APPENDIX A

LANDSCAPE REQUIREEMNTS:
VEGETATED STORMWATER MANAGEMENT FACILITIES

A.1.00 Introduction

a. This appendix provides information on plant selection and design guidance for a variety of stormwater management facilities. The role of plants in facilities is critical. The success or failure of a facility can depend on the proper selection and location of plants. The main purpose of vegetation in facilities is to provide the maximum amount of water quality benefit for stormwater management.

b. The surface area of a typical stormwater facility allows runoff to pond and evaporate while sediments settle into a layer of mulch. The organic mulch layer prevents soil bed erosion and retains moisture for plant roots. It also provides a medium for biological growth and the decomposition or decay of organic matter. The soil stores water and nutrients to support plant life. Worms and other soil organisms are very good at degrading organic pollutants, like petroleum-based compounds. They also help mix organic material, increase aeration, and improve water infiltration and water holding capacity. Bacteria and other beneficial soil microbes process the majority of pollutants, including most of the nitrogen. The stiff structure of plants such as rushes and sedges slows water passage and traps sediments within the surface area of the facility. (BES Stormwater Management Manual - 2008)

c. In designing vegetated stormwater management facilities, there are a range of considerations for plant selection and design, including the site context, protection of native biodiversity, creation of habitat, limitation of noxious invasive species, and aesthetics. The following sections provide guidance for the proper selection of plants.

A.2.00 Native and Adapted Plants

a. Plants approved for stormwater management facilities can be grouped into three categories: natives, native cultivars, and non-native adapted plants.

   1. Native plants are plants that are indigenous to our specific region. They typically require minimal care once they are planted because they have evolved and adapted to the growing conditions and climate of the region. Because of their place in the local ecology, native plants also provide habitat value for birds and other local species. For these reasons, native plants are strongly recommended for stormwater management facilities and should be used whenever suitable.

2. Native cultivars are cultivated varieties of native plants produced by horticultural techniques and are not normally found in wild populations. Cultivars are bred for certain desired characteristics that make them different from their native counterparts. Native cultivars may be selected over a native plant if it is more suitable for certain conditions, such as densely urbanized applications. For example, Kelsey Dogwood (Cornus sericea 'Kelseyi) is a cultivar of the native Red Twig Dogwood (Cornus sericea). Kelsey Dogwood has been selectively bred to be much smaller at maturity than red twig dogwood, which can be advantageous in small-scaled urban stormwater management facilities. In such instances, the native cultivar is preferred because it will not outgrow the facility or require frequent pruning maintenance, while still offering the same vegetative advantages as its native counterpart.

3. Non-Native adapted plants are plants that are not native to our region, but have certain characteristics that make them very useful and well adapted to stormwater facilities. The non-native adapted plants included on the stormwater facility plant lists are plants that have proven to be non-invasive.

b. The plant lists provided for each type of stormwater management facility identifies native, native cultivars and non-native adapted plants that are approved for use. The use of plants not identified on the plant lists shall be approved by the City's authorized representative.

A.2.01 Relationship of Form and Hydrology

a. Careful consideration of the soil moisture conditions within a stormwater facility will help to ensure the success of a planting design (See *Planting Zones by Facility Type*). Planting conditions for sloped, basin-like stormwater facilities such as swales, rain gardens and constructed wet ponds have a variety of moisture levels from dry to wet. Soil conditions at and near the bottom of the facility can be wet due to frequent or constant inundation, and side slopes vary from wet at the bottom to relatively dry near the top. The moisture gradient varies with the designed maximum water depth, the time it takes for a facility to drain after a storm event, and the steepness of the side slopes.

b. The zone from the bottom of the facility to the designed high water line or top of freeboard should be planted with plants that tolerate occasional standing water and wet-to-moist conditions. Above the designed high water line vegetation is not affected by stormwater entering the facility and should be planted with species well-suited to the local climate and site-specific conditions (i.e., solar aspect, micro climate, etc.). Planting conditions are more uniform for planters and vegetated filter strips because of the relatively uniform and flat surface.

A.2.02 Vegetated Stormwater Management Facilities and Habitat

a. A habitat is a space that provides food, water, and shelter for the survival and reproduction of an organism. Vegetated stormwater management facilities can be designed to mimic the natural habitats, processes, and hydrology of a particular site.

b. The environmental benefits of vegetated stormwater management facilities include:

1. Less disturbance to sites than conventional stormwater management methods

2. Reduced and delayed peak stormwater flows

3. Reduced discharge of pollutants

4. Increased planted space and habitat

5. Creation of a multifunctional landscape that enhances visual and functional amenities

c. Vegetated stormwater management facilities also generate a variety of off-site benefits that preserve and enhance riparian and wetland habitats "downstream" from the facility by reducing the negative environmental effects associated with urban development. Nearly all vegetated stormwater management facilities have the potential to create and improve habitat on and near the site. Water is one of the most important factors in the creation of habitat, and because most stormwater management facilities receive large amounts of stormwater they offer a great opportunity to create habitat. Planting vegetation is one of the most practical ways to create habitat within a stormwater management facility.

d. All of the vegetated stormwater management facilities have planting design guidelines, such as required plant spacing and plant types, but there is flexibility to maximize habitat for a variety of organisms such as invertebrates, amphibians, small mammals, and birds. Created habitat can also enhance conditions for predators that feed on mosquitoes.

A.2.03 Climate and Microclimate

a. All stormwater management facility vegetation should be well-adapted to both the northwest regional climate and the facility's microclimate.

b. Although regional climate dictates average seasonal temperatures, amount of rainfall and available daylight, site-specific microclimates can vary considerably and should be factored into the planting design, particularly in an urbanized environment. For example, sword fern is a plant native to woodlands of the Pacific Northwest that likely would not survive if placed in a south facing flow-through planter with direct sun exposure most of the day and heat radiating off the building. But sword fern placed in a flow-through planter on the north side of the building likely would thrive.

A.2.04 Habitat Diversity and Layering of Plants

a. Natural environments in the Pacific Northwest are characterized by diverse, layered plant habitats. A forest typically has three broad habitats vertically arranged one on top of the other; low-growing groundcovers, topped by shrubs, topped by arborescent shrubs (shrubs that look like small trees) and trees. These layers vary in composition and form from one habitat type to another, such as the different northwest habitats of

forest, wetland, and riparian. Different organisms occupy different niches within these habitats, creating greater biodiversity.

b. A range of habitats can be created in vegetated stormwater management facilities by selecting a variety of complementary vegetation to plant together, such as groundcovers, perennials, shrubs, and trees. The structural variety of a diversified planting design can also be very pleasing to the eye. Vegetated stormwater management facilities should reflect a natural ordering of plantings, as well as mimicking a mixture of deciduous and evergreen materials.

A.2.05 Maintenance

Water efficient irrigation shall be applied for at least the first 2 years after construction of the facility, particularly during the dry summer months, while plantings become established. If temporary irrigation is installed it must be removed by the end of the maintenance period. The following maintenance inspections and activities shall be performed:

1. Check regularly for weeds. Remove weeds or invasive plants such as blackberries and ivy, and implement a weed control program as needed.

2. Check mulch regularly to maintain uniform coverage. Many vegetated stormwater management facilities specify a mulch cover such as river rock to prevent erosion and moisture loss during dry periods.

3. Replant bare patches as necessary to comply with the facility's coverage requirements and maintenance plan.

4. Implement all of the required maintenance activities listed in the vegetated stormwater management facility details.

A.2.06 Planting Zones by Vegetated Stormwater Management Facility Type

Vegetation for stormwater facilities is categorized according to the degree of soil moisture that will be encountered in the facility. For green roofs, the critical planting factor is the depth of the planting soil. Consideration of these zones will enhance the success of a facility's planting design.

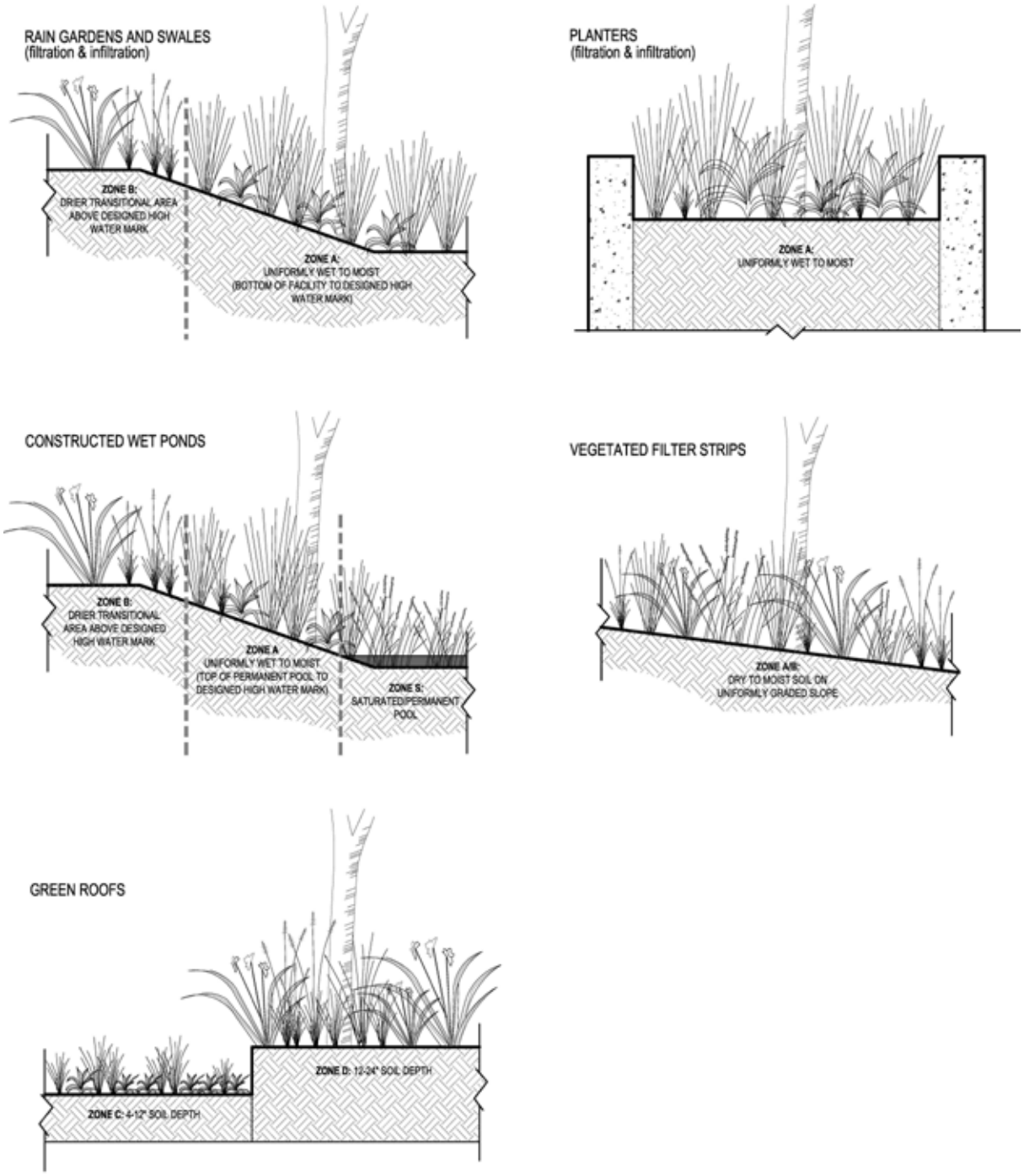

Figure A-1. Planting Zones by Vegetated Stormwater Management Facility Type

A.3.00 Planting Plan Methods

Planting plans are required for development projects with stormwater management facilities. Planting plans should address four major components: hydrology, soils, plant materials, and maintenance. When developing planting plans, the following steps should be used:

a. Step 1: Assess Hydrologic and Hydraulic Conditions

Use the City's BMP sizing tool and cross sections in Figure A-1 to assign appropriate hydrologic zones to the facilities and identify them on the plan. Most facilities include one or more of the following planting zones with respect to hydrology during the growing season:

1. Wet (Zone S): standing or flowing water/nearly constant saturation; anaerobic soils

2. Moist (Zone A): periodically saturated; anaerobic and/or aerobic soils

3. Dry (Zones B, C, and D): infrequent inundation/saturation, if any; aerobic soils

b. Step 2: Identify Plants to be Preserved, Select Plant Materials, Quantities, Placement, and Assign Planting Zones and Specifications to Plans

1. Preservation: Every effort shall be made to protect a site's existing native vegetation. Native vegetation along natural areas and the Significant Resource Overlay Zone shall be retained to the maximum extent practicable.

2. Selection: Plant selection shall be from the plant lists found in Tables A1-A5, unless approved by the City's authorized representative. Planting requirements are as follows:

(a) Deep rooting trees and shrubs (e.g. willow) shall not be planted on top of concrete pipes, or within 10 feet of retaining walls, inlet/outlet structures or other culverts; and

(b) Large trees or shrubs shall not be planted on berms over four feet tall that impound water. Small trees or shrubs with fibrous root systems may be installed on berms that impound water and are less than four feet tall.

3. Quantities: Plant quantities shall be calculated as follows, unless approved by the City's authorized representative. All quantities shall be calculated per 100 square foot of facility area.

(a) Moisture Zone (S): 115 herbaceous plants.

(b) Moisture Zone (A): 3 large shrubs / small trees, 4 small shrubs, and 115 groundcover plants.

(c) Moisture Zone (B): 1 tree, 3 large shrubs / small trees, 4 small shrubs, and 115 groundcover plants.

(d) Moisture Zone (C & D): 115 sedums, succulents, and herbaceous plants

4. Fully Lined Facilities – Trees are not required

5. Minimum Sizes:

(a) Herbaceous Plants: SP #4 container

(b) Small Shrubs / Groundcover: # 1 container

(c) Large Shrubs / Small Trees: 30” Height

(d) Deciduous Trees: 1” caliper

(e) Evergreen Trees: 6’ height

6. Design: All planting plans must have a minimum of 50 percent evergreen plants and at least two species from the Herbaceous and Small Shrubs/Groundcover plant communities.

c. Step 3: Determine Plant Installation Requirements and Assign Specifications to Plans

1. Timing: Containerized stock shall be installed only from February 1 through May 1 and October 1 through November 15. Bare root stock shall be installed only from December 15 through April 15. Seeding shall occur only between March 1 through May 15 and September 1 through October 15. Planting or seeding outside these times may require additional measures to ensure survival which shall be specified on the plans and require the City’s approval.

2. Erosion Control: Grading, soil preparation, and seeding shall be performed during optimal weather conditions and at low flow levels to minimize sediment impacts. Site disturbance shall be minimized and desirable vegetation retained, where possible. Slopes shall be graded to support the establishment of vegetation. Where seeding is used for erosion control, an appropriate native grass, *Regreen* (or its equivalent), or sterile wheat shall be used to stabilize slopes until permanent vegetation is established. Biodegradable fabrics (coir, coconut or approved jute matting (minimum ¼ inch square holes) may be used to stabilize slopes and channels. Fabrics such as burlap may be used to secure plant plugs in place and to discourage floating upon inundation. No plastic mesh that can entangle wildlife is permitted. Consult Section 101.9.00, Environmental Protection, Erosion Prevention, and Sediment Control for additional information.

3. Mulching: Mulching for stormwater management facilities shall be per **Section A.3.7**.

4. Plant Protection from Wildlife: Depending on site conditions, appropriate measures shall be taken to limit wildlife-related damage.

5. Irrigation: Appropriate plant selection, along with adequate site preparation and maintenance, reduces the need for irrigation. However, unless site hydrology is currently adequate, a City approved irrigation system or equivalent shall be used during the 2-year plant establishment period. Watering shall be at a rate to maintain all plantings in a healthy thriving condition during establishment Other irrigation techniques, such as deep watering, may be allowed with prior approval by the City's authorized representative.

6. Access: Stormwater management facility access requirements are provided in Section 301.11.04.

d. Step 4: Determine Plant Monitoring and Maintenance Requirements

1. Monitoring: Site visits are necessary throughout the growing season to assess the status of the plantings, irrigation, mulching, etc. and ensure successful plant establishment.

2. Weed Control: The removal of non-native, invasive weeds shall be necessary throughout the maintenance period, or until a healthy stand of desirable vegetation is established.

3. Plant Replacement and Preservation: At the end of the maintenance period, all plants not in a healthy growing condition, will be noted and as soon as seasonal conditions permit, shall be removed from the site and replaced with plants of the same species and size as originally specified. Prior to replacement, the cause of loss (wildlife damage, poor plant stock, etc.) shall be documented with a description of the corrective actions taken.

e. Step 5: Prepare Construction Documents and Specifications

The construction documents and specifications shall include:

1. Site preparation plan and specifications, including limits of clearing, existing plants and trees to be preserved, and methods for removal and control of invasive, non-native species, and location and depth of topsoil and or compost to be added to planting area.

2. Planting plan and specifications shall include all of the following:

(a) Planting table that documents the common name, scientific name, distribution (zone and spacing), condition and size of plantings

(b) Installation methods for plant materials

(c) Mulching

(d) Plant tagging for identification

(e) Plant protection

(f) Seeding mix, methods, rates, and areas

3. Irrigation plan and specifications, including identification of water source, and, maintenance of the system.

4. Maintenance schedule; including responsible party and contact information, dates of inspection (minimum three per growing season and one prior to onset of growing season) and estimated maintenance schedule (as necessary) over the 2-year monitoring period.

5. Access points for installation and maintenance including vehicle access if required.

6. Standard drawing details (north arrow, scale bar, property boundaries, project name, drawing date, name of designer and Property Owner).

A.4.00 Stormwater Facility Growing Medium

Furnish imported growing medium for vegetated stormwater management facilities conforming to the following:

a. Standard Blend: Use this blend for all vegetated stormwater management facilities, except those in the right-of-way where compaction from foot traffic is a concern.

1. General Composition: The medium shall be a blend of loamy soil, sand, and compost that is 30 to 40 percent compost (by volume) and meets the criteria in this specification.

2. Analysis Requirements for the Blended Material:

(a) Particle Gradation: A particle gradation analysis of the blended material, including compost, shall be conducted in conformance with ASTM C1 17/C136 (AASHTO T1 1/T27). The analysis shall include the following sieve sizes: 1 inch, 3/8 inch, #4, #10, #20, #40, #60, #100, and #200. The gradation of the blend shall meet the following gradation criteria.

Sieve Size	Percent Passing
1 inch	100
# 4	60 -100
# 10	40-100
# 40	15-50

# 100	5-25
# 200	3-5

(b) The blend shall have a Coefficient of Uniformity (D60/D10) equal to or greater than 6 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 10 percent passing.

3. 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 10 percent, as reported by that test.

4. Measured pH: The blended material shall be tested and have a pH of 5.5 to 7.

b. Infiltration Blend for the Right-of-Way: Use this blend for facilities in the right-of-way where compaction from foot traffic is a concern. Approval is required.

1. General Composition: The medium shall be a mix of sand and compost, blended by volume. The medium shall consist of 60 to 70 percent sand and 30 to 40 percent compost (by volume).

2. Analysis Requirements**:** The requirements are the same as those specified in Section A.4.00.a for the "Standard Blend." The single difference is the particle gradation criteria, which are as follows.

Sieve Size	**Percent Passing**
1 inch	100
# 4	60-100
# 10	40-100
# 40	15-50
# 100	5-20
# 200	3-5

c. General Requirements for the Blended Material:

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, screened and free of stones 1 inch (25 mm) or larger in any dimension; free of roots, plants, sod, clods, clay lumps, pockets of coarse sand, paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials harmful to plant growth; free of weeds and invasive plants including but not limited to:

(a) Cirsium arvense (Canadian Thistle)

(b) Convolvulus spp. (Morning Glory)

(c) Cytisus scoparus (Scotch Broom)

(d) Dipsacus sylvestris (Common Teasel)

(e) Festuca arundinaceae (Tall Fescue)

(f) Hedera helix (English Ivy)

(g) Holcus canatus (Velvet Grass)

(h) Lolium spp. (Rye Grasses)

(i) Lotus corniculatus (Bird's Foot Trefoil)

(j) Lythrium salicaria (Purple Loose Strife)

(k) Melilotus spp. (Sweet Clover)

(l) Myriophyllum spicatum (Eurasian Milfoil)

(m) Phalaris arundinaceae (Reed Canary Grass)

(n) Rubus discolor (Himalayan Blackberry)

(o) Solanum spp. (Nightshade)

(p) Trifolium spp. (Clovers), and

(q) Not infested with nematodes, grubs, other pests, pest eggs, or other undesirable organisms and disease-causing plant pathogens; friable and with sufficient structure to give good tilth and aeration. Continuous, air-filled, pore-space content on a volume/volume basis shall be at least 15 percent when moisture is present at field capacity. Soil shall have a field capacity of at least

15 percent on a dry weight basis.

4. It shall have no visible free water.

5. It shall be obtained from naturally well drained construction or mining sites where topsoil occurs at least 4 inches deep; it shall not be obtained from bogs, wetlands, or marshes.

d. Compost: The compost shall be derived from plant material and provided by a member of the U.S. Composting Council Seal of Testing Assurance (STA) program. See www.compostingcouncil.org for a list of providers in Portland.

1. 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 U.S. Composting Council STA Compost Technical Data Sheet provided by the vendor:

(a) 100 percent of the material must pass through a 1/2-inch screen.

(b) The pH of the material shall be between 6 and 8.

(c) Manufactured inert material (plastic, concrete, ceramics, metal, etc.) shall be less than 1.0 percent by weight.

(d) The organic matter content shall be between 35 and 65 percent.

(e) The soluble salt content shall be less than 6.0 mmhos/cm.

(f) Germination (an indicator of maturity) shall be greater than 80 percent.

(g) The stability shall be between classes 5-7.

(h) The carbon/nitrogen ratio shall be less than 25:1.

(i) The trace metals test result = “pass.”

e. Submittals: At least 14 working days in advance of construction, submit the following:

1. Documentation for the three analyses (particle gradation with calculated coefficient of uniformity; organic matter content; pH) described in this specification. The analyses shall be performed by an accredited laboratory with certification maintained current. The date of the analyses shall be no more than 90 calendar days prior to the date of the submittal. The report shall include the following information:

(a) Name and address of the laboratory

(b) Phone contact and e-mail address for the laboratory

(c) Test data, including the date and name of the test procedure

2. A compost technical data sheet from the vendor of the compost. The analysis and report must be consistent with the sampling and reporting requirements of the U.S. Composting Council STA program. The analysis shall be performed and reported by an approved independent STA program laboratory.

3. The date of the analysis shall be no more than 90 calendar days prior to the date of the submittal.

4. A description of the location, equipment, and method proposed to mix the material.

f. Stormwater Management Facility Growing Medium Installation

1. Protection of the Growing Medium: The growing medium shall be protected from all sources of contamination, including weed seeds, while at the supplier, in conveyance, and at the project site.

2. Placement of the Growing Medium: The medium shall be placed in loose lifts, not to exceed 8 inches and each lift shall be compacted with a water-filled landscape roller. The material shall not otherwise be mechanically compacted.

3. Timing of Plant Installation: Weather permitting, plants shall be installed as soon as possible after placing and grading the growing medium in order to minimize erosion and further compaction.

4. Erosion Control: Temporary erosion control measures are required until permanent stabilization measures are functional, including protection of overflow structures.

5. Protection of the Facility: In all cases, the facility must be protected from foot or equipment traffic that is unrelated to the construction of the facility. Temporary fencing or walkways should be installed as needed to keep workers, pedestrians, and equipment out of the facility. Under no circumstances should materials and equipment be stored in the facility.

6. Stormwater management facilities shall be kept clean and shall not be used as erosion and sediment control structures during construction.

7. Wet and Winter Conditions: Placement of the growing medium will not be allowed when the ground is frozen or saturated or when the weather is determined to be too wet.

g. Watering, Fertilizing, and Mulching

1. Water all plants during establishment to maintain all plantings in a healthy thriving condition.

2. Fertilizers should generally be avoided in stormwater facilities. Fertilize all plants during establishment as needed with slow release, organic (low yield) material.

3. The purpose of mulching soils is to conserve moisture, hold plantings and topsoil in place, limit weed establishment and moderate soil temperatures.

4. Mulch for Vegetated Stormwater Facilities: The use of mulch in frequently inundated areas shall be limited to avoid any possible water quality impacts including the leaching of tannins and nutrients, and the migration of mulch into waterways. Mulches to be used shall be a stable and inert (non-leaching) matter of sufficient mass and density that it will not float in standard flows. Mulch cover should be maintained throughout the life of the stormwater facility with minimum thickness of 2 inches in depth.

h. Stormwater Facility Plant Lists

1. The plant lists provided in the following tables are separated by facility type (such as planters, rain gardens, green roof, etc.). Each facility list includes a suitability matrix for limiting contextual factors (such as moisture zones and width of facility) as well as a listing of specific characteristics for each species, such as native to the area, if it is an evergreen, its average height and the on-center spacing.

2. The following characteristics are included in plant matrices to aid in plant selection:

(a) Botanical name, Common Name: Plants are listed by their botanical name first, in italics, followed by a generally accepted common name. Note that common names vary, so use of the botanical name is recommended to ensure proper plant selection

(b) Zone: Denotes the planting moisture zone as noted in the facility diagrams in Figure A-1. Some plants work in multiple moisture zones, and others only in a particular dry, moist, or wet condition.

(c) Origin: The distinction between Northwest native plants, cultivated varieties of Northwest Natives, and plants that are non-native but adapted to our specific climate.

(d) Type/Size: A range of factors to aid in plant selection showing individual plant characteristics:

(1) (E)vergreen/(D)ecidious: Identifies the characteristic of a plant to keep foliage during winter months. Planting placement and selection should maintain a balance of evergreen and deciduous materials.

(2) Potential Height: Maximum size at maturity to use as a design guideline.

(3) On-Center Spacing: Optimum spacing for new plantings. This is to be used as a guideline and may vary slightly depending on site conditions.

(e) Context Factors

(1) Facilities less than 3 feet wide: Narrow conditions require plants that are not too large and will outgrow or have potential for roots to damage, narrow planters.

(2) Fully Lined Facility: Limit larger material or plants with aggressive roots.

(3) Parking Area: Use plant materials that do not limit necessary line of sight visibility.

(4) Streets: Use plant materials that do not limit necessary line of sight visibility.

(5) Adjacent to Buildings: Limit plants that are too large for areas next to buildings and would not be compatible with building footings, windows or other systems.

