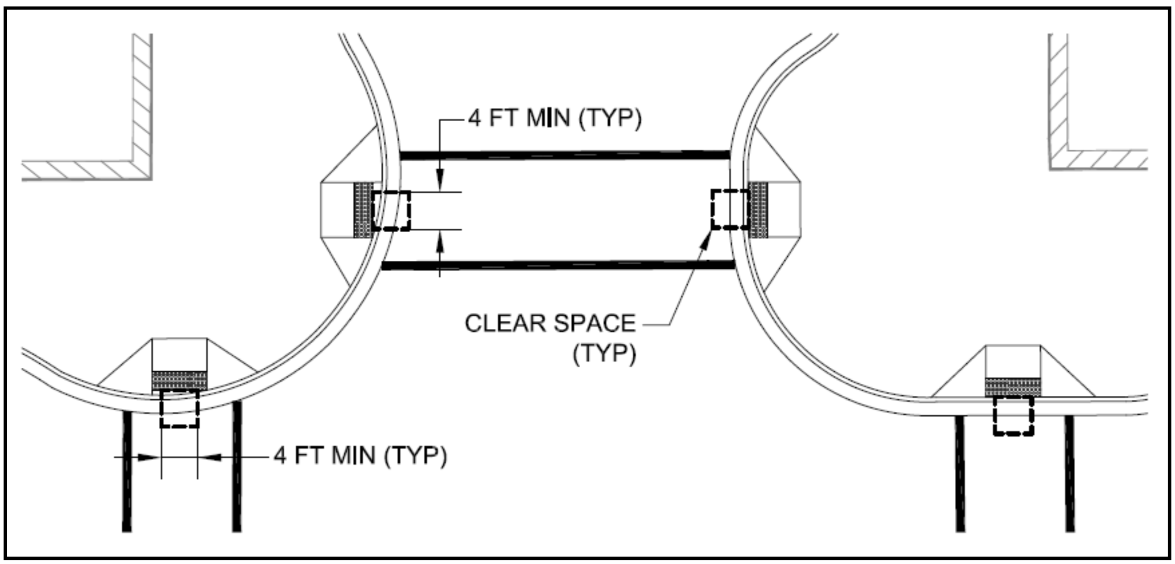


Figure 6-23. Location of Curb Ramps and Blended Transitions

6.20—Accessible On-Street Parking

(a) Threshold Requirements

Where on-street parking is provided on the block perimeter and the parking is marked or metered, accessible parking spaces shall be provided in accordance with Table 6-20. Where parking on part of the block perimeter is altered, the minimum number of accessible parking spaces required is based on the total number of marked or metered parking spaces in the block perimeter.

Top Div 6

Total Number of Marked or Metered Parking Spaces on the Block Perimeter	Minimum Required Number of Accessible Parking Spaces
1 to 25	1
26 to 50	2
51 to 75	3
76 to 100	4
101 to 150	5
151 to 200	6
201 and over	4 percent of Total

Table 6-20. On-Street Parking Space Requirement

(b) <u>Parking Spaces and Access Aisles—General</u>

Accessible on-street parking spaces shall be in accordance with the ADA and this Section.

(1). Location

Accessible parking spaces shall be located as close to an accessible curb ramp or blended transition as possible. Access aisles shall adjoin an accessible route.

(2). Parking Space Width

Accessible car and van parking spaces shall be a minimum of eight feet in width.

(3). Access Aisles Width

Access aisles serving accessible car and van parking spaces are required and shall be a minimum of eight feet in width measured perpendicular to the aisle strip (see Figure 6-24).

(4). Access Aisle Length

Access aisles shall extend the full length of the parking spaces they serve.

(5). Parking Space and Access Aisle Slope

Slopes shall not exceed two percent in all directions.

(6). Marking

Access aisles shall be marked to discourage parking in them per Figure 6-24.

Top Div 6

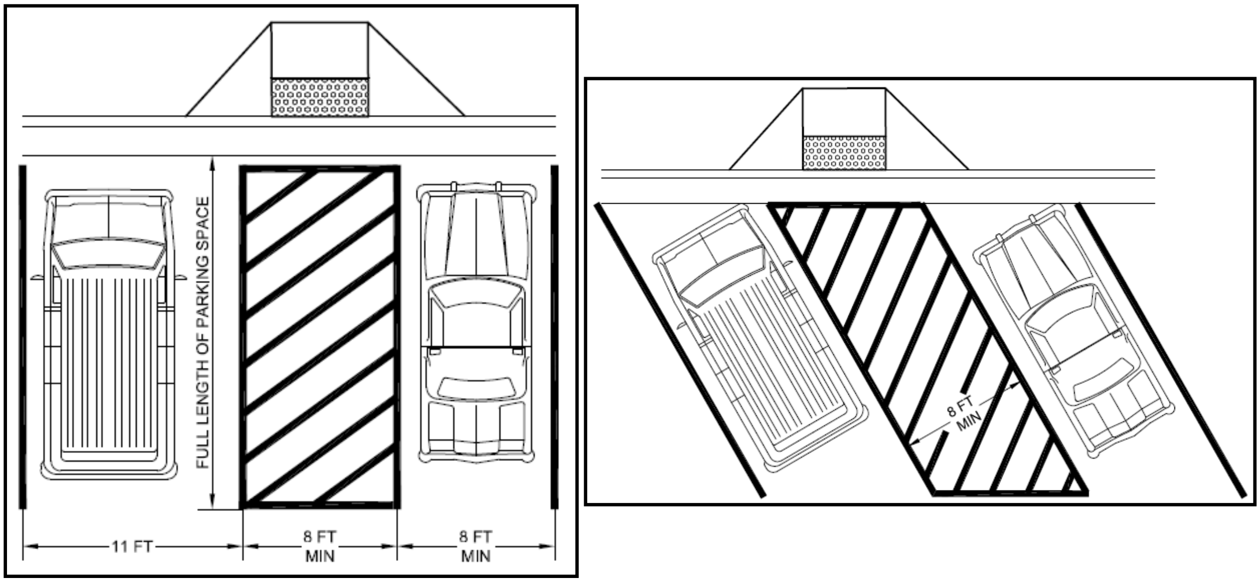


Figure 6-24. Perpendicular and Angled Vehicle Parking Space and Access Aisle

(c) <u>Parallel Parking Spaces</u>

(1). Wide Sidewalks

Where the width of the adjacent sidewalk or the available ROW exceeds 14 feet, an access aisle five feet in width shall be provided at street level the full length of the accessible parking space and shall connect to an accessible route. Access aisles shall not encroach on vehicular travel lanes.

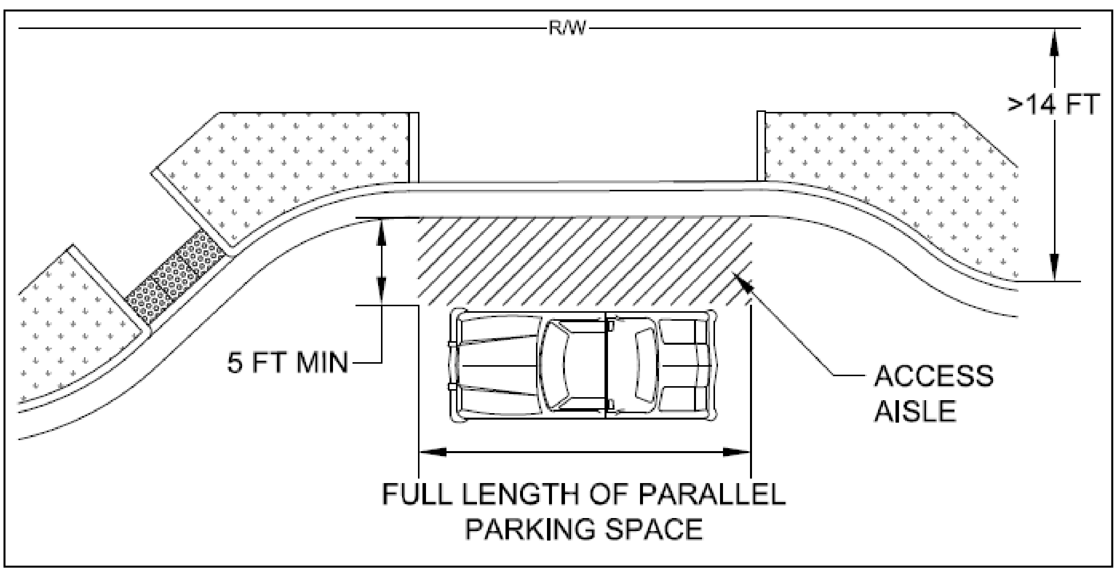


Figure 6-25. Accessible Parallel Parking for Wide Sidewalks

NOTE: *Standards for horizontal direction changes for curbs are set forth in Section 6.11–Curbs.*

Top Div 6

(2). Narrow Sidewalks

An access aisle is not required where the width of the adjacent sidewalk or the available ROW is less than or equal to 14 feet. When an access aisle is not provided, the accessible parking spaces shall be located at the end of the block face.

6.21—Centralized Mailbox Unit (CMU)

> ***NOTE:*** *CMUs shall have the same meaning as Clustered Mailboxes as defined in ORS Chapter 227 and the term Centralized Box Units as used by the United States Postal Service. The policy of USPS is that (1) mail delivery to all new developments be centralized delivery using Centralized Box Units; and (2) it is the responsibility of the developers and builders to provide the necessary mail receptacle equipment.*

(a) Location

CMU locations shall be coordinated with the USPS and shall not be permitted in the following locations:

(1). Where the adjacent street slope exceeds ten percent.

(2). Within the areas 75 feet upstream from an intersection or 50 feet downstream from an intersection.

(3). CMUs are not permitted in any other location where the City Traffic Engineer determines they would present a safety hazard.

(b) Accessibility Requirements

(1). Turning Space. A concrete accessible turning area six-foot-minimum by six-foot-minimum shall be provided at the front of each CMU and shall be permitted to overlap other turning spaces and the public sidewalk. The running slope and cross slope of the turning space shall not exceed two percent.

(2). Access to Pedestrian Circulation. An accessible route shall connect the turning space to the public sidewalk.

(3). Access to the Street. A pedestrian access route shall be provided within 50 feet from the vehicular way to the turning space at the CMU.

(c) Construction Timing

For new developments, all requirements of this section shall be constructed prior to city acceptance of street improvements.

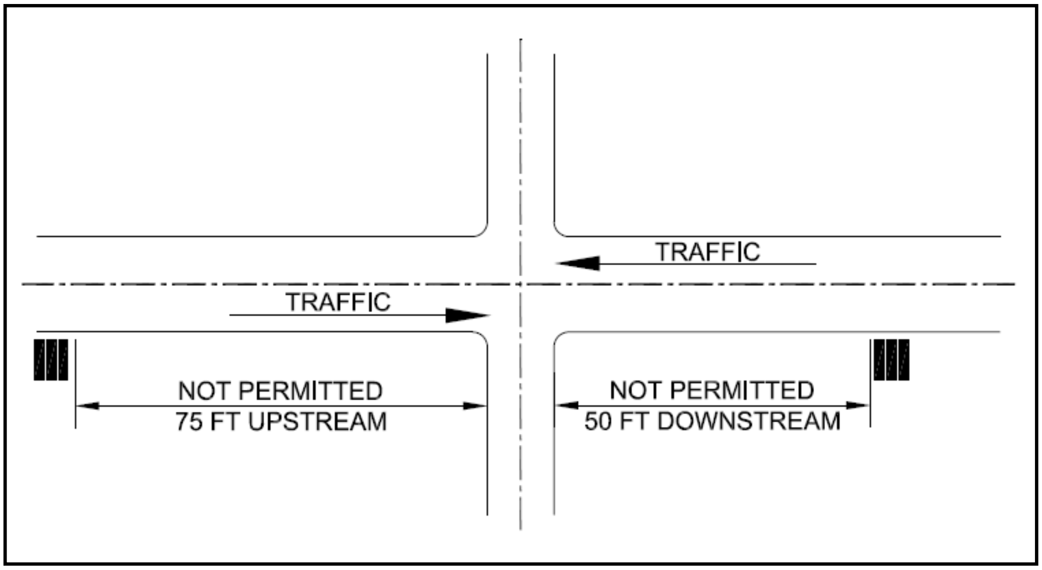


Figure 6-26. Cluster Mailbox Location

(d) <u>Construction Plans</u>

Construction plans shall include the following information for each Cluster Mailbox site:

(1). A plan view clearly depicting location and horizontal dimensions of required turning spaces and access routes.

(2). Design running slopes and cross slopes for any curb ramps, blended transitions, and turning spaces.

6.22—Signs

(a) <u>General</u>

Signs are required to comply with MUTCD, Oregon MUTCD supplement, ODOT Sign Policy and Guidelines, the Federal Highway Administration's Standard Highway Signs, and this section.

(b) <u>Location</u>

Sign locations shall comply with the requirements and recommendations of the MUTCD and the following:

(1). All portions of signs shall be located in the ROW or in a sign easement. No portion of any sign shall be closer than 2.5 feet from the face of curb, nor shall they obstruct an accessible route.

(2). Street name signs are required at all intersections, and shall be located on nearside corners of the minor roadway.

6.23—Pavement Markings

Pavement Markings shall comply with MUTCD, the Oregon MUTCD Supplement, the ODOT Traffic Line Manual, and this section.

Pavement markings shall be methyl methacrylate or thermoplastic as depicted on Standard Plans or details unless otherwise noted as paint on the Standard Plans or details. Pavement Markings with paint may be required by the City as interim marking wherever markings are known to be temporary due to construction phasing or interim improvements as approved by the City Engineer.

6.24—Asphalt Concrete (AC) Pavement

(a) Site Exploration

A site exploration, conducted under the direction of an Oregon State licensed civil engineer with geotechnical specialty, shall be performed for all AC pavement designs. Site explorations shall conform to the following requirements:

(1). Existing Pavement Structure

The thickness of existing AC and base rock sections shall be determined by drilled borings. At least one boring is required for each 200 lineal feet of existing pavement. Where, in the opinion of the City Engineer, the public records indicate reasonable uniformity of pavement structure, the spacing between borings may be increased to 500 feet. In no case shall less than two drilled borings be taken through the existing pavement structure.

(2). Subgrade Soil Exploration

The modulus of the subgrade soil shall be determined by subsurface explorations. Field explorations shall consist of non-destructive testing (NDT) using a falling weight deflectometer (FWD) or Dynamic Cone Penetration (DCP) testing as determined by the Geotechnical Engineer. If FWD is not performed, Laboratory tests to determine resilient modulus (MR), California Bearing Ratio (CBR), or R-value are required. Minimum frequency shall be in accordance with Table 6-21.

Test Method	Frequency
FWD	One test per 50 feet of alignment in each direction of travel
DCP	One test per 200 feet of alignment
(MR), CBR, or R-Value	One laboratory soil strength/modulus test per soil unit expected at subgrade elevations, with minimum two tests per project

Table 6-21. Minimum Frequency for Subsurface Explorations

(b) Geotechnical Report

A report prepared by an Oregon state licensed civil engineer with geotechnical specialty shall be prepared for all AC pavement designs. The report shall, at a minimum, make recommendations addressing the following:

(1). Subgrade soil strength/modulus.

(2). Subgrade preparation and protection during construction.

(3). Provisions for wet weather construction.

(4). Mitigation of wet and soft subgrade if encountered during construction.

(5). Consideration for soil shrink-swell and frost-heave conditions.

(c) Subgrade Class

Subgrade soil strength/modulus, determined in accordance with testing required by the site exploration, shall be classified in accordance with Table 6-22. The weakest subgrade soil strength results shall be used for determining subgrade classification.

Soil Strength Test Method	Subgrade Class			
	Poor	Fair	Good	Excellent
Resilient Modules (MR)	3K < 5K	5K < 10K	10K < 15K	15K <
CBR	< 4	4 < 11	11 < 20	20 <
R-Value	< 25	25 < 45	45 < 60	60 <

Table 6-22. Subgrade Classification

(d) Traffic

The number of 18 Kip equivalent axle loads (EALs) shall be used as an input variable for pavement thickness designs. The EALs shall be determined by classified truck traffic counts. If a classified count is not performed, the default EALs for various street classifications shall be as shown in Table 6-23.

Street Classification	Default 18Kip EALs
Local (cul-de-sac)	10,000
Local	100,000
Collector	1,000,000
Minor Arterial	4,000,000
Major Arterial	10,000,000

Table 6-23. Default Traffic Counts for Various Street Classifications

Top Div 6

(e) Pavement Design Procedure

Pavements shall be designed in accordance with the AASHTO Guide for Design of Pavement Structures, 1993, or by the Prescriptive Method in Subsection 6.24(f)—Prescriptive Pavement Thickness Design Method.

(1). AASHTO Method

Input variables for AASHTO design formulas shall conform to the following:

A. Design Life – 25 years (local streets); 20 years (all others).

B. Initial Serviceability – 4.2.

C. Terminal Serviceability – 2.5.

D. Reliability Level – 90 percent.

E. Asphalt Structural Coefficient – 0.41.

F. Aggregate Structural Coefficient – 0.10.

G. Drainage Coefficient (asphalt) – 1.0.

H. Drainage Coefficient (aggregate)–0.8.

I. Minimum Pavement Thickness Notwithstanding the resultant AC and base rock thicknesses computed in accordance with design procedures set forth above, AC layer and Base Rock thickness shall be not less than as shown in Table 6-24.

Street Classification	AC	Base Rock
Local	4”	6”
Collector	4”	8”
Arterial	6”	8”

Table 6-24. Minimum AC/Base Rock Thickness for Various Classified Streets

(f) Prescriptive Pavement Thickness Design Method

Unless a site-specific pavement design conforming to Subsection 6.24(e)—Design Pavement Procedure is performed, pavement thickness for various traffic loads and subgrade soil classifications shall be not less than as shown in Table 6-25. Data in Table 6-25 represents thickness of AC over crushed aggregate base, both measured in inches.

Traffic 18 Kip EALs	Subgrade Class			
	Poor	Fair	Good	Excellent
10—50,0000	4.0/14.0	4.0/9.0	4.0/6.0	4.0/6.0
50—100,000	4.5/15.0	4.5/10.0	4.0/6.0	4.0/6.0
100—250,000	5.0/18.0	5.0/11.0	4.5/8.0	4.5/8.0
250—500,000	6.0/19.0	6.0/12.0	5.5/8.0	5.5/8.0
500—1,000,000	7.0/19.0	7.0/12.0	6.0/8.0	6.0/8.0
2.5—5,000,000	8.0/28.0	8.0/18.0	8.0/10.0	8.0/8.0
5—10,000,000	9.0/30.0	9.0/18.0	9.0/10.0	9.0/8.0

Table 6-25. Minimum AC/Base Rock Thickness (inches) for Various EALs and Subgrade Soils

(g) Pavement Design Submittals

The following shall be provided with all pavement designs:

(1). Data from Site Explorations performed in accordance with Subsection 6.24(a)—Site Exploration.

(2). A geotechnical report prepared in accordance with Subsection 6.24(b)—Geotechnical Report.

(3). Classified Truck traffic counts, if performed.

(4). Pavement design calculations conforming to this section, if not using the prescriptive method for pavement thickness.

6.25—Permeable AC Pavement

(a) General

This section is reserved for future expansion.

6.26—Portland Cement Concrete (PCC) Pavement

(a) General

PCC pavement structures shall be designed using the 1993 AASHTO Guide for Design of Pavement Structures, along with the 1998 Supplement to the AASHTO Guide for Design of Pavement Structures, Part II, Rigid Pavement Design & Rigid Pavement Joint Design. PCC concrete pavement shall be either reinforced or be plain with dowel bars and tie bars to reinforce the joints.

(b) Design Life

PCC Pavement design life shall be 40 years for residential and collector streets and 50 years for arterial streets.

(c) Minimum Thicknesses

PCC streets shall be designed in accordance with the guides above; however, in no case shall the thickness be less than the following:

Street Classification	Pavement Thickness
Residential Street	6 inches
Collector Street	7 inches
Arterial Street	8 inches

(d) Joint Spacing

A joint spacing plan shall be provided to show the transverse and longitudinal joints to control cracking. The plan shall also include manholes, valve boxes, inlets, joint layouts, dowels, tie bars, and other reinforcement here required. Joint layout shall be designed in accordance with American Concrete Paving Association (ACPA) recommendations and requirements contained in this section.

Longitudinal joint spacing shall not exceed two times the slab thickness in feet up to a maximum of 15 feet, as shown in Table 6-26, below:

PCC Thickness	Maximum Joint Spacing
6 inches	12 feet
7 inches	14 feet
8 inches	15 feet

Table 6-26. Maximum Joint Spacing

Dowel bars shall be placed across transverse joints and deformed tie bars shall be placed across longitudinal joints.

(e) Aggregate Base

If aggregate base is not required per the pavement design analysis, a leveling course of two inches of compacted ¾-inch-minus crushed rock shall be placed over compacted subgrade before the concrete street section is placed.

6.27—Traffic Signals

(a) General

Traffic Signals shall be fully actuated with protective/permissive left turn phases, operated by video detection, equipped with video transmission, interconnected to other traffic signals, and have emergency preemptive systems. All signal equipment shall be located within the ROW.

> ***NOTE:*** *ODOT Traffic Signal Design Manual, ODOT Standard Drawings TM400 and TM600 and MUTCD provide general guidance for traffic signal design.*

(b) Preliminary Design Meeting

A preliminary design meeting between Design Engineer and City Engineering staff is required prior to application for plan review for the purpose of reviewing Traffic Impact Analysis and resolving design requirements applicable for the signal.

(c) Traffic Signal Requirements

(1). Traffic Signal Poles. Traffic signal poles shall:

A. Be designed for mast arm installation.

B. Be located behind current or future sidewalk.

C. Incorporate street light for pavement illumination.

(2). Street Light. The street light requirements are as follows:

A. Mount luminaires at 35 feet high extending in the same plane as the signal mast arm.

B. Design a single master photocell to control the intersection lighting with a test switch located in the service cabinet.

(3). Signal Control. Signals shall be controlled by Type 2070 traffic signal controllers in Model 332 controller cabinets. Control programs will be furnished by City. Controller cabinets shall:

A. Be located near the intersection and oriented such that the doors open parallel with the adjacent roadway with a view of the intersection facing the front of the controller.

B. Be located minimum 25 feet downstream from the intersection, or as approved by City Traffic Engineer.

Top Div 6

(4). Fire Preemptive System. Signals shall be designed with fire preemptive systems conforming to the following:

A. "Opticom" brand system shall be used as manufactured by the Traffic Control Products Division of the 3M Company. "Opticom" brand Model 752 Discriminator modules shall be specified for the Type 170 controller.

B. Locate detectors on the end of mast arms, oriented for emergency vehicles approaching the intersection in the direction opposite the direction of the signal head on the mast arm.

C. Video Detection. The video cameras shall be mounted to the traffic signal luminaire arms for each approach of the intersection and shall provide a minimum of 300 feet of detection in advance of each stop bar. Bicycle detection will be accomplished with the same cameras.

D. Video Transmission. The traffic signal shall incorporate video transmission compatible the City's facilities and equipment and shall include the installation of modems or other equipment along the City's existing interconnect cables to transmit the video signals from the intersection to the City's Traffic Operation Center.

E. Interconnect. Traffic signal interconnect shall be provided with three-inch electrical conduit, hand holes, splice vaults, and fiber optic interconnect cable to the nearest location in accordance with the City of Salem Interconnect Master Plan.

(d) Pedestrian Signals

Pedestrian signal heads shall be symbolic, single section type, mounted to independent pedestrian signal poles traffic signal mast arm poles. Pedestrian signals shall be audible and conform to ADA Standards and the MUTCD.

(e) Electrical Power

Underground power service shall be provided. Electrical service shall terminate at a free standing electrical service cabinet located at the traffic signal controller. Service conductors for street light circuit and interior illuminated sign circuit shall not be routed through the traffic signal controller cabinet. Separate breakers shall be provided for all services.

6.28—Street Lighting

(a) General

Street Lighting shall comply with NEC. For new streets, street lighting shall be provided by street light only poles, energized by an underground power system of conduit, wiring, and junction boxes.

Street lighting systems shall be designed to provide the most cost efficient design for overall operation and maintenance. Designs should consider locating luminaire poles and fixtures at strategic locations to minimize overall number of installations while complying with either the prescriptive standards of Subsection 6.28(b)—Prescriptive Standard or the pavement illumination requirements of Subsection 6.28(c)—Pavement Illumination Design. Designs for arterial and parkway streets must follow pavement illumination design requirements in Subsection 6.28(c)—Pavement Illumination Design.

(b) Prescriptive Standard

Unless a pavement illumination design complying with Subsection 6.28(c)—Pavement Illumination Design is performed, street lights shall be installed in accordance with this subsection.

Street Classification	Spacing (ft)		Minimum Initial Lumins (thousands)
	Min.	Max.	
Local (30 ft)	150	200	6
Collector "A" or "C"	150	190	6
Collector "B"	140	170	6

Notes:

(1) Street lights are all on one side set 3 feet to 6 feet behind curb face.

(2) Mast arm lengths equal 6 feet and pole height of 30 feet.

(3) If street lights are designed to be on the non-parking side of a Collector "B", then spacing shall comply with Collector "A" and "C".

Table 6-27. Prescriptive Standard for Street Lighting

(c) Pavement Illumination Design

Unless street lighting is designed in accordance with prescriptive standards set forth in Subsection 6.28(b)—Prescriptive Standard, pavement illumination designs shall comply with Subsection 6.28(c)—Pavement Illumination Design.

(1). Area Classification. Street light design requirements vary with area classifications described below:

Commercial—means that portion of the City containing commercial, business, and industrial activity where ordinarily there are large numbers of pedestrians and a heavy demand for parking space during periods of peak traffic or a sustained high pedestrian volume and a continuously heavy demand for off-street parking space during business hours.

Urban Intermediate—means that portion of the City which is outside of a downtown area but generally within the zone of influence of a business or industrial development, often characterized by a moderately heavy nighttime pedestrian traffic and a somewhat lower parking turnover than is found in a commercial area. This description includes densely developed apartment areas, hospitals, public libraries, and neighborhood recreational centers.

Top Div 6

Residential—means a residential development or a mixture of residential and commercial establishments, characterized by few pedestrians and a low parking demand or turnover at night. This description includes areas with single family homes, townhouses, and/or small apartments. Regional parks, cemeteries, and vacant lands are also included.

(2). Illumination Levels

Street lighting shall illuminate pavements to levels not less than as set forth in Table 6-28. The average-to-minimum uniformity ratios for streets in commercial and intermediate areas shall be 4:1 or better and 6:1 or better for residential areas.