TABLE A-1: Stormwater Facility Plant Lists: Planters (Infiltration and Filtration)

Planters (infiltration and filtration)	**Zone**	**Origin**			**Type/Size**			**Context Factors**				
Plant Name ***Botanical*, common**	Moisture zone (A) Uniformly wet to moist	NW native	NW native cultivar	Non-native adapted	(E)vergreen /(D)eciduous	Potential height	Typical on center spacing	Facilities < 3 feet wide	Fully-lined facility	Parking areas	Streets	Adjacent to buildings
Herbaceous Plants												
Carex densa, Dense sedge	•	•			E	24"	12"	•	•	•	•	•
Carex rupestris, Curly sedge	•			•	D	14"	12"	•	•	•	•	•
Carex testacea, New zealand orange sedge	•			•	E	24"	12"	•	•	•	•	•
Eleocharis ovata, Ovate spike rush	•	•			E	30"	12"	•	•	•	•	•
Juncus ensifolius, Dagger-leaf rush	•			•	D	10"	12"	•	•	•	•	•
Juncus patens, Spreading rush	•	•			E	36"	12"	•	•	•	•	•
Shrubs/Groundcover												
Cornus sericea, Red twig dogwood	•	•			D	6'	4'			•		•
Cornus sericea 'Kelseyi', Kelsey dogwood	•		•		D	24"	24"	•	•	•	•	•
Mahonia aquifolium, Oregon grape	•	•			E	5'	3'		•	•	•	•
Physocarpus capitatus, Pacific ninebark	•	•			D	10'	3'		•			
Polystichum munitum, Sword fern	•	•			E	2'	2'	•	•	•	•	•
Rosa pisocarpa, Swamp rose	•	•			D	8'	3'		•			•
Large Shrubs/Small Trees												
Rubus spectabilis, Salmonberry	•	•			D	10'	4'		•			•
Salix lucida var. 'Lasiandra', Pacific willow	•		•		D	13'	6'					
Salix purpurea nana, Blue arctic willow	•			•	D	8'	6'			•		
Salix sitchensis, Sitka willow	•	•			D	20'	6'					
Spirea douglasii, Douglas spiraea	•	•			D	7'	4'		•			•
Viburnum edule, Highbush cranberry	•	•			D	6'	4'		•	•	•	
Trees												
Acer circinatum, Vine maple	•	•			D	15'	10'	•	•	•		•
Acer rubrum, Red maple	•			•	D	40'	25'		•	•	•	
Alnus rubra, Red alder	•	•			D	80'	15'			•		
Crataegus douglasii, Black hawthorn	•	•			D	40'	10'		•	•		
Fraxinus latifolia, Oregon ash	•	•			D	30'	20'			•		
Malus fusca, Pacific crabapple	•	•			D	30'	10'	•	•	•		
Nyssa sylvatica, Black tupelo	•			•	D	25'	20'			•	•	
Salix hookeriana, Hooker's willow	•	•			D	15'	10'			•		
Thuja plicata, Western red cedar	•	•			E	150'	25'			•		

TABLE A-2: Stormwater Facility Plant Lists: Rain Gardens and Swales (Infiltration and Filtration)

Rain Gardens and Swales (infiltration and filtration)	**Zone**		**Origin**			**Type/Size**			**Context Factors**				
Plant Name ***Botanical*****, common**	Moisture zone (A) Uniformly wet to moist	Moisture zone (B) Drier transitional area	NW native	NW native cultivar	Non-native adapted	(E)vergreen/(D)eciduous	Potential height	Typical on center spacing	Facilities < 3 feet wide	Fully-lined facility	Parking areas	Streets	Adjacent to buildings
Herbaceous Plants													
Carex obnupta, Slough sedge	•		•			E	48"	12"		•	•	•	•
Carex testacea, New Zealand orange sedge	•				•	D	24"	12"		•	•	•	•
Deschampsia cespitosa, Tufted hair grass	•		•			D	36"	12"	•	•	•	•	•
Elymus glaucus, Blue wild rye	•	•	•			E	24"	12"	•	•	•	•	•
Juncus ensifolius, Dagger-leaf rush	•				•	D	10"	12"	•	•	•	•	•
Juncus patens, Spreading rush	•	•			•	E	36"	12"	•	•	•	•	•
Scirpus microcarpus, Small fruited bulrush	•		•			E	24"	12"	•	•	•	•	•
Small Shrubs/Groundcover													
Arctostaphylos uva-ursi, Kinnickinnick		•	•			E	6"	12"	•	•	•	•	•
Cornus sericea 'Kelseyi', Kelsey dogwood	•	•		•		D	2'	12"	•	•	•	•	•
Fragaria chiloensis, Coastal strawberry		•	•			E	6"	12"	•	•	•	•	•
Mahonia aquifolium, Oregon grape	•	•	•			E	5'	3'		•	•	•	•
Physocarpus capitatus, Pacific ninebark	•		•			D	6'	3'		•			
Polystichum munitum, Sword fern	•	•	•			E	2'	2'	•	•	•	•	•
Spirea betulifolia, Birchleaf spiraea	•	•	•			D	2'	2'	•	•	•	•	•
Symphoricarpus alba, Snowberry	•	•	•			D	3'	3'	•	•	•	•	•
Large Shrubs/Small Trees													
*Cornus sericea,*Red-Twig dogwood	•	•	•			D	6'	4'					
Holodiscus discolor, Western serviceberry	•	•	•			*D*	*6'*	*4'*		•	•	•	
Rosa nutkana, Nootka rose	•	•	•			D	8'	4'		•		•	
Omleria cerasiformis, Indian plum	•		•			D	6'	4'		•	•	•	
Ribes sanguimeum, Red flowering currant	•	•	•			D	8'	4'		•	•	•	•
Salix sitchensis, Sitka willow	•		•			D	15'	5'					
Spirea douglasii, Douglas spiraea		•	•			D	7'	4'		•	•	•	•
Trees													
Acer circinatum, Vine maple	•	•	•			D	15'	8'	•	•	•	•	•
Alnus rubra, Red alder	•	•	•			D	80'	20'					•
Cornus nuttalii, Pacific dogwood	•	•	•			D	20'	10'	•	•	•	•	•
Fraxinus latifolia, Oregon ash	•		•			D	30'	25'					
Malus fusca, Pacific crabapple	•		•			D	30'	10'	•	•			•
Pseudotsuga menziesii, Douglas fir	•	•	•			E	200'	30'					
Thuja plicata, Western red cedar	•	•	•			E	150'	20'			•		

TABLE A-3: Stormwater Facility Plant Lists: Constructed Wet Ponds

Constructed Wet Ponds	**Zone**			**Origin**			**Type/Size**			**Context Factors**				
Plant Name ***Botanical*, common**	Moisture zone (S) Saturated/permanent pool	Moisture zone (A) Uniformly wet to moist	Moisture Zone (B) Drier transitional area	NW native	NW native cultivar	Non-native adapted	(E)vergreen/(D)eciduous	Potential height	Typical on center spacing	Facilities < 3 feet wide	Fully -lined facility	Parking areas	Streets	Adjacent to buildings
Herbaceous Plants														
Alisma plantago-aquatica, Water plantain	•			•			D	24"	12"	•	•			
Camassia quamash, Camas lily		•	•	•			D	24"	12"	•	•	•	•	•
Carex obnupta, Slough sedge	•	•		•			E	48"	12"		•	•	•	•
Deschampsia cespitosa, Tufted hair grass		•		•			D	36"	12"	•	•	•	•	•
Eleocharis ovata, Ovate spike rush	•			•			E	30"	12"	•	•			
Elymus glaucus, Blue wild rye		•	•	•			E	24"	12"	•	•	•	•	•
Juncus ensifolius, Dagger-leaf rush	•	•				•	D	10"	12"	•	•	•	•	•
Juncus patens, Spreading rush	•	•	•			•	E	36"	12"	•	•	•	•	•
Sagittaria latifolia, Wapato	•			•			D	24"	12"	•	•			
Scirpus acutus, Hardstem bulrush	•					•	D	10"	12"	•	•			
Scirpus microcarpus, Small fruited bulrush	•	•		•			E	24"	12"	•	•	•	•	•
Veronica liwanensis, Speedwell		•				•	D	2"	12"	•	•	•	•	•
Small Shrubs/Groundcover														
Cornus sericea 'Kelseyi', Kelsey dogwood	•	•	•		•		D	2'	1'	•	•	•	•	•
Mahonia aquifolium, Oregon grape		•	•	•			E	5'	3'		•	•	•	•
Physocarpus capitatus, Pacific ninebark	•	•		•			D	6'	3'		•			
Polystichum munitum, Sword fern		•	•	•			E	2'	2'	•	•	•	•	•
Spirea betulifolia, Birchleaf spiraea		•	•	•			D	2'	2'	•	•	•	•	•
Smphoricarpus alba, Snowberry		•	•	•			D	3'	3'	•	•	•	•	•
Large Shrubs/Small Trees														
*Cornus sericea,*Red-Twig Dogwood	•	•	•	•			D	6'	4'					
Holodiscus discolor, Western serviceberry		•	•	•			D	6'	4'		•	•	•	
Rosa nutkana, Nootka rose		•	•	•			D	8'	4'		•		•	
Omleria cerasiformis, Indian plum		•		•			D	6'	4'		•	•	•	
Ribes sanguimeum, Red flowering currant		•	•	•			D	8'	4'		•	•	•	•
Salix sitchensis, Sitka willow	•	•		•			D	15'	5'					
Spirea douglasii, Douglas Spiraea			•	•			D	7'	4'		•	•	•	•
Ceanothus velutinus, Snowbrush		•	•	•			E	6'	3'		•	•	•	•
Trees														
Acer circinatum, Vine maple		•	•	•			D	15'	8'	•	•	•	•	•
Acer rubrum, Red Maple	•	•	•			•	D	40'	25'		•	•	•	
Alnus rubra, Red alder	•			•			D	80'	20'					•
Cornus nuttalii, Pacific Dogwood		•	•	•			D	20'	10'	•	•	•	•	•
Fraxinus latifolia, Oregon Ash	•	•		•			D	30'	25'					
Malus fusca, Pacific Crabapple	•	•		•			D	30'	10'	•	•			•

TABLE A-3: Stormwater Facility Plant Lists: Constructed Wet Ponds														
Constructed Wet Ponds	**Zone**			**Origin**			**Type/Size**			**Context Factors**				
Plant Name ***Botanical*, common**	Moisture zone (S) Saturated/permanent pool	Moisture zone (A) Uniformly wet to moist	Moisture Zone (B) Drier transitional area	NW native	NW native cultivar	Non-native adapted	(E)vergreen/(D)eciduous	Potential height	Typical on center spacing	Facilities < 3 feet wide	Fully -lined facility	Parking areas	Streets	Adjacent to buildings
Pseudotsuga menziesii, Douglas fir		•	•	•			E	200'	30'					
Thuja plicata, Western red cedar	•	•	•	•			E	150'	20'			•		

TABLE A-4: Stormwater Facility Plant Lists: Vegetated Filter Strips

Vegetated Filter Strips	**Zone**	**Origin**			**Type/Size**			**Context Factors**					
Plant Name ***Botanical*, Common**	Moisture zone (A/B) Dry to moist on slope	NW native	NW native cultivar	Non-native adapted	(E)vergreen/(D)eciduous	Potential height	Typical on center spacing	Facilities < 3' wide	Fully-lined facility	Parking areas	Streets	Adjacent to buildings	In buffer area
Herbaceous Plants													
Aster suspicatus, Douglas' aster	•	•			D	36"	12"	•	•	•	•	•	•
Camassia quamash, Camas lily	•	•			D	24"	12"	•	•	•	•	•	•
Deschampsia caespitosa, Tufted hair grass	•	•			D	36"	12"	•	•	•	•	•	•
Festuca rubra, Red fescue	•	•			E	24"	12"	•	•	•	•	•	•
Elymus glaucus, Blue wild rye	•	•			E	24"	12"	•	•	•	•	•	•
Juncus patens, Spreading rush	•			•	E	36"	12"	•	•	•	•	•	
Lupinus polyhyllus, Large-leaved lupine	•	•			D	36"	12"	•	•	•	•	•	•
Sedum oreganum, Oregon stonecrop	•	•			E	4"	12"	•	•	•	•	•	•
Sisyrinchium californicum, Yellow-eyed grass	•	•			E	4"	12"	•	•	•	•	•	•
Veronica liwanensis, Speedwell	•			•	D	2"	12"	•	•	•	•	•	
Small Shrubs/Groundcover													
Cornus sericea 'Kelseyi', Kelsey dogwood	•		•		D	2'	12"	•	•	•	•	•	
Fragaria chiloensis, Coastal strawberry	•	•			E	6"	12"	•	•	•	•	•	•
Gaultheria shallon, Salal	•	•			E	24"	24"	•	•	•	•	•	•
Mahonia aquifolium, Oregon grape	•	•			E	5'	3'		•	•	•	•	•
Physocarpus capitatus, Pacific ninebark	•	•			D	6'	3'		•				•
Polystichum munitum, Sword fern	•	•			E	2'	2'	•	•	•	•	•	•
Rosa pisocarpa, Swamp rose	•	•			D	8'	3'		•	•			•
Spirea betulifolia, Birchleaf spiraea	•	•			D	2'	2'	•	•	•	•	•	•
Symphoricarpus alba, Snowberry	•	•			D	3'	3'	•	•	•	•	•	•
Large Shrubs/Small Trees													
*Cornus sericea,*Red-Twig dogwood	•	•			D	6'	4'						•
Holodiscus discolor, Western serviceberry	•	•			D	6'	4'		•	•	•		•
Omleria cerasiformis, Indian plum	•	•			D	6'	4'		•	•	•		•
Ribes Sanguimeum, Red flowering currant	•	•			D	8'	4'		•	•	•	•	•
Salix stichensis, Sitka willow	•	•			D	15'	5'						•
Salix purpurea nana, Blue arctic willow	•			•	D	8'	6'			•	•	•	
Ceanothus sanguineum, Redstem ceanothus	•	•			E	7'	3'		•	•	•	•	•

TABLE A-4: Stormwater Facility Plant Lists: Vegetated Filter Strips

Vegetated Filter Strips	**Zone**	**Origin**			**Type/Size**			**Context Factors**					
Plant Name ***Botanical*, Common**	Moisture zone (A/B) Dry to moist on slope	NW native	NW native cultivar	Non-native adapted	(E)vergreen/(D)eciduous	Potential height	Typical on center spacing	Facilities < 3' wide	Fully-lined facility	Parking areas	Streets	Adjacent to buildings	In buffer area
Trees													
Acer circinatum, Vine maple	•	•			D	15'	8'	•	•	•	•	•	•
Alnus Rubra, Red alder	•	•			D	80'	20'					•	•
Cornus nuttalii, Pacific dogwood	•	•			D	20'	10'	•	•	•	•	•	•
Fraxinus Latifolia, Oregon ash	•	•			D	30'	25'						•
Malus Fusca, Pacific crabapple	•	•			D	30'	10'	•	•			•	•
Pseudotsuga menziesii, Douglas fir	•	•			E	200'	30'						•
Thuja plicata, Western red cedar	•	•			E	150'	20'			•			•

TABLE A-5: Stormwater Facility Plant Lists: Green Roofs

Green Roofs	**Zone**		**Origin**			**Type/Size**		
Plant Name ***Botanical*, common**	Moisture Zone (C) Extensive Ecoroof	Moisture zone (D) Intensive Roof Garden	NW native	NW native cultivar	Non-native adapted	(E)vergreen/(D)eciduous	Potential height	Typical on center spacing
Sedums and Succulents								
Delosperma ssp., Ice plant	•	•			•	E	4"	6-12"
Malephora crocea v. purpureo, Coppery mesemb	•	•			•	E	10"	6-12"
Sedum acre, Biting stonecrop	•				•	E	2"	6-12"
Sedum album, White stonecrop	•				•	E	3"	6-12"
Sedum divergens, Pacific stonecrop	•				•	E	3"	6-12"
Sedum hispanicum, Spanish stonecrop	•				•	E	3"	6-12"
Sedum kamtschaticum, Kirin-so	•	•			•	D	6"	6-12"
Sedum oreganum, Oregon stonecrop	•	•	•			E	4"	6-12"
Sedum sexangulare, Tasteless stonecrop	•	•			•	E	4"	6-12"
Sedum spathufolium, Stonecrop	•	•			•	E	4"	6-12"
Sedum spurium, Two-row stonecrop	•	•			•	E	6"	6-12"
Sempervivum tectorum, Hens and chicks	•				•	E	3"	6-12"
Herbaceous Plants								
Achillea millefolium, Common yarrow	•	•			•	D	24"	24"
Artemesia 'Silver Mound', Artemesia	•	•			•	D	12"	12"
Castilleja foliosa, Indian paintbrush	•	•	•			D	10"	12"
Dianthus ssp., Dianthus	•				•	D	12"	12"
Erigeron discoideus, Fleabane	•				•	D	12"	12"
Festuca glauca 'Elijah's Blue', Elijah's blue fescue	•	•			•	E	12"	12"
Fragaria chiloensis, Coastal strawberry	•	•	•			E	6"	12"
Gilia capitata, Blue thimble flower	•		•			D	12"	12"
Lobularia maritima, Sweet alyssum	•				•	D	12"	12"
Polystichum munitum, Sword fern	•	•	•			E	24"	24"
Thymus serphyllum, Creeping thyme	•				•	D	3"	6"
Veronica liwanensis, Speedwell	•				•	D	2"	6"

APPENDIX B

INFILTRATION TESTING

B.1.00 GENERAL

a. To properly size and locate stormwater management facilities, it is necessary to characterize the soil infiltration conditions at the location of the proposed facility.

b. All projects that require a stormwater management facility shall evaluate existing site conditions and determine if the site's infiltration rate is adequate to support the proposed stormwater management facility.

c. A qualified professional shall exercise judgment in the selection of the infiltration test method. The three infiltration testing methods used to determine a design infiltration rate are:

   1. Open pit falling head

   2. Encased falling head

   3. Double-ring infiltrometer

B.2.00 TESTING CRITERIA

a. Testing shall be conducted or observed by a qualified individual working under the supervision of a Professional Engineer (PE), Registered Geologist (RG), or Certified Engineering Geologist (CEG) licensed in the state of Oregon.

b. The location and depth of the test shall correspond to the facility location and depth.

c. Infiltration testing should not be conducted in engineered or undocumented fill.

d. Test Pit or Boring logs shall be provided as supporting information with infiltration and depth to groundwater tests.

Note: All testing data shall be documented with the project's submittals. The submittals shall adequately demonstrate that the proposed facilities 1) are appropriate to the assessment and characterization of the site, 2) will work, based on in situ infiltration tests, and 3) are sized appropriately, based on design infiltration rates.

B.2.01 Depth and Location of Required Tests

a. Infiltration tests shall be performed at the base of the proposed facility.

b. If a confining layer, or soil with a greater percentage of fines, is observed during the subsurface investigation to be within 4 feet of the bottom of the planned infiltration system, the testing shall be conducted within that confining layer.

c. Tests shall 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.

d. 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.

B.2.02 Minimum Number of Required Tests

a. At least one test for any proposed facility.

b. The number of tests, at the discretion of the qualified professional, shall produce a picture of the subsurface conditions that fully represents the conditions throughout the facility site. However, the City reserves the right to direct the frequency and number of tests to be performed.

c. Where multiple types of facilities are used, it is likely that multiple tests will be necessary, since an infiltration test can test only a single soil stratum. At a minimum an infiltration test shall be performed in each soil stratum proposed to be used for infiltration.

d. Factors of Safety

Table B-1 lists the minimum allowable factors of safety applied to field obtained infiltration rates for use in stormwater system design. To obtain the infiltration rate used in design, divide the infiltration rate measured in the field by the factor of safety. The factor of safety used in design should be chosen by collaboration between the geotechnical engineer or geologist overseeing the infiltration testing and the civil engineer designing the stormwater management system. Determination of the factor of safety shall include consideration of project specific conditions such as soil variability, testing methods, consequences of system failure, complexity of proposed construction, and other pertinent conditions. The maximum design infiltration rate is 20 inches per hour.

TABLE B-1. Infiltration Rate Safety Factor	
Test Method	**Required Correction Factor**
Encased Falling Head	3
Open Pit Falling Head	2
Double-Ring Infiltrometer	Public Facilities: 1 Private Facilities: 2

B.2.03 Open Pit Falling Head Test Procedure

The open pit falling head test 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.

The following steps shall be followed in completing the test procedure:

a. Excavate an approximately 2-foot by 2-foot-wide hole into the native soil to the elevation of the proposed facility bottom. 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 auguring tools or a smooth excavation bucket is used, scarify the sides and bottom of the hole with a sharp-pointed instrument, and remove the loose material from the bottom of the test hole.

b. A 2-inch layer of coarse sand or fine gravel may be placed to protect the bottom from scour and sloughing.

c. Fill the hole with clean water a minimum of 1 foot above the soil to be tested, and maintain this depth of water for at least 4 hours (or overnight if clay soils are present) to presoak the native material.

d. Percolation rate measurements shall 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 shall be removed and the water level shall be adjusted to 6 inches above the added gravel (or 8 inches above the bottom of the hole).

e. 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 10 minutes, the test can proceed immediately.

f. 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.

g. Measure the water level to the nearest 0.01 foot (1/8 inch) at 10-minute intervals for a total period of 1 hour. If the water has not completely drained within 1 hour, continue taking measurements at 20-minure intervals for another hour (2 hour maximum) or until all of the water has drained. At no time during the test is the water level allowed to rise more than 6 inches above the sand or gravel (or 8 inches above the bottom of the hole).

h. Successive trials shall be run until the measured infiltration rate between two successive trials does not vary by more than 5 percent. At least three trials shall be conducted. After each trial, the water level is readjusted to 6 inches above the sand or gravel (or 8 inches above the bottom of the hole). Enter results into the data table (See **Figure B-2**).

i. The results of the last water level drop are used to calculate the tested infiltration rate. The final rate shall be reported in inches per hour. See the calculation following **Figure B-2**.

j. 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:

   1. Approximate the area over which the water is infiltrating.

   2. Using a water meter, bucket, or other device, measure the rate of water discharging into the test pit.

   3. Calculate the infiltration rate by dividing the rate of discharge (cubic inches per hour) by the area over which it is infiltrating (square inches, including floor and area of sidewalls exposed to infiltration).

k. Continue excavating the test pit a minimum of five feet below the testing elevation (B.2.06.b). Upon completion the excavation shall be backfilled.

B.2.04 Encased Falling Head Test Procedure

The encased falling head test 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 6-inch casing that is embedded approximately 6 inches into the native soil. The goal of this field test is to evaluate the vertical infiltration rate through a 6-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.

The following steps shall be followed in completing the test procedure:

a. Embed a solid 6-inch-diameter casing into the native soil at the elevation of the proposed facility bottom (see **Figure B-1**). Ensure that the embedment provides a good seal around the pipe casing so that percolation will be limited to the 6-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.

b. A 2-inch layer of coarse sand or fine gravel may be placed to protect the bottom from scour and sloughing.

c. Add clean water to the casing to a minimum of 1 foot above the soil to be tested, and maintain this depth for at least 4 hours (or overnight if clay soils are present) to presoak the native material.

    1. Percolation rate measurements shall 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..

    2. In sandy soils with little or no clay, soaking is not necessary. If after filling the casing twice with 12 inches of water, the water seeps completely away in less than 10 minutes, the test can proceed immediately.

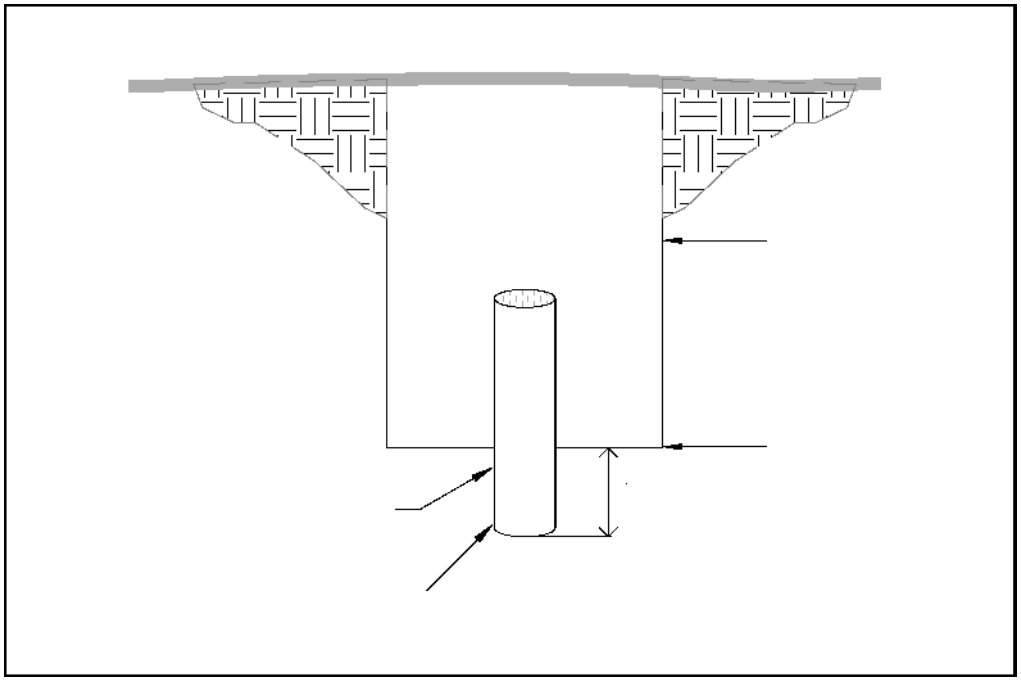

Figure B.1. Encased Falling Head Procedure

d. To conduct the first trial of the test, add clean water to the pipe to approximately 6 inches above the sand or gravel (or 8 inches above the bottom of the hole) and measure the water level to the nearest 0.01 foot (1/8 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.

e. Measure the water level to the nearest 0.01 foot (1/8 inch) at 10-minute intervals for a total period of 1 hour. If the water has not completely drained within 1 hour, continue taking measurements at 20-minure intervals for another hour (2 hour maximum) 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 5 percent. At least three trials shall be conducted. After each trial, the water level shall be readjusted to the 6 or 8 inch level. Enter results into the data table (see **Figure B-2**). At no time during the test is the water level allowed to rise more than 6 inches above the sand or gravel (or 8 inches above the bottom of the hole).

f. The result of the last water level drop is used to calculate the tested infiltration rate. The final rate shall be reported in inches per hour.

g. Continue boring a minimum of 5 feet below the testing elevation (B.2.06.b). Upon completion of the boring, fill borehole in compliance with Oregon DEQ requirements.

B.2.05 Double Ring Infiltrometer Test

The double-ring infiltrometer test procedure shall conform to ASTM 3385-09. 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.

B.2.06 Reporting Requirements

In addition to the information required by the state for a signed and stamped geotechnical report, the following information should be included in the project's submittals:

a. Infiltration results in inches per hour.

b. Location and depth of excavation. The excavation should be deep enough to verify that there is a 5-foot separation between the final depth of the facility and the seasonal high groundwater or soil layer that could reduce the infiltration rate.

c. Summary and discussion of infiltration testing, 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.

d. Discussion of how the test was performed:

1. Open pit (size of area)
2. Encased falling head
    (a) Pipe type
    (b) Embedment depth
    (c) Size of pipe
3. Double ring infiltrometer
    (a) Pipe type
    (b) Embedment depth
    (c) Size of pipe
4. Soil types with depth (Test Pit and/or Boring logs)
5. Groundwater observations–seasonal high groundwater level estimation

Figure B-2. Infiltration Test Data Table Example

Location: Lot 105, Low Point Heights Subdivision			**Date:** 6/28/2010	**Test Hole Number:** B-3	
Depth to bottom of hole: 57 inches			**Diameter of hole:** 0.5 feet	**Test Method:** Encased Falling Head	
Tester's Name: C.J. Tester Tester's Company: Tester Company Tester's Contact Number: 555-1212					
Depth, feet			**Soil Texture**		
0-0.5			Black Top Soil		
0.5-1.0			Brown SM		
1.0-2.2			Brown ML		
2.2-5.1			Brown CL		
Time	**Time interval, minutes**	**Measurement, feet**	**Drop in water level, feet**	**Percolation rate, inches per hour**	**Remarks**
9:00	0	4.08	-		Filled with 8"
9:20	20	4.16	0.08	2.88	
9:40	20	4.24	0.08	2.88	
10:00	20	4.31	0.07	2.52	
10:20	20	4.37	0.06	2.16	
10:40	20	4.44	0.07	2.52	
11:00	20	4.50	0.06	2.16	
11:20	20	4.55	0.05	1.98	
					Adjusted to 8" level for Trial #2

Calculation is performed for each water level drop

= (Drop in water level/Time interval) x conversion

= 0.055ft/20min x (12in/ft) x (60min/hr)

= 1.98 inches per hour

The design infiltration rate of two successive trials shall have a difference of 5% 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**

CITY OF WILSONVILLE

PUBLIC WORKS STANDARDS - 2014

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SECTION 3

STORMWATER & SURFACE WATER DESIGN AND CONSTRUCTION STANDARDS

301.1.00 ENGINEERING

301.1.01 Introduction

This section outlines design and construction requirements for stormwater and surface water management. The provisions and technical specifications herein set forth the requirements of the City of Wilsonville for constructing stormwater and surface water improvements. Interpretations of such provisions and their application in specific circumstances shall be made by the City's authorized representative, unless specifically stated otherwise. Refer to Section 1 of the "Public Works Standards" for general provisions and requirements.

Design guidelines established here are consistent with the City of Wilsonville Stormwater Master Plan. These provisions are intended to prevent or reduce adverse impacts to the drainage system and water resources of the Willamette River Basin. In combination with other federal, state, and local laws and ordinances, these requirements are intended to protect the beneficial uses of waters in the Willamette River Basin and inside the Wilsonville city limits.