Street Classification	Average Maintained Footcandles		
	Commercial (high)	Urban Intermediate	Residential (low)
Local	0.9	0.6	0.4
Collector	1.2	0.9	0.6
Arterial	2.0	1.4	1.0
Parkway	1.4	1.2	1.0
Intersections *	* Pavement illumination levels for intersections shall be double the levels shown in this table.		
(Based on recommendations of the Illuminating Engineering Society)			

Table 6-28. Required Pavement Illumination Levels

(d) <u>Luminaire Mounting Height</u>

Street light luminaires shall be mounted in accordance with the heights shown in Table 6-29 as measured from the pavement surface.

Street Classification	Mounting Height (feet)	
	Minimum	Maximum
Local	25	30
Collector	25	35
Arterial	35	40
Parkway	35	40

Table 6-29. Luminaire Mounting Height (feet)

(e) <u>Location</u>

Position street lights as near as practical to the intersection of private property lines within the ROW so as to not unreasonably interfere with existing or future driveways.

(f) <u>Luminaire Type</u>

All new luminaires shall be high efficiency LED conforming to SCS and requirements established by PGE or Salem Electric, as applicable.

6.29—Street Trees

(a) General

The requirements for providing City trees in the ROW are contained within SRC Chapter 86. Trees shall be incorporated in the street cross section to the maximum extent feasible in accordance with these Design Standards.

(b) New Trees in the ROW

Street trees shall have a minimum caliper of 1.5 inches at the time of planting, or larger as required, with the first branch no lower than six feet above ground level.

(1). Trees in Planting Strips

A. Only approved street trees from the City's Street Tree List shall be specified. The approved street tree list is available on the City's website. This list provides appropriate options for allowable trees in the ROW based on the width of the planting strip and whether overhead power lines are present.

B. Linear Spacing of Trees

The horizontal distance between trees shall be based on the tree species, shape, and size at maturity. The required linear spacing is listed in Table 6-30. The types of trees are illustrated in Figure 6-27.

Type of Tree	Spreading (ft)	Global/ Pyramidal (ft)	Fastigiate/ Columnar (ft)
Shade Tree	40	35	20
Ornamental Tree	25	15	10

Table 6-30. Minimum Linear Spacing of Trees in the ROW

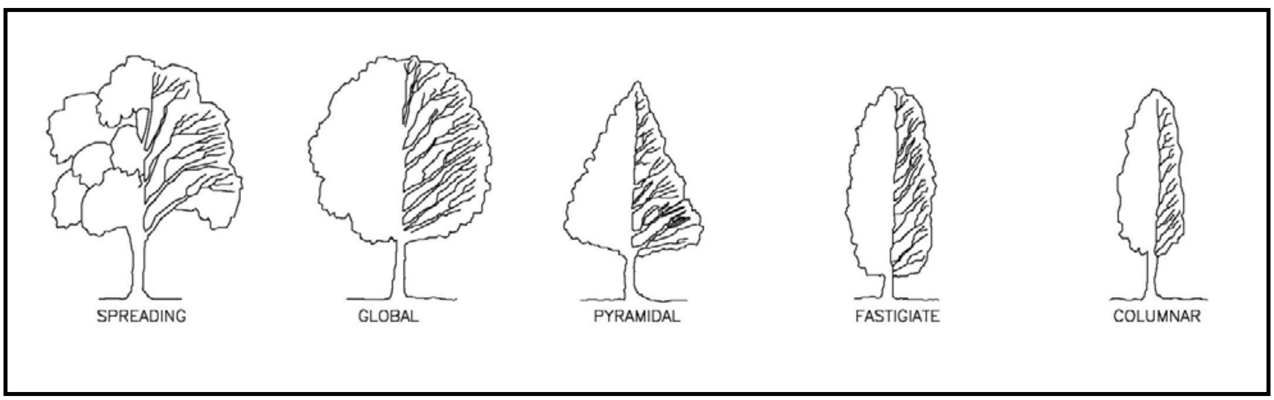


Figure 6-27. Types of Trees

Top Div 6

C. Street trees shall not be located in planting strips that are less than four feet in width.

D. Trees that commonly produce a large buttress root crown (e.g. Bigleaf Maple) shall only be allowed in planting strips that are eight feet or more in width. Cherry trees may be planted in planting strips that are six feet or more in width.

E. Where there are overhead power lines above the planting strip, only trees which have a mature height of less than 35 feet shall be allowed.

F. Required Distance from Utilities and Other Infrastructure

Street trees shall be provided adequate spacing from new and existing utilities and infrastructure. The required minimum separation is listed in Table 6-31. The EOR shall consider the location of existing utilities along with proposed future utilities when locating street trees. All measurements are to the nearest point of the structure.

Utility/Infrastructure	Distance (ft)
Curb, Sidewalk	2
Access Walkways, Fire Hydrants, Roof Drains in the Curb, Catch basins, Manholes, Water Meters, Water Services, Gas and Electric Services, Utility Boxes and Vaults, Mounted Pedestal, Stormwater Planters	6
Alleys, Driveways, Traffic Signs and Signals (on approach), Street Light on Utility Pole, and Water, Wastewater, and Stormwater lines (1)	10
(1) *This requirement only applies where these utilities are perpendicular to the planting strip.*	

Table 6-31. Minimum Horizontal Distances from new or existing Utilities or Infrastructure

G. Tree Wells in Non-Streetscape Areas

(i). Minimum Size: The minimum size of a tree well shall be 16 square feet (4 feet x 4 feet)

(ii). Where the sidewalk width is less than eight feet, a tree grate shall be used. All tree grates shall be mounted in frames with the frames inserted into the concrete sidewalk or surface material and flush with the surrounding surface.

H. All new trees shall be shown on the Plans in accordance with the requirements listed in Division 001—General, Section 1.11—Preservation of Trees and Vegetation; and Division 002—Drafting and Drawings Standards, 2.17—Landscaping.

(c) **Protection of Existing City Trees**

(1). Existing City trees that are not permitted for removal must be protected in accordance with Standard Plan 820 and Administrative Rule 109-500-2. The City's Urban Forester shall make the final determination regarding the location of the Tree Protection area based on the type of work being performed and the existing site constraints.

(2). Removing Existing Hardscape

A. Where sidewalks or other structures are being removed from within the CTZ, the following notes shall be added to the demolition plan:

(i). Remove hardscape in such a manner to minimize disturbance to tree roots, base rock, and underlying soil.

(ii). Keep heavy equipment on undisturbed hardscape and off of exposed roots.

(iii). Minimize removal of base rock or underlying material that has established roots.

(iv). If roots 2-inch or larger are encountered which must be removed, call the City Urban Forester for an inspection.

(3). Trenching in the Critical Tree Zone

A. Removing hardscape and trenching in the CTZ shall be avoided wherever possible. Where trenching must be performed in the TPA below the level of hardscape, the following measures shall be listed on the plans:

(i). Excavation within the TPA below the level of hardscape (for hardscape removal see Subsection 6.29(c)(2)) shall be limited to hand driven trencher wherever the trench is less that 12-inches wide and 36-inches deep. In some cases hand tools may be required to minimize root damage. Where deeper and wider trenches are required, a backhoe or track hoe may be used. Heavy equipment use within the TPA shall be minimized and appropriately sized for the installation. Surface protection measures provided in Standard Plan 821 shall be used to support the equipment. Measures to protect the tree trunks shall also be used in accordance with the SCS.

(ii). No trenching is allowed within two feet of any City tree, as measured from the side of the trench to the nearest point on the trunk.

(iii). Trench width shall be limited to the minimum width necessary to provide safe installation of the utility.

Top Div 6

(iv). If roots are exposed, supplemental watering of exposed roots shall be provided in conformance with the SCS. Supplemental watering shall not jeopardize OSHA trench safety requirements.

(4). Boring, Tunneling, and Jacking within the Critical Tree Zone

See Division 001 for requirements of Boring, Tunneling, and Jacking near or under City trees.

(d) Temporary Irrigation

Temporary irrigation systems are not required for City trees when planted; however, supplemental watering may be required during construction to maintain tree health. New trees must be watered in accordance with the SCS.

6.30—Alleys

(a) General

Alley width and improvement requirements shall comply with Standard Plan Numbers 304 or 305. Alleys shall be designed to meet the following conditions:

(b) Pavement Structure

Alley pavement structures in residential areas shall be designed to conform to local street pavement standards set forth in Section 6.24–Asphalt Concrete (AC) Pavement, or Section 6.25–Permeable AC Pavement, or Section 6.26–Portland Cement Concrete (PCC) Pavement.

(c) Clearance Strip

All alley improvements shall require a one-foot clearance strip between the edge of alley and ROW line except for alleys ten feet wide or less. In this case, the clearance strip shall be six inches in width.

(d) Drainage

Alleys shall have piped drainage systems conforming to Division 004—Stormwater System. Not more than 2,000 square feet of surface drainage shall be permitted to flow from alley across the alley approach.

(e) Approach

(1). The curb radius connecting the alley to the street is typically equal to the distance from the street curb face to the street property line. The minimum radius shall be 15 feet. Where the radius would be less than 15 feet, a “dust pan” drive approach is acceptable.

(2). Where a sidewalk intersects with an alley, a pedestrian access route shall be provided across the alley approach per Section 6.4–Pedestrian Access Routes.

(3). Dead-end alleys shall also have a public turnaround to prevent the need to trespass on private property. Due to the limited room normally available, a hammer-head turnaround per Standard Drawing 316 may be acceptable as approved by the City Engineer.

(4). Parking dimensions and layout shall be per SRC Chapter 133 and Table 133-3.

6.31—Shared Use Paths

(a) <u>Grade</u>

(1). Within Street ROW. Where shared use paths are contained within a street ROW, the grade of shared use paths shall not exceed the general grade established for the adjacent street.

(2). Not Within Street ROW. Where shared use paths are not contained within a street or highway ROW, the grade of shared use paths shall be five percent maximum.

(3). Within Pedestrian Street Crossings. Where shared use paths are contained within a pedestrian street crossing, the grade of shared use paths shall be five percent maximum.

(b) <u>Continuous Width</u>

Shared Use Paths shall have a continuous width not less than ten feet measured perpendicular to the direction of travel. A pedestrian access route shall be provided for the full width of the shared use path per Section 6.4–Pedestrian Access Routes.

(c) <u>Protruding Objects</u>

Objects shall not overhang or protrude into any portion of a shared use path at or below eight feet measured from the finish surface.

(d) <u>Curb Ramps</u>

The width of curb ramps runs and blended transitions shall be equal to the width of the shared use path.

6.32—Bridges and Culverts

(a) <u>Environmental Permits</u>

Unless exempted by the USACE or Oregon DSL, environmental permits are required for all bridges and culverts that cross natural waterways, intermittent streams, or wetlands.

(b) Spans Exceeding 20 feet

Bridges and box culverts having spans 20 feet and greater shall comply with the following:

(1). Design. Design shall comply with the current edition of the ODOT Bridge Design and Drafting Manual (BDDM).

(2). Geotechnical Report. A report prepared by an Oregon State licensed civil engineer with geotechnical specialty shall be prepared for all bridge and culvert designs. The report shall comply with the current edition of the ODOT Geotechnical Design Manual.

(3). Hydraulic Analysis. A hydraulic analysis report complying with ODOT Hydraulics Manual, shall be prepared for bridge and culvert designs.

(c) Headwalls

(1). Culverts 30-inch diameter and larger crossing a street shall be designed with headwalls and wing walls. For additional information on the design of culverts, See Division 004—Stormwater System.

(2). Headwalls are required for all box culverts.

(d) Design Submittals

The following shall be provided with all bridge and culvert designs:

(1). The geotechnical report conforming to Appendix 1B—Requirements for Geotechnical Reports.

(2). The hydraulic analysis conforming to Division 004—Stormwater System, as applicable.

(3). Environmental Permits or documentation that no permit is required.

6.33—Traffic Impact Analysis (TIA)

SRC Chapter 803 identifies the threshold for requiring a TIA.

(a) Standards

Level of Service (LOS) Standards. Maximum operational standards (LOS E) for intersections shall be as shown in Table 6-32.

Traffic Control Device	Maximum Operational Standard
Signalized Intersection	LOS E Control Delay < 80 Seconds and/or v/c < 0.900
Two-way or All-Way Stop Control	LOS E Total Delay < 50 seconds

Table 6-32. Level of Service Standards for Various Traffic Control Devices

(b) <u>Analysis</u>

Level of Service and volume to capacity calculations must be done using the most current version of the Transportation Research Board, Highway Capacity Manual methodologies.

(1). Ideal saturation flow rates greater than 1,800 vehicles per hour of green per lane should not be used unless a separate flow rate analysis has been completed.

(2). Queue lengths shall be calculated at the 95^{th} percentile.

(3). Signal cycle lengths and signal operation shall be based upon actual signal timing and shall account for pedestrian crossings.

(c) <u>Extent of Study Area</u>

TIA study area shall extend to the following:

(1). All proposed site access points.

(2). Any intersection where the proposed development can be expected to contribute 50 or more trips during the analysis peak hour on a collector, arterial or parkway, or 20 or more trips on a local street or alley.

(3). Any intersection where the additional traffic volume created by the proposed development is greater than ten percent of the current traffic volumes on any leg.

(4). Any other intersections identified by City staff as having capacity, safety, neighborhood, and/or geometric concerns.

(d) <u>Impacts to Other Jurisdictions</u>

If a proposed development impacts any other jurisdictions, the preparer shall coordinate the specific jurisdiction and may be required to meet their TIA standards.

(e) <u>Horizon Year</u>

The horizon year of a TIA is defined as the most distant future year that shall be considered.

Proposed Development	Horizon Year
Allowed under existing zoning	Year of Opening
Multi-phased Development	Year of opening each phase
Comp Plan Amendment and/or Zone Change.*	Salem TSP Horizon Year
Multi-Jurisdictional (ODOT, Marion or Polk County, Keizer)	As required by Jurisdiction
**Subject to the requirements of the Transportation Planning Rule (OAR 660-012)*	

Table 6-33. Horizon Year for Various Proposed Developments

(f) <u>Peak Traffic Hours</u>

The City Traffic Engineer will determine which peak hours are required for traffic study. The selected peak will depend upon the development type, traffic generation, peak hour character of the development, and peak hour of the adjacent roadway. Unless otherwise required by City Traffic Engineer, Traffic studies shall comply with the following:

(1). Traffic counts shall be collected for both the AM (6:00-9:00 AM) and the PM (3:00-6:00 PM) peak.

(2). Traffic counts shall be collected on a Tuesday, Wednesday, or Thursday that is not a city, state or federal holiday, when K-12 school in is session.

(3). Traffic counts that are older than two years; taken during holiday weeks; or taken during construction shall not be used.

(g) <u>Background Growth and Trip Distribution</u>

Background rates and trip distribution shall be based upon the Mid-Willamette Valley Council of Governments Transportation Model. If model data is not available, background growth rates and trip distribution shall be determined by the City Traffic Engineer.

(h) <u>Site Generated Traffic</u>

Trip generation for the proposed development shall be estimated using the most current version of the Institute of Transportation Engineers (ITE) Trip Generation Manual. For land uses not listed in the ITE Trip Generation Manual, studies for similar development in similar regions may be used upon approval by the City Traffic Engineer. Pass-by trips must be quantified and may be approved based upon sufficient supporting data.

(i) <u>Mitigation</u>

The TIA shall identify and propose transportation system improvements that will restore the operations to a level of service not exceeding pre-development conditions, for each applicable horizon year from the proposed development. The proposed improvements shall:

(1). Be described and/or designed in sufficient detail for the City to determine if they meet the Design Standards.

(2). Identify required ROW acquisition or dedication.

(3). Be accompanied by an estimate of construction costs and ROW acquisition if applicable.

(j) Report Certification and Format

Traffic Impact Analyses shall be prepared under the direction of a Traffic Engineer or a Civil Engineer with experience in traffic engineering registered in the State of Oregon. The preparer is encouraged to coordinate the Traffic Impact Analysis with City staff and the other jurisdictions as appropriate to ensure the necessary components are included. Refer to Appendix 1C—Traffic Impact Analysis Report Format for a suggested report format.

6.34—Streetscape

(a) General

Streetscape requirements apply to special service areas as identified in the SRC. In general, streetscape requirements apply to the area between the curb and ROW line and include elements such as sidewalk treatments; curb ramp areas; tree wells; landscape, irrigation "pedestrian scale" lighting, bike racks, benches, newspaper and magazine racks, information kiosks, and trash receptacles, etc. Streetscape elements shall comply with sight distance requirements as shown in SRC Chapter 76. The selection of materials and amenities which are placed in streetscape areas shall require a minimum amount of maintenance.

(b) Streetscape Areas

Streetscape areas are currently in and around the downtown area; however, they have been used on entryway arterial streets. Each streetscape area may have a special design theme appropriate to that area. Current streetscape areas include the following areas with boundaries shown in Figure 6-28 and 6-29.

(1). Broadway—High Overlay Zones per SRC Chapters 613, 614, and 615.

(2). Central Business District per SRC Chapter 524.

(3). Historic Core District per SRC Chapter 154.055(b).

(4). South Waterfront Mixed-Use Zone Area per SRC Chapter 531.

(5). Edgewater Street Corridor Overlay Zone per SRC Chapter 610 and Second Street Corridor Overlay Zone per SRC Chapter 611.

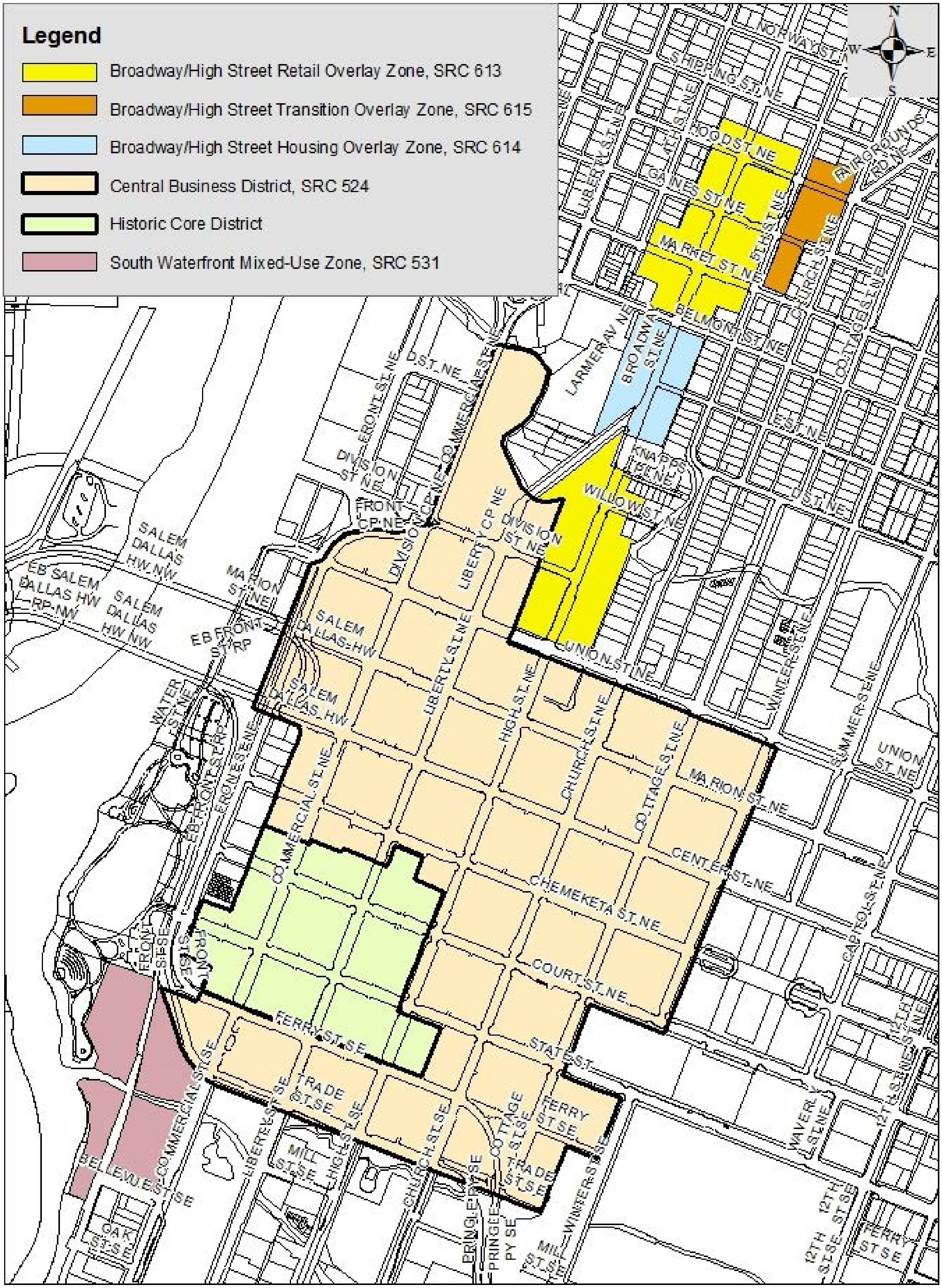


Figure 6-28. Map of Downtown Streetscape Areas with Specific Design Considerations

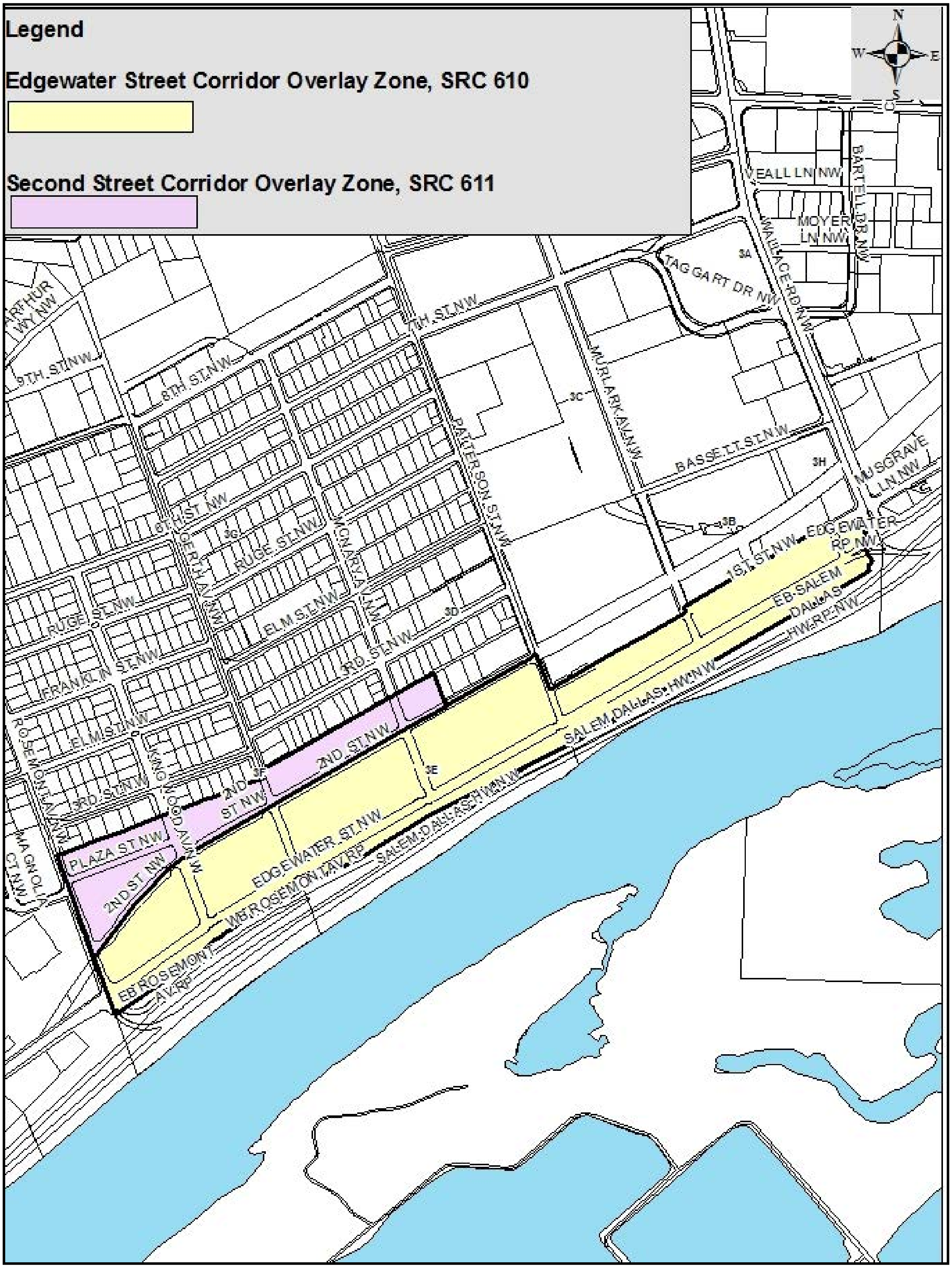


Figure 6-29. Map of West Salem/Edgewater URA Streetscape Areas with Specific Design Considerations

(c) Sidewalks

(1). Sidewalks shall meet the general requirements of this Division, including accessibility requirements.

(2). Sidewalks shall have a light broomed finish with shallow contraction joints, a shined joint is not to be used.

(3). Provide ADA Ramps per the Standard Drawings.

(4). When sidewalks cover the entire area between the curb and ROW line, use a three-foot by three-foot square pattern starting at the street ROW and working toward curb.

(5). When development initiates a frontage improvement, where improvements are conditioned, and the frontage improvement intersect with the streetscape area boundary at an intersection, the following shall apply: replace the existing five-foot-wide sidewalk, if such exists, with a six-foot-wide sidewalk utilizing the three-foot by three-foot scoring pattern.

(d) Curb Extensions and Transit Pullouts

(1). There may be curb extensions at intersections to improve visibility, provide ADA access, and/or to reduce crosswalk distances and time per Section 6.2–Street Classifications and Cross Sections. No street furniture is allowed in intersection curb extensions due to ADA requirements for clearance and maneuvering.

(2). Transit pullouts provide loading/unloading areas for transit users along with elements such as waiting areas, covers, benches, trash receptacles, schedule information, etc. Streetscape elements in transit pullouts shall be coordinated and located in accordance with the Salem/Keizer Transit District recommendations.

(3). Sidewalk in the accessible route and outside the decorative finishing zone shall have a three-foot by three-foot pattern.

(4). Curb extensions in streetscape areas shall include decorative finishing zones in the two quadrants directly outside of the accessible routes. The sidewalk pattern in the decorative finishing zones shall be a one-foot by one-foot smooth trowel with final light sandblast finish pattern surrounded with a continuous 12-inch-wide band with a sponge trowel finish. Figure 6-30 provides a typical layout.

(e) Trees

(1). General tree and shrub requirements are included in SRC Chapter 86. The Urban Forester has a list of approved street trees for downtown and other locations.

(2). Pre-existing Trees. The Urban Forester shall review and approve all existing trees to be removed or saved in tree wells that are in areas of new streetscape development, prior to final plan approval.