301.1.02 Stormwater Management Thresholds

The site development thresholds and applicability of these standards are as follows:

a. All development that results in 5,000 square feet of new or replaced impervious surface, cumulative over a 5-year period, is subject to the requirements of these standards. Development includes new development, redevelopment, and/or partial redevelopment.

b. All development that results in 500 square feet of new or replaced impervious surface shall be subject to the erosion prevention and sediment control requirements outlined in Section 101.9.00.

c. Properties or development draining directly to and within 300 feet of the Willamette River or the Coffee Lake wetlands are exempt from the flow control standards. These projects are still subject to the water quality, conveyance and erosion prevention and sediment control provisions of these standards.

d. All site development that results in any new or replaced impervious surfaces and is categorized as high risk for increased pollutant loading in stormwater runoff is required to comply with Section 301.12, "Source Controls" in addition to all

requirements within these standards. High-risk sites include, but are not limited to, the following site uses:

1. Fuel Dispensing Facilities and Surrounding Traffic Areas
2. Above-Ground Storage of Liquid Materials
3. Solid Waste Storage Areas, Containers, and Trash Compactors
4. Exterior Storage of Bulk Materials
5. Material Transfer Areas/Loading Docks
6. Equipment and/or Vehicle Washing Facilities
7. Development on Land With Suspected or Known Contamination
8. Covered Vehicle Parking Areas
9. Industrial and Commercial High Traffic Areas
10. Land Uses Subject to Oregon Department of Environmental Quality (ODEQ) 1200-Z Industrial Stormwater Permit Requirements

301.1.03 Alternative Design and Construction Standards

If approved by the City Engineer, alternative design and/or construction standards may be substituted for the standards specified herein. Any requests for substitution must be in writing, stamped by a Professional Engineer registered in the State of Oregon at the time of submittal, and submitted at least three weeks prior to the Engineering Plan Review submittal process. The City Engineer may request submission of any additional information deemed necessary to properly evaluate alternative design and/or construction standards.

301.1.04 Exemptions from Stormwater Management Requirements

Projects in the following categories are generally exempt from the requirements of these standards:

a. Stream enhancement or restoration projects approved by the City unless required by other State or Federal agencies;

b. Farming practices as defined by Oregon Revised Statutes (ORS) 30.930 and farm use as defined in ORS 214.200; except that buildings associated with farm practices and farm use are subject to the requirements of these standards;

c. Actions by a public utility or any other governmental agency to remove or alleviate an emergency condition;

d. Road and parking area preservation/maintenance projects such as pothole and square cut patching, surface sealing, provided the preservation/maintenance activity does not

expand the existing area of impervious coverage above the thresholds listed in Section 301.1.02.a, "Stormwater Management Thresholds";

e. Maintenance activities, such as overlaying or repairing existing asphalt or concrete pavement without expanding the area of coverage above the thresholds listed in Section 301.1.02.a, "Stormwater Management Thresholds";

f. Pedestrian and bicycle improvements (sidewalks, trails, pathways, and bicycle paths/lanes) where no other impervious surfaces are created or replaced, built to direct stormwater runoff to adjacent vegetated areas;

g. Underground utility projects that replace the ground surface with in-kind material or materials with similar runoff characteristics;

h. Operation and maintenance or repair of existing utilities.

301.1.05 Stormwater Systems Design Criteria

a. Stormwater conveyance systems are to be designed to intercept and convey stormwater runoff efficiently enough to meet flood protection criteria. The conveyance system should complement the ability of the site design and structural stormwater controls to mitigate the major impacts of urban development.

b. Stormwater systems shall strive to maintain the pre-development stormwater runoff characteristics to minimize effects on the drainageways such as sediment transport, erosion and degradation generally associated with urbanization. Stormwater management facilities shall be designed to maximize groundwater recharge through the process of infiltration of runoff into vegetated facilities and the use of what is referred to as Low Impact Development (LID) facilities and/or flow controls to address hydromodification.

c. In selecting a stormwater management approach, the designer shall consider site characteristics, anticipated land uses, runoff characteristics, and treatment objectives. Once the site analysis is complete, the designer shall incorporate the most effective stormwater management facilities into the stormwater management plan for the proposed development. See Section 301.2.00, "Site Assessment and Planning" for additional details on site assessment and planning, and Section 301.11.02, "Stormwater Management Facility Design Standards" for design criteria, design methods and facility selection and sizing.

d. Developments shall accommodate existing off-site drainage entering a development site so as to not impact upstream property owners. Modifications to the existing on-site storm drainage facilities shall not restrict flows thereby creating backwater onto off-site property to levels greater than the existing situation, unless approved by the impacted off-site property owners and the City's authorized representative, and an inundation easement is provided.

e. Surface or subsurface drainage, caused or affected by development, shall not flow over adjacent public or private property in a volume or location significantly different

from that which existed prior to development, but shall be collected and conveyed to an acceptable point of discharge as approved. The City generally does not allow the diversion of stormwater from one drainage basin or watershed to be directed to another drainage basin or watershed.

f. Land use assumptions for 25- and 100-year flows for design of conveyance systems shall be based on full build-out of the upstream basin based upon the most recently approved City Comprehensive Land Use Plan and/or realistic estimates of development densities in areas included in recent additions to the Urban Growth Boundary or Urban Growth Reserve. Storm drainage facilities shall be designed and constructed to accommodate all assumed future full build-out flows generated from upstream property within the basin based on the most recent approved comprehensive land-use plan.

g. Conveyance systems shall be designed and constructed to carry the 25-year design storm flowing full with no pressure flow. Flow conditions in existing pipe systems will be evaluated on a case by case basis for adequacy.

h. Generally, the Santa Barbara Urban Hydrograph (SBUH) method for computing peak discharge is preferred by the City. Other acceptable methods include Technical Release 55 (TR-55), stormwater management model (SWMM), or other standard methods as approved by the City. For drainage basins 25 acres or less, the *Rational Method* is acceptable (Section 301.5.02, "Rational Method").

i. Manning's equation shall generally be acceptable for determining pipe or open channel capacity only within a drainageway with an upstream drainage area of 50 acres or less. For larger drainage areas, backwater effects shall be included in determining capacity for a drainageway, typically using Hydrologic Engineering Centers-River Analysis System (HEC-RAS) or equivalent computer modeling software.

j. Constructed channels shall be designed per Section 301.6, "Constructed Channel Design Standards."

k. Culverts shall be designed per Section 301.7, "Culvert Design Standards."

l. Stormwater manholes, pipes and catch basins shall be designed per Section 301.8, "Storm Manhole, Pipe and Catch Basin Design Standards."

m. Stormwater management facilities shall be designed per Section 301.11, "Stormwater Management Facility Selection and Design."

301.1.06 Regional Stormwater Management Facilities

When a proposed development is unable to meet the flow control or water quality requirements of these standards, the City may allow applicants to build a stormwater management facility offsite or pay a fee in lieu of onsite improvements. In such a case,

the City will determine whether the applicant shall construct the offsite stormwater management facilities or pay the City (or an adjacent property owner by agreement) for the construction of offsite facilities. The fee shall be based on the proportional cost for the construction of the stormwater management facilities to be used plus engineering design, contingency, project management and project inspection. Any development which is utilizing offsite facilities shall pay all applicable fees prior to approving, permitting, or recording of a plat for the development.

301.1.07 Additional Requirements

The requirements presented in these standards do not exclude or replace the requirementsof other applicable codes or regulations, such as the Willamette Basin Total MaximumDaily Load (TMDL) Program, the industrial NPDES permitting program, or any other applicable state or federal regulations or permit requirements.

All development within Federal Emergency Management Agency (FEMA)-regulated streams and floodplain overlay zones shall meet the FEMA floodplain permit approval process requirements through the local planning and building authority.

301.1.08 Easements

Piped storm systems shall generally be located in the right-of-way. When it is not possible or practical to install Public storm conveyance facilities in a dedicated public street the facilities shall be located within a storm drainage easement granted to the City. Storm drain easements shall typically be exclusive and conform to Section 101.8.14, “Easements.”

301.1.09 Point of Discharge

a. Provide an acceptable point of discharge from the developed site. All conveyance system considerations and/or limitations will be evaluated prior to approving the point of discharge. Developments shall not materially increase or concentrate runoff onto adjacent properties, except when the runoff is contained in an existing drainage way. To prevent concentrated runoff, a development may be required to discharge stormwater via a flow spreader device approved by the City’s authorized representative.

b. The applicant shall establish an acceptable point of discharge, as approved by the City’s authorized representative.

c. Runoff from developed portions of the site drainage basin should be discharged at the existing natural drainage outlet or outlets.

d. Runoff must be discharged in a manner that will not cause adverse impacts to downstream properties or previously constructed stormwater systems.

e. The applicant will be responsible for acquiring approval from any other agency having jurisdiction or permitting authority related to the activity. City may require a

copy of other jurisdictional approval(s) prior to approving the stormwater management plan.

f. If the point of discharge is an open drainageway then adequate velocity dissipation and/or additional channel protection shall be required to prevent erosion and/or alteration to the existing downstream drainageway.

g. Any connection to a public or private piped downstream stormwater conveyance system shall be approved by the City's authorized representative. The means and methods of connecting or extending a piped conveyance system will be consistent with City standards and/or other standards required by agencies having the authority to regulate the connection.

301.1.10 On-site Runoff Conveyance

The following on-site conveyance system requirements shall be incorporated into the design of the stormwater management plan:

a. The site shall be planned and designed so as to generally conform to on-site natural drainage patterns and discharge to natural drainage paths within a drainage basin. These natural drainage paths should be modified as necessary to contain and safely convey the peak flows generated by the development.

b. Open channel conveyance systems are preferred over closed conduits where feasible, especially where they might provide opportunities for water quality treatment, wildlife habitat improvement, or emergency overland flood relief routes.

c. In establishing the layout of stormwater networks, it is essential to ensure that flows will not discharge onto private property prior to the system design storm capacity.

d. It shall be the responsibility of the owner to provide a conveyance drainage system for all stormwater runoff and/or or surface water entering the property from off-site. Surface water, springs, and groundwater shall be incorporated into the drainage design.

e. An overland emergency flow path must be identified and/or designed that allows large flow events to discharge without risk of injury or property damage. The emergency flow path must be incorporated into the design and show how flow will escape from the site during rainfall events larger than the design storm events and/or from failure of the primary stormwater conveyance system. Any emergency overflow structures shall be designed for the 100-year design storm.

f. It is important to ensure that the on-site conveyance system is designed to reduce blockages and flows in excess of the design storm capacity to minimize the likelihood of nuisance flooding or damage to private properties. If failure of these systems and/or drainage structures occurs during these periods, the risk to life and property could be significantly increased.

301.1.11 Upstream Drainage Basin(s) Conveyance

Developments are required to convey upstream drainage through or around the development.

a. The upstream off-site stormwater or other surface water runoff will be conveyed through the development in a separate main line system and will not be mixed with the stormwater collected and treated with on-site stormwater BMPs unless the stormwater BMP facilities are designed to include the additional flows from the upstream drainage basin(s) assuming full development potential. Stormwater collected and treated on-site can be released to a main line system provided a natural point of discharge in not available.

b. Upstream drainage basin analysis shall assume ultimate build out and/or maximum zoning density in determining the size of the conveyance system required through the site.

c. Generally, land use zoning adopted by the City will be used to size the capacity of the bypass system. For areas within the upstream basin that currently have a rural zoning designation but have the potential to be incorporated into the Urban Growth Boundary or Reserve, the City will assign the appropriate zoning designation and/or allowable maximum density to use in the upstream basin analysis for ultimate development potential and conveyance system sizing.

301.1.12 Extension of Public Storm Sewer Systems

a. The extension or upsizing of the public stormwater systems in excess of 12 inches in diameter (or equivalent flows) or as shown in the Wilsonville Stormwater Master Plan to serve the ultimate development density of the contributing area shall be done by the property owner or permit applicant and may be subject to applicable System Development Charge (SDC) credits.

b. The City reserves the right to perform the work or cause it to be performed and bill the owner for the cost of the work or to pursue special assessment proceedings.

c. The public storm sewer system shall extend to the most distant parcel boundary and be designed at a size and grade to facilitate future extension to serve development of the entire contributing area.

d. Where public infrastructure improvements paid for by the property owner or permit applicant directly benefit adjacent properties, the property owner or permit applicant may pursue establishment of a reimbursement district per Section 3.116 of the City Code.

e. The City's authorized representative may require a storm pipeline that serves or may serve more than one property to be a public system.

301.1.13 Conveyance System Hydraulic Standards

a. The conveyance system shall be designed to convey and contain at least the peak runoff for the 25-year design storm.

b. Structures for proposed pipe systems must be demonstrated to provide a minimum of 1 foot of freeboard between the hydraulic grade line and the top of the structure or finish grade above pipe for the 25-year post-development peak rate of runoff.

c. Design surcharge in new pipe systems shall not be allowed if it will cause flooding in a habitable structure, including below-floor crawl spaces.

d. The 25-year design shall be supplemented with an overland conveyance component demonstrating how a 100-year event will be accommodated. The overland component shall not be allowed to flow through or inundate an existing building.

e. Flows in streets during the 25-year event shall not run deeper than 4 inches against the curb or extend more than 2 feet into the travel lane.

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

301.1.14 Storm Systems and Fish Passage

For pipe systems that convey flows from a stream or through sensitive areas, a local representative of ODFW or other applicable state or federal agency shall be contacted to determine whether fish passage is required and to identify site-specific design criteria. All culverts shall be designed for fish passage in accordance with ODFW's *Fish Passage Criteria*, or latest edition, unless exempted by ODFW and the City.

301.1.15 Surveying

a. The design engineer shall be responsible for establishing the location of the storm facilities by means of reference stakes offset along the centerline of the storm facilities. No construction shall be allowed to begin before construction staking. All staking shall be performed by or under the direction of a Professional Land Surveyor registered in the State of Oregon.

b. Stakes shall locate all public tees, cleanouts, manholes, catch basins, area drains, water quality stations, and pump stations. Maximum spacing for reference stakes is 50 feet. Stakes shall reference cuts or fills to all invert elevations and rim grades. The design engineer shall also be responsible for identifying and staking easements during construction.

301.1.16 Hydrologic Analysis

The hydrologic analysis shall be consistent with Section 301.5.00, "Hydrology and Hydraulics." The design engineer may use various computer models or formulas for the

hydrograph analysis, but the City's authorized representative may verify the design flows and volumes based on InfoSWMM® modeling software, or as alternatively identified in Section 301.5.00, "Hydrology and Hydraulics."

301.2.00 SITE ASSESSMENT AND PLANNING

301.2.01 Introduction

The purpose of the site assessment and planning requirements is to ensure that the physical attributes of the development site are reviewed before placing man-made structures such as streets, parking lots, and buildings. This is meant to optimize site design of stormwater management techniques and protection of sensitive areas, and to reduce or eliminate potential conflicts between site development elements and required stormwater management systems. A layout that integrates site attributes to manage stormwater and protect habitat may reduce the number, size, and cost of stormwater management facilities required for the site.

301.2.02 Applicability

This section describes the process for preparing the Site Assessment and Planning submittal, the first step in meeting the City's stormwater management requirements. The *Site Assessment and Planning Checklist* shall be submitted with a development permit application. Refer to Section 301.3.00, "Submittal Requirements" for additional information. The Site Assessment and Planning submittal is required for all development which creates 5,000 square feet (SF) or more of new and/or modification of existing impervious surface area. A professional engineer registered in the State of Oregon shall prepare the plans and documentation required by this section.

301.2.03 Stormwater Site Assessment

a. As part of the applicant's development permit application submittal a Stormwater Site Assessment will be completed. The assessment will include the completed checklist, site assessment maps, preliminary site plan, proposed impervious surface area, preliminary stormwater facility sizing documentation, and supporting materials as required.

The following Table 3.1 and sections describe the process for completing the Stormwater Site Assessment and Planning checklist and associated mapping and supporting materials for submittal according to these standards.

Table 3.1 Site Assessment and Planning Checklist

	Information Needed	Provide information as required; Attach supporting materials as needed
1 Site Information		
	Applicant Contact Information	Applicant name Business name Contact address, phone number, and e-mail
	Project Location	Site Address Site Description Major Drainage Basin Vicinity Map of the site (including location of property in relation to adjacent properties, roads, and pedestrian/bike facilities)
	Project Type	Identify types of development planned for the site such as commercial, industrial, single-family residential, multi-family residential, or other (describe)
	Size of site	Size of site (acres) and number of existing/ proposed tax lots
2 Site Assessment (attach engineered scale Site Assessment Map and documentation)		
	Topography Evaluate site and map slopes: Flat (0-10%), Moderate (10-20%), Steep (20%+)	Attach aerial based mapping with 2-foot intervals for slopes 0-20% slope, 10-foot intervals for steeper. Shade or mark areas of flat, moderate and steep slopes. If required, attach geologist/geotechnical report. Slope information may be available from the City.
	Soils and Groundwater Research and map site soil hydrologic group, depth to groundwater	Natural Resources Conservation Service (NRCS) Hydrologic Soil Type (show on map if more than one type present): Attach seasonal groundwater depth evaluation if available or required (site has floodplain and/or wetland). Groundwater depth information is available from the City.
	Infiltration Assessment Determine soil capacity for onsite infiltration	If an infiltration test is performed attach the documentation. Report the test type (Basic/Professional) performed and results. See Appendix B for the approved infiltration testing methods. Test Type:_____(inches/hour):_____
	Hydrology - Conditions and Natural Features Map site floodplains, wetlands, streams, and location of outfalls	Clearly label on map all streams, rivers and wetlands, FEMA floodplains, and existing drainage systems (pipes, ditches, outfalls). Check here if present on site: Sensitive Area(s) ____, Floodplain _____.

Table 3.1 Site Assessment and Planning Checklist		
	Information Needed	**Provide information as required; Attach supporting materials as needed**
	Downstream Conveyance	Prepare and attach Preliminary Drainage Report with analysis of upstream drainage area and downstream conveyance capacity, as required by Section 301.3.02. Check here if analysis indicates adequate downstream capacity is NOT available: ____
	Existing Vegetation Map trees and vegetation	Using aerial photos or survey, map all trees and vegetation. Note all existing trees 6-inch caliper and greater (DBH) on map. Delineate and identify other areas and types of existing vegetation.
	Natural Resource Areas and Setbacks Assess and map buffers	Identify the Significant Resource Overlay Zone and other natural resourceareas.
	Land Use and Zoning	Existing Land Use Zoning designation(s):
	Access and Parking	Delineate proposed access points for all transportation modes on map. Indicate amount and area of required parking onsite if applicable, attach documentation as needed:
	Utilities to Site and Surrounding Area	Map existing utilities including stormwater management facilities, storm conveyance, sewer, water, wells, drywells, on-site septic systems, electricity, phone/cable, gas, and any public storm system/facility downstream.
3 Site Planning Design Objectives (attach engineered scale Preliminary Site Plan)		
	1. Preserve Existing Natural Resources	**Required:** Show the Siginificant Resource Overlay Zone and other natural resource areas on the site plan. Show any proposed areas of encroachment and associated mitigation areas.
	2. Minimize Site Disturbance	**Required:** Delineate protection areas on site plan for areas to remain undisturbed during construction.
	3. Minimize Soil Compaction	**Required:** Delineate and note temporary fencing on site plan for proposed infiltration facilities, vegetated stormwater management facilities, and re-vegetation areas.
	4. Minimize Imperviousness	**Required:** Complete and attach *Impervious Area Threshold Determination Form*. Delineate impervious reduction methods on site plan.
4 Proposed Stormwater Management Strategy		
	Proposed Stormwater Management Strategy	___ LID facilities to the MEP ___ All onsite infiltration including retention of the 10-year storm event. ___ LID facilities and infiltration are limited by the following conditions (include a geotechnical analysis of the site and report): ___ Stormwater management facility to be located on fill

Table 3.1 Site Assessment and Planning Checklist		
	Information Needed	**Provide information as required; Attach supporting materials as needed**
		___ Steep slopes ___ High Groundwater ___ Contaminated Soils ___ Conflict with required Source Controls (Section 301.12.00)
	Check Minimum Facility Size Required	A. Calculate surface area of onsite LID facility, as determined by BMP Sizing Tool or Engineered Method: _____ SF; or B. Calculate MEP surface area of onsite LID facility for sites with limiting conditions: total new/redeveloped impervious area (SF) x 0.10 = _____ SF C. Required surface area of onsite LID facility: [A] or [B] _____ SF D. Proposed LID facility: must be equal to or larger than [C] _____ SF
5	**Facility Selection/Sizing**	
	Proposed Facility Type(s)	Check all that apply, attach output from BMP Sizing Tool application, and show proposed facilities on Preliminary Site Plan. LID facilities: ___ Infiltration Stormwater Planter ___ Filtration Stormwater Planter ___ Infiltration Rain Garden ___ Filtration Rain Garden ___ Vegetated Filter Strip ___ Vegetated Swale ___ Detention Pond Other Stormwater Management Facilities as approved: ___ Infiltration Trench ___ Manufactured Treatment Technology ___ Underground Detention Tank ___ Other: _____

1. **Site Information**

   Provide the site information as stipulated in the checklist, with reference to supporting documentation and maps as appropriate for the site.

2. **Site Assessment**

   Applicants shall inventory conditions on and adjacent to the site. This information shall be presented on a Site Assessment Map at a standard engineer scale appropriate for analyzing the information. The goal is to learn how stormwater moves through the site and how natural hydrologic functions may be protected and preserved.

   The site assessment should follow the order depicted in Fig. 2-1. The required information is detailed below.

   (a) Topography

   Steep slopes greater than 20% should be avoided for clearing, grading and building. Infiltration is not allowed on steep slopes and slide prone areas. Infiltrating stormwater on moderate slopes of 10% or greater requires a geologist or geotechnical engineering analysis to determine the appropriate strategies.

   (b) Soils and Seasonal High Groundwater

   Use soil maps (NRCS Soil Survey) to determine the site hydrologic soil type (an indication of soil infiltration capacity). An assessment of the seasonal high water table may be required to ensure the functionality of the system.

   (c) Infiltration Assessment

   Stormwater management facility sizing is based on tested infiltration rates. See

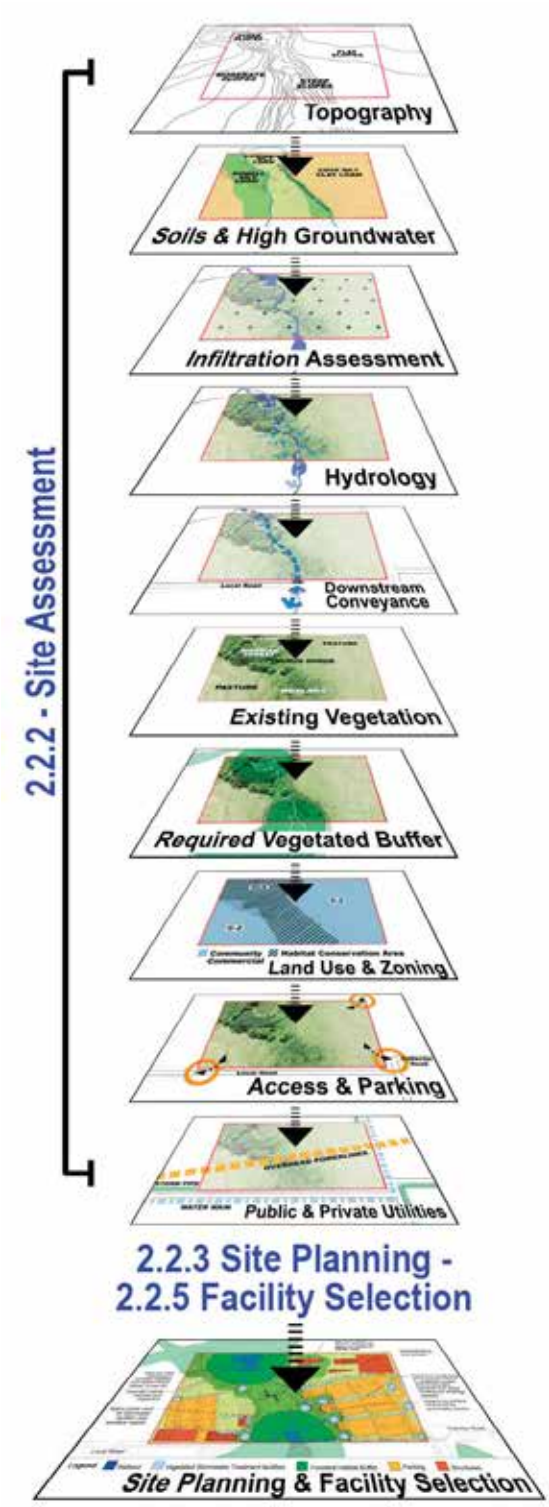

Fig. 3.1 Site Assessment Process

Appendix B for specific infiltration testing requirements and methods.

(d) Hydrology – Site Conditions and Natural Features
Show natural and manmade drainage features including channels, pipes, and outfalls. Identify jurisdictional wetland(s) (per Oregon Department of State Lands [ODSL] and U.S. Army Corps or Engineers [USACE]) or 100-year floodplain (per FEMA mapping) present on the site.

(e) Downstream Conveyance

See Section 301.11.02, "Stormwater Management Facility Design Standards" for upstream and downstream analysis requirements, and attach the required Storm Drainage Report documentation to this submittal package.

(f) Existing Vegetation

Using aerial photos or survey, map all trees and vegetation. Show all existing trees on the site assessment map and mark areas of other vegetation types (e.g., shrubs, pasture). Native trees and vegetation should be protected whenever possible.

(g) Natural Resource Areas

If natural resources areas are present, show these areas on the Site Assessment Map.

(h) Land Use and Zoning

Document existing zoning, including any special overlay zones and/or special districts.

(i) Access and Parking

Map proposed access points for all modes of transportation.

(j) Private and Public Utilities – Site and Surrounding Area

Map existing public and private utilities.

3. **Site Planning and Objectives**

Prepare a Preliminary Site Plan at an engineer scale appropriate to review the information which includes proposed grading, clearing areas, stormwater management facilities, natural resource areas and required setbacks, buildings, parking areas, streets and other proposed impervious areas. The preliminary site plan must address the four objectives listed below to reduce the impact of stormwater runoff from development, which may reduce the size of stormwater management facilities required.

(a) Preserve Existing Resources

On the Preliminary Site Plan, show the Significant Resource Overlay Zone and any other natural resource areas. If encroachment into any natural resource area is proposed, show the area of encroachment on the site map and the required mitigation area. Check with the Planning Division to identify any other buffer or conservation requirements.

(b) Minimize Site Disturbance

Protecting undisturbed, uncompacted areas from construction activities provides more rainfall interception, evapo-transpiration and runoff rate attenuation than clearing and replanting, even with soil amendments. On the Preliminary Site Plan, identify areas that will not be cleared during construction.

(c) Minimize Soil Compaction

Avoid any construction activity that could cause soil compaction in areas designated for stormwater management facilities to preserve filtration and infiltration characteristics of the soil. Also avoid soil compaction in natural resource areas, and mitigation and/or re-vegetation areas. Delineate these areas on the Preliminary Site Plan and protect them during construction with orange construction fencing.

(d) Minimize Imperviousness

Complete and attach the Impervious Area Threshold Determination Form. The form allows for impervious area reduction credits for use of porous pavement, green roofs, tree preservation and tree planting (tree credits apply to non-single family developments only). Identify proposed impervious area reduction methods, and show them on the Preliminary Site Plan.

Table 3.2 Impervious Area Threshold Determination

IMPERVIOUS AREA THRESHOLD DETERMINATION FORM

1. TOTAL NEW AND REPLACED IMPERVIOUS AREA, SF: ☐

2. APPLY IMPERVIOUS REDUCTION METHODS:

- **2a. Porous Pavement, SF:** ☐
- **2b. Green Roof, SF:** ☐
- **Tree Credit – Maximum total tree credit allowed is 10% of the Impervious Area in BOX 1:**

  New Trees

  To receive credit, trees must be planted in excess of Planning Division (landscaping) requirements. New evergreen trees must be at least 6 feet tall at the time of planting and new deciduous trees must be at least 2-inch caliper (diameter at 4 feet high). Trees must be planted within 25-feet of ground-level impervious surfaces. New trees cannot be credited against rooftop surfaces or porous pavement. New trees must be selected from tree species included in Appendix A unless otherwise approved.

  2c. Number of new trees meeting criteria x 100 SF each, SF: ☐

  Existing Tree Canopy

  To receive credit, existing tree canopy must be preserved during and after construction (recorded on property deed). Existing trees cannot be credited against rooftop surfaces or porous pavement. Minimum tree size to receive credit is 6-inch caliper. No credit will be given for existing trees required to be preserved by the Planning Division. Tree canopy is measured as the area under the tree drip-line and that is within 25 feet of ground-level impervious surfaces.