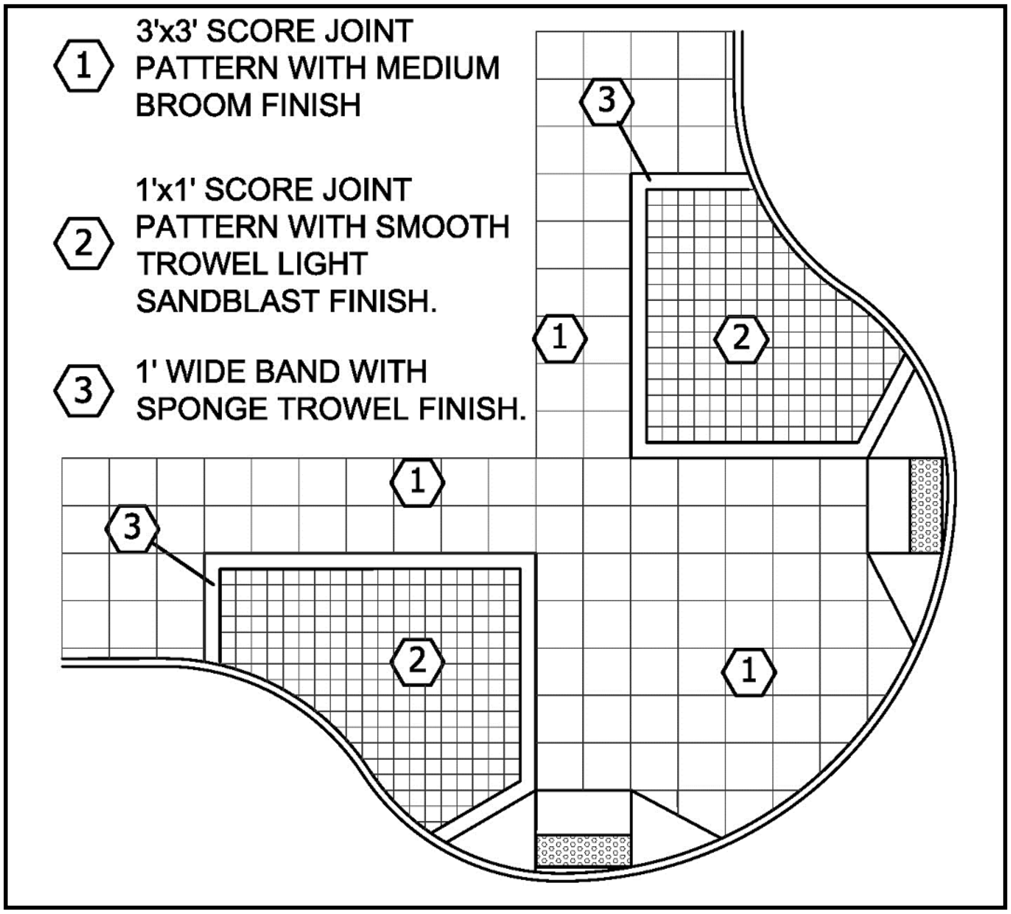


Figure 6-30. Streetscape Curb Extensions

(3). Location.

A. Minimum spacing is 40 feet per SRC 86.130. Maximum spacing is 80 feet.

B. Spacing is dependent on tree species and other obstructions.

C. Plant trees not less than six feet from driveway or water meter, and not less than 15 feet from a street light.

D. Plant trees near center of tree wells and no closer than four feet from curb per SRC 86.134(c)(4).

E. Trees shall not be planted in locations that obstruct entrances to buildings, or obscure significant architectural features, or business signs.

(4). Tree Wells

A. Tree wells shall be located to allow for compliance with all ADA requirements.

B. Tree wells shall contain pervious materials to provide drainage to the underlying soils.

C. No other facilities or added utilities shall be placed within the tree well.

D. Tree wells shall be located adjacent to back of curb, rectangular in shape, generally six-foot width (perpendicular to curb) by six-foot-long (parallel to curb) by 3.5-foot minimum depth of soil. Other shapes are not allowed.

E. Where necessary to work around obstacles, the tree wells shall be a minimum of 24 square feet of surface area with a minimum of six feet in one direction.

F. The outside edge of tree well shall be aligned with adjacent sidewalk scoring pattern.

G. The plans shall include a note stating that no tree well shall be dug or prepared until its location and size is approved by the Urban Forester.

H. The area between the soil surface and the top of the tree grate shall be filled with material in accordance with Standard No. 810.

I. Only pervious material shall be placed over the opening of the tree well.

J. Tree wells may be planted with groundcover. Such groundcover may be partially or totally trimmed, replaced, or removed as necessary to properly maintain the tree and ground cover. Tree grates shall not be removed to place ground cover.

(5). Tree Grates

A. Tree grates around trees are required, construct per Standard Plan 810.

B. Tree grates shall be manufactured of cast iron materials shall a have locking mechanism.

C. Tree grates must be level with the adjoining sidewalk or curb and not create a tripping hazard.

D. Tree grates need to be designed for the growth of the tree trunk, which may include removable sections to accommodate the growth.

E. If a tree grate cannot be installed around a pre-existing tree, the backfill shall be level with the adjacent sidewalk to avoid the creation of a tripping hazard.

(f) Pedestrian Light Standards

(1). Design

A. Pedestrian lighting shall be designed per one of the following options:

(i). Typical layout, as shown in Figure 6-31, can be utilized in lieu of a lighting analysis. In this typical layout, four pedestrian lights are used per block. Longer-than-standard blocks may require additional lighting.

(ii). Lighting analysis shall be performed utilizing pedestrian scale lights with a 12-foot mounting height (approximately 14 feet to center of light) and dark sky compliant LED luminaires equivalent to a 70-watt HPS fixture. Coverage characteristics shall be determined based on spacing, fixture type, wattage, etc., in accordance with IES standards.

(iii). Trees, underground vaults, utility vaults, business entryways, etc., shall be taken into consideration to avoid conflicts with the proposed pedestrian lighting.

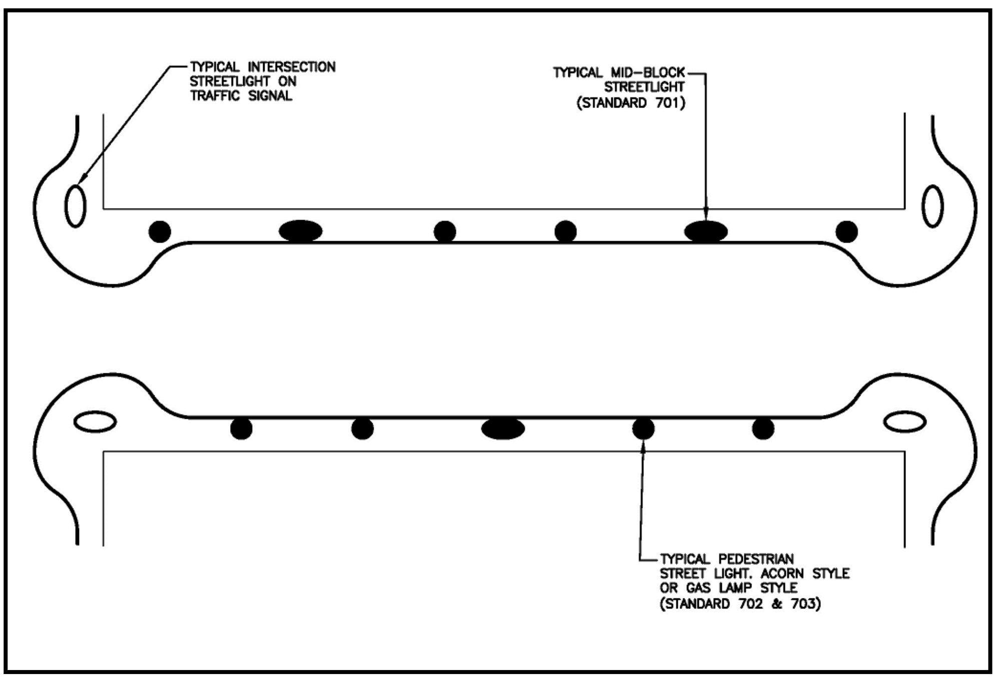


Figure 6-31. Typical Layout for Block with Pedestrian and Street Lights

(2). Aesthetics

A. In streetscape areas, other than a historic district, use a standard "acorn" style luminaire as shown on Standard Plan 702.

B. In the historic district, which is within the streetscape area, use a standard "gas lamp" style luminaire as shown on Standard Plan 703.

C. Provide hanging basket bracket for 100-pound basket per the applicable Standard Plan.

D. Provide banner brackets for top of a banner per the applicable Standard Plan.

E. Pole and fixture color shall be in accordance with the applicable Standard Plan.

(3). Electrical Requirements

A. Provide 120v, 15 AMP ground fault interrupted (GFI) duplex electrical outlet(s) with weatherproof covers located in line with hand-hole, per applicable Standard Plan. A transformer may be required to adjust fixture voltage to outlet voltage.

B. Street light circuits can be with 220 single phase (2-110v to ground wires, plus a ground wire) or a 220v to ground wire with a ground wire, depending on the location and service provider (Salem Electric or Portland General Electric).

(g) <u>Street Lights</u>

(1). See General Standards in Section 6.28–Street Lighting.

(2). Design.

A. Utilize street lights with a 30- to 36-foot mounting height and dark sky-compliant luminaires per Standard Plan 701.

B. Use LED equivalent cobra heads on mid-block lights.

C. Designers may follow the typical layout, as shown in Figure 6-30, in lieu of a lighting analysis. In this typical layout, two street lights are used per block. Longer-than-standard blocks may require additional lighting.

D. Poles shall be per Standard Plan 701.

(3). Electrical Requirements

A. Street light circuits shall be either 220 single phase (2–110v to ground wires, plus a ground wire) or a 220v to ground wire with a ground wire, depending on the location and service provider (Salem Electric or Portland General Electric).

Top Div 6

(4). Intersection Lighting—General

At street intersections, include one street light on each corner of the intersection. Luminaire shall be mounted integral with the traffic signal poles or on a separate light pole, as necessary.

(h) Street Furniture

When street furniture and furnishings are required or desired the following requirements will be utilized for placement and acceptable materials:

(1). The "street furniture area" is that portion of the street right-of-way between the property line sidewalk (as defined above), the intersecting street sidewalk extensions, and a line three feet from and parallel to the face of the curb, save and except alley intersections, underground sidewalk vaults, etc. See allowable street furniture location Figure 6-32.

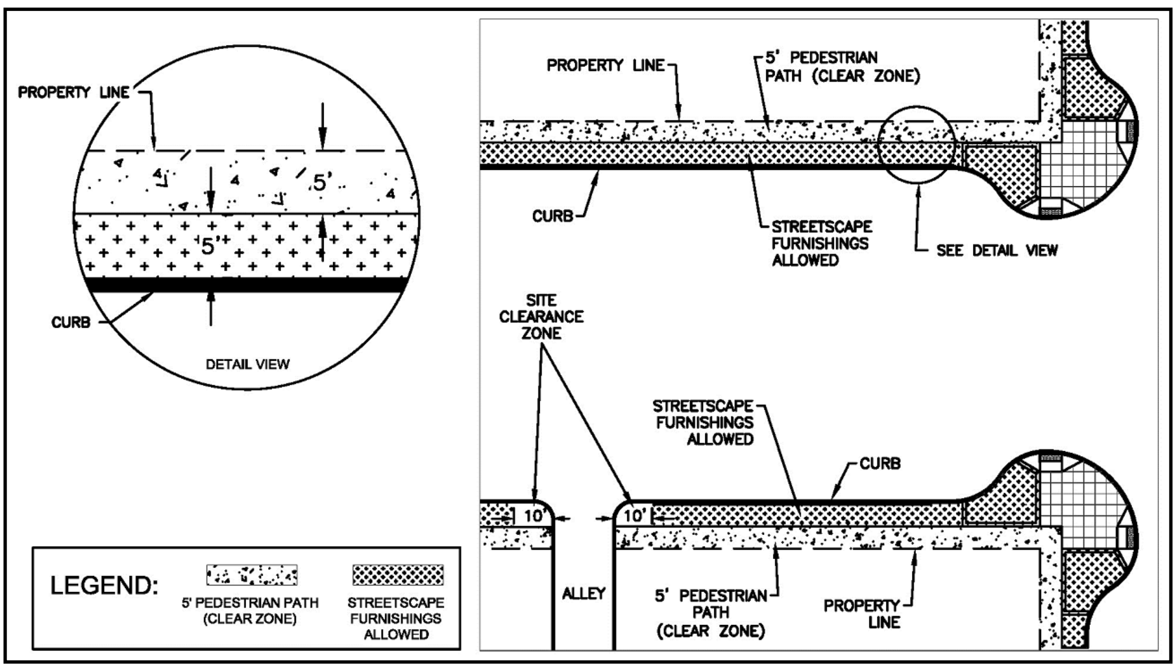


Figure 6-32. Diagram of Streetscape Furniture Area

(2). All street furniture items must be strong, durable, vandal resistant, graffiti resistant, and easy to clean around. Metal portions shall be black matte powder coated.

(3). Street furniture shall include, but not be limited to, benches, trash receptacles, and bicycle racks.

(4). Newspaper and Pamphlet racks are not to be secured to traffic signal, street light, power poles, etc., per SRC 95.200.

Main Menu

CITY OF SALEM
DEPARTMENT OF PUBLIC WORKS
ADMINISTRATIVE RULES
CHAPTER 109
DIVISION 007
EROSION PREVENTION AND SEDIMENT CONTROL PLAN

SECTION

APPENDICES

Division 007—Erosion Prevention and Sediment Control Plan

7.1—Introduction

This Division presents the Design Standards for the preparation of an Erosion Prevention and Sediment Control Plan (EPSCP).

(a) <u>Objectives</u>

The objectives of these Standards are to plan land development and construction activities in order to prevent erosion and control sediment discharge through the use of Best Management Practices (BMPs) that will:

(1). Protect waterways, wetlands, and the public storm drainage system.

(2). Safely convey surface water flows to an approved storm drainage system down slope of construction sites.

(3). Identify appropriate BMPs for use on construction projects which comply with City, State, and Federal requirements.

(b) <u>Applicability</u>

These Standards shall govern all construction and other land disturbing activities within the City of Salem in accordance with the administrative authority granted in SRC Chapters 65, 68, 69, 75, and with the regulatory requirements and permits as referenced in this chapter. They apply to both publicly and privately owned lands and those projects within the ROW.

(c) <u>Responsibility</u>

The applicant is responsible to ensure that adequate erosion prevention and sediment control measures are planned, designed, constructed, operated, and maintained to prevent sediment and pollutants from leaving the construction site. These requirements shall be upheld throughout the life of the construction project. Additional or revised erosion control measures may be necessary based upon field observations of the effectiveness of the original planned measures. The applicant shall revise and add measures as necessary to comply with SRC and regulatory permit requirements. Approval of an EPSCP by the City does not relieve the applicant's responsibility to comply with SRC and regulatory permit requirements.

(d) <u>Regulatory Requirements</u>

All ground disturbing activity shall conform to the applicable regulatory requirements as follows:

(1). National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer Systems (MS4) Discharge Permit issued to the City.

NOTE: *The U.S. Environmental Protection Agency (EPA) requires large municipalities to obtain NPDES permits for their MS4. In Oregon, the Department of Environmental Quality (DEQ) has been charged with administering the MS4 NPDES permit program. An MS4 is a storm water conveyance system that includes roads, ditches, gutters, catch basins, detention/retention basins, and storm drains owned and/or operated by a public body.*

(2). SRC Chapter 75—Erosion Prevention and Sediment Control.

(3). Oregon DEQ 1200C Permits—Required for private development sites greater than one acre.

(4). Oregon DEQ 1200CA Permits—General blanket DEQ permit issued to the City for capital construction.

(5). Requirements of other involved agencies such as Marion County, Polk County, City of Keizer, ODOT, UPRR, and/or BNSF.

(6). Oregon Department of State Lands (DSL) Permits—This includes special requirements of other state agencies such as the Oregon Department of Fish & Wildlife (ODFW) and Oregon DEQ.

(7). United States Army Corps of Engineers (USACE) Permits—This includes special requirements of other federal agencies such as the EPA, the National Marine Fisheries Services (NMFS), and the U.S. Fish and Wildlife Service (USFWS).

(e) References

The following publications serve as references for construction site runoff control; and for designing and implementing erosion prevention and sediment control BMPs:

(1). The City of Salem Erosion Prevention and Sediment Control (EPSC) Plan Technical Guidance Handbook (Version 11/17/2003). (http://www.cityofsalem.net/Departments/PublicWorks/Operations/EnvironmentalServices/Best%20Management%20Practices%20BMPs/Salem%27s%20Erosion%20Control%20Handbook.pdf)

(2). Clean Water Services Erosion Prevention and Sediment Control Planning and Design Manual, December 2008. (http://www.cleanwaterservices.org/Content/Documents/Permit/Erosion%20Prevention%20And%20Sediment%20Control%20Manual.pdf)

(3). Oregon Association of Clean Water Agencies (OR-ACWA) Construction Stormwater Guide, March 2013. (http://www.oracwa.org/documents/ACWASWSiteGuide0313w.pdf)

(4). Oregon DEQ Construction Stormwater Best Management Practices Manual. (http://www.deq.state.or.us/wq/wqpermit/docs/general/npdes1200c/BMPManual.pdf)

(5). Oregon Coast and Pacific Northwest Weather Forecasts provide weather predictions as well as current weather data. (http://IWIN.nws.noaa.gov/iwin/or/or.html).

(6). West Coast Weather Observation, (www.ocs.orst.edu/) gives information on temperatures, wind direction, relative humidity, and precipitation for Oregon.

(7). The Natural Resource Conservation Service Soil Survey for Marion and Polk Counties is available on the Internet at http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm

(f) Drafting and Drawing Requirements

See Division 002—Drafting and Drawing Standards for drafting and drawing requirements for EPSC improvement plans.

7.2—EPSCP General Requirements

(a) EPSC Plan (EPSCP)

An EPSCP shall be submitted concurrent with site development plans, subdivision plans, grading plans and/or public improvement plans for review and approval by the City. An approved EPSCP shall be available on site at all times for review. BMPs shall be adjusted and modified in the field as necessary and as required to provide adequate EPSC.

(b) Site Assessment

The development of the EPSCP must consider existing site conditions and characteristics to maximize the effectiveness of BMPs. The site assessment should include, but not be limited to, identifying existing runoff patterns, off site contributory flows, length, steepness of slopes, soil types, existing vegetation, and existing stormwater systems. The EPSCP shall clearly show existing topography features and contour lines at 2-foot intervals.

(c) BMPs

The EOR is required to select, design, size, and locate adequate BMPs to prevent erosion, sediment, and pollutants from leaving the construction site to comply with the regulatory requirements as referenced in Subsection 7.1(d)—Regulatory Requirements. The City has endorsed the BMPs and details contained in the adopted *"Clean Water Services Erosion Prevention and Sediment Control Planning and Design Manual,"* and the *"Oregon DEQ Construction Stormwater Best Management Practices Manual,"* as referenced in Subsection 7.1(e)(1).

BMPs frequently need to be modified, revised, replaced, and/or added if they are not effective for specific site conditions. The permit registrant shall revise and/or add measures as necessary to meet the requirements of SRC and applicable Federal and State regulatory requirements.

The EPSCP shall include construction details and specifications of BMPs planned for use or references to standard drawings to clearly convey the requirements for construction, implementation, and placement.

(d) Wet Weather Season

The wet weather season extends from October 15 through April 30 as defined by the City's MS4 Permit. However, rain storms can occur throughout the year, and the EPSCP shall anticipate the occurrence of rainfall events that could cause erosion and sediment flow from the site at any time. Duration and amount of site disturbance should be minimized.

Wet weather season work requires more rigorous measures to be employed and shall be reflected in the EPSCP. The following items are additional items required during the wet weather season:

(1). Stockpiles shall be fully covered with secured plastic sheeting or two inches of straw mulch, and isolated with sediment control BMPs at the end of each workday.

(2). Exposed soil not planned for work until the following spring shall be stabilized with established grass or other acceptable BMPs.

(3). Exposed soil shall be covered with appropriate soil stabilization BMPs when not planned for work for a period of 48 hours or greater.

(e) EPSCP Drawing Requirements

EPSCPs must include the elements itemized in Division 002—Drafting and Drawing Standards Section 2.6–Erosion Prevention and Sediment Control Plan. The Standard Notes as included in Appendix 7A—EPSC Plan Standard Notes shall be included in all EPSCPs.

(f) Plan Review Checklist

Appendix 7B—Plan Requirement Checklist will be used by the City during review and evaluation of an EPSCP. The checklist is provided as part of these Design Standards to inform designers of the items the City will evaluate during plan review.

(g) Natural Resource Agency Permits

Any permits required from other regulatory agencies for a project shall be obtained prior to the approval of the EPSCP. Copies of permits issued by other agencies shall be submitted with the EPSCP.

(h) Construction Stages

The plan shall indicate specific BMPs required prior to, during, and post construction. This may require additional drawings for each stage.

(i) Hydrology and Hydraulic Calculations

The EOR is responsible for designing conveyance facilities, infiltration and filtration measures, sedimentation basins, and treatment to accommodate site runoff and the projected concentrated flows and volumes. The EOR must consider soil types and erodibility (natural resource conservation service K value) and perform necessary hydrology and hydraulic calculations as necessary. Hydrology and hydraulic calculations shall be submitted upon request by the City for larger, complex projects.

7.3—Design Elements

The following elements shall be included in the EPSCP.

- Phasing and Sequencing of Ground Disturbance and Grading.
- Sensitive Area Protection.
- Construction Access.
- Flow Rate Control.
- Sediment Control Measures.
- Soil Stabilization.
- Slope Protection.
- Drain Inlet Protection.
- Channel and Outlet Stabilization.
- Pollutant Controls.
- Dust Control.
- Dewatering Controls.
- Ground Cover of Disturbed Soil.
- BMP Maintenance.

Applicable BMPs for each of the design elements are identified in the following sections. The listed BMPs are not intended to be exhaustive and other BMPs or combinations of BMPs may be required to meet the objectives of the design elements and to comply with regulatory requirements as referenced in Subsection 7.1(d)—Regulatory Requirements.

(a) Phasing and Sequencing of Ground Disturbance and Grading

Phasing of ground disturbance and grading, and protecting existing vegetation is the single most effective method for reducing site erosion. Ground disturbing activities shall be phased in such a way to minimize the area and duration of exposed soils. Existing vegetation shall be protected to the maximum extent feasible and areas of protection clearly delineated in the field with sufficient buffers to enhance protection. Phasing of ground disturbance is critical for large sites and long linear projects that would result in large areas of disturbed ground being inactive for more than two weeks. The EPSCP shall delineate the sequencing limits and their order of execution and the BMPs required for each phase.

(b) Sensitive Area Protection

Any project, regardless of size, that disturbs areas near or within a stream or associated buffer, a wetland or its associated buffer, or within 50 feet of a lake, pond or other water body has the potential to seriously damage water resource sensitive areas. Work shall be prohibited in sensitive areas. The applicant is responsible to obtain natural resource agency permits as necessary if work will impact sensitive areas and protect these areas from sediment and pollutants.

Applicable BMPs:

(1). Plastic or Wire Safety Fence.
(2). Sediment Fence.
(3). Preservation of Natural Vegetation.
(4). Buffer Zones.

(c) Construction Access

Construction site exits, haul roads, construction roads, staging areas, and parking areas shall be stabilized using aggregate base materials to control sediment transport off the site. Aggregate should be appropriately sized depending on the location and intended use for sediment control purposes.

Access points shall be installed prior to any soil disturbing activities, and be limited to the fewest number possible. Whenever practicable, slope entrances and exits downward into the site to prevent discharges onto the roadway.

Construction exit BMPs shall be supplemented with onsite tire washing facilities if the construction exit BMP is not effectively preventing sediment from being tracked on the adjacent roadways.

Applicable BMPs:

(1). Limiting Site Access Points.
(2). Stabilization of Exits and Entrances.
(3). Haul and Access Road Stabilization.
(4). Street Cleaning.
(5). Tire Wash.
(6). Steel Rumble Pads.

(d) Flow Rate Control

Decreasing surface water volume and velocity reduces erosion and controls sediment and pollutants from being carried offsite. Surface water controls shall be used to collect, convey, and control surface water volumes and velocities to prevent erosion and control sediment transport. Runoff shall be intercepted on and above disturbed slopes whenever possible. Concentrated runoff from disturbed areas shall be conveyed to a sediment trap, basin, or stabilized outlet and released down slope of any disturbed areas. If feasible and effective, maintain and treat runoff as sheet flow over existing vegetated areas whenever possible.

Applicable BMPs:

(1). Check Dam.
(2). Diversion Dike/Swale.
(3). Outlet Protection.
(4). Pipe Slope Drain.
(5). Surface Roughening.
(6). Preservation of Existing Vegetation.

(e) <u>Sediment Control Measures</u>

Sediment control shall be used as a last line of defense when included in an EPSCP. When sediment control is used by itself, the potential for catastrophic failures is high; therefore, sediment control will be used in addition to other Erosion Prevention BMPs.

Sediment control BMPs shall be installed before soil-disturbing activities. Consider site-specific factors, such as changing topography and soil characteristics, during the installation and ongoing maintenance of the EPSC plan. Direct sheet flow runoff through sediment control BMPs specifically designed to remove sediment from sheet flows, such as filter berms, vegetated filter strips, wattles, or compost socks.

These measures either reduce runoff velocity, retain sediment while allowing water to pass, or collect runoff and direct it to a sediment trap or basin for treatment. Sediment controls at the perimeter may be used as the primary means of sediment removal when the catchment area is very small. It may be a secondary means of sediment removal, for instance, following a sediment trap or basin. Hydrology and hydraulic calculations will be required for larger projects to size sediment ponds, treatment facilities, conveyance facilities, and be available for the City to review upon request.

Applicable BMPs:

(1). Plastic Sheeting of Stock Piles.
(2). Sediment Fence.
(3). Construction Stormwater Filtration.
(4). Check Dam.
(5). Temporary Sediment Pond or Trap.
(6). Outlet Protection.
(7). Street Cleaning.
(8). Surface roughening.
(9). Level Spreader.
(10). Inlet Protection.
(11). Portable Storage Water Tanks.
(12). Wattle.
(13). Filter Berm (gravel, wood chip, or compost).
(14). Vegetated Filter Strip.

(15). Preserving Natural Vegetation.
(16). Stormwater Chemical Treatment.