  2d. SF of existing tree canopy that meets criteria: ☐

  2e. Total Tree Credit (Box 2c + 2d), OR 10% of Box 1, whichever is SMALLER: ☐

3. TOTAL IMPERVIOUS AREA REDUCTION, (Sum of Boxes 2a, 2b, and 2e), SF ☐

4. PROPOSED IMPERVIOUS AREA, (Box 1 minus Box 3), SF (compare to thresholds): ☐

4. **Proposed Stormwater Management Strategy**

Given suitable site and soil conditions, the City requires that development shall incorporate LID facilities to infiltrate stormwater runoff to the Maximum Extent Practicable (MEP) to recharge groundwater and mimic pre-development hydrologic conditions. LID facilities will be designed and sized according to the soil classification and/or infiltration testing rate. Onsite soil characteristics may require a geotechnical report to address soil conditions, infiltration rates and groundwater to incorporate an infiltration strategy into the stormwater management plan to the MEP.

(a) For the *Site Assessment and Planning Checklist*, the applicant must identify and select a proposed stormwater management strategy from the choices below.

(1) LID facilities to the MEP – Check this option if LID facilities will be utilized to the MEP to address the water quality and flow control requirements of the site. LID facilities must be sized according to the design requirements in Section 301.11.00, "Stormwater Management Facility Selection and Design" utilizing either the BMP Sizing Tool or the Engineered Method. MEP is defined as installing LID facilities with a surface area of at least 10% of the total new or redeveloped impervious area. Approved stormwater management facilities that qualify as LID facilities are defined in Section 301.11.00.

(2) Onsite retention of the 10-year design storm – Where possible, retain and infiltrate all stormwater runoff up to and including the 10-year storm onsite using LID facilities. Infiltration of the full 10-year design storm is assumed to satisfy both water quality and flow control requirements of Section 301.11.00, "Stormwater Management Facility Selection and Design".

(b) Limiting conditions for LID facilities - The following limiting conditions restrict the practicality of using onsite infiltration and may require the use of lined, non-infiltrating stormwater management facilities or underground facilities to meet stormwater management requirements. When sites have limiting conditions, a geotechnical report is required to document one of the following:

i. Stormwater management facilities will be located on fill.

ii. Site areas with steep slopes (≥20%) and/or slope stability concerns (geotechnical engineering or geologist report and City approval required for infiltration facilities on moderate slopes of 10-20%).

iii. Sites in areas of seasonal high groundwater table (for site planning submittal, sites with jurisdictional wetlands or FEMA floodplains may be required to perform a seasonal high groundwater table assessment and determine that the seasonal groundwater table is below the proposed bottom elevation of stormwater infiltration facilities).

iv. Sites with contaminated soils (sites that have contaminated soils conditions must be evaluated by the Oregon Department of Environmental Quality (ODEQ) and/or the Environmental Protection Agency to determine if areas on the property are suitable for infiltration without the risk of mobilizing contaminants in the soil or groundwater. Documentation showing contamination assessment and determination must be submitted to the City at the time of application).

v. There is a conflict with required source controls for high-risk sites (a geotechnical report is not required to document this limiting condition, but approval from the City is required to install lined and/or underground facilities in place of LID facilities).

5. **Facility Selection/Sizing**

After selecting a stormwater management strategy, applicants shall indicate which stormwater management facilities are proposed for the site based on the results of the site assessment and planning process. The BMP Sizing Tool shall be used to calculate the size of the facilities and the BMP Sizing Tool report shall be included as part of the application. All proposed impervious area reduction methods and proposed stormwater management facilities shall be shown on the Preliminary Site Plan.

301.3.00 SUBMITTAL REQUIREMENTS

The Developer's engineer shall submit sufficient supporting information as outlined below to justify the proposed stormwater management design meets all the provisions within these standards and the land use conditions of approval. It is the design engineer's responsibility to ensure that engineering plans are sufficiently clear and concise to construct the project in proper sequence, using specified methods and materials, with sufficient dimensions to fulfill the intent of these design standards. A Storm Drainage Report as outlined in Section 301.3.02, "Storm Drainage Report", is required to be prepared and submitted with the design plans.

301.3.01 Supporting Information

a. All elevation on design plans and record drawings shall be based on the applicable NAVD 88 Datum specified in Section 101.7.07.a, "NAVD 88 Datum."

b. Existing conditions and facilities on design plans and record drawings shall be shown in light, grey print. Proposed conditions and facilities on design plans and record drawings shall be shown in bold, black print.

c. All engineering drainage plans shall be stamped by a Professional Engineer registered in the State of Oregon. At a minimum, the drainage plans shall contain the following:

1. At least one sheet shall show a plan view of the entire project site. If the project site is sufficiently large that detailed drainage plans on any given sheet do not encompass the entire project site, then a sheet showing the plan view of the entire site must serve as an index to subsequent detailed plan sheets.

2. A topographic map showing existing conditions for the site, including:

   (a) Existing conditions and topography for the site. Plan views showing existing features may be required for a distance of up to 100 feet (or further if warranted) beyond the proposed improvement in order to prevent future grade conflicts and will be determined on a case-by-case basis by the City's authorized representative.

   (b) Adjacent streets, trails, multi-use paths, and rail lines, including the respective names.

   (c) Existing utilities, including franchised utilities located above or below ground and drainage facilities that transport surface water onto, across, or from the project site. Existing drainage pipes, culverts, and channels shall include the invert or flowline elevations.

   (d) Existing vegetation, including denoting the type, DBH, and canopy size of trees within the construction limits.

   (e) Existing sensitive areas (e.g., ravines, swales, steep slopes, wells, springs, wetlands, creeks, lakes). For natural drainage features, show direction of flow, drainage hazard areas, and 100-year floodplain boundary (if applicable).

   (f) Adjacent existing features that are within 25 feet outside of the site boundary, including but not limited to construction activities that will potentially compromise the structural stability or condition of off-site features, such as cultivated vegetation, landscaping, and trees, buildings, fences, decks, walls, slabs, and pavements. Denote the type, DBH, and canopy size of all trees.

3. Plans for proposed drainage improvements shall include the following:

   (a) Grading and erosion control plan.

   (b) Finished grades, showing the extent of cut and fill by existing and proposed contours, profiles, or other designations. Plan views showing finished grades may be required for a distance of up to 100 feet (or further if warranted) beyond the proposed improvement in order to prevent future grade conflicts and will be determined on a case-by-case basis by the City's authorized representative.

   (c) Horizontal stationing along centerline, showing points of tangency and curvature, including centerline stationing of all intersecting streets.

   (d) Proposed structures, including roads and road improvements, parking surfaces, building footprints, walkways, landscaped areas, etc.

   (e) Location, dimensions, slopes, and elevations of all existing and proposed drainage facilities, including pipes, open channels, culverts, stormwater management facilities, outfalls, riprap treatment, energy dissipaters, and all storm system structures and appurtenances, including but not limited to manholes, catch basins, area drains, inlet/outlet structures, clean outs, and

service laterals. Notes shall be included for referencing details, cross-sections, profiles, etc.

(f) Existing and proposed utilities, showing exact line and grade of all utilities crossings with proposed drainage system.

(g) All proposed off-site improvements.

(h) Applicable detail drawings.

(i) Existing and proposed property lines, right-of-way lines, survey monuments, and easements.

(j) Setbacks from environmentally sensitive areas or resource areas protected within the Significant Resource Overlay Zone (SROZ).

(k) Maintenance access, as applicable (See Section 301.8.07. "Access").

(l) Show emergency overflow pathway(s).

(m) Any proposed phasing of construction. (Note: stormwater management facilities must be constructed before completion of any phased construction)

(n) Any additional information that the City's authorized representative deems necessary.

4. Profiles for proposed drainage improvements will be provided at the same horizontal scale as the plan sheets and a 1" = 5' vertical scale. Profile drawings shall be drawn below the plan view or immediately following the associated plan view sheets. Profile views showing existing features may be required for a distance of up to 100 feet (or further if warranted) beyond the proposed improvement in order to prevent future grade conflicts and will be determined on a case-by-case basis by the City's authorized representative. The profiles shall include the following:

   (a) Existing and proposed ground along proposed storm facility alignments.

   (b) Conveyance systems, including pipe, culvert, and channel sizes, types and materials, lengths, backfill material, and all drainage system structures and appurtenances, including but not limited to manholes, catch basins, area drains, inlet/outlet structures, fittings, and clean outs. Notes shall be included for referencing details, cross-sections, etc.

   (c) Existing and proposed utilities, showing exact line and grade of all utilities crossing the proposed drainage system. The vertical separation from existing and proposed utilities shall be labeled for all proposed utility crossings.

   (d) Any additional information that the City's authorized representative deems necessary.

5. A detailed grading plan shall be provided for all open stormwater management facilities. The plan shall include the following:

(a) Existing ground contours (shaded) and proposed ground contours at a minimum 2-foot contour interval. Slopes steeper than 6H:1V shall be identified.

(b) Location of top and toe of slope.

(c) Limits of embankment designed to impound water.

(d) Location of all drainage structures as well as any other piped utilities in vicinity (0.1-foot detail).

(e) Flow route of the secondary/emergency overflow system (0.1-foot detail).

(f) Maintenance access, as applicable (see Section 301.08.07, "Access").

6. A detailed landscape plan shall be provided for open stormwater management facilities. The plan shall include the following:

   (a) Final ground contours at a minimum 1-foot contour interval.

   (b) Location of top and toe of slope.

   (c) Maximum water surface elevations.

   (d) Location of all drainage structures as well as any other piped utilities in vicinity (screened) (0.1-foot detail).

   (e) Limits of areas to receive amended topsoil.

   (f) Irrigation plan to achieve the required plant survival rate.

   (g) Planting species, locations and densities in accordance with the landscape requirements in Appendix B.

7. Cross-sections shall be provided for at least the following:

   (a) Stormwater management facilities, including but not limited to ponds, swales, rain gardens, and stormwater planters. Cross-sections shall graphically illustrate the following:

      i. Design maximum water surface for the 2-year, 10-year, and 25-year design storms.

      ii. Proposed dead storage water surface (as applicable).

      iii. Pavement section or amended soil section, as applicable.

   (b) Proposed ditches and swales, including vegetated swales.

8. Interference with City Drainage System Prohibited

   No person shall block, obstruct, or interfere with any portion of the City drainage system without a diversion plan being submitted and approved by the City's

authorized representative. This prohibition includes, but is not limited to, the obstruction of the flow of storm water from, and to any point within, the City drainage system.

301.3.02 Storm Drainage Report

a. The drainage report shall be on 8½-by-11 paper. Maps shall be folded to 8½-by-11 size unless another format is approved before the report is submitted.

b. If Low Impact Development pervious features are being proposed with the project the Impervious Area Reduction Form shall be included with the Storm Drainage Report.

c. The drainage report shall be prepared by and bear the seal and original signature of a Professional Engineer registered in the State of Oregon and shall contain the following information:

1. Cover sheet, including the project name, project tracking number (Planning DB No.), applicant's name, address, and telephone number, design engineer's name, and date of submittal.

2. Table of contents, with page numbers for each section of the report, including exhibits, appendices, and attachments.

3. Vicinity Map.

4. Project description, specifying type of permit(s) for which the applicant is applying, size and location of the project site, address or parcel number, legal description of the property, and property zoning. Also describe other permits required (e.g., Corps of Engineers 404 fill permit). Describe the project, including proposed land use, proposed site improvements, proposed construction of impervious surfaces, proposed landscaping, and special circumstances.

5. Existing Conditions

(a) Describe existing site conditions and relevant hydrological conditions, including but not limited to the following:

i. Project site topography.

ii. Land cover and land use.

iii. Abutting property land cover, land use, and ownership information.

iv. Off-site drainage to the property.

v. Natural and constructed channels.

vi. Wetlands, creeks, ravines, gullies, steep slopes, springs, and other sensitive areas on or adjacent to the project site.

(b) General soil conditions in the project site, using SCS soil designations.

(c) Points of discharge for existing drainage from the project site.

(d) References to relevant reports, such as basin plans, flood studies, groundwater studies, wetland designations, watershed plans, subbasin master plans, sensitive area designation, environmental assessments, water quality reports, or other relevant documents. Where such reports impose additional conditions on the applicant, those conditions shall be included in the report.

(e) Soils report(s) and/or infiltration test results and seasonal groundwater depth evaluation, where applicable.

(f) Hydrologic analysis, pursuant to Section 301.4.01, "Hydrologic Analysis."

(g) Basin map(s), showing boundaries of project, any off-site contributing drainage basins, on-site drainage basins, approximate locations of all major drainage structures in the basins, and depicting the course of stormwater originating from the subject property and extending to the closest receiving body of water. Reference the source of the topographic base map (e.g., USGS), the scale of the map, and include a north arrow.

(h) Description of drainage basin(s) to which the project site contributes runoff, and identification of the receiving waters for each basin.

6. Developed Conditions

(a) Developed site drainage conditions: Describe the land cover resulting from the proposed project; describe the potential stormwater quantity and quality impacts resulting from the proposed project; describe the proposed methods for collection and conveyance of runoff from the project site, for the control of any increase in stormwater quantity resulting from the development, and for maintaining stormwater quality.

(b) Description of upstream and downstream basins, identifying any sources of runoff to the project site. Description shall be based on field investigation. Any existing drainage or erosion issues upstream that may affect the proposed development shall be noted.

(c) Downstream analysis, pursuant to Section 301.11.02.d.5, "Review of Downstream System".

(d) Hydraulic design computations, supporting the design of all proposed stormwater conveyance, stormwater management facilities, and verifying the capacity of existing and proposed drainage facilities. These computations may include capacity and backwater analysis required either as part of the proposed drainage design or as part of the downstream drainage investigation, and flood routing computations required for the design of detention/retention storage facilities, for wetland impact analysis, or for floodplain analysis. Include a description of how the stormwater system will function during the water quality storm, 2-year storm, 10-year storm, 25-year storm, and 100-year storm.

(e) Operation and maintenance manual, required for privately owned and maintained stormwater management facilities. The manual will be an

attachment to the City's Stormwater Maintenance Covenant and Access Easement.

(f) Appendices shall include necessary technical information.

301.4.00 HYDRAULIC ANALYSIS

301.4.01 General

The method of hydraulic calculations shall be subject to approval from the City's authorized representative and shall be consistent with Section 301.5.00, "Hydrology and Hydraulics."

301.4.02 Hydraulic Design

Computational Methods for Runoff Calculations

a. Unless an alternative method is approved by the City in writing, calculation of storm runoff used for conveyance design shall be based on SBUH, TR-55 or the SWMM methods with the following limitations.

b. The rainfall distribution to be used within the City is the design storm of 24-hour duration based on the standard National Resources Conservation Service's (NRCS) Type 1A rainfall distribution using the 24-hour precipitation isopluvials in the National Oceanic and Atmospheric Administration Atlas 2, Volume 10, *Precipitation-Frequency Atlas of the Western United States*.

c. Curve numbers shall be derived from the NRCS runoff curve numbers contained in TR-55 *Urban Hydrology for Small Watersheds*.

d. Soil types shall be derived from the NRCS Soil Survey for Clackamas County.

e. The maximum overland distance for sheet flow used in calculations shall be 300 feet.

f. Detention/retention design shall be assessed by dynamic flow routing through the basin. Documentation of the proposed design shall be included in the drainage report. Exemptions to the on-site detention requirements may be considered for situations in which properties discharge directly to the Willamette River or to open bodies of water that have no capacity limitations, or areas where detention in downstream reaches could increase peak stormwater flow rates, and other areas or unique circumstances as identified by the City Engineer.

301.4.03 System Design Considerations

Stormwater management facilities shall be designed in conformance with Section 301.11.02, "Stormwater Management Facility Design Standards".

301.5.00 HYDROLOGY AND HYDRAULICS

301.5.01 Hydrologic Analysis

This section describes acceptable methods of estimating the quantity and characteristics of surface water runoff, as well as the assumptions and data required as input to the methods. These methods shall be used to analyze existing and to design proposed drainage systems and related facilities.

301.5.02 Rational Method

The Rational Method is most accurate for runoff estimates from small drainages with large amounts of impervious area and is approved for analyzing drainage basins of less than 25 acres with the following limitations:

a. Use it only in predicting a conservative peak flow rate to be used in determining the required capacity for conveyance elements.

b. Drainage subbasin area cannot exceed 25 acres for a single calculation without approval from the City's authorized representative.

c. The time of concentration shall be 5 minutes if computed to be less than 5 minutes.

d. Rainfall intensities shall be from **Table 3.3,** or an alternative approved by the City's authorized representative.

e. Rational formula: Q=C*I*A Where: Q = Flow in cubic feet per second
C = Runoff coefficient (0.9 for paved surfaces)
I = Intensity
A = Area in acres

Table 3.3. RATIONAL METHOD FOR DERIVING RAINFALL INTENSITIES[1]

Time of Concentration (minutes)	Storm Event (storm event, probability, inches per hour)					
	2 (50%)	5 (20%)	10 (10%)	25 (4%)	50 (2%)	100 (1%)
0	1.90	2.50	3.00	3.40	4.00	4.50
5	1.90	2.50	3.00	3.40	4.00	4.50
10	1.30	1.70	2.20	2.50	3.00	3.50
15	1.10	1.40	1.80	2.10	2.50	2.90
20	0.90	1.20	1.50	1.80	2.10	2.40
30	0.75	0.95	1.20	1.40	1.65	1.90
40	0.60	0.75	1.00	1.15	1.30	1.60
50	0.55	0.70	0.85	1.00	1.15	1.35
70	0.45	0.55	0.70	0.82	0.95	1.10
100	0.40	0.45	0.55	0.67	0.75	0.90
180 or more	0.35	0.40	0.50	0.60	0.70	0.85

1. Data for east Washington County; data from CleanWater Services.

301.5.03 Unit Hydrograph Methods

a. **Hydrograph Analysis:** To obtain a realistic and consistent hydrologic analysis for each development site, all developments shall use the hydrograph analysis method for drainage planning and design unless otherwise approved in advance by the City's authorized representative. 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 Santa Barbara Urban Hydrograph (SBUH) will be the primary acceptable unit hydrograph method.

   The City's authorized representative may check all hydrologic calculations using InfoSWMM® modeling software. However, the City will allow the use of the rational method for analysis of drainage basins of 25 acres or less.

b. **Design Storm:** Return frequency and duration specify the design storm event. The design storms shall be based on two parameters:

   1. Total rainfall (depth in inches).

   2. Rainfall distribution (dimensionless).

c. **Design Storm Distribution:** The total depth of rainfall for storms of 24-hour duration is shown in **Table 3.4.** The rainfall distribution to be used in the City is the design storm of 24-hour duration based on the standard National Resource Conservation Service (NRCS), formerly known as the Soil Conservation Service (SCS), type 1A rainfall distribution using **Table 3.5**.

Table 3.4. RAINFALL DISTRIBUTION

Recurrence Interval (years)	Total Precipitation Depth (inches)
2	2.50
5	3.00
10	3.45
25	3.90
50	4.25
100	4.50

Table 3.5. DESIGN STORM DISTRIBUTION CHART1

Hour	Percent Rainfall		Rainfall Depth (inches)					
			2-Year Storm	5-Year Storm	10-Year Storm	25-Year Storm	50-Year Storm	100-Year Storm
	Incremental	Cumulative	2.50	3.00	3.45	3.90	4.25	4.50
1	2.40	2.40	0.06	0.07	0.08	0.09	0.10	0.11
2	2.60	5.00	0.07	0.08	0.09	0.10	0.11	0.12
3	3.20	8.20	0.80	0.10	0.11	0.12	0.13	0.14
4	3.80	12.00	0.10	0.12	0.13	0.15	0.16	0.17
5	4.44	16.44	0.11	0.14	0.15	0.17	0.19	0.20
6	5.18	21.62	0.13	0.16	0.18	0.20	0.22	0.23
7	6.48	28.10	0.16	0.20	0.22	0.25	0.27	0.29
8	16.44	44.54	0.41	0.51	0.57	0.64	0.69	0.74
9	7.58	52.12	0.19	0.23	0.26	0.30	0.32	0.34
10	5.28	57.40	0.13	0.16	0.18	0.21	0.22	0.24
11	4.96	62.36	0.12	0.15	0.17	0.19	0.21	0.22
12	4.32	66.68	0.11	0.13	0.15	0.17	0.18	0.19
13	4.02	70.70	0.10	0.12	0.14	0.16	0.17	0.18
14	3.42	74.12	0.09	0.11	0.12	0.13	0.14	0.15
15	3.28	77.40	0.08	0.10	0.11	0.13	0.14	0.15
16	3.00	80.40	0.08	0.09	0.10	0.12	0.13	0.14
17	2.80	83.20	0.07	0.09	0.10	0.11	0.12	0.13
18	2.40	85.60	0.06	0.07	0.08	0.09	0.10	0.11
19	2.40	88.00	0.06	0.07	0.08	0.09	0.10	0.11
20	2.40	90.40	0.06	0.07	0.08	0.09	0.10	0.11
21	2.40	92.80	0.06	0.07	0.08	0.09	0.40	0.11
22	2.40	95.20	0.06	0.07	0.08	0.09	0.10	0.11
23	2.40	97.60	0.06	0.07	0.08	0.09	0.10	0.11
24	2.40	100.00	0.06	0.07	0.08	0.09	0.10	0.11

1. Source: *Subbasin Hydrologic Modeling Criteria*, Kramer, Chin, & Mayo, Inc. 1991.

d. **Runoff Parameters:** The physical drainage basin characteristics listed below shall be used to develop the runoff hydrograph.

1. **Area**

(a) To obtain the highest degree of accuracy in hydrograph analysis requires the proper selection of homogeneous basin areas. Significant differences in land use in a given basin must be addressed by dividing the basin area into subbasin areas of similar land use or runoff characteristics. Hydrographs shall

be computed for each subbasin area and superimposed to form the total runoff hydrograph for the basin.

(b) All pervious and impervious areas within a given basin or subbasin shall be analyzed separately. This may be done by either computing separate hydrographs or computing the precipitation excess. The total precipitation excess is then used to develop the runoff hydrograph. By analyzing pervious and impervious areas separately, the cumulative errors associated with averaging these areas are avoided, and the true shape of the runoff hydrograph is better approximated.

2. **Selection of Curve Number**

(a) The NRCS has developed CN values based on soil type and land use. The combination of these two factors is called the "soil-cover complex." Storm water modeling shall be based on these NRCS CN values; alternate methods subject to approval by the City's authorized representative.

(b) Soil-cover complexes have been assigned to one of four hydrologic soil groups, according to their runoff characteristics. Soil hydrologic groups may be found on-line on the NRCS website.

i. 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.

ii. CN values can be area-weighted when they apply to pervious areas of similar CN (within 20 CN points). However, high CN areas shall not be combined with low CN areas (unless the low CN areas are less than 15% of the subbasin).

iii. Antecedent soil moisture values shall be considered. Soil shall be considered to be saturated before the start of a precipitation event.

3. **NRCS Curve Number Equations**

(a) The rainfall-runoff equations of the NRCS curve number method relate a land area's runoff depth (precipitation excess) to the precipitation it receives and to its natural storage capacity, as follows:

$$Q_d = (P_R - 0.2S)^2 / (P_R + 0.8S), \text{ for } P_R > 0.2S$$

and

$$Q_d = 0, \text{ for } P_R < 0.2S$$

where Q_d = runoff depth in inches over the area.

P_R = precipitation depth in inches over the area.

S = potential maximum natural detention/retention, in inches over the area, due to infiltration, storage, etc.

The area's potential maximum detention/retention, S, is related to its curve number, CN:

$$S = (1000/CN) - 10$$

The computed runoff represents inches over the tributary area. Therefore, the total volume of runoff is found by multiplying Q_d by the area (with necessary conversions):

Total runoff volume (cf) = Q_d (in) ´ A (ac) x 3,630 (ft^3/(ac-in))

(b) **Time of Concentration:** Time of concentration (T_c) is the time for runoff to travel from the hydraulically most distant point of the watershed to the point where the hydrograph is to be calculated. Travel time (T_t) is the time it takes water to travel from one location to another in a watershed. T_t is a component of T_c. T_c is computed by summing all the travel times for consecutive components of the drainage conveyance system. T_c influences the shape and peak of the runoff hydrograph.

(1) **Sheet Flow:** Sheet flow is flow over plane surfaces. It usually occurs in the headwater of streams. For sheet flow up to 300 feet, use the kinematics solution below to directly compute T_t:

$$T_t = (0.93L^{0.6} \text{´} n^{0.3}) / (I^{0.4} \text{´} S^{0.3})$$

where T_t = travel time (minutes).
n = Manning's effective roughness coefficient for sheet flow.
L = flow length (feet).
I = rainfall intensity (inches per hour).
S = slope of hydraulic grade line (feet per foot [ft/ft])

Sheet flow shall not be used for distances over 300 feet.

(2) **Shallow Concentrated Flow:** For slopes less than 0.005 ft/ft (0.5%), the following equations can be used:

(a) For unpaved surfaces: $V=16.1345\ (S)^{0.5}$

(b) For paved surfaces: $V=20.3282\ (S)^{0.5}$

where V = velocity (feet per second)
S = slope (ft/ft).

(3) **Channel Flow:** A commonly used method of computing average velocity of flow, once it has measurable depth, is the following equation:

$$V = (1.486 / n) \text{´} R^{0.6} \text{´} S^{0.5}$$

where V = velocity (ft/s)
n = Manning's roughness coefficient.
S = slope of flow path (ft/ft)
R = area/perimeter.

301.5.04 Hydraulics

Catch Basins, curb inlets and ditch inlets collect water from an adjacent gutter, street pavement, or ditch and convey the water to a storm sewer or culvert. The inlet systems are to be designed in accordance with Section 301.8.05, "Drain Inlet Design Standards."

301.6.00 CONSTRUCTED CHANNEL DESIGN STANDARDS

301.6.01 Application

This section applies to open channels constructed to convey runoff to the existing public stormwater and surface water conveyance system. For work in existing stream channels, applicant shall follow the recommendation and requirements set forth in ODFW's *Fish Passage Criteria,* or latest edition, or an equivalent study or guideline approved by the City's authorized representative. The applicant shall comply with all applicable requirements of the Army Corps of Engineers and Oregon Department of State Lands for construction activities that may impact wetlands or waterways. Development that regrades existing roadside ditches or constructs new roadside ditches shall meet applicable City codes and standards.

301.6.02 Channel Design

a. Channel design shall be in accordance with Section 301.5.00, "Hydrology and Hydraulics."

b. Manning's Roughness Coefficient ("n") shall generally comply with the ODOT *Hydraulic Manual.*

c. Open channels shall be designed to prevent scouring of the channel and shall be sized to pass the required flows without causing erosion and have side slopes no steeper than 2H:1V.

d. Vegetation-lined channels shall be used whenever practicable, as determined by the City's authorized representative. Rock-lined channels shall be used only where a vegetative lining will not provide adequate protection from erosion. Channels shall be protected in accordance with Section 301.4.07, "Channel protection."

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

f. Constructed open channels shall be sized to pass the required flows and have sideslopes no steeper than 3H:1V. In areas where 3H:1V side slopes are impracticable because of existing natural features or other limitations obstructing the channel, the bank slope shall be no steeper than 2H:1V. Any proposed constructed channel improvement that does not meet these requirements shall be piped, unless an exception is approved by the City's authorized representative.

g. The flow-line slope is generally dictated by the natural contours. The minimum flow-line slope is 1% where practicable, but in no case shall the design flow velocity be less than 2 fps except as approved by the City's authorized representative.

h. Banks shall be designed with a minimum 1 foot of freeboard above the design storm provided no structures are impacted by the design water surface elevation. The surface configuration at the top of bank should provide adequate accessibility for maintenance as determined by the District.

i. Roadside ditches shall be constructed in conformance with ODOT SSC Section 00330, "Earthwork." Normal maximum depth for open channels constructed adjacent to roadways shall be 2 feet.

j. No protruding pipes, culverts, utilities, or other structures will be allowed that reduce or hinder the flow characteristics of the channel. All pipe connections shall match sideslopes, incorporate a headwall, and be designed with an energy dissipater device (see Sections 301.6.03, "Channel Protection," and 301.6.05, "Outfall Protection").

k. Bank Stabilization: Open channel designs shall be based on the minimum level or protection shown in **Table 3.6**.

1. Open channel waterways shall be designed and constructed with temporary and permanent bank stabilization measures in all locations. Specialized bank stabilization shall be considered as follows:

(a) Natural bank stabilization measures (i.e., slope pull-back, willow mats, rock barbs, or revegetation with localized native plant species) shall be used.

(b) Areas of extreme curvature, changes in channel cross-section, or low-flow channels with design flow velocities exceeding 3 fps shall be designed and constructed with bank stabilization to consider additional potential for scouring from turbulent flows.

(c) Post-construction bank stabilization shall minimize the potential for erosion or sedimentation.

(d) In areas of waterway convergence or other points of disposal, bank stabilization shall meet these requirements.

301.6.03 Channel Protection

Open channels shall be designed to prevent long-term scouring of the channel. Where rip rap protection is specified, rip rap protection shall be placed over a filter fabric base or a minimum 6-inch thick gravel base. **Table 3.6** provides additional design guidance for the design engineer; however, the design engineer is, as always, responsible for the final design.

Table 3.6. CHANNEL PROTECTION, NEW CHANNEL CONSTRUCTION

Velocity at Design Flow (fps)				
Greater than	**Less than or equal to**	**Required protection**	**Thickness (ft)**	**Minimum height above design water surface (ft)**
0	5	Vegetation lining	Not applicable	.05
5	8	Bioengineered lining[1] ODOT Class 50 riprap[2]	Not applicable 1.5	1.0
8	12	ODOT Class 200 riprap[2]	2.5	2.0
12	20	Slope mattress, etc.[3]	Varies	2.0
20		Engineer designed[3]		

[1]Bioengineered lining allowed for flows between 5 and 8 feet per second.
[2]ODOT riprap class in English units
[3]For high-velocity channels, engineering calculations are to be submitted to the City's authorized representative for review and approval.

301.6.04 Outfalls to Open Channel Waterways

The outlets of pipes and lined channels are points of critical erosion potential. Stormwater that is transported through man-made conveyance systems at design capacity generally reaches a velocity that exceeds the capacity of the receiving channel or area to resist erosion. To prevent scour at stormwater outlets, protect the outlet structure and minimize the potential for downstream erosion, a flow transition structure is needed to absorb the initial impact of flow and reduce the speed of the flow to a non-erosive velocity.

a. Outfalls to waterways may require ODSL and USACE permits. The applicant is responsible for obtaining necessary State and Federal permits and providing proof of approval to the City.

b. Direct outfalls greater than 4 inches in diameter to open channel waterways shall typically be designed by a licensed engineer. Outfalls shall be constructed to minimize the potential for erosion and other potential damage to the waterway banks. Outfall designs shall address erosion and scouring within the waterway upstream and downstream of the outfall structure.

c. Bank stabilization shall not reduce the carrying capacity of the water course. Bank stabilization designs shall consider the 25-year flow velocities of pipe outlets and 25-year flow velocities of open channel waterways. 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

d. Flow from the outfall structure shall be directed downstream, typically no less than 30 degrees from perpendicular to the waterway flow.

e. Outfalls shall be located at a higher elevation than the downstream mean low water level. The mean low water level is defined as the average height of the low waters of a 10-year period. The area between the mean low water and the outfall discharge location shall be stabilized with material to dissipate energy.

f. 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 10 fps. These shall be designed by a professional engineer using published references such as Hydraulic Design of Energy Dissipaters for Culverts and Channels (U.S. Department of Transportation, Federal Highway Administration) and other references. The construction plan submittal shall identify the design reference.

g. Outfalls shall be inter-planted with willow stakes or other approved plantings, every 2 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.

301.6.05 Outfall Protection

Storm system outfalls shall be designed to prevent scouring at, or in association with, the outfall discharge and provide velocity reduction before discharge to the receiving channel. With hillside locations, storm pipes will be extended to the bottom of slope wherever possible and the energy dissipater installed at the end of pipe. Outfalls shall be at or just above the mean low water level unless an exception is approved by the City.

Engineered energy-dissipaters, including but not limited to, stilling basins, drop pools, and hydraulic jump basins shall be required for outfalls with design flow discharge velocities greater than 3 feet per second (fps). All outfalls shall be provided with a rock splash pad or other approved erosion control measure. **Table 3.7** provides design guidance for the design engineer; however, the design engineer is, as always, responsible for the final design.

Table 3.7. ROCK PROTECTION

Discharge Velocity at Design Flow (fps)	Required Protection (Minimum Dimension)				
	Type	Thickness[2]	Width	Length	Height
0 to 5	ODOT Class 50 riprap[1]	1.5 ft	Diameter + 6 ft	8 ft or 4 x diameter, whichever greater	Crown + 1 ft
5 to 10	ODOT Class 200 riprap[1]	2.5 ft	Diameter + 6 ft or 3 x diameter, whichever greater	12 ft or 4 x diameter, whichever greater	Crown + 1 ft
Greater than 10	Designed system[3]	As required	As required	As required	Crown + 1 ft

[1]ODOT riprap class in English units.
[2]Riprap shall be grouted in place (see Detail No. S-2225 or S-2275 of these standards). In environmentally sensitive areas a woven geo-textile fabric may be specified by the City.
[3]For high-velocity outfalls, engineering calculations are to be submitted to the City's authorized representative for review and approval.

301.7.00 CULVERT DESIGN STANDARDS

301.7.01 Application

a. Culverts provide for passage of water under or through obstructions placed across streams and drainageways. Culverts shall be designed to pass the required flows without compromising public safety or causing new or additional flooding.

b. For pipe systems or culverts that convey flows from a stream or through sensitive areas, a local representative of ODFW or other applicable state or federal agency shall be contacted to determine whether fish passage is required and to identify site-specific design criteria. Additionally, ODFW may require fish passage accommodations on any stream that has a history or the potential for fish production.

c. All culverts shall be designed for fish passage in accordance with ODFW's *Fish Passage Criteria,* or latest edition, unless otherwise exempted by ODFW and the City.

d. Culverts within Federal Emergency Management Agency (FEMA) floodplains shall be reviewed and approved by the local FEMA-designated floodplain permitting authority.

e. Culverts placed in streams or drainageways determined to be "waters of the State" require approval from the Oregon Department of State Lands (ODSL) and the U.S. Army Corps of Engineers (USACE).

f. For culverts which convey flows from or through water quality sensitive areas; a local representative of Oregon Department of Fish and Wildlife (ODFW) or other applicable state or federal agency shall be contacted to determine if fish passage is required and to identify site specific design criteria.

301.7.02 Hydraulic Design

Culverts shall be designed to safely pass the 100-year design storm flow.

301.7.03 Headwater

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

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

c. The maximum headwater elevation of a design storm event for new culverts shall be at least 1 foot lower than the road or parking lot subgrade

301.7.04 Inlet

The embankment around the culvert inlet shall be protected from erosion by lining around the inlet with rock, bioengineering, or other protection approved by the City's authorized representative. The lining shall extend upstream of the culvert a minimum of 10 feet, be designed to provide a smooth transition for water flow into the culvert, and shall be as high as the designed headwater elevation. Trash racks or debris barriers shall follow the design requirements of Section 301.8.09, "Trash Racks or Debris Barriers."

301.7.05 Outlets

The receiving channel of the outlet shall be protected from erosion by rock lining, bioengineering, or other energy dissipating devices (Section 301.6.03, "Channel Protection," and Section 301.6.05, "Outfall Protection") as approved by the City's authorized representative. Runoff exiting a development site shall be discharged with adequate energy dissipaters to prevent downstream damage.

301.7.06 Inlet Control Analysis

The headwater depth for pipes under inlet control shall be determined using the nomographs as provided in Detail No. S-2205 and S-2210 of these standards, the ODOT "Hydraulics Manual," or a modeling method consistent with FHWA's HY8 software.

301.7.07 Outlet Control Analysis

The headwater depth for pipes under outlet control shall be determined using the nomographs as provided in Detail No. S-2220 of these standards, the ODOT "Hydraulics Manual", or a modeling method consistent with FHWA's HY8 software.

301.7.08 Outfall Design Standards

a. Outfalls shall be above the mean low-water level, unless an exception is approved by the City's authorized representative. All outfalls shall be provided with a rock splash

pad or other approved erosion-control measure. Erosion protection at outfalls shall be designed in accordance with the guidelines in Section 301.6.05, "Outfall Protection," unless exceptions are approved by the City's authorized representative.

b. Mechanisms that reduce velocity before water discharges from an outfall are required. The dissipaters shall be designed using published references such as FHWA's "Hydraulic Design of Energy Dissipaters for Culverts and Channels," the ODOT "Hydraulics Manual", and others. Design references shall be cited in the construction plan submittal.

c. Non-erosive stormwater flow velocities shall be maintained for the entire overland flow from the energy dissipating device to the receiving public waterway. The City's authorized representative shall approve structures and/or methods to maintain non-erosive flow velocities prior to construction or installation.

301.8.00 STORM MANHOLE, PIPE AND CATCH BASIN DESIGN STANDARDS

The following design standards are intended only as a guide for the design of storm sewer improvements.

301.8.01 Manhole Design

a. Manholes shall be provided at least every 400 feet, unless otherwise approved by the City's authorized representative. Manholes shall be located at every grade change, change in pipe size, change in alignment, pipe connection greater than 6" in diameter, and at the end of main lines not to be extended in the future. Manhole lids shall be located as indicated in the street detail drawings of these standards unless an exception is approved by the City's authorized representative).

b. A shallow manhole with precast grooves shall be provided for manholes 4 feet deep from crown of pipe and less. The shallow manhole top shall consist of a short eccentric cone as shown in **Detail No. S-2025** of these standards. Where the short eccentric cone top is not feasible as determined by the City's authorized representative, a flat slab top may be permitted as shown in **Detail No. S-2030** of these standards..

c. Flat-top manholes shall be designed to be installed at an elevation to permit construction of the full street section, allowing for the design gradients; if this is not possible, additional construction measures may be required to prevent premature failure of the road surface.

d. Manholes shall be designed such that the manhole cover is flush with the surrounding grade in paved areas, set 1-foot above grade in landscape areas unless otherwise directed by the City's authorized representative.

e. Manhole grade rings shall be concrete, key-lock joint designed to withstand AASHTO H-20 loadings. Grade rings shall not exceed 12 inches in height.

f. The minimum manhole size shall be as follows:

1. 48-inch diameter manhole for pipe equal to or less than 24 inch diameter

2. 60-inch diameter manhole for pipe between 27-inch and 36-inch diameter

3. 72-inch diameter manhole for pipe equal to or greater than 42-inch diameter.

g. Suburban style manholes frames shall not be used in PCC streets.

h. There shall be a maximum of 4 pipes entering/exiting a manhole unless otherwise approved by City's authorized representative.

i. Detail(s) shall be submitted with the plans where pipes into or out of a manhole are larger than 24 inches or where more than four mainline connections are made. The manufacturer or design engineer shall provide the City's authorized representative with supporting calculations, stamped by a Professional Engineer registered in the State of Oregon, documenting the structural integrity of the manhole.

j. A storm service lateral entering a manhole within a public conveyance system shall be designed so that the invert of the lateral is 6 inches above the invert of the outlet pipe and enters the manhole at an angle of 60 to 90 degrees from the mainline sewer.

k. Connections to an existing manhole, elevation of the existing ledge, location of steps, and elevations of existing inlets and outlets shall be submitted with the plans.

l. All precast manhole bases and sections shall be manufactured with smooth, clean openings at the design inlet and outlet points for the size of pipe specified. Manholes shall be core drilled to field adjust the design connection joints. Openings shall not be sawcut or broken out.

m. Where a connection is proposed to an existing manhole the connection shall be core drilled and elevations of the existing ledge, location of steps, and elevations of existing inlets and outlets shall be submitted as a detail on the plans.

n. A minimum of 8 inches shall separate connections, measured from the outside diameter of the core holes.

o. All manhole bases shall be properly channelized.

p. All manholes shall have inlets at a minimum 90-degree angle in relation to the outlet, as measured from the center of the manhole base.

q. The crowns of all incoming pipes shall be at least as high as the crown of the outgoing pipe.

r. Manholes shall have a minimum free drop of 0.20 feet. Any drop greater than 0.20 feet shall only be allowed when existing utilities or physical obstructions prevent a connection from being made within this specification as determined by the City's authorized representative. Where allowed, the maximum free-drop shall be 1.5 feet.

s. When the free-drop exceeds 1.5 feet an inside drop shall be installed in the manhole per Detail S-2041 of these standards. Outside drop manholes are not allowed.

t. An oversize curb inlet manhole as shown in Detail No. S-2090 of these standards may be used in lieu of a manhole, as required by Section 301.8.04, "Catch Basin Design", when approved as part of a flow-through system. Oversized gutter or curb and gutter catch basins will be allowed in lieu of manholes, with approval of the City's authorized representative.

u. Stormwater pretreatment manholes shall be installed where required and in conformance with Section 301.11.06, "Stormwater Pretreatment Manholes."

301.8.02 Storm Pipe Design

a. Manning's equation shall be used to calculate pipe capacity.

b. **Pipe size:** The design size shall be based on hydraulic calculations provided by the design engineer. The minimum diameter of public storm pipe is identified below:

1. Pipe from the catch basin to the mainline in the public right-of-way shall be nominal 10-inch-diameter pipe.

2. Mainline pipe shall be nominal 12-inch-diameter pipe.

3. Storm pipes located out of a public street right-of-way, with no reasonable need to be extended, and with roof drains or area drains connected, shall be a minimum 10-inch-diameter pipe.

c. **Materials:**

1. Generally, storm sewer mains and laterlas shall be Polyvinyl Chloride (PVC) pipe, ASTM D-303, SDR 35 or lower, unless otherwise recommended by the Engineer of Record and directed by the City's authorized representative.

2. Pipe materials shall conform to the specifications in Section 301.9.03.b, "Materials" unless otherwise approved by the City's authorized representative.

3. Pipe and fittings shall consist of one type of material throughout and no interchanging of pipe and fitting material is allowed.

d. **Location:** Storm sewers located within the public right-of-way shall generally be installed at or near the street centerline as indicated in the street detail drawings of these standards. All storm sewer locations shall be approved by the City's authorized representative. Storm drain inlets shall be designed as per Section 301.8.05, "Drain Inlet Design Standards".

e. **Easements:** Easements shall be provided as specified in Section 301.1.08, "Easements".

f. **Alignment:** Public storm pipe shall be laid on a straight alignment and at uniform grade. Where storm drains are located parallel with other utility pipe or conduit lines, the vertical and horizontal alignment should permit future side connections of main or lateral storm drains and avoid conflicts with the parallel utility without abrupt changes in vertical grade of main or lateral storm drains. Storm drain alignments shall

accommodate future planned projects such as street widening, changes in horizontal or vertical street alignment, and master plan water or sewer facilities.

g. **Horizontal separation:** The minimum separation distance between parallel storm sewers and other utilities shall be 5 feet measured from the edge of each pipe.

h. **Vertical separation:** Utility crossings shall be constructed as near 90 degrees as practicable. Utility crossings of storm pipes with other utilities shall have a minimum 6 inches of vertical separation measured from the edge of each pipe.

i. **Curb Marking:** Newly constructed curbs or replaced curbs shall be stamped with the capitol letters "SD" on the outer edge of the gutter pan at the location of each storm lateral crossing. Letters shall be 3 inches in height and embossed a minimum of ⅛-inch deep.

j. **Locating Wire, Tape, and Marker:** Storm laterals and mains shall have tracer wire installed beside the pipe and plastic caution tape installed 1-foot above the pipe crown as shown in Detail No. S-2175 of these standards. Tracer wire shall be connected at all junctions, including service laterals, using a solderless connection kit suitable for direct burial that joins wires mechanically and electrically and seals out moisture, GelCap or approved equal. Tracer wire shall be 12-guage stranded or solid copper insulated High Molecular Weight Polyethylene (HMW-PE) with a white insultated cover a minimum 45 mil in thickness and the wire UL rated for 140°F. A 2 x 4 wood marker shall be installed at the end of the storm lateral extending from the invert of the pipe to 3 feet above the ground surface. The stake shall painted white in color to identify the storm lateral. Locating wire and tape shall be tied off to the 2 x 4 marker. A cleanout installed on the lateral located on the private side of the right-of-way boundary is an acceptable permanent marker.

k. **Grade:** Storm sewers shall be laid on a grade that maximizes the serviceable area to facilitate future extension of the storm sewer system as determined by the City's authorized representative. The maximum serviceable area shall be based on the future development within the contributing area as identified by the Wilsonville Stormwater Master Plan. The use of drop manholes in the design of new storm sewers shall be restricted as necessary to maximize the serviceable area.

   All storm lines shall have sufficient slope to maintain a minimum flow velocity of 3 feet per second when flowing full.

l. **Steep Slopes:** Where soil conditions warrant it, storm pipes on slopes in excess of 20% gradient shall be secured with approved anchor walls as shown in Detail No. S-2195 of these standards or other approved anchor systems as approved by the City's authorized representative. Spacing for anchors shall be as shown in **Table 3.8**.

Table 3.8. SECURING STORM SEWERS ON SLOPES

Minimum Anchor Spacing Storm Sewer Gradient >20%	
Grade (%)	**Center to Center (feet)**
<35	35
35-50	25
>50	15 (or concrete encasement)

m. **Pipe Cover:** All storm sewer pipes shall be laid at a depth sufficient to drain building storm sewers. Minimum pipe cover shall be in compliance with this section, unless an exception is approved by the City's authorized representative. In paved areas, pipe cover shall be measured from the finished grade to the upper surface of the pipe barrel; the pipe bell shall not intrude into the base rock. In areas without pavement, the pipe cover shall be measured from the finish grade to the upper surface of the pipe barrel. Minimum cover requirements are shown in **Table 3.9.**

Table 3.9. MINIMUM PIPE COVER

Type of Pipe	Cover (inches)
Other Pipe Materials	36
Nonreinforced	36
RCP Class III	36
RCP Class IV	24
RCP Class V	12
AWWA C-900	12
AWWA C-905	12
Ductile Iron	12

301.8.03 Storm Service Connection Laterals Design

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

a. The provisions of the City requiring permits, fees, and other requirements shall be complied prior to the start of work on any portion of the storm pipeline systems.

b. Minimum diameter for storm service laterals shall be 6 inches.

c. Lateral connections to the mainline sewer on new construction work shall be done using manufactured tees installed at surveyed locations. Lateral connections to existing storm lines may be done using either saddle tees as per Section

401.4.02.b.5(a), or by using Inserta Tee® as per Section 401.4.02.b.5(c). Laterals shall be of same material as main.

d. Laterals connections to a manhole shall be in accordance with Section 301.8.03, "Storm Service Connection Laterals Design".

e. Laterals shall contain no bends from the mainline to the edge of right- of-way.

f. A minimum grade of 2% is required for service laterals, unless a lesser grade is approved by the City's authorized representative.

301.8.04 Catch Basin Design

Design of catch basins shall follow the specifications provided in Section 301.8.05, "Drain Inlet Design Standards."

a. **Standard Catch Basin System:** All catch basins shall be sumped. The main storm line shall not pass through any catch basins or sumped manholes unless approved by the City's authorized representative. No more than three catch basins may be connected in a series before connecting to the main storm line. A ditch inlet or field inlet may be connected directly to the end of the main storm line.

b. **Series Catch Basin System:** Unsumped catch basins are allowed, provided that a sumped manhole is constructed below the unsumped catch basins before the flow enters the main storm line. No more than three unsumped catch basins may be constructed above a water quality or stormwater pretreatment manhole. The main storm line may not pass through the catch basins or sumped manholes. No ditch inlet or field inlet may be part of a series of unsumped catch basins.

c. **Flow-through Catch Basin System:** This system is allowed within an arterial or collector road, provided that the mainline storm pipe has a design velocity of at least 3 feet per second. Unsumped catch basins, ditch inlets, and field inlets are allowed to connect directly to the main storm line. An adequately sized water quality manhole is required at the downstream end of the flow-through system.

301.8.05 Drain Inlet Design Standards

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

a. Design Criteria

1. The following sources shall be used to locate catch basins and inlets:

(a) ODOT's "Hydraulics Manual."

(b) Hydraulic Engineering Circular 12 (Federal Highway Administration, FHWA-84-202), "Drainage of Highway Pavements."

2. Precast and poured-in-place-catch basins and curb inlets are allowed.

3. All curb inlets shall be constructed with an 18-inch minimum sump unless they are part of a series or a flow-through curb inlet system, and approved by the City's authorized representative.

4. A main storm line shall not pass through a sumped curb inlet.

5. Avoid placing curb inlets along curb radius at street intersections. Grated catch basin inlets shall not be placed in front of ADA access ramps.

6. Spacing of curb inlets shall be determined by the capacity of each to pass a 10-year storm event. In addition, curb inlets shall be installed just before the upstream curb radius at all intersections.

7. Curb inlets, except for CG-48, shall be a maximum depth of 6 feet from the top of grate to the flowline of the lowest pipe invert. When depth from top of grate to flowline is greater than 5 feet, curb inlets shall be oversized and have steps installed.

8. Between the inlet and the mainline or mainline structure, the maximum length of pipeline shall be 40 feet for 10-inch pipe and 60 feet for 12-inch pipe, unless additional length is required to cross the street right-of-way.

9. Tee connections may be used in street right-of-way only with approval of the City's authorized representative. The lateral shall be no larger than 50% the diameter of the main line, unless otherwise approved by the City's authorized representative. The connecting curb inlet shall be oversized.

b. Area Drains and Ditch Inlets

1. The standard area drain shall be as shown in Detail No. S-2105 or S-2110 and S-2115 of these standards, and the ditch inlet shall be as shown in Detail No. S-2120 and S-2125 of these standards, unless an exception is approved by the City's authorized representative.

2. Area drains in rear or sideyards shall not be sumped. Ditch inlets shall be equipped with an 18-inch sump unless the inlets are part of a flow-through system.

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

4. Area drains or ditch inlets may be located at the upper terminus of a main storm line, may connect to the main storm line at a manhole, or may connect to the main storm line through a tee when the lateral is no larger than 50% of the diameter of the main line.

5. The maximum acceptable intake flow rates for area drains and ditch inlets with a grate angle of 30 degrees are shown in **Table 3.10** where H is the hydraulic head measured in feet from the bottom of the grate to headwater and Q is the flow rate in cubic fps.

Table 3.10. MAXIMUM INTAKE FLOW RATES

Area Drains and Ditch Inlets with Grate Angle of 30 degrees

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

301.8.06 Distance Between Structures

The maximum distance between structures, such as manholes, area drains, and catch basins, but excluding cleanouts, for 10-inch and larger pipe shall be 400 feet.

301.8.07 Access

Access roads are for maintenance and inspection purposes. All-weather access shall be provided to every manhole. Access roads shall be constructed as per Section 301.11.05, "Access Road Design."

301.8.08 Headwalls and Endwalls

Pipe end protection shall be required where pipe material other than concrete or ductile iron is exposed in the design of an outlet or inlet pipe or where required to stabilize a slope. Details of all headwalls and end protection shall be included in the construction drawings.

301.8.09 Trash Racks or Debris Barriers

Trash racks or debris barriers are required by the City on inlets for pipe or culvert systems greater than 18 inches in diameter. The design engineer shall submit the trash rack/debris barrier system design to the City's authorized representative for approval.

301.9.00 MATERIAL AND TECHNICAL SPECIFICATIONS

301.9.01 Manholes and Structures

a. **General**

Manholes shall be constructed at locations shown on the plans and in compliance with the design requirements of Section 301.8.01, "Manhole Design", or as required by the City's authorized representative.

b. **Materials**

1. **Aggregate and Cement:** Aggregate shall meet the standards set forth in ODOT SSC Section 02690, "PCC Aggregates"; Portland cement shall meet the standards set forth in ODOT SSC Section 02010, "Portland Cement."

2. **Concrete:** PCC for poured in place manholes and structures shall conform to ODOT Class 3000 – 1½, Commercial Grade Concrete. Slump shall be between 2 and 4 inches.

3. **Manhole Frames and Covers:**

   (a) Casting shall be of new material, tough, close-grained gray iron conforming to ASTM A-48, Class 30B and AASHTO M 105, Class 30B. Where the ASTM and AASHTO specifications differ, the more stringent shall apply. Castings shall be smooth and clean, free of blisters, blowholes, and all defects. Bearing surfaces shall be planed or ground to ensure flat, true surfaces. Covers shall be true and set within rings at all points.

   (b) Rings shall be grouted in place and made watertight with a high-strength, non-shrink grout meeting ODOT SSC Section 02440.50(b), "Non-Shrink Grout," such as Alcrete Twenty Minute Fast Setting Grout®, or approved equal. Unused grout shall be discarded after 20 minutes and shall not be used. Rings shall not be brought to grade with lumber.

   (c) Frames and covers shall be standard or suburban, depending on the manhole location and as approved by the City's authorized representative. Suburban style manhole frames shall not be installed in PCC streets or arterial roadways.

   (d) Manholes installed outside of paved street or sidewalk areas shall be installed with a tamperproof frame and cover as shown in Detail No. S-2060 of these standards.

4. **Manhole Types:** Manholes shall conform to the following.

   (a) **Precast 48-Inch-Diameter Manholes:** Materials shall conform to the requirements of ASTM C-478. Minimum wall thickness shall be 5 inches.

   (b) **Precast Large-Diameter (60-inch or larger) Manholes:** Materials shall conform to the requirements of ASTM C-478. The manufacturer or design engineer shall submit supporting calculations, stamped by a Professional Engineer registered in the State of Oregon, documenting the structural integrity of the manhole.

   (c) **Precast Manhole Tops:** Standard eccentric cone, short eccentric cone, and flat slab tops shall be provided in accordance with Section 301.8.01, "Manhole Design." Eccentric cones shall conform to all requirements of ASTM C-478, with the exception of the steel reinforcement requirement. Precast manhole tops shall be designed to withstand AASHTO H-20 loadings.

   (d) **Permeability Testing:** Before precast manhole sections of any size are delivered to the job site, the sections shall meet the permeability test requirements of ASTM C-14 and ASTM C-497.

   (e) **Precast Bases:** Precast manhole bases shall be used, except when placing a manhole over existing pipe. Precast bases shall conform to the requirements of ASTM C-478. The base riser section shall be integral with the base slab.

(f) **Poured-in-place Bases:** Poured-in-place manhole bases may only be used when placing a manhole over an existing pipe.

5. **Manhole Pipe Connectors:** Connections to manholes shall be made with an approved flexible connector specifically manufactured for the intended use, conforming to ASTM C923, and in accordance with Detail No. S-2005 of these standards. Field fabricated waterstops or improvised adapters, such as gaskets stretched over the pipe, will not be allowed.

   Connections to existing manholes may be made with a sand collar fabricated of the same material as the connecting pipe by an approved manufacturer in accordance with Detail No. S-2005 of these standards. Sand collars shall be constructed with a gasketed joint located within 12" or half the pipe diameter, whichever is greaer, from the manhole wall. Sand collars shall not be fabricated in the field.

6. **Pipe Stubouts for Future Sewer Connections:** Pipe stubouts shall be the same type as approved for use in the lateral, main, or trunk sewer construction. Strength classifications shall be the same class as in adjacent trenches. Where two or more different classes of pipe exist at a manhole, the City's authorized representative shall determine the strength classification. Connect stubouts to manholes as specified in Section 301.8.01.d.2, "Connection to Existing Manholes." Rubber-gasketed, watertight plugs shall be furnished with each stubout and shall be adequately braced against air test pressures.

7. **Gaskets:** Manhole sections shall be installed with either preformed rubber gaskets or preformed flexible joint sealant or plastic gaskets. Rubber gaskets shall conform to AASHTO M 315 and ASTM C-443. Preformed flexible joint sealant and plastic gaskets shall meet all requirements of AASHTO M 198 and ASTM C-990.

8. **Manhole Steps**: Steps shall be required and shall be constructed as specified and shown in Detail No. S-2080 of these standards, unless otherwise approved by the City's authorized representative. When pipe is 24 inches in diameter or smaller, steps shall be located as indicated in Detail No. S-2065 of these standards. For pipe larger than 24 inches in diameter, steps shall be located over a bench as coordinated with the City's authorized representative.

c. **Workmanship**

1. **Foundation Stabilization:** If, in the opinion of the geotechnical engineer or the City's authorized representative, unstable subgrade material exists that will not support the manhole or other structure, the contractor shall excavate below grade and backfill with foundation-stabilization material in accordance with the standards of Section 601.3.02.d, "Trench Foundation."

2. **Pipe Connections:** All rigid pipes, such as concrete, entering or leaving the manhole shall be provided with flexible joints within 1 foot or half the pipe diameter, whichever is greater, of the manhole structure and shall be placed on firmly compacted bedding. All flexible pipe, such as PVC, shall connect to manholes using connectors as specified in Section 301.8.01.b.5, "Manhole Pipe

Connectors." Special care shall be taken to see that the openings through which pipes enter the structure are completely watertight.

3. **Flexible Joints:** At rigid pipe connections, such as concrete,, where a flexible joint cannot be provided within the greater of 1 foot or half the pipe diameter from the manhole, a 6-inch concrete encasement shall be constructed around the entire pipe, from the manhole base to within 1 foot of the pipe joint, at the discretion of the City's authorized representative. The pipe encasement shall be constructed integrally with the manhole base. Pipes laid out of the manhole shall be shortened to ensure that the first flexible joint is no more than 1 foot from the manhole base.