(f) **Soil Stabilization**

Soil Stabilization is a critical practice in preventing erosion and controlling sediment. The EPSCP shall include rigorous BMPs to prevent erosions. All exposed, disturbed, and unworked soils that have not been actively worked within 14 calendar days are required to be properly stabilized to prevent erosion of the soil from wind, rain, and flowing water. Selected soil stabilization BMPs must be appropriate for site conditions and estimated duration of use to prevent erosion. Ground cover selected shall be appropriate for slope gradient, soil types, and seasonal conditions. Use of ground cover will require specifications for seed mixes, soil amendments, fertilizers, etc. Soil stockpiles shall always be protected with plastic sheeting or tarpaulins, in addition to silt fence, diversion dikes, or combinations thereof. See Subsection 7.2(d)—Wet Weather Season for additional requirements during wet weather construction.

Applicable BMPs:

(1). Preserving vegetation.
(2). Sodding.
(3). Temporary mulching.
(4). Check dam.**
(5). Soil binding using polyacrylamide.*
(6). Wattle.**
(7). Erosion control blankets and matting.
(8). Gravel base.
(9). Placing compost blanket.
(10). Stabilized construction entrance.
(11). Plastic sheet covering of stock piles.
(12). Construction road stabilization.
(13). Seeding and planting.
(14). Dust control BMPs.
(15). Long-term mulch.
(16). Moderate-term mulch.

** While polyacrylamide (PAM) alone does help stabilize soils, using it in conjunction with mulch provides more protection for disturbed soil.*

*** Check dams and wattles alone do not stabilize soils. Use these BMPs in conjunction with other soil stabilization BMPs.*

(g) **Slope Protection**

The EPSCP shall mitigate runoff over and on slopes by using management strategies that minimize the developed energy of the runoff. Design and construct cut and fill slopes to minimize erosion by intercepting runoff on and above sloped areas. Minimize the continuous length of slopes as much as possible through terracing and diversions to reduce slope steepness. Protect all soil from concentrated flows through temporary conveyance systems.

Applicable BMPs:

(1). Channel Lining (riprap, grass).
(2). Subsurface Drains.
(3). Temporary Pipe Slope Drain.
(4). Level Spreader.
(5). Temporary Curb.
(6). Live Fascines.
(7). Interceptor Dike and Swale.
(8). Gradient Terraces.
(9). Roughening Slope Surfaces.
(10). Top of Slope Diversions and Pipe Slope Drains.
(11). Minimize Area of Exposed Slope/Duration by Phasing Grading.
(12). Solid Lining for Conveyances Exceeding a Ten Percent Slope.

(h) <u>Drain Inlet Protection</u>

Protect all operable storm drain inlets from sediment with approved inlet BMPs. Inlet protection devices must be capable of being maintained and shall be inspected and maintained frequently. Unmaintained, these devices clog easily and overflow; therefore, inlet protection shall be used in conjunction with source control BMPs. Wherever feasible, use inlet covers or plugs.

Applicable BMPs:

(1). Inlet Protection Devices (above/below grate and grate covers).
(2). Compost Sock.
(3). Rock Check Dam.

(i) <u>Channel and Outlet Stabilization</u>

Design, construct, and stabilize all temporary conveyance channels to prevent erosion. Use the design criteria contained in Division 004—Stormwater System. Provide stabilization methods, including armoring material, adequate to prevent erosion at the outlets of all conveyance systems. Common outlet locations include areas where ponds, culverts, or pipe slope drains discharge. Plastic covering increases flow rates, therefore, stabilize outlet areas where water is running off plastic. Use a solid lining for conveyances exceeding a ten percent slope. Place check dams at regular intervals based on the grade of the conveyance.

Applicable BMPs:

(1). Rock Check Dam.
(2). Riprap.
(3). Re-Vegetation.

(j) Pollutant Controls

In addition to sediment control, pollution control measures shall be implemented during construction and the EPSCP shall include requirements as necessary to address these measures. Pollutants besides sediment include nutrients, bacteria, oxygen demanding minerals, heavy metals, petroleum hydrocarbons, and synthetic hydrocarbons and synthetic organic chemicals.

Handle and dispose of all pollutants, including construction materials, waste materials, and demolition debris, in a manner that does not cause contamination of stormwater. Describe methods for controlling nonhazardous pollutants in the EPSCP. Discharge tire wash wastewater to a separate onsite treatment system that prevents discharge to surface waters, such as a closed loop recirculation system or upland application.

Wash out concrete trucks in designated concrete washout areas only. Concrete wash out debris shall be contained in impermeable basins and properly disposed at a concrete plant.

Discharging of stormwater or groundwater that has come into contact with curing concrete or other pH-modifying substances shall require correct monitoring and treatment methods. Infiltrate high-pH stormwater or groundwater in designated areas or neutralize prior to discharge.

Applicable BMPs:

(1). Proper Material Storage and Handling.
(2). Controlled Application of Slow Release Fertilizers.
(3). Spill Prevention Measures and Practices.
(4). Equipment Diapers to Prevent Oil Leaks when Working in Sensitive Areas.
(5). Proper Handling of Contaminated Soils.
(6). Concrete Waste and Washout Containment.
(7). Use Drop Pans and Absorbent Materials.
(8). Channel Lining (riprap, grass).
(9). Erosion Control Blanket.
(10). Level Spreader.
(11). Sodding.
(12). Sediment BMPs, as applicable.

(k) Dust Control

Dust control shall be used as applicable in the EPSCP to minimize the transport of soil by wind and traffic, thereby reducing traffic hazards and sediment deposition in water resources and on adjacent properties.

Applicable BMPs:

(1). Watering.
(2). Mulching.
(3). Seeding.
(4). Application of Dust Palliative.

(l) <u>Dewatering Controls</u>

When groundwater is encountered in an excavation or other area; control, treat, and discharge it in a manner as to not exceed the Oregon DEQ turbidity and pollution standards. Uncontaminated dewatering water is an authorized non-stormwater discharge. If dewatering water comes into contact with pH-modifying substances, monitor and sample before discharge to surface waters of the State to ensure high-pH groundwater is not discharged into surface waters of the State. Examples of pH-modifying substances frequently found in construction are concrete, Portland cement, lime, ash, fuels, etc. Infiltrate in designated areas or neutralize before discharge.

Applicable BMPs:

(1). Sediment Basin.
(2). Filter Tanks.
(3). Chemical Treatment.

(m) <u>Maintain BMPs</u>

The EPSCP shall contain notes and specifications for maintenance of BMPs during construction. The following items shall be addressed by the notes and specifications:

EPSCP Required Information

(1). Permit Registrant must inspect BMPs every 24 hours and/or as required by site permit conditions to ensure the BMPs perform their intended function properly until final stabilization is achieved.

(2). Where the Contractor's activities have compromised the erosion control functions of existing grasses, the Contractor shall over-seed.

(3). When the depth of accumulated sediment and debris reaches approximately one-third the height of the device, the contractor must remove the deposits.

(4). Document BMP implementation and maintenance in the site log book.

(5). Remove temporary BMPs within 30 days after final stabilization is achieved or after the BMPs are no longer needed.

(6). Biodegradable BMPs manufactured to be left in place do not need to be removed.

CITY OF SALEM
DEPARTMENT OF PUBLIC WORKS
ADMINISTRATIVE RULES
CHAPTER 109
DIVISION 007 APPENDIX A
EPSC PLAN STANDARD NOTES

SECTION

7A.1—Standard Notes

The following are standard notes to be included on each EPSC plan:

(a) Pre-Construction

(1). Prior to any land disturbing activities, the boundaries of the clearing and grading limits, vegetated buffers, and any sensitive areas shown on this plan shall be clearly delineated in the field. Unless otherwise approved, no disturbance is permitted beyond the clearing limits. The Contractor must maintain the delineation for the duration of the project. Note: vegetated corridors to be delineated with orange construction fence or approved equal.

(2). BMPs that must be installed prior to land disturbing activities are construction entrance, perimeter sediment control, and inlet protection.

(3). Hold a preconstruction conference to review the EPSCP and with the City's Project Manager and Inspector.

(b) Construction

(1). All sediment is required to stay on site. Sediment amounts greater than ½ cubic foot which leave the site must be cleaned up within 24 hours and placed back on the site and stabilized or properly disposed. Vacuuming or dry sweeping must be used to clean up released sediment and it must not be swept or washed into storm sewers, drainage ways, or water bodies. The cause of the sediment release must be found and prevented from causing a recurrence of the discharge within the same 24 hours. Any in-stream clean up of sediment shall be performed according to the DSL required time frame.

(2). Construction, maintenance, replacement, and upgrading of erosion prevention and sediment control facilities is the sole responsibility of the Contractor until all construction is completed, approved, and permanent erosion control (i.e., vegetation/landscaping) is established on all disturbed areas.

(3). All recommended erosion prevention and sediment control procedures are dependent on construction methods, staging, site conditions, weather, and scheduling. During the construction period, erosion control facilities shall be revised, upgraded, replaced, or added, to comply with SRC and State and Federal regulatory requirements.

(4). The Contractor is solely responsible for protection of all adjacent property and downstream facilities from erosion and siltation during project construction. Any damage resulting from such erosion and siltation shall be corrected at the sole expense of the Contractor.

(5). When saturated soil is present, water-tight trucks must be used to transport saturated soils from the construction site. Soil may be drained on site at a designated location, using appropriate BMPs. Soil must be drained sufficiently to drip less than one gallon per hour prior to leaving the site.

(6). All materials spilled, dropped, or washed into storm drains must be removed immediately, and the Contractor shall provide protection of downstream inlets and catch basins to ensure sediment-laden water does not enter the storm drain system.

(7). All discharge of sediment-laden water must be treated with an appropriate BMP to remove sediment from discharge waters and to comply with SRC and State and Federal Regulatory Permits.

(8). In areas subject to wind erosion, appropriate BMPs must be used which may include the application of fine water spraying, plastic sheeting, mulching, or other approved measures.

(9). The EPSC measures and BMPs shown on this plan are the minimum requirements for anticipated site conditions. During the construction period, these measures shall be upgraded as needed to maintain compliance with all regulations.

(10). The contractor shall provide onsite water or other appropriate BMPs to prevent dust and wind erosion of fine grain soils.

(11). Disturbed areas must be stabilized after 14 days of inactivity, or immediately if rain is forecasted. See Subsection 7A.1(d)—Wet Weather Period.

(12). During the wet weather work period or when rain is forecasted, all active and inactive soil stock piles must be covered with appropriate plastic sheeting. Plastic sheeting must cover the entire stock pile and be sufficiently anchored.

(c) Pollutants, Solid Waste and Hazardous Materials Management

(1). Any use of toxic or other hazardous materials must include proper storage, application, and disposal.

(2). The contractor is solely responsible to properly manage pollutants, hazardous wastes, used oils, contaminated soils, concrete waste, sanitary waste, liquid waste, or other toxic substances discovered or generated during construction to prevent leakage, spills or release of pollutants to the environment and surface waters.

(3). Contractor shall develop a project specific written spill prevention and response procedures that includes employee training on spill prevention and proper disposal procedures; regular maintenance schedule for vehicles and machinery; and material delivery and storage controls, signage, material use, and use of covered storage areas for waste and supplies. The plan shall comply with SRC and Federal and State requirements, and shall be available on site at all times.

(d) Wet Weather Period (October 15 through April 30)

(1). Construction activities must avoid or minimize the duration of disturbed areas.

(2). Temporary stabilization of the site including covering of bare soils with approved BMPs, must be installed at the end of the shift before a holiday or weekend, or at the end of each workday if rainfall is forecast in the next 24 hours.

(3). Temporary stabilization or covering of soil stockpiles and protection of stockpiles located away from construction activity must occur at the end of each workday.

(e) Maintenance

(1). Erosion control measures shall be maintained in such a manner as to ensure that erosion is prevented and sediment-laden water does not enter a drainage system, roadway, or violate applicable water quality standards.

(2). Sediment shall not be washed or swept into storm sewers, drainage ways, or water bodies.

(3). Sediment must be removed from behind all sediment control measures when it has reached a height of ⅓ the barrier height, and prior to the control measures removal.

(4). Removal of trapped sediment in a sediment basin or sediment trap or catch basins must occur when the sediment retention capacity has been reduced by 50 percent; is not functioning properly and/or at the completion of project.

(5). Cleaning of all structures, inlet protection BMPs, and sump pumps must be completed regularly and as required to ensure structures and inlets function properly and flow freely.

(6). Construction site exits shall be maintained in a condition that will prevent tracking or flow of mud onto the ROW or approved access point. The entrance may require periodic top dressing as conditions demand, and repair and/or cleanout of any structures used to trap sediment. Wheel washing shall be required to prevent sediment and material tracking on road surfaces if passive BMPs are not effective.

(f) Inspection

(1). The EPSCP must be kept onsite at all times. All measures shown on the plan must be installed properly to ensure compliance with SRC and State and Regulatory permits, and that sediment does not enter a surface water system, roadway, or other properties.

(2). Written EPSC inspection logs shall be maintained onsite and available to City inspectors upon request.

(3). All BMPs shall be inspected at least every week. When a rainfall event exceeds ½″ in a 24-hour period, daily inspection of the erosion controls, sediment controls, and discharge outfalls must be conducted and documented. Inspections shall be done by a representative of the permit registrant who is knowledgeable and experienced in the principles, practices, installation, and maintenance of erosion and sediment controls.

(g) Inactive Construction Periods and Post-Construction

(1). Should work cease in any area for 14 days, the inactive area must be stabilized with appropriate soil stabilization BMPs. If all construction activity ceases the entire site must be temporarily stabilized using vegetation, heavy mulch layer, temporary seeding, or other method.

(2). All temporary erosion prevention and sediment control facilities shall be removed by the contractor within 30 days after permanent landscaping/vegetation is established and the threat of erosion and sediment transport has been mitigated.