4. **Manhole Connections:** The contractor shall connect sewer pipe to manholes as specified in Section 301.9.01.d, "Types of Connections."

5. **Concrete Bases (Poured-in-Place):** Poured-in-place bases shall be used over existing pipelines in accordance with Detail No. S-2010 of these standards for 48" diameter manholes. For manholes greater than 48" in diameter, poured-in-place bases shall be provided in accordance with Detail No. S-2045 of these standards. The contractor shall remove water from the excavated area, place the compacted aggregate base, construct the concrete base, and set the first precast manhole section before the concrete has set. The first precast manhole section shall be properly located and plumb and have a uniform bearing throughout the full circumference. The contractor shall deposit sufficient concrete on the base to assure a watertight seal between base and manhole wall. Twenty-four hours shall be allowed to elapse before the remaining manhole sections are placed on the base, unless otherwise approved by the City's authorized representative. Where poured-in-place concrete bases are used to construct manholes over existing storm lines, comply with Section 301.9.01.d.3, "Manholes Over Existing Sewers."

6. **Drop Manholes**

   (a) The maximum free drop in a manhole shall be 18 inches. See Section 301.9.01.d.4, "Shallow Inside Drop Manhole," for construction of this connection.

   (b) When more than 18 inches feet of drop exists, a drop manhole shall be provided in accordance with Section 301.8.01, "Manhole Design."

7. **Placing Manhole Section:** The contractor shall clean the end of each sections of foreign material. Manholes shall be installed with either watertight rubber O-rings, preformed flexible joint sealant or preformed plastic gaskets per Section 301.9.01.b.7, "Gaskets" and in conformance with the manufacturers' recommendations. If plastic gaskets are used, the inside seams shall be grouted with a high-strength, non-shrink grout meeting ODOT SSC Section 02440.50(b), "Non-Shrink Grout," such as Alcrete Twenty Minute Fast Setting Grout®, or approved equal. Unused grout shall be discarded after 20 minutes and shall not be used. All grouted joints and pick holes shall be troweled smooth. Manholes will be visually inspected for water leakage by the City's authorized representative. Any leakage observed shall be repaired at the contractor's expense, and the manhole re-inspected.

8. **Manhole Inverts:** The contractor shall construct manhole inverts in conformance with Detail No. S-2005 or Detail No. S-2010 of these standards. Inverts shall have smooth transitions to ensure an unobstructed flow through the manhole. The contractor shall remove all sharp edges or rough sections that tend to obstruct flow.

9. **Manhole Stubouts:** The contractor shall install stubouts from manholes for sewer extensions, as shown in these standards or as required by the City's authorized representative. A watertight flexible connection shall be provided in all new manholes. The contractor shall construct invert channels in accordance with Detail No. S-2005 or Detail No. S-2010 of these standards. The minimum length of stubouts in existing manholes shall be 12 inches outside the manhole wall. Pipes shall be grouted in precast walls or the manhole base to create a watertight seal around the pipes. The contractor shall add compacted base rock, as specified in these standards, over undisturbed earth under all stubouts.

10. **Manhole Extensions, Rings, and Covers:** The contractor shall install rings and covers on top of manholes to positively prevent all infiltration of surface water or groundwater into manholes. Rings shall be set in a bed of high-strength, non-shrink grout meeting ODOT SSC Section 02440.50(b), "Non-Shrink Grout," such as Alcrete Twenty Minute Fast Setting Grout®, or approved equal, with the grout carried over the flange of the ring, and shall be set so that tops of covers are flush with the surface of the adjoining pavement, or 1 foot above natural ground, unless otherwise directed by the City's authorized representative. Unused grout shall be discarded after 20 minutes and shall not be used. Grouted surfaces shall be troweled smooth. Total thickness of grade rings shall not exceed 12 inches; rings shall be grouted watertight. Drop from rim to first manhole step shall not exceed 27 inches. In designated floodplain areas, all manholes shall be at an elevation of at least 2 feet greater than the 100-year storm event.

d. **Types of Connections**

1. **Connections to New Manholes:** The contractor shall connect storm sewers to new manholes at the locations shown on the plans. All pipes entering or exiting the manhole shall be water tight. Connection shall be done using a rubberized, core-seal boot. The connection shall be grouted smooth on both the interior and exterior of the manhole..

2. **Connection to Existing Manholes:** The contractor shall connect storm sewers to existing manholes at the locations shown on the plans. Contractor shall submit a plan for diversion control and receive written approval from the City's authorized representative before proceeding with construction. The contractor shall provide all diversion facilities, and shall perform all work necessary to maintain sewage flow in existing sewers while connections are being made to the manholes. Connections to existing manholes shall be core-drilled, and the bases shall be grouted as necessary to allow a smooth flow into and through the existing manholes.

3. **Manholes Over Existing Sewers:**

   (a) The contractor shall construct manholes over existing operating storm sewer lines at the locations shown on the plans.

   (b) Manholes constructed over existing storm sewers shall have all portions of the pipe to be in contact with the manhole cleaned and:

      i. Concrete Pipe Connections: An approved commercial concrete bonding agent shall be applied to the pipe prior to placement of concrete.

      ii. PVC Pipe Connections: A dense coating of clean mortar sand shall be applied to the pipe using PVC solvent cement. After the cement has cured, an approved commercial concrete bonding agent shall be applied to the sand prior to placement of concrete. Water as a substitute for commercial bonding agent will not be allowed.

   (c) The contractor shall construct a poured-in place base under the existing sewer and the precast sections as specified.

   (d) The contractor shall not cut into any existing lines until the new manhole(s) are grouted and the new lines are balled, cleaned, and deflection tested and all portions of the storm line have been approved and accepted by the City's authorized representative.

   (e) After acceptance, the contractor shall sawcut into the existing line; cut edges of concrete pipe shall be covered with grout and troweled smooth; with ductile iron or plastic pipe, grout shall be applied up to cutout and troweled smooth.

4. **Shallow Inside Drop Manhole:** Where the invert of the connecting pipe is above the manhole shelf and less that 18 inches above the outlet, an inside drop shall be constructed utilizing Portland cement concrete. The stormwater entering the manhole shall follow a smooth concrete channel transitioning evenly from the invert of the inlet pipe into the main channel. Stormwater shall not be allowed to fall freely to the manhole base.

301.9.02 Catch Basins and Inlets

a. Materials

1. Aggregate, Cement, and Concrete: These materials shall meet the requirements of Section 301.9.01.b, "Manholes and Structures, Materials."

2. Frames, Grates, and Covers: All materials shall be flat bar steel (standard grade), cast iron or ductile iron complying with the requirements of ASTM A-36, A-663, or A-709.

3. Forms: All exterior surfaces shall be formed with steel or plywood. Other surfaces shall be formed with matched boards, plywood, or other approved material. Trench walls, rock, or earth will not be acceptable as form material.

4. Metal Reinforcement: All metal reinforcement shall conform to the requirements of ASTM A-615, Grade 60, deformed bars.

5. Precast Concrete Units: All precast units shall conform to the same requirements as manholes (ASTM C-478).

b. Workmanship

1. Excavation and backfill shall conform to the requirements of Section 301.9.01.c, "Workmanship."

2. **Bedding:** The contractor shall remove all water and debris from the excavation area, and shall install an 8-inch-minimum layer of compacted ¾"-0" crushed aggregate for a base.

3. **Cast-in-Place:** Cast-in-place catch basins shall have a minimum of 6 inches of concrete between the compacted crushed aggregate and the lowest invert. The forms used for cast-in-place catch basins shall be tight and well-braced. The storm pipe material shall extend into the poured concrete of the catch basin. All corners shall be chamfered. Immediately after placement, the concrete shall be consolidated with an approved vibrator. The top surface shall be screed, and exposed surfaces shall be troweled to a smooth finish, free from marks or irregularities. After forms are removed, the contractor shall patch any defects in the concrete with approved material.

4. **Precast:** After the base is prepared, the contractor shall set the precast catch basin to the proper line and grade. The storm pipe material being used shall connect to the precast catch basin.

5. **Inverts, Stubouts, and Sections:** Contractor shall clean the ends of all pipes and sections that contact the catch basin. All inverts, stubouts, and sections shall be installed according to Detail No. S-2085, S-2090, S-2095, or S-2120 of these standards, using a high-strength, non-shrink grout meeting ODOT SSC Section 02440.50(b), "Non-Shrink Grout," such as Alcrete Twenty Minute Fast Setting Grout®, or approved equal, making sure all sharp edges or rough sections are removed, to prevent obstruction of the flow. Unused grout shall be discarded after 20 minutes and shall not be used.

6. **Catch Basin Steps:** All catch basins deeper than 5 feet, measured from the top of the frame to the flowline, shall be oversized and have steps.

301.9.03 Stormwater Pipe and Fittings

a. General

1. It is not intended that the materials listed herein are to be considered equal or to be generally interchangeable for all applications. The material suitable for project conditions shall be determined by the Engineer of Record and approved by the City's authorized representative.

2. The materials used shall be adequate to carry anticipated dead and live loads within the deflection limits specified by the manufacturer. All pipe and culverts

shall have a minimum design service life of 75 years. Joints shall be gasketed, unless otherwise approved by the City's authorized representative.

3. Each piece of pipe and fitting shall be clearly identified as to strength, class, and date of manufacture.

b. Materials

Storm sewer pipe installed by open trenching shall have a minimum pipe stiffness at 5% deflection of at least 45 psi. Materials shall be the following types or approved equal:

1. **Reinforced Concrete Pipe**

(a) Reinforced concrete, nonpressure pipe shall conform to the requirements of ASTM C-76 and shall be of the class specified. Unless otherwise specified, pipe shall meet the design requirements of Wall B.

(b) Gaskets shall conform to the requirements of ASTM C-443.

(c) All steam-cured concrete pipe must be at least seven days old before it can be used. If the pipe has not been steam-cured, it must not be used before it has cured for 28 days.

(d) Fittings shall be manufactured integrally and be of a class at least equal to that of the adjacent pipe. Field taps shall be machine-drilled.

(e) Mortar used shall be standard nonshrink premixed mortar conforming to ASTM C-387 or in a proportion of one part Type II Portland cement to two parts clean, well-graded sand that will pass a ⅛-inch screen. Mortar mixed for longer than 30 minutes shall not be used.

2. **Ductile Iron Pipe (D.I.P.)**

(a) Ductile iron pipe shall be cement mortar lined with push-on joints conforming to the requirements of AWWA C-151/ANSI A21.51 and AWWA C-104/ANSI A21.4. The minimum thickness class shall be Class 50 (up through 12-inch diameter pipe) and Class 51 (for 14-inch diameter and larger pipe).

(b) Fittings shall be mechanical or push-on and be of a class at least equal to that of the adjacent pipe. Mechanical joint ductile iron fittings shall conform to AWWA C-110/ANSI A21.10. Push-on joint fittings shall be gray iron, with body thickness and radii of curvature conforming to ANSI A-21.10. Rubber gasket joints shall conform to AWWA C-111/ANSI A-21.11.

3. **Polyvinyl Chloride Pipe (PVC)**

(a) PVC pipe and fittings shall conform to ASTM D-3034 (SDR 35 or lower) and ASTM F-679. Where added pipe strength is required, PVC pipe shall conform to AWWA C-900and AWWA C-905.

(b) A2000 (PVC): All A2000 PVC pipe and fittings shall conform to ASTM F-949 specifications.

(c) PVC rib: PVC rib pipe and fittings shall be made of PVC, as defined in ASTM D-1784. The pipe stiffness shall correspond with the series, in accordance with ASTM D-2412. Series 46 and 28 are allowed. Gaskets shall conform to ASTM F-477.

4. **Corrugated polyethylene (CPP):** Corrugated polyethylene pipe, double wall, and fittings shall be made of polyethylene compounds that conform with the physical requirements of Type III, Category 3, 4 or 5, P23, P33, P34, Class C, with the applicable requirements defined in ASTM D-1248. CPP installed by open trenching shall have minimum pipe stiffness at 5% deflection of at least 45 psi. Spiral pipe is not acceptable. Corrugated polyethylene pipe shall conform to AASHTO M-294 specifications.

5. **Fittings**

(a) General

i. Manufactured tee fittings shall be provided in the sewer main for side sewers. Fittings shall be of sufficient strength to withstand all handling and load stresses encountered.

ii. Fittings shall be of the same materials as the pipe. Material joining the fittings shall be of the same material as the pipe.

iii. Material joining the fittings to the pipe shall be free from cracks and shall adhere tightly to each joining surface.

iv. All fittings shall be capped or plugged, and shall be gasketed with the same gasket material as the pipe joint, fitted with an approved mechanical stopper, or have an integrally cast knockout lug. The plug shall be able to withstand all test pressures without leaking. When later removed, the plug shall permit continuation of piping with jointing similar to joints in the installed line.

(b) Mechanical Couplings: Mechanical couplings shall be wrought steel. Installation procedures must meet the manufacturers' recommendations.

6. **Line Tap Saddle**

All saddles approved for sanitary sewer tap installation (see Section 401.4.02.b.5) shall be allowed on storm taps, and as follows:

(a) DFW/HPI saddle—an elastomeric polyvinyl chloride saddle with steel-reinforced edges and stainless-steel bands, series 300. This saddle is allowed on PVC, clay, IPS, concrete, asbestos cement, and PE pipe.

(b) Saddles installed on corrugated aluminum pipe shall be fabricated and installed using stainless-steel nuts and bolts. Bolts and nuts shall conform to AWWA C-111/ANSI A21.11.

c. Workmanship

1. **Line and Grade**

(a) Survey control hubs for both line and grade shall be provided by the design engineer in accordance with Section 301.1.15, "Surveying."

(b) Variance from the established line and grade shall not be greater than ¼ inch for grade and ½ inch for line, provided that such variation does not result in a level or reverse-sloping invert.

(c) The contractor shall check line and grade as necessary. If the limits prescribed in these standards are not met, the work shall be immediately stopped, the City's authorized representative notified, and the cause remedied before proceeding with the work.

(d) Variation in the invert elevation between adjoining ends of pipe, due to nonconcentricity of joining surface and pipe interior surfaces, shall not exceed 1/64 per inch of pipe diameter, or ½ inch maximum.

2. **Pipe Handling**

(a) The contractor shall unload pipe only by approved means. Pipe shall not be unloaded by dropping it to the ground and pipe shall not be dropped or dumped into trenches.

(b) Pipe shall not be unloaded or stored within the public right-of-way unless approved by the City's authorized representative.

(c) The contractor shall inspect all pipe and fittings before lowering them into trenches to ensure that no cracked, broken, or otherwise defective materials are used.

(d) The contractor shall clean the ends of pipe thoroughly, remove foreign matter and dirt from inside the pipe, and keep it clean during laying and joining.

(e) The contractor shall lower the pipe into the trench in such a manner as to avoid any physical damage to the pipe.

(f) The contractor shall remove all damaged pipe from the job site.

3. **Foreign Material**

(a) The contractor shall take all necessary precautions to prevent excavated or other foreign material from entering the pipe during the laying operation.

(b) At all times, when laying operations are not in progress, the contractor shall use a mechanical plug at the open end of the last laid section of pipe to prevent entry of foreign material or creep of the gasketed joints.

4. **Pipe Laying**

(a) Trench excavation shall be in accordance with Section 6, "Trench Excavation and Backfill."

(b) Pipe laying shall proceed upgrade, with the spigot ends pointing in the direction of flow.

(c) After a section of pipe is lowered into the prepared trench, the contractor shall clean the end of the pipe to be joined, the inside of the joint, and the rubber ring (if required) immediately before joining the pipe.

(d) At the location of each joint, dig bell (joint) holes of ample dimensions in the bottom of the trench and at the sides, where necessary, to permit the joint to be made properly.

(e) The joint shall be assembled according to the recommendations of the manufacturer. The contractor shall provide all special tools and appliances required for the joint assembly. The contractor shall take care to properly align the pipe before forced entirely home.

(f) Upon completion of pipe laying all pipe joints shall be in the "home" position, which is defined as the position where the least gap (if any) exists, when the pipe components that comprise the joint are fitted together as tightly as the approved joint design will permit. Gaps at pipe joints shall not exceed that allowed by the manufacturer's recommendations.

(g) Joints that exceed the manufacturers allowed gap shall be repaired as required by the City's authorized representative at no cost to the City. Where 3 or more joint gaps between two structures exceed that recommended by the manufacturer, then all pipe from the first gap to the structure shall be properly re-laid at the Contractor's sole expense.

(h) After the joint is made, the pipe shall be checked for alignment and grade.

(i) The trench bottom shall form a continuous and uniform bearing and support for the pipe at every point between joints.

(j) After installation, the contractor shall backfill the trench to the extent necessary to prevent pipe movement from any cause including uplift or floating. Upon inspection and approval by the City's authorized representative, the contractor shall complete backfill of the trench.

(k) Do not lay pipe in water or when, in the opinion of the City's authorized representative, trench conditions are unsuitable.

5. **Movable Shield:** When pipe is laid in a movable trench shield, the contractor shall take all necessary precautions to prevent the pipe joints from pulling apart when the shield is moved ahead. The bottom of the shield shall not extend below the springline of the pipe without recompacting the pipe zone.

6. **Cutting Pipe:** When cutting or machining the pipe is necessary, the contractor shall use only the tools and methods recommended by the pipe manufacturer and approved by the City's authorized representative. The contractor shall cut ductile

iron pipe using a method approved by the City's authorized representative; all burrs or rough edges shall be removed before joining pipe. The contractor shall not flame-cut the pipe.

7. **Transition Fittings:** When joining different types of pipes, the contractor shall use approved ridged fittings. Where ridged fittings are not available, flexible fittings with No. 305 stainless steel bands, such as Fernco, Caulder, or approved equal, may be considered upon approval of the City's authorized representative. Flexible fittings may require additional support under the coupling. Bell type couplings are considered flexible.

   (a) Shear ring/ridge transition couplings meeting ASTM C-564 or equal shall be used.

   (b) PVC couplers or adapters shall meet the specifications for ASTM D-3034, SDR 35 pipe fittings.

   (c) Ductile iron transition couplings shall be manufactured from ductile iron conforming to ASTM A-536, grade 65-45-12, for center and end rings. Rubber gaskets, bolts, and nuts shall conform to AWWA C-111/ANSI A21.11.

8. **Concrete Closure Collars**

   (a) The contractor shall pour closure collars against undisturbed earth, remove all water from the excavation, and construct suitable forms to obtain shapes that will provide full bearing surfaces against undisturbed earth, as indicated in Detail No. S-2190 of these standards.

   (b) Closure collars shall be used only when approved by the City's authorized representative, and then only to make connections between dissimilar pipe or where standard rubber-gasketed joints are impractical.

   (c) Before the closure collars are installed, the contractor shall wash the pipe to remove all loose material and soil from the surface where they will be placed.

9. **Trench Backfill:** The contractor shall place trench backfil in accordance with Section 6, "Trench Excavation and Backfill."

10. **Storm Sewer Laterals and Tees**

    (a) Lateral storm sewers shall be connected to new storm sewer mains with manufactured tee fittings per Section 301.9.03.b.5, "Fittings", except where storm sewer laterals are larger than 50% of the diameter of the main line. Such storm laterals shall be connected to the main line through the installation of a manhole. Line taps in new storm sewer mains are not permitted.

    (b) Install storm sewer laterals and tee fittings in accordance with Detail No. S-2175 of these standards.

    (c) Lateral pipe and fittings shall consist of one type of material throughout and no interchanging of pipe and fitting material is allowed.

11. **Line Taps**

(a) Line taps are allowed on existing storm sewer lines only and shall be core-drilled unless otherwise approved by the City's authorized representative. Core-drilled holes shall be made using a cylinder-style hole saw for plastic pipe material only, or a diamond core bit for concrete and ductile iron pipes.

(b) Line tap connections to storm lines shall be located a minimum 12" from the storm mainline pipe bell.

(c) PVC tee saddles shall be installed in accordance with Detail No. S-2155 of these standards. Inserta Tee® shall be installed in accordance with Detail No. S-2160 of these standards.

(d) Line taps shall be centered on the spring line of the pipe being tapped.

(e) The area around the line tap installation site shall be cleaned and free of all rough edges before installing the fittings.

(f) While installing the connection, no rock, dirt, or debris shall be allowed to enter the main sewer line from the core hole.

(g) The contractor shall install ¾"-0" crushed aggregate in the pipe zone around the line tap, from 6 inches below the pipe to 12 inches above the pipe.

(h) Laterals shall have tracer wire installed beside the pipe and plastic caution tape installed 1-foot above the pipe crown as shown in Detail No. S-2175 of these standards.

301.10.00 CONSTRUCTION SPECIFICATIONS

301.10.01 General Provisions

The specifications outlined here, together with the standards established by the Oregon DEQ, the U.S. Environmental Protection Agency, and any other applicable requirements of the City, shall govern the character and quality of material, equipment, installation, and construction procedures for gravity-flow portions of public storm systems.

301.10.02 Scheduling

a. The contractor shall plan their construction work in conformance with Section 101.8.02, "Scheduling."

b. Newly installed storm sewer lines shall not be placed in service until necessary testing is complete and system has been approved by the City's authorized representative.

301.10.03 Environmental Protection, Erosion Prevention, and Sediment Control

The contractor shall take all appropriate measures and precautions to minimize the work's impact on the environment and shall control erosion, as outlined in Section 101.9.00, "Environmental Protection, Erosion Prevention, and Sediment Control."

301.10.04 Interferences and Obstructions

Various obstructions may be encountered during the course of the work. The contractor shall follow the guidelines established in Section 101.8.05, "Interferences, Obstructions, and Abandoned Utilities."

301.10.05 Abandon Storm Facilities

a. **Storm Sewer Pipe:** Storm sewer pipe facilities to be abandoned shall be cut off and completely removed at 48-inches minimum below finish grade, unless specifically stated otherwise. Storm sewer pipe to be abandoned shall be removed or completely filled with a flowable, Controlled Low-Strength Material (CLSM) as directed by the City's authorized representative.

b. **Manholes:** Manholes to be abandoned shall have manhole frame, cover, grade rings, cone section or flat slab top removed and manhole sections cut and removed at 48-inches minimum below finish grade, unless specifically stated otherwise. The manhole base shall be rubblized or perforated to prevent the entrapment of water. The remaining portion of manhole shall be backfilled with Class B material in accordance with Section 6, "Trench Excavation and Backfill."

301.10.06 Contaminated Soil or Hazardous Material

If during construction contaminated soil or hazardous materials or chemicals are encountered, the Contractor shall follow the procedures specified in Section 101.9.02, "Contaminated Soils or Hazardous Materials."

301.10.07 Trench Excavation, Preparation, and Backfill

Trench excavation, preparation, and backfill shall conform to the requirements of Section 6, "Trench Excavation and Backfill."

301.10.08 Preservation, Restoration, and Cleanup

a. **Cleanup:** Cleanup of all construction debris, excess excavation, and excess materials and complete restoration of all fences, mailboxes, ditches, culverts, signposts, and similar items shall be completed according to Section 101.8.16, "Preservation, Restoration, and Cleanup."

b. **Preservation of Drainage Ditches:** After backfilling the trenches, the contractor shall restore all public and private storm drain ditches that were destroyed, damaged, or otherwise modified during construction to the condition of the ditch before construction. Ditches shall be built in their original locations unless otherwise redesigned as part of the project.

301.10.09 Bores

a. General

The carrier pipe in all bores shall be installed inside a steel case, unless otherwise approved by the City's authorized representative (see Detail No. S-2165 of these standards).

b. Installation

1. **Casing:** The casing shall be smooth steel of a size to permit proper construction to the required line and grade. The steel casing shall be fabricated in sections for field-welded joints. The casing wall thickness shall be a minimum of ¼ inch for pipe diameters of 6 to 12 inches and shall be a minimum of 5/16 inch for pipe diameters of 15 to 24 inches, or in accordance with the requirements of the jurisdiction of the right-of-way.

2. **Pipe Supports:** The sewer pipe shall be continuously supported on three sides by pipe supports, except at joints. Pipe supports shall be No. 2 HDPE plastic block, or approved equal. Strapping and hardware shall be stainless steel.

3. **Placing Fill in Casing:** The annular space shall be completely filled between the casing and pipe with lean grout or sand to prevent pipe flotation.

4. **Concrete Seals and Fill:** After the storm pipe is tested and approved, concrete plugs shall be poured at each end of the casing. The annular space between the casing and pipe shall be completely filled with lean grout or sand to prevent pipe flotation.

c. Railroad Crossings

Prior to beginning any under-track work, applicant shall obtain proper permit(s) from ODOT or present owner of railroad line and written approval of plans from user(s) of railroad line. Install the pipe by tunneling, jacking, boring or similar methods, approved by the Railroad. Install the pipe to the lines and grades established and backfill completely all voids around the installation with specified material, to the satisfaction of the railroad.

301.11.00 STORMWATER MANAGEMENT FACILITY SELECTION AND DESIGN

Each new development is responsible for mitigating its impacts on the public stormwater system. The City's authorized representative shall determine which of the following techniques may be used to satisfy this requirement. Stormwater quantity on-site detention/retention facilities shall be designed to mitigate post-development flows in conformance with this section. Mitigation requirements shall meet applicable federal, state, and local standards and regulations.

This section describes the methods and criteria for selecting and designing stormwater management facilities for projects that exceed the development thresholds in Section 301.1.02, Stormwater Management Thresholds". The pollutants of concern include, but

are not limited to, sand, silt, and other suspended solids; metals such as copper, lead, and zinc; nutrients such as nitrogen and phosphorus; certain bacteria and viruses; and organics such as oil, grease, petroleum hydrocarbons, and pesticides. Methods of removing pollutants include sedimentation or settling, filtration, plant uptake, ion exchange, adsorption, and bacterial decomposition. Floatable pollutants such as oil, debris, and scum can be removed with separators. Additional water quality treatment is required for certain types of development categorized as high-risk for pollutants described in Section 301.12.00, "Source Controls".

301.11.01 Impervious Area Used in Design

a. Stormwater management facilities are required when proposed development establishes or increases the impervious surface area by more than 5,000 square feet. Development includes new development, redevelopment, and/or partial redevelopment.

b. For single-family and duplex residential subdivisions, stormwater management facilities shall be sized for all impervious areas created by the subdivision, including all residences on individual lots at the current rate of 2,750 square feet of impervious surface area per dwelling unit.

c. For all developments other than single-family and duplex dwellings, including rowhouses and condominiums, the sizing of stormwater management facilities shall be based on the impervious area to be created by the development, including structures and all roads and impervious areas. Impervious surfaces shall be based on building permits, construction plans, or other appropriate methods of measurement deemed reliable by the City's authorized representative.

d. The City encourages design initiatives that reduce the effective impervious area. For developments other than single-family and duplex dwellings, a smaller stormwater management facility may be possible.

301.11.02 Stormwater Management Facility Design Standards

a. **Purpose**

New development and other activities that create new impervious surfaces or increase the amount of stormwater runoff or pollution leaving the site are required to construct or fund permanent stormwater management facilities to reduce contaminants entering the stormwater and surface water system.

b. **Criteria for requiring construction of a stormwater management facility**

A stormwater management facility shall be constructed on site unless, in the judgment of the City's authorized representative, any of the following conditions exist:

1. The site location, size, gradient, topography, soils, or presence of an SROZ make it impractical or ineffective to construct an on-site facility.

2. The subbasin has a more effective, existing regional site designed to incorporate the development or which has the capacity to treat the site stormwater.

3. The development is for construction of one- or two-family (duplex) dwellings on existing lots of record which will establish or create less than 5,000 square feet of impervious surface.

c. **Facility Selection**

1. LID facilities such as planters, swales, rain gardens, ponds, and other vegetated facilities are the preferred strategy to meet the stormwater management requirements for water quality treatment and flow control. Impervious area reduction techniques, such as preservation of existing trees, retaining vegetation and open space, clustering buildings, disconnecting residential downspouts, and constructing pervious pavement and green roofs, may be used as techniques to help mitigate stormwater runoff and reduce the size of the required stormwater management facilities.

   The following types of stormwater management facilities can be used to meet these standards:

   (a) Impervious Area Reduction Methods:

      i. Porous pavement

      ii. Green roof

      iii. Planting and preservation of trees (subject to limitations)

   (b) Stormwater Management Facilities:

      i. Stormwater planters

      ii. Rain gardens

      iii. Vegetated filter strips

      iv. Vegetated swales

      v. Detention ponds

      vi. Manufactured treatment technologies (various types, subject to limitations)

      vii. Underground detention facilities (for flow control)

2. To select the most appropriate facilities applicants may use Table 3.11 as a quick reference to match stormwater management facility types with common design objectives and site constraints.

Table 3.11. Facility Selection

Facility can be used for:	Porous Pavement	Green Roof	Tree	Stormwater Planter	Rain Garden	Filter Strip	Vegetated Swale	Detention Pond	Manufactured Treatment	Detention Tank
Impervious Area Reduction	✓	✓	✓							
LID Facility Requirements*	✓	✓		✓	✓	✓	✓	✓		
Flow Control	✓	✓		✓	✓		✓	✓		✓
Water Quality Treatment	✓	✓		✓	✓	✓	✓	✓	✓	
Private Property	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Public Right-of-Way (ROW)	✓	✓	✓	✓	✓	✓	✓	✓		✓
Steep Slopes		✓	✓						✓	✓

*Facilities that include impermeable liners to prevent infiltration do not meet the LID requirements.

3. Alternate Facilities - Applicants may propose stormwater management facilities that are not listed in Table 3-11. Such a proposal will require the applicant to submit a request for a modification to these standards. Alternate facilities must be sized using the Engineered Method as described in this section. An example of an alternate facility would be for the use of a drywell, infiltration trench, or other underground injection control (UIC) facility on private property. To propose a UIC on private property, the applicant would need to prepare appropriate registration information to ODEQ and submit a modification request to the City.

d. **Design Criteria**

1. Stormwater management facility design is based on meeting the City's design criteria to address LID requirements, water quality treatment standards, and flow control requirements.

2. The goal is to prioritize the use of LID facilities to the MEP to mimic the natural stormwater runoff conditions of the pre-developed site and recharge the groundwater. The City's strategy to meet this goal is to incorporate LID principles in site planning and facility design.

3. Either one of the following two options may be used to meet the LID requirement:

   (a) LID facilities to the MEP – Utilize LID facilities to the MEP to address the water quality and flow control requirements of the site. LID facilities shall

be sized according to the design requirements of this section, utilizing either the BMP Sizing Tool or the Engineered Method. When site constraints limit the surface area available for stormwater management facilities, MEP is defined as installing LID facilities with a surface area of at least 10% of the total new plus replaced impervious area.

(b) Onsite Retention – Retain and fully infiltrate the 10-year design storm on site using LID facilities. This is equivalent to retaining and infiltrating runoff from new impervious surface for the 3.4-inch storm over 24 hours. The facility shall fully infiltrate within 72 hours following the beginning of the storm event. Infiltration of the full 10-year design storm is assumed to satisfy both water quality and flow control requirements.

4. **On-site and off-site drainage concerns:** Site development improvement projects shall address on-site and off-site drainage concerns, both upstream and downstream of a project, including but not limited to the following:

   (a) Modifications to the existing on-site storm drainage facilities shall not restrict flows creating backwater onto off-site property to levels greater than the existing situation, unless approved by the impacted off-site property owners and the City's authorized representative. The off-site property owner(s) shall agree to and sign a permanent easement legally describing the location of the backwater storage and authorizing the use of their property for stormwater drainage and detention/retention purposes. The easement shall be in a form approved by the City.

   (b) Stormwater runoff will be discharged in a manner to not adversely affect the safety and/or flooding potential of adjacent or downstream property owners. The design of storm drainage facilities shall analyze the impact of restrictions downstream of the project site, in accordance with Section 301.11.02.5, "Review of Downstream System." Downstream restrictions that create on-site backwater may be required to be removed by the applicant, at the discretion of the City's authorized representative, or the on-site backwater shall be addressed in the design of the development's storm system. The removal of downstream obstructions shall not be allowed if removal would create downstream capacity problems.

   (c) If the projected increase in the surface water runoff from a proposed development will cause or contribute to damage from flooding to existing buildings or dwellings, the downstream stormwater system shall be enlarged to relieve the identified flooding condition before development, or the applicant shall construct an on-site detention/retention facility.

5. **Review of Downstream System:** The design engineer must perform a two-stage analysis of the drainage system downstream of the development

   (a) The analysis shall extend downstream to a point in the drainage system where the additional flow from the proposed development site constitutes 10% or less of the total tributary drainage flow (for example, the analysis point for a 10-acre site would be analyzed to the nearest downstream point with a drainage area of 100 acres).

(b) When the additional flow from the proposed development drops to less than 10% of the total tributary drainage flow, the analysis will continue for the lesser of the following:

i. One-quarter of a mile; or

ii. Until the additional flow constitutes less than 5% of the total tributary drainage flow.

6. **Limited Downstream Conveyance:** If the downstream capacity is undersized, the following design requirements shall be considered:

(a) Downstream system capacity analysis is the responsibility of the applicant for new development. Based on the information submitted, the City will determine the adequacy of the downstream system. This determination will be based on the analysis submitted but may also be based upon existing information indicating current or past drainage problems downstream from the project.

(b) When downstream drainage conveyance systems have limited or inadequate capacity or systems are determined to be undersized, or when, in the opinion of the City, property or properties may be adversely affected by the existing and/or proposed stormwater release rates; additional stormwater flow control measures may be required to reduce flow contributions to the downstream system. This additional flow control requirement may still require downstream conveyance system improvements in order to safely convey all existing and proposed stormwater runoff generated from the upstream and onsite drainage basins.

(c) If additional stormwater flow control measures are required by the City, the applicant may have the option to correct and/or improve downstream drainage conditions so that the proposed stormwater release rates do not have to be further restricted.

(d) The applicant is responsible to replace, repair, upsize, construct, or reconstruct the downstream conveyance system in order to provide the capacity necessary to develop the property. The downstream conveyance system may include any open or closed public or private stormwater conveyance system.

(e) The applicant is required to identify all off-site downstream conveyance restrictions and the cost of upsizing/improving these conveyance systems to meet the minimum conveyance requirements established in this section.

(f) Any off-site improvements will be the requirement and responsibility of the applicant to obtain easements, design approval, and authorization from all owners of any property and/or agency having the authority to regulate the activity. All agreements, easements, authorization and approvals shall be acquired prior to stormwater management plan approval.

7. **Severely Limited or No Downstream Conveyance System**

   (a) Where no conveyance system exists at the adjacent down gradient property line and the discharge was previously un-concentrated or significantly lower concentrated flow, measures must be taken to prevent adverse downstream impacts.

   (b) Drainage easements from downstream property owners may be needed and shall be obtained in addition to the construction of an adequate conveyance system prior to the City approving the stormwater management plan and/or issuing a Public Works Permit.

8. **Limited Infiltration:** For sites with conditions that limit the use of infiltration (fill, steep slopes, high groundwater table, well-head protection areas, and/or contaminated soils), utilizing LID facilities may not be practicable and the applicant may use lined, non-infiltrating or underground stormwater management facilities. In such cases, the applicant shall submit documentation of limiting conditions from a geotechnical engineer or engineering geologist registered in the State of Oregon, or documentation from ODEQ.

9. **Water Quality Requirement:** Water quality facilities shall be designed to capture and treat 80% of the average annual runoff volume to the MEP with the goal of 70% total suspended soils (TSS) removal. The treatment volume equates to a design storm of 1.0 inch over 24 hours. The BMP Sizing Tool addresses these water quality requirements to size stormwater management facilities.

   Hydrodynamic separators, when used as a sole method of stormwater treatment, do not meet the MEP requirement for stormwater treatment effectiveness with regard to these stormwater standards.

10. **Flow Control Requirement:** The duration of peak flow rates from post-development conditions shall be less than or equal to the duration of peak flow rates from pre-development conditions for all peak flows between 42% of the 2-year storm peak flow rate[1] up to the 25-year peak flow rate, based on a 2- through 25-year, 24-hour return storm. Specifically, the 2-year post-development runoff rates shall not exceed 42% of the 2-year predevelopment runoff rates; the 10- and 25-year post-development runoff rates shall not exceed the respective 10- and 25-year predevelopment runoff rates. A hydrologic/hydraulic analytical model capable of performing a continuous simulation of peak flow rates based on local rainfall data as presented in the Design Storm Distribution Chart (Table 3.4) shall be used to determine the peak flow rates, recurrence intervals and durations. The BMP Sizing Tool addresses flow control requirements for 42% of the 2-year to 10-year storm events to size stormwater management facilities. For the 25-year storm event the design engineer shall refer to Section 301.1.05.h, "Stormwater Systems Design Criteria".

[1] The lower threshold of 42% of the 2-year peak flow rate for flow-duration matching is based on a 2008 study by the Oregon Department of Transportation (ODOT) titled, "Water Quantity (Flow Control) Design Storm Performance Standard." ODOT's study found that bed movement in sand-bedded streams occurs at approximately two-thirds of the bank full flow, which is assumed to be roughly equivalent to the 1.2 year discharge. ODOT's flow frequency analysis established that two thirds of the 1.2-year discharge is approximately equivalent to 42 percent of the 2-year discharge.

11. The average, wet-season groundwater elevation shall be determined for the proposed stormwater management facility. Groundwater elevation may be established through measurements at existing wells, installation of piezometer(s), or other methods approved by the City's authorized representative. The facility shall be designed to exclude detention/retention capacity below the established wet-season groundwater elevation.

12. Stormwater management facilities may be allowed in the public right-of-way if approved by the City's authorized representative and maintained by the development.

13. Stormwater management facilities shall not be located in an area designed or used for vehicular parking.

14. General Conveyance: The conveyance system shall be designed in compliance with Section 301.1.13, "Conveyance System Hydraulic Standards". Development shall not cause or increase flooding of adjacent or downstream property. An upstream and downstream analysis of the drainage system shall be conducted according to the guidelines in Section 301.11.02, "Stormwater Management Facility Design Standards"**.**

15. Stormwater management facilities shall be designed to include inlet energy dissipation in conformance with Section 301.6.05, "Outfall Protection".

16. Stormwater management facilities shall be designed to allow for proper functioning with full sediment accumulation as allowed in Section 301.13.06, "Sediment Management/Pollutant Control, Requirements."

17. Interior sideslopes up to the maximum water surface = 4H:1V.

18. Maximum exterior sideslopes = 2H:1V, unless analyzed for stability by a Professional Engineer registered in the State of Oregon whose area of expertise is geotechnical engineering.

19. If slopes need to be mowed, maximum sideslope = 4H:1V

20. **Walls in Stormwater Management Facilities**

    (a) Retaining walls may serve as pond walls if the design is prepared and stamped by a Professional Engineer registered in the State of Oregon and a fence is provided along the top of the wall. At least 25% of the pond perimeter will be vegetated to a maximum side slope of 3:1.

    (b) Walls that are 4 feet or higher must meet all of the following criteria:

        i. Be approved by a Professional Engineer registered in the State of Oregon whose area of expertise is structural or geotechnical engineering.

        ii. The City shall not have maintenance responsibility for the wall. The party responsible for maintenance of the walls within the water

management facility tract or easement shall be clearly documented in the City's Stormwater Maintenance Covenant and Access Easement.

21. Minimum freeboard = 1 foot between the hydraulic grade line and the top of the structure or finish grade above pipe for the conveyance design from the 25-year design storm water surface elevation.

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

23. Maximum water storage depth in stormwater management facilities for the 100-year storm event shall not exceed 4 feet in depth, unless otherwise approved by the City's authorized representative. Where design depth exceeds 4 feet, the facility shall be constructed in conformance with public safety considerations (see Section 301.11.04.c).

24. A pond overflow system shall provide for discharge of the design storm event without overtopping the pond embankment or exceeding the capacity of the emergency spillway. Provide an emergency spillway sized to pass the 100-year storm event or an approved hydraulic equivalent. The emergency spillway shall be located in existing soils when feasible and armored with riprap embedded in concrete, or other approved erosion protection extending to the toe of the embankment (see Detail No. S-2275 of these standards).

25. Stormwater management facilities shall be designed in conformance with public safety considerations (see Section 301.11.04.c).

26. Stormwater management facilities shall be protected in conformance with Section 301.11.04, "Stormwater Management Facility Protection."

27. Access roads to stormwater management facilities shall be in conformance with Section 301.11.05, "Access Road Design."

28. Where an underground detention pipe system is used each pipe shall be provided with a clean out and a manhole access located at either end of the pipe structure

29. Vegetation within the stormwater management facilities shall be planted in accordance with Appendix B, "Landscape Requirements."

30. Stormwater management facilities shall be operational prior to installation of any impervious surface or hardscape designed to drain to the facility.

c. **Design Methods**

This section explains the two methods accepted by the City for designing stormwater management facilities: the BMP Sizing Tool Method and the Engineered Method. To use a different method for sizing a treatment facility type not covered in these standards, applicants shall obtain approval from the City's authorized representative prior to submitting permit applications for review.

1. BMP Sizing Tool Method

   (a) A BMP Sizing Tool application is available from the City to assist with the sizing of stormwater management facilities that meet the requirements of these standards. The following facilities can be sized using the tool:

      i. Rain Garden – Infiltration and Filtration

      ii. Stormwater Planter – Infiltration and Filtration

      iii. Vegetated Swale - Infiltration and Filtration

      iv. Infiltrator

      v. Detention Pond

   (b) The detention pond option will allow credit for the utilization of upstream LID facilities.

   (c) The report generated by the BMP Sizing Tool shall be included with permit application submittals. The BMP Sizing Tool can be used during the initial site planning and during final design. The soil infiltration rates used during final design shall meet the criteria outlined in these standards.

2. Pre-developed Hydrology

   For the purposes of hydrologic modeling, the pre-developed conditions of the site will be modeled as the historical vegetation which existed at the site prior to urban settlement. In many areas of the City, the pre-developed vegetation included Oak Savannah, which should be modeled in the sizing tool as grassland, good condition. Areas of the City that were cultivated for agriculture prior to urban development also may be modeled as grassland under the pre-developed condition requirements. The applicant may use historic photos, reports, or other available sources to document the condition of the site prior to urban settlement.

3. Facility Design Specifications

   (a) The BMP Sizing Tool was developed based on specific design requirements for each facility type. Facilities sized using the tool must follow the design details for ponding depth, overflow height, depth of growing media, depth of drain rock, and sizing of orifice controls (where relevant). Applicants who wish to propose alternate facility specifications may use Table 3-12 to adjust the size of the stormwater management facility calculated from the BMP Sizing Tool.

   (b) Applicants considering design adjustments beyond those included in Table 3.12 should utilize the Engineered Method to show how the proposed facility size and design specifications will meet the flow control and water quality requirements of these standards.

Table 3.12. Facility Sizing Adjustments

Facility Types	Design Modification	Facility Size Adjustment
Stormwater Planter Rain Garden Vegetated Swale	Increase growing media depth by 12 inches or more	Reduce required facility surface area by 25%

4. Engineered Method

   (a) As an alternative to the BMP Sizing Tool, the Engineered Method may be used to calculate the required size of stormwater management facilities for any size or type of development. The Engineered Method provides the developer with flexibility to factor in a wider variety of site data and facility design parameters to determine the size and configuration of stormwater management facilities.

   (b) The Engineered Method may be used to do the following:

      i. Address unique site conditions

      ii. Apply a new or emerging design technology

      iii. Propose alternate facility design specifications

   (c) The Engineered Method requires the development of a hydrologic/hydraulic analytical model capable of performing a continuous simulation of peak flows from long-term local rainfall records. The City must pre-approve the hydrologic/hydraulic analytical model prior to submittal or development of any plans and/or calculations. Regardless of how the stormwater calculations are performed, the report submitted to the City must show how the proposed stormwater management facilities meet the design criteria for LID, water quality, flow control, and conveyance provided in this section.

d. **Infiltration Rate and Testing**

1. To size stormwater management facilities, it is necessary to know the infiltration rate of the soil at the actual facility location. Infiltration testing is not required on development projects which create less than 5,000 square feet of new or replaced impervious surface.

2. The City has approved three methods for performing an infiltration test: Open pit falling head, Encased falling head, and Double-ring infiltrometer. Specifications for the test procedures are included in Appendix B.

e. **UIC Registration**

Subsurface discharging infiltration facilities that are defined by ODEQ as UICs (e.g., private soakage trenches or dry wells) shall be designed with approved pretreatment devices and registered with ODEQ as required. The City will not allow new UIC devices which accept stormwater runoff from a public ROW or for public ownership or maintenance.

f. **Planting and Irrigation Requirements**

1. Stormwater management facilities with vegetative plantings shall meet the following requirements:

   (a) Stormwater management facilities shall be planted and functional prior to impervious surfaces being installed.

   (b) Establishment procedures, such as control of invasive weeds, animal and vandal damage, mulching, re-staking, watering, and mesh or tube protection replacement, shall be implemented for the two-year landscape maintenance assurance period (Section 101.8.18.c) to ensure plant survival.

   (c) Selected plant materials should be appropriate for soil, hydrologic, and other facility and site conditions (See Appendix A).

   (d) The design for plantings and planting medium shall minimize the need for herbicides, fertilizers, pesticides, or soil amendments at any time before, during, and after construction and on a long-term basis.

   (e) Plants shall be selected and planted to minimize the need for mowing, pruning, and irrigation.

   (f) Certified weed-free native grass or native wildflower seed shall be applied at the rates specified by the suppliers. If plant establishment cannot be achieved with seeding prior to installation of impervious surfaces, the contractor shall plant the area with approved sod, plugs, container plants, or other means to complete the specified plantings and protect against erosion before water is allowed to enter the facility.

   (g) Side slopes of planted areas shall not exceed 3 feet horizontal to 1 foot vertical.

2. Soil Mixes for Use in Facilities

   Vegetated facilities require a soil/landscape system that simultaneously supports plant growth, soil microbes, water infiltration, nutrient and pollutant adsorption, and pollutant filtration and decomposition. Therefore, the soil mix selected for a facility is critical to its success. See the specific facility design details, and also refer to Appendix A for growing medium specifications for vegetated facilities.

3. Irrigation

   The applicant is allowed to choose the method to irrigate, such as by truck or irrigation system. Plant survival rates shall be in compliance with Section 101.8.18.c. “Landscape Maintenance Assurance”, as such the City recommends on-site irrigation to maintain the plant survivability. Temporary irrigation systems must be fully removed before the City releases the Landscape Maintenance Assurance bond.

301.11.03 General Requirements

a. No stormwater management facility shall be built in a public easement unless approved by the City's authorized representative. Stormwater management facilities are allowed to be located in the landscape areas of the public right-of-way when approved by the City's authorized representative and maintained by the Applicant.

b. Safety of stormwater management facilities shall be in conformance with Section 301.11.04, "Stormwater Management Facility Protection."

301.11.04 Stormwater Management Facility Protection

a. Stormwater management facilities shall be designed to prevent scouring at the inflow structure(s) by use of an engineered energy-dissipating device such as a Swale Inflow Spreader (see Detail No. S-2225 of these standards) or other method approved by the City's authorized representative.

b. The nearest upstream manhole from a stormwater management facility or any point of discharge shall be a stormwater pretreatment manhole conforming to Detail No. S-2050 of these standards.

c. Safety

1. Stormwater management facilities shall include a vegetated buffer or a safety bench.

2. Sideslopes in stormwater management facilities shall not exceed 4H:1V up to the maximum design water elevation.

3. Stormwater management facilities shall be posted with warning signs that prohibit swimming or wading.

4. Where fencing is required by federal, state, and local laws and ordinances for public safety considerations or security reasons, the fencing shall be aesthetically designed. No barbed wire fencing shall be used.

301.11.05 Access Road

Access roads are for maintenance and inspection purposes. All-weather access shall be provided for the entire perimeter of the stormwater management facility, unless otherwise approved by the City's authorized representative. At a minimum, access shall be provided for maintenance and inspection of the inflow and outflow structures of the facility. The following criteria are the minimum City requirements:

a. Three inches of Class C AC; over 8 inches of ¾"-0"compacted crushed aggregate; over firm subgrade. Crushed aggregate and subgrade shall be compacted to 95% of maximum dry density, as determined by AASHTO T-180.

or

The design engineer may submit a certified road design capable of supporting a 30-ton maintenance vehicle in all weather conditions.

b. The plan shall include design of strengthened sidewalk sections where maintenance vehicles will cross.

c. Maximum grade: 15% with a maximum 3% cross-slope.

d. Minimum width: 15 feet on straight runs and curves. Curves shall be designed with a minimum 40-foot interior radius.

e. A 2-foot wide gravel shoulder shall be provided on the facility side of the access road.

f. Access shall extend to within 10 feet of all control structures, unless otherwise approved by the City's authorized representative.

g. If fencing is required for public safety or security reasons (see Section 301.11.04.c.4), the fence shall include a 12-foot-wide lockable gate for maintenance access.

301.11.06 Stormwater Pretreatment Manholes

a. Hydraulic criteria

1. Minimum design flow = water quality flow.

2. An upstream flow splitter manhole may be used to bypass conveyance flows in excess of the Water Quality flow.

b. Design criteria

1. Shall be required immediately upstream of all stormwater management facilities, or any release point to a natural drainage.

2. Shall conform to Detail No.S-2050, "Stormwater Pretreatment Manhole," or an equivalent detail approved by the City's authorized representative.

3. Minimum manhole diameter shall be 60 inches.

4. Sump depth shall be no deeper than 5 feet from invert to bottom of sump, unless approved by City's authorized representative.

5. Volume of sump shall be 20 cubic feet per 1.0 cfs of flow into the water quality manhole, up to the 25-year flow. Flow calculations shall include the effect of an upstream flow splitter.

6. Maintain a 3-foot clear access zone between the inside structure wall and the interior outlet structure.

7. Orient access to structure in a clear zone.

301.11.07 Proprietary Stormwater Management Facilities

a. Proprietary stormwater management facilities are permitted on a case-by-case basis, with approval of the City's authorized representative.

b. The devices shall be sized in accordance with the manufacturer's recommendations. However, the facilities shall comply with the stormwater management facility design requirements in this section.

c. Technical submittals from the manufacturer are required, including hydraulic design criteria, particulate removal efficiency, and maintenance requirements and schedule.

d. When a proprietary stormwater system is used, prior to City acceptance of the project the applicant shall provide a letter from the system manufacturer stating that the system was installed per specifications and is functioning as designed.

301.11.08 Flood Management Design Standards

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

b. **Flood Management Areas Defined:** Flood management areas shall include, but are not limited to, the following:

1. Land identified within the 100-year floodplain and floodway, as shown on the Federal Emergency Management Agency (FEMA) flood insurance maps.

2. Land identified in updated flood studies or any other authoritative data documenting flood elevations, as approved by the City. The design engineer shall use the most recent and technically accurate information available to determine flood areas.

c. **Flood Plain Delineation:** In areas of the City where the 100-yr flood plain has not been defined as per Section 301.11.08.b, "Flood Management Areas Defined," the City Engineer may require a study to delineate the 100-yr flood plain prior to development of a site to access the potential impact to upstream or downstream properties.

d. **Design Criteria:** Design and construction of improvements within the 100-yr flood plain shall be in conformance with these Standards, Section 4.172, "Flood Plain Regulations" of the Wilsonville City Code, and all applicable federal, state, and local statutes and rules governing floodplains and flood hazard areas.

1. All fill placed in a floodplain shall be balanced with an equal amount of removed soil material and shall not decrease the floodplain storage capacity at any stage of a flood (2-, 10-, 25-, or 100-year event). No net fill in any floodplain is allowed except when ***all*** of the following conditions are met:

(a) When an area has received special protection from floodplain improvement projects that lower the floodplain or otherwise protect affected properties.

(c) Where the exceptions comply with adopted master plans, watershed management plans, or subbasin plans, if any.

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

2. Large areas may not be excavated to gain a small amount of fill in a floodplain. Excavation areas shall not exceed the fill areas by more than 50% of the square footage, unless approved by the City's authorized representative.

3. Any excavation dug below the winter low-water elevation shall not count toward compensating for fill, because those areas would be full of water in the winter and not available to hold stormwater after a rain. Winter low-water elevation is defined as the water surface elevation during the winter when it has not rained for at least three days, and the flows resulting from storms have receded. The elevation can be determined from records, studies, or field observation. Any fill placed above the 100-year floodplain will not count toward the fill volume.

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

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

6. Temporary fills permitted during construction shall be removed at the completion of construction and before the close of the in-stream work window, as defined by the ODFW or federal, state, or other local authority.

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

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

9. The floodplain may not be modified to increase water velocities such that streambank erosion will be increased, unless the streambanks are protected to prevent the increased erosion.

10. Uncontained areas of hazardous materials, as defined by the Oregon DEQ, are prohibited in flood management areas.

11. Any proposed work within, or modification to, a floodway must be certified by a Professional Engineer registered in the State of Oregon as to how it conforms to these standards and FEMA regulations.

12. For streams, creeks, rivers, and other watercourses where the floodway has not been identified, the entire floodplain shall be treated as a floodway unless a study has been prepared by a Professional Engineer registered in the State of Oregon and approved by the City's authorized representative to define the floodway limits for a stream section.

301.12.00 SOURCE CONTROLS

301.12.01 Applicability

Some site characteristics and uses may generate specific pollutants of concern or levels of pollution that are not addressed solely through implementation of the pollution reduction measures identified in this section. The site characteristics and uses in this section have been identified as potential sources for chronic loadings or acute releases of pollutants such as oil and grease, toxic hydrocarbons, heavy metals, toxic compounds, solvents, abnormal pH levels, nutrients, organics, bacteria, chemicals, and suspended solids. This section presents source controls for managing these pollutants at their source.

Stormwater discharge benchmarks for pollutants exist in National Pollutant Discharge Elimination System (NPDES) industrial stormwater 1200-Z permits issued by the Oregon Department of Environmental Quality (ODEQ) for facilities with industrial activities that are exposed to rainfall and stormwater runoff. The state also has water quality standards listed in Oregon Administrative Rules (OAR) 340 Division 041 for discharges to surface waters.

These source controls apply to all development, including new development, redevelopment, tenant improvements, or those existing sites proposing new off-site discharges. With tenant improvements, only those areas of a structure or activity area that are being disturbed under the permit are required to make the structural changes identified in this section. With new off-site discharges, only those proposed areas draining off-site will be subject to these regulations.

The requirements of this section are in addition to the applicable requirements as identified in these standards. Development sites discharging to storm and sanitary sewers are required to provide pollution reduction and flow control for stormwater in accordance with the standards.

For all structural BMP source controls, a *Source Control Installations Form*, which can be found on the City's website, shall be submitted as part of the stormwater management plan and/or building permit application packet. Applicants may propose alternatives to the source controls identified in this section. In that case, the applicant shall complete the *Special Requests Form*, which also can be found on the City's website. Requests for alternative source control or alternative design elements will require an additional review process and may delay issuance of related site development, building and/or plumbing permits.

Note: Developments which have existing or proposed off-site stormwater BMP facilities are not exempt from the source control requirements of this section.

301.12.02 Goals and Objectives for Source Control

The specific source control requirements are based on the following goals and objectives:

a. Prevent stormwater pollution by eliminating pathways that may introduce pollutants into stormwater.

b. Protect soil, groundwater, and surface water by capturing pollutants and reducing impacts to the environment.

c. Permit the wastewater discharges and areas with the potential for relatively consistent wastewater discharges (such as vehicle washing facilities) to the sanitary sewer system. Excluding non-contaminated stormwater runoff.

d. Direct areas that have the potential for pollutant releases or accidental spills, and are not expected to regularly receive flow or require water use (such as covered fuel islands or covered containment areas) to an approved method of containment or disposal.

e. Safely contain spills on-site, avoiding preventable discharges to any storm sewers, sanitary and/or drainageways.

f. Emphasize structural BMP controls over operational procedures. Structural BMP controls are not operator dependent and are considered to provide more permanent and reliable source control. Any proposals for operation-based source controls need to describe the long-term viability of the maintenance program.

301.12.03 Signage Requirements

Informational signage is required for some site uses and activities that have the potential to contaminate stormwater. Signage addresses good housekeeping rules and provides emergency response measures in case of an accidental spill.

All signage shall conform to the requirements described in the box below. Signage requirements for specific activities are noted in applicable sections.

Signs shall be located and plainly visible from all activity areas. More than one sign may be needed to accommodate larger activity areas. Signs shall be water-resistant. They shall include the following information:

Safety precautions

Immediate spill response procedures—for example:
"Turn the valve located at..." or "Use absorbent materials".

Emergency contact(s) and telephone number(s).

Signs may need to be in more than one language if required to effectively communicate with employees and delivery personnel.