(3). Temporary grass cover measures must be fully established by October 15 or other cover measures (i.e., erosion control blankets with anchors, one-inch of straw mulch, six mil HDPE plastic sheet, etc.) shall be in place over all disturbed soil areas until April 30. To establish an adequate grass stand for controlling erosion by October 15, it is recommended that seeding and mulching occur by September 1.

(4). Permanent erosion control vegetation on all embankments and disturbed areas shall be re-established as soon as construction is completed.

(h) Specifications

(1). Soil preparation. Topsoil should be prepared according to the landscape plans, if available, or recommendations of the grass seed supplier. Slopes shall be textured before seeding by rack walking (i.e., driving a crawling tractor up and down the slopes to leave a pattern of cleat imprints parallel to slope contours) or other method to provide stable areas for seeds to rest.

(2). Seeding. Erosion control grass seed mix shall be as follows: Dwarf grass mix (low height, low maintenance) consisting of dwarf perennial ryegrass (80 percent by weight), creeping red fescue (20 percent by weight). Application rate shall be 100 pounds per acre minimum.

(3). Grass seed shall be fertilized at a rate of ten pounds per 1,000 square feet with 16- 16-16 slow release type fertilizer. Disturbed areas within 50 feet of water bodies and wetlands must use a non-phosphorous fertilizer.

(4). The application rate of fertilizers used to reestablish vegetation shall follow manufacturer's recommendations. Nutrient releases from fertilizers to surface waters shall be minimized. Time release fertilizers shall be used. Care shall be made in the application of fertilizers within any waterway riparian zone to prevent leaching into the waterway.

(5). When used, hydromulch shall be applied with grass seed at a rate of 2,000 pounds per acre between April 30 and June 10, or between September 1 and October 1. On slopes steeper than ten percent, hydroseed and mulch shall be applied with a bonding agent (tackifier). Application rate and methodology shall be in accordance with seed supplier recommendations.

(6). When used in lieu of hydromulch, dry, loose, weed-free straw used as mulch shall be applied at a rate of 4,000 pounds per acre (double the hydromulch application requirement). Anchor straw by working in by hand or with equipment (rollers, cleat trackers, etc.). Mulch shall be spread uniformly immediately following seeding.

(7). When conditions are not favorable to germination and establishment of the grass seed, the Contractor shall irrigate the seeded and mulched areas as required to establish the grass cover.

(8). Sediment fences shall be constructed of continuous filter fabric to avoid use of joints. When joints are necessary, filter cloth shall be spliced together only at a support post, with a minimum six-inch overlap, and both ends securely fastened to a post.

(9). The standard strength filter fabric shall be fastened securely to stitched loops installed on the upslope side of the posts, and six inches of the fabric shall be extended into the trench. The fabric shall not extend more than 30 inches above the original ground surface. Filter fabric shall not be stapled to existing trees.

(10). Bio-filter bags shall be clean 100 percent wood product waste. Bags shall be 18-inch x 18-inch x 30-inch, weigh approximately 45 pounds, and be contained in a bag made of ½ inch plastic mesh.

Top Div 7A

(11). Minimum wet weather slope protection. For 3H:1V or steeper slopes use Bon Terra Type C2 or North American Green Type C125 erosion control blankets. Use a minimum of two inches straw mulch or North American Green Type S150 for slopes flatter than 3H:1V and greater than 6H:1V. Slopes flatter than 6H:1V use one inch straw mulch, hydroseed with hydromulch and tackifier. Slope protection shall be placed on all disturbed areas immediately after completion of each section of construction activity, until the erosion control seeding has been established. As an option during temporary or seasonal work stoppages, a six-mil HDPE plastic sheet may be placed on exposed slopes. The plastic sheet shall be provided with an anchor trench at the top and bottom of the slope, and shall be sandbagged on the slopes as required to prevent damage or displacement by wind.

CITY OF SALEM
DEPARTMENT OF PUBLIC WORKS
ADMINISTRATIVE RULES
CHAPTER 109
DIVISION 007 APPENDIX B
PLAN REQUIREMENT CHECKLIST

SECTION

7B.1—Plan Requirement Checklist

(a) EPSC Plan Submittal

The EPSC Plan submittal must include:

- ☐ Cover sheet with a site location map.
- ☐ Proposed public and private stormwater system plan or composite utility plan.
- ☐ Final site stabilization or planting plan.
- ☐ Completed EPSC plan as noted below.

(b) The EPSC Plan

The EPSC Plan must include the following items:

- ☐ Name and number of the designated person (permittee or EPSC Manager) responsible for erosion control.
- ☐ Contour lines with elevations included on the plan. Contours should extend beyond the property line a sufficient distance to define where stormwater enters the site.
- ☐ Adjacent natural resources, such as streams, creeks, wetlands, ponds, drainage channels, lakes, and other sensitive areas.
- ☐ Identification of slopes, drainage patterns, and concentrated flows.
- ☐ Location of cuts and fills.
- ☐ Location of excavated materials storage.
- ☐ Identified clearing limits.
- ☐ Identified area for concrete truck and equipment washout containment area.
- ☐ Location of gravel construction entrances.
- ☐ Locations of erosion prevention and sediment control BMPs (refer to previous table for minimum BMP requirements).

    1. Sediment control devices, such as downslope barriers, slope breaks, inlet protection, and outlet protection.
    2. Erosion prevention devices, such as temporary vegetation, matting, mulch, or other appropriate groundcovers.

Top Div 7B

3. Runoff controls, such as slope drains, temporary diversions, and check dams.

4. Temporary/permanent detention facilities.

☐ Description of all non-stormwater pollution controls.

☐ Details and/or specifications for all proposed BMPs.

☐ Standard notes.

☐ BMP maintenance and inspection schedule.

☐ Construction schedule.

(c) <u>Wet Weather Requirements (October 15 through April 30)</u>

Wet Weather Plan Requirements (October 15 through April 30) must include the following items:

☐ Native vegetation, established temporary vegetation, such as seeding and mulch or mulch and tackifier, binders, or matting.

☐ Slope stabilization, such as horizontal tracking, terracing, temporary or permanent ground cover, interceptor dikes, or bio-swales.

(d) <u>Additional Considerations</u>

Additional Considerations:

☐ Remove only vegetation necessary to conduct the work.

☐ Construction phase of the project and associated BMPs for each phase.

☐ Intercept stormwater runoff and direct flow away from exposed soils to be a stabilized outlet.

☐ How to prepare for predicted rain events.

CITY OF SALEM
DEPARTMENT OF PUBLIC WORKS
ADMINISTRATIVE RULES
CHAPTER 109
DIVISION 007 APPENDIX C
EPSC PLANS FOR SINGLE-FAMILY RESIDENTIAL

SECTION

FIGURES

TABLES

7C.1—Overview

The following describes the requirements for preparing Erosion Prevention and Sediment Control Plans (Plans) for new or modified single-family and duplex construction requiring a building permit.

7C.2—Requirements

> ***NOTE:*** *The City of Salem does not require that a registered engineer prepare the Plan for single-family/duplex construction, unlike development projects.*

The City's inspection threshold for erosion prevention and sediment control is any disturbance of 1,000 square feet or more. It is the responsibility of the permit holder to keep sediment on-site. Plans shall describe ways to minimize the discharge of pollutants in runoff from any construction activity, using erosion prevention, sediment, runoff, and non-stormwater pollution control BMPs.

The Plan designer shall incorporate information and observations obtained from the City, applicable resource agencies, and a site visit. In addition, the designer must identify potential erosion and sediment problems, develop design objectives, formulate and evaluate alternatives, select best erosion prevention measures, and develop a Plan.

The permit holder shall designate a person with erosion prevention and sediment control experience. The designated person, whether contractor or erosion and sediment control specialist, has a defined responsibility to prevent sediment from leaving the site. The designee must follow the Plan, or make approved revisions to the Plan as necessary, and ensure that the site is stable. Although a permitted Plan may appear to have addressed all issues, the designer shall adapt the plan during implementation to ensure proper performance.

The Plan shall be submitted with the building permit application.

7C.3—Minimum BMPs for Single-Family/Duplex Projects

Minimum BMPs for single family or duplex permitted projects are listed in Table 7C-1. Note that wet season construction requires augmented protection measures. If planned dry season construction becomes delayed into the next wet season, the Plan must be revised to include at least the minimum wet season BMPs.

MINIMUM BMPs FOR SINGLE-FAMILY/DUPLEX PROJECTS		
Best Management Practice[1]	**Year Round**	**Wet Season[2]**
Linear Barrier and Perimeter Control	✓	
Storm Drain Inlet Protection	✓	
Construction Entrance/Exit Tracking Controls	✓	
Non-Soil Stockpile Management	✓	
Concrete Management	✓	
Inspection and Maintenance	✓	
Soil Stockpile Management	✓	
Seeding and Planting/Temporary and Permanent	✓	✓
Non-Stormwater Pollution Controls	✓	✓
Slope Breaks for Steep Slopes	✓	✓
[1] BMPs not included or referenced in these Design Standards may be submitted to the City for consideration. [2] Additional measures required from October 1 to April 30.		

Table 7C-1. Minimum BMPs for Single-Family/Duplex Projects

(a) <u>Site Plan Checklist</u>

Site plan must include the following:

- ☐ Provide the name and phone number of the person(s) responsible for erosion prevention and sediment control on site.
- ☐ Site contours and/or drainage patterns found on site—identify any slope greater than five percent.
- ☐ Location and maintenance schedule of erosion prevention and sediment control measures to be used on site. This includes, but is not limited to:
  - ☐ Gravel construction entrance.
  - ☐ Sediment barrier: downslope side of the site along contours.
  - ☐ Stormwater inlet protection.
- ☐ Between October 1 and April 30 notes describing additional wet weather BMPs to be utilized and ground cover.

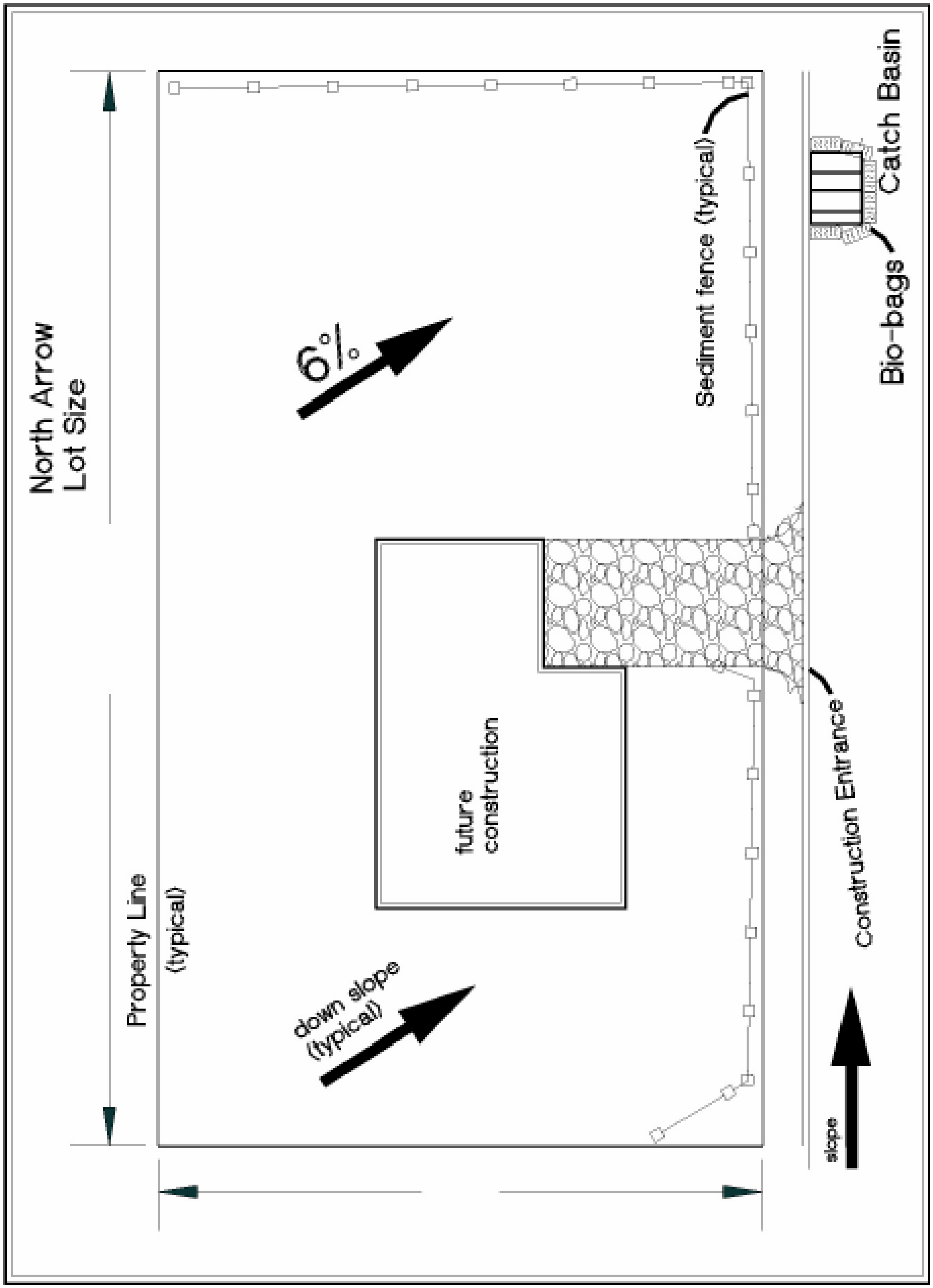


Figure7C-1. Example Site Plan