Any applicable spill response supplies need to be clearly marked and located where the signage is posted and near the high-risk activity area. More than one spill response kit may be necessary to accommodate larger activity areas.

301.12.04 Request for Alternative Method of Source Control

Applicants may request an alternative method of source control by notifying the City's authorized representative. To make the request complete the Special Requests Form specifying the reason for the request and supporting it with technical and factual data. .

The City's authorized representative will check the submitted form and supporting information for completeness and make a final determination about the request.

301.12.05 Additional Requirements

Conformance with this section's requirements does not relieve the applicant of other applicable local, state, or federal regulatory or permit requirements. This section is intended to complement any additional requirements, and is not expected to conflict with, exclude, or replace those requirements. In case of a conflict, the most stringent local, state, or federal regulations generally apply. Any conflict will be resolved by the City's authorized representative in consultation with appropriate agencies. Some of the more common additional requirements that may apply are summarized below:

a. Spill response supplies, such as absorbent material, containment booms, and protective clothing, shall be available at all potential spill areas. Employees shall be familiar with the site's operations and maintenance plan; spill prevention, containment and countermeasure (SPCC) plan; and/or proper spill cleanup procedures.

b. Some facilities may be required to obtain an NPDES Industrial Stormwater General Permit 1200-Z before discharging to the City's storm sewer system or to waters of the state. Applicants may also be required to obtain an Industrial Wastewater Discharge Permit for discharges to the sanitary sewer system. Facilities subject to these requirements are generally commercial or industrial. Typical discharges include

process wastewater, cooling water, or other discharges generated by some of the sources in this section that drain to a storm or sanitary sewer system. The applicant shall obtain approval from the City's authorized representative prior to discharge of any substance into the public/private storm or sanitary sewer system.

c. An evaluation will be done during the stormwater management plan review process to determine if source control and/or discharge permit(s) are required. If a NPDES discharge permit is required, the permit application process will be independent of the stormwater management plan review/approval process. However, the stormwater management plan may have to be revised to accommodate industrial permitting compliance requirements (e.g., submittal of a Non-Residential form and/or NPDES Discharge Permit Application form, sampling points, pretreatment facilities, and monitoring sites). Please note that a change in site activity and/or discharges could trigger source control, NPDES discharge and other related permitting requirements in the future.

d. The City will accept ODEQ approved and permitted Underground Injection Control (UIC) devices on private property, but will not accept UIC devices that the City will maintain, or private UIC devices which accept drainage from publicly owned or maintained improvements.

e. The ODEQ identifies drywells and piped soakage trenches as "Class V Injection Wells" under the federal UIC Program.

f. The requirements presented in this section do not exclude or replace the requirements of other applicable codes or regulations, such as the hazardous substances storage requirements of articles 79 and 80 of the Oregon State Fire Code; the SPCC regulations of 40 CFR 112 (EPA); the Resource Conservation and Recovery Act (RCRA); Willamette Basin Total Maximum Daily Load (TMDL) Programs regulated by ODEQ; or any other applicable local, state, or federal regulations or permit requirements.

301.12.06 Public Sanitary Sewer Discharge Permit

Connection/discharge to the public sanitary sewer system requires prior approval by the Public Works Director.

301.12.07 Fuel Dispensing Facilities and Surrounding Traffic Areas

a. Applicability

The requirements in this section apply to all development where vehicles, equipment, or fuel tanks are refueled on the premises; whether a large-sized gas station, a single-pump maintenance yard, or a small-sized fuel tank. A fuel dispensing facility is defined as the area where fuel is transferred from bulk storage tanks to vehicles, equipment, and/or mobile containers (including fuel islands, above- or below-ground fuel tanks, fuel pumps, and the surrounding pad). Propane tanks are exempt from these requirements.

The discharge or point of connection to the public system shall be authorized and permitted by the City. Discharges of hydrocarbons are prohibited to the public sanitary and storm sewer systems. When a containment or storage device is utilized

the owner or responsible person shall contact the City's authorized representative and Public Works Director for authorization to open any valve and discharge to a public sanitary or stormwater sewer system.

b. Requirements

1. **Cover:** The fuel dispensing area shall be covered with a permanent canopy, roof, or awning so precipitation cannot come in contact with the fueling activity area. Rainfall shall be directed from the cover to a stormwater disposal point that meets all applicable code requirements.

   (a) Covers 10 feet high or less shall have a minimum overhang of 3 feet on each side. The overhang shall be measured relative to the perimeter of the hydraulically isolated fueling activity area it is to cover.

   (b) Covers higher than 10 feet shall have a minimum overhang of 5 feet on each side. The overhang shall be measured relative to the perimeter of the hydraulically isolated fueling activity area it is to cover.

2. **Pavement:** A paved fueling pad of asphalt or concrete shall be placed under and around the fueling activity area and shall meet all applicable building code requirements. Sizing of the paved area shall be adequate to cover the activity area, including placement and number of the vehicles or pieces of equipment to be fueled by each pump. Fuel pumps shall be located a minimum of 7 feet from the edge of the fueling pad.

3. **Drainage:** The paved area beneath the cover shall be hydraulically isolated from the surrounding area through grading, berms, or drains. This will prevent uncontaminated stormwater from running onto the area and carrying pollutants away. Drainage from the hydraulically isolated area shall be directed to an authorized pretreatment facility. Surrounding runoff shall be directed away from the hydraulically isolated fueling pad to a stormwater disposal point that meets all stormwater management requirements of this manual and other applicable code requirements.

4. **Signage:** Signage shall be provided at the fuel dispensing area and shall be plainly visible from all fueling activity areas. Detailed signage information is located in Section 301.12.03, "Signage Requirements".

5. Pretreatment – Coalescing Oil water separator

   (a) An oil/water separator with a coalescing plate shall be installed in the catchment area. The purpose of the device is to treat runoff from the cleaning of the fueling area and prevent small spills from entering the public sanitary sewer system.

   (b) Coalescing plate separators shall be designed to achieve 100-parts per million (pmm) non-polar oil and grease in the effluent from the peak flow generated by the washing activity. Testing information must be submitted by the manufacturer of the unit that supports the 100-ppm effluent standard at the calculated flow rate. Use of surfactants or emulsifying agents shall be prohibited.

(c) Standard flow from a 5/8-inch hose is estimated to be 10 gallons per minute (gpm).

(d) For specially designed washing units, check the vendor specifications for maximum flow rates. Separator details must be shown on the building plans submitted at the time of building permit application and shall match manufacturer specifications and details, including the unit flow rate, effluent water quality, and maximum process flow rate. All separators shall be maintained per the manufacture specifications and have a maintenance plan reviewed and approved by the City.

6. Spill Control Manholes

A spill control manhole shall be installed on the discharge line of the fueling pad before the public sanitary sewer line tie-in. The tee section shall extend 18 inches below the outlet elevation, and 60 cubic feet of dead storage volume shall be provided below the outlet elevation for storage of oil, grease, and solids. The manhole shall be located on private property. A shut-off valve is required prior to discharge to the public sanitary sewer system and shall be in the closed position at all times with a clear visible way to verify that it is closed. Any discharge to the public sanitary sewer system will need approval from the City.

7. Shut-Off Valves

Shut off valves are required to protect sewer systems from spill risks that present a danger for widespread contamination, system damages, or risk to the public health.

Shut-off valves with a clear visible way to verify that it is closed are required for any of the following situations:

(a) Site or activity areas are exposed to corrosives or oxidizers that can harm conveyance system components (such as, but not limited to, battery acid).

(b) Substances (such as, but not limited to, oil and grease) that do not settle or remain in one location, and are capable of being dissolved in or float on water. These substances can spread rapidly into downstream conveyance and disposal systems, causing widespread impacts and difficult cleanup situations.

(c) Substances that are known to infiltrate through soils and contaminate groundwater.

(d) Traffic pathways that surround fueling pads are considered high-use/high-risk areas and will require a valve on the storm drainage system. Valves installed on storm drainage systems shall be installed downstream of all applicable private stormwater management facilities to accommodate spill containment. These valves shall be left open to facilitate stormwater flows during normal conditions, and immediately closed in the event of a spill.

(e) Fueling pads require a valve downstream of the spill control manhole. Valves installed on sanitary sewer systems shall be installed before the public sanitary sewer system tie-in. These valves shall be kept closed with a clear visible way

to verify that it is closed, and opened only to allow incidental drainage activities that do not pose a threat or risk to the disposal point system. Any discharge to the public sanitary sewer system will need to be approved by the Public Works Director. The valve shall be closed immediately after drainage activities are completed.

(f) Shut-off valves shall be located on private property and downstream of the exposed area's collection system. All valves shall be installed and maintained as per manufacturer's recommendations with a clear visible way to verify that it is closed. For more information about shut-off valves and associated valve boxes, contact the City's authorized representative.

8. Additional Fuel Dispensing Facilities Requirements

(a) A Source Control Installations Form shall be submitted as part of the stormwater management plan submittals to facilitate tracking of spill control manhole and shut-off valve installations.

(b) Installation, alterations, or removal of above-ground fuel tanks larger than 55 gallons, and any related equipment, are subject to additional building permit requirements. For technical questions and permitting, contact the City's authorized representative.

9. Bulk fuel terminals, also known as tank farms, require the following:

(a) Secondary containment equal to 110% of the product's largest container or 10% of the total volume of product stored, whichever is larger.

(b) A separate containment area for all valves, pumps, and coupling areas, with sub-bermed areas either in front of or inside the main containment areas. These sub-bermed areas shall have rain shields and be directed to a public sanitary sewer system with a valve to control disposal. Any discharge to the public sanitary sewer system will need to be approved by the Public Works Director. If no public sanitary sewer is available, drainage shall be directed to a temporary holding facility for proper disposal and may require a water pollution control facility (WPCF) permit from the Water Quality Division of ODEQ.

(c) An impervious floor within all containment areas. Floors shall be sealed to prevent spills from contaminating the groundwater.

(d) Truck loading and off-loading areas. These areas shall follow cover, pavement, drainage, spill control, and shut-off valve requirements identified for fuel dispensing facilities.

(e) Shut-off valves should be installed for the drainage of the tank yard. The valves shall be installed downstream of the drainage system of the primary containment area and kept closed with a clear visible way to verify that it is closed. Valves installed for the drainage of the truck pad and sub-bermed containment areas shall be installed on the sanitary waste line downstream of the spill control manhole. Any discharge to the public sanitary sewer system will need to be approved by the Public Works Director.

(f) Approval of a batch discharge from the City is required before draining a containment area. This approval will determine appropriate disposal methods, identify pretreatment requirements (if applicable), and approval of the discharge. Pretreatment may be required for oil and grease removal, and testing may be required at the owner's expense to establish the specific characteristics of the discharge. Contact the City's authorized representative to request authorization for batch discharge.

(g) Underground fuel tanks less than 4,000 gallons in size are subject to additional permitting requirements by ODEQ, and tanks larger than 4,000 gallons are referred to the EPA. For technical questions and permitting, call ODEQ's Northwest Region Portland office and ask for the Underground Storage Tank Permitting Department.

10. Exceptions

The requirement to cover the fuel dispensing area can be appealed if the fuel dispensing area is generally used to service oversized equipment (e.g., cranes) that cannot maneuver under a roof or canopy. A *Special Requests Form* shall be submitted as part of the building permit application to evaluate exception qualifications.

(a) Propane tanks are exempt from the requirements of this section.

(b) Existing fueling areas are not required to install source controls identified in this section if the scope of work is limited to the following:

i. A new canopy installation over an existing fuel pad that is not being upgraded.

ii. An underground tank replacement for compliance with state regulations.

iii. The replacement of a fuel pump on an existing fuel pad that is not being upgraded.

(c) If any improvements are made to the fueling activity area and/or pad, such as regrading or surface replacement, retrofits are required to comply with all fueling activity source controls identified in this section.

301.12.08 Above-Ground Storage of Liquid Materials

a. Applicability

The requirements in this section apply to all development where there is any exterior storage of liquid chemicals, food products, waste oils, solvents, process wastewaters, or petroleum products in above-ground containers, in quantities of 50 gallons or more. This includes both permanent storage and temporary storage areas. Underground storage tanks or installations requiring a WPCF permit are exempt from these requirements, but must go through ODEQ's WPCF permit process.

b. Requirements

1. Containment

(a) Liquid materials shall be stored and contained in such a manner that if the container(s) is ruptured, the contents will not discharge, flow, or be washed into a receiving system. A containment device and/or structure for accidental spills shall have enough capacity to capture a minimum of 110% of the product's largest container, or 10% of the total volume of product stored, whichever is larger.

(b) Double-walled containers are generally exempt from these spill containment requirements.

(c) Quantity thresholds of products that are generally exempt from these spill containment measures are:

i. Janitorial and cleaning supplies of less than 100 pounds net weight or 15 gallons net volume. These supplies shall be packaged for consumer use in containers of five gallons or less or having a net weight of less than 30 pounds per container. This does not include cleaners or solvents used for cleaning machinery or motor vehicle and machine parts.

ii. Office and stationary supplies less than 100 pounds net weight. These supplies shall be packaged for consumer use in containers sized less than 5 gallons in size or 30 pounds in weight.

2. Cover

(a) Storage containers (other than tanks) shall be completely covered so rainfall cannot come in contact with them. Runoff shall be directed from the cover to a stormwater disposal point that meets all applicable code requirements.

i. Covers 10 feet high or less shall have a minimum overhang of 3 feet on each side. The overhang shall be measured relative to the perimeter of the hydraulically isolated activity area.

ii. Covers higher than 10 feet shall have a minimum overhang of 5 feet on each side. The overhang shall be measured relative to the perimeter of the hydraulically isolated activity area.

3. Pavement

A paved storage area is required unless otherwise approved by the City's authorized representative. The storage area shall be paved with asphalt or concrete and shall meet all applicable building code requirements. Sizing of the paved areas shall be adequate to cover the area intended for storage. The applicant shall clearly identify any requested alternative method by submitting a *Special Requests Form*.

4. Drainage

   All paved storage areas shall be hydraulically isolated through grading, berms, or drains to prevent uncontaminated stormwater run-on to a storage area.

   (a) Covered storage areas: Significant amounts of precipitation are not expected to accumulate in covered storage areas, and drainage facilities are not required for the contained area beneath the cover. If the applicant elects to install drainage facilities, the drainage from the hydraulically isolated area shall be directed to an approved public sanitary sewer or authorized pretreatment facility.

   (b) Uncovered storage areas with containment: Water will accumulate in uncovered storage areas during and after rain. Any contaminated water shall be collected, inspected, and possibly tested at the expense of the property owner before proper disposal can be determined and authorized. Frequent draining may be required during the wet season, which may prove costly. Some type of monitoring may also be needed to determine the characteristics and level of contamination of the stormwater.

   (c) All discharges to the public sanitary sewer shall be, at a minimum, considered batch discharges and require approval by the Public Works Director and pretreatment and testing at the expense of the owner prior to discharge. In some cases, an industrial discharge permit may be required. Pretreatment requirements shall be set as part of the discharge approval process, based on the types and quantities of material to be discharged. A discharge evaluation shall be performed before connection to a public sanitary sewer or storm sewer. Testing may be required to establish characteristics of the wastewater or contaminated stormwater and to verify that local discharge limits are not exceeded. For batch discharge applications and industrial discharge permit requirements, call the City's authorized representative.

5. Signage

   Signage shall be provided at the liquid storage area and shall be plainly visible from all surrounding activity areas. Detailed information is located in Section 301.12.03, "Signage Requirements".

6. Additional Requirements

   (a) A *Source Control Installations Form* shall be submitted as part of the building permit application to facilitate tracking of containment and shut-off valve installations.

   (b) A shut-off valve with a clear visible way to verify that it is closed may be required for the covered storage area if the applicant elects to install drainage facilities to an approved public sanitary sewer connection. The City will make this determination based on the type of material stored and the proposed system receiving the discharge.

   (c) Uncovered storage areas: A shut-off valve shall be installed in the storage area so excess stormwater can be drained out of the activity area and

directed either to the storm drainage facilities (if clean) or into the public sanitary sewer or authorized pretreatment facility (if contaminated). Any discharge to the public sanitary sewer system will need to be approved by the Public Works Director. Except when excess stormwater is being discharged, the valve shall always be kept closed with a clear visible way to verify that it is closed so any spills within the activity area can be effectively contained.

(d) Tank farms shall follow the criteria established for bulk fuel terminals in Section 301.12.07, "Fuel Dispensing Facilities and Surrounding Traffic Areas". Exceptions may be granted, based on the product being stored. Requests for an exception will require an additional review process and may delay issuance of related building permits.

(e) Storage of reactive, ignitable, or flammable liquids shall comply with the Uniform Fire Code as adopted by the State of Oregon. Source controls presented in this section are intended to complement, not conflict with, current fire code requirements. None of these requirements shall exclude or supersede any other requirements in this manual, other City permit requirements, or state and federal laws pertaining to water quality. Contact the City's authorized representative for further information and requirements.

301.12.09 Solid Waste Storage Areas, Containers, and Trash Compactors

a. Applicability

The requirements in this section apply to all commercial and industrial development with facilities that store solid wastes (both food and non-food wastes). A solid waste storage area is a place where solid waste containers are collectively stored. Solid waste containers include compactors, barrels, dumpsters, and garbage cans.

Requirements of this section also apply to activity areas used to collect and store refuse or recyclable materials, such as can or bottle return stations, grease containers, and debris collection areas.

This section applies to multi-family residential sites of three or more units if a shared trash collection area is proposed. However, the requirements of this section do not apply to single-family homes or debris collection areas used for the temporary storage of wood pallets or cardboard.

b. Requirements

1. The following design requirements apply for approval of solid waste storage and handling activity areas in the City. The matrix below clarifies each requirement.

Table 3.13 Solid Waste Storage Area Matrix

Activity/Use	Requirements	
	(1) Pavement	(2) Isolation
Multi-family (with shared trash areas)	X	X
Commercial	X	X
Industrial	X	X
Compactors (regardless of use)	X	X
Can and bottle return stations	X	X

2. Pavement

   A paved waste storage area is required when a structural cover or trash compactor is used. The area shall be paved with asphalt or concrete and meet all applicable building code requirements. Sizing of the paved area shall adequately cover the activity area intended for refuse storage, or the trash compactor(s) and associated equipment.

3. Isolation

   Hydraulic isolation shall be provided for the solid waste storage activity area and shall be designed to prevent uncontaminated stormwater runoff from entering the area and carrying pollutants away. Runoff occurring outside the hydraulically isolated area shall be directed to a stormwater disposal point that meets all applicable code requirements. This can be achieved by reverse grading at the perimeter of an activity area, perimeter curbing or berming, or the use of area drains to collect and divert runoff.

301.12.10 Exterior Storage of Bulk Materials

a. Applicability

   1. The requirements of this section apply to developments that stockpile or store materials in outdoor containers that may erode or have negative stormwater impacts. The materials are separated into three categories, based on risk assessments for each material stored: high-risk, low-risk, and exempt. These include, but are not limited to, the following general types of materials:

Table 3.14 Exterior Storage Bulk Materials

High-Risk Materials	Low-Risk Materials	Exempt Materials
· Recycling materials with potential effluent · Corrosive materials (e.g., lead-acid batteries) · Storage and processing of food items · Chalk/gypsum products · Feedstock/grain · Material by-products with potential effluent · Fertilizer · Pesticides · Lime/lye/soda ash · Animal/human wastes	· Recycling materials without potential effluent · Scrap or salvage goods · Metal · Sawdust/bark chips · Sand/dirt/soil (including contaminated soil piles) · Material by-products without potential effluent · Unwashed gravel/rock · Compost · Asphalt	· Washed gravel/rock · Finished lumber · Rubber and plastic products (hoses, gaskets, pipe, etc.) · Clean concrete products (blocks, pipe, etc.) · Glass products (new, non-recycled) · Inert products

2. Materials with any of the following characteristics are exempt from the requirements of this section:

   (a) Have no measurable solubility or mobility in water and no hazardous, toxic, or flammable properties.

   (b) Exist in a gaseous form at ambient temperature.

   (c) Are contained in a manner that prevents contact with stormwater (excluding pesticides and fertilizers).

b. Requirements

1. Pavement

   (a) Low-risk material storage areas are not required to be paved.

   (b) High-risk material storage areas shall be paved beneath the structural cover. Sizing of the paved area shall adequately cover the activity area intended for storage.

2. Drainage

   (a) Low-risk material storage areas are typically allowed in areas served by standard stormwater management systems. However, all erodible materials being stored must be protected from rainfall.

   (b) If materials are erodible, a structural containment barrier shall be placed on at least three sides of every stockpile. The barrier shall be tall enough to prevent run-on of uncontaminated stormwater into the storage area and migration of the stored materials as a result of being blown or washed away. If the area under the stockpile is paved, the barrier can be constructed of asphalt berms, concrete curbing, or retaining walls. If the area under the stockpile is unpaved, sunken retaining walls or ecology blocks can be used. The applicant shall clearly identify the method of containment on the building plans.

   (c) For high-risk material storage areas, the paved area beneath the structural cover shall be hydraulically isolated through grading, structural containment berms or walls, or perimeter drains to prevent uncontaminated stormwater from running onto the area and carrying pollutants away.

3. Additional Requirements

   (a) A Source Control Installations Form shall be submitted as part of the stormwater management plan/building permit application to facilitate tracking of containment, sampling manholes, and shut-off valve installations.

   (b) Storage of pesticides and fertilizers may need to comply with specific regulations outlined by ODEQ. For answers to technical questions, call ODEQ's Northwest Region Portland office.

   (c) A sampling manhole or other suitable stormwater monitoring access point may be required to monitor stormwater runoff from the storage area. This may apply to certain types of storage activities and materials or if an alternative source control is proposed. The City's authorized representative will review for applicability of this requirement.

   (d) Signage shall be provided at the storage area if hazardous materials or other materials of concern are stored. Signage shall be located so it is plainly visible from all storage activity areas. More than one sign may be needed to accommodate large storage areas. Detailed information and examples are provided in Section 301.12.03, Signage Requirements".

   (e) A shut-off valve with a clear visible way to verify that it is closed may be required if the applicant elects to install drainage facilities to an approved public sanitary sewer. The City's authorized representative will make this determination based on the type of material stored and the proposed system receiving the discharge.

301.12.11 Material Transfer Areas/Loading Docks

a. Applicability

1. The requirements in this section apply to all developments proposing the installation of new material transfer areas, or structural alterations to existing material transfer areas (e.g., access ramp regrading, leveler installations).

   Two standard types of material transfer areas associated with buildings are:

   (a) Loading/Unloading facilities with docks

   (b) Large bay doors without docks

2. The requirements apply to all material transfer areas, including loading/unloading docks, bay doors, and any other building access point(s) with the following characteristics:

   (a) The area is designed (size, width, etc.) to accommodate a truck or trailer being backed up to or into it, and

   (b) The area is expected to be used specifically to receive or distribute materials to and from trucks or trailers.

3. The requirements may not apply to areas that are used only for mid-sized to small-sized passenger vehicles and that are restricted (by lease agreements or other regulatory requirements) to storing, transporting, or using materials that are classified as domestic use. Examples of domestic uses include primary educational facilities (elementary, middle, or high schools), buildings used for temporary storage (a lease agreement will need to be provided), and churches. Contact the City's authorized representative for help in determining if requirements apply.

b. Requirements

1. Pavement

   A paved material transfer area of asphalt or concrete shall be placed underneath and around the loading and unloading activity area and shall meet all applicable building code requirements. This will reduce the potential for soil contamination with potential impacts on groundwater, and will help control any acute or chronic release of materials present in these areas.

2. Isolation

   (a) Loading Docks: The first 3 feet of the paved/covered area, measured from the building or dock face, shall be hydraulically isolated through grading, berms, or drains to prevent uncontaminated stormwater from running onto the area and carrying pollutants away.

(b) Bay Doors and Other Interior Transfer Areas: Bay doors and other interior transfer areas shall be designed so that stormwater runoff does not enter the building. This can be accomplished by grading or drains.

(c) Bay Doors and Other Interior Transfer Areas**:** Because interior material transfer areas are not expected to accumulate precipitation, installation of floor drains is not required or recommended. It is preferable to handle these areas with a dry mop or absorbent material.

4. Signage

Signage shall be provided at the material transfer area and shall be plainly visible from all surrounding activity areas. Detailed information is located in Section 301.12.03, "Signage Requirements".

5. Additional Requirements

(a) A *Source Control Installations Form* shall be submitted as part of the building permit application to facilitate tracking of shut-off valve installations.

(b) Bay doors and other interior transfer areas shall provide a 10-foot "no obstruction zone" beyond the entrance within the building. This will allow the transfer of materials to occur with the truck or trailer end placed at least 5 feet inside the building, with an additional staging area of 5 feet beyond that. The "no obstruction" zone shall be clearly identified on the stormwater management plan at the time of the building permit application, and shall be painted at the facility with bright or fluorescent floor paint.

(c) A shut-off valve with a clear visible way to verify that it is closed may be required for the sanitary drainage facilities of the material transfer area. The City's authorized representative will make this determination, based on the type of material being transferred and the proposed system receiving the discharge.

(d) Shut-off valves are required to protect the public sanitary sewer and drainage way systems from spills of chemicals and other constituents that may provide a danger of widespread contamination, system damage, or risk to public health.

(e) Shut-off valves are required for any of the following situations:

i. Site activity areas that are exposed to corrosives or oxidizers that can harm conveyance system components (such as battery acid).

ii. Substances (such as oil and grease) that do not settle or remain in one location, and are capable of being dissolved in or float on top of water. These substances can spread rapidly into downstream systems, causing widespread impacts and difficult clean-up situations.

iii. Substances that are known to infiltrate through soils and contaminate groundwater.

(f) Valves located in material transfer areas are typically left open to facilitate drainage during normal conditions, and immediately closed in the event of a spill.

(g) Prior to transfer activities of harmful substances, the valves shall be closed with a clear visible way to verify that it is closed and reopened only after the transfer is complete. The shut-off valves shall be located on private property and downstream of the exposed area's collection system.

(h) All valves shall be installed and maintained in accordance with manufacturer specifications. For more information about shut-off valves and associated valve boxes, contact the City's authorized representative.

301.12.12 Equipment and/or Vehicle Washing Facilities

a. Applicability

The requirements in this section apply to all development with a designated equipment and/or vehicle washing or steam cleaning area. This includes smaller activity areas, such as wheel-washing stations. Residential sites are exempt.

b. Requirements

1. Cover

(a) The washing area shall be covered with a permanent canopy or roof so precipitation cannot come in contact with the washing activity area. Precipitation shall be directed from the cover to a stormwater disposal point that meets all applicable code requirements.

i. Covers 10 feet high or less shall have a minimum overhang of 3 feet on each side. The overhang shall be measured relative to the perimeter of the hydraulically isolated washing activity area it is to cover.

ii. Covers higher than 10 feet shall have a minimum overhang of 5 feet on each side. The overhang shall be measured relative to the perimeter of the hydraulically isolated washing activity area it is to cover.

2. Pavement

A paved wash pad of asphalt or concrete shall be placed under and around the washing activity area and shall meet all applicable building code requirements. Sizing of the paved area shall adequately cover the activity area, including the placement of the vehicle or piece of equipment to be cleaned.

3. Drainage

The paved area beneath the cover shall be hydraulically isolated through grading, berms, or drains to prevent uncontaminated stormwater from running onto the area and carrying pollutants away. Drainage from the hydraulically isolated area shall be directed to an approved public sanitary sewer or authorized pretreatment facility. If connected to the public sanitary sewer, Wilsonville City Code requires

that equipment and/or vehicle washing facilities shall be equipped with a water recycling system approved by the Public Works Director. Best available technology shall be utilized for the pretreatment system of any drainage to the public sanitary sewer system. For further questions, contact the City's authorized representative. Surrounding runoff shall be directed away from the hydraulically isolated washing pad to a stormwater disposal point that meets all applicable requirements of this section.

4. Oil Controls

Wilsonville City Code requires that equipment and/or vehicle washing facilities shall be equipped with a water recycling system approved by the Public Works Director. Best available technology shall be utilized for the pretreatment system of any drainage to the public sanitary sewer system. The system shall comply with the public sanitary sewer discharge limits. For discharge requirements and limitations to the public sanitary sewer system contact the City's authorized representative.

(a) Washing Areas Protected with a Cover or Located Inside a Structure.

   i. Baffled oil/water separators and spill control (SC-type) separators shall not be allowed for use with equipment and/or vehicle washing applications. Note: Activities and processes of a washing facility change over time, and the introduction of heat and surfactants may occur.

   ii. Coalescing plate separators shall be designed to achieve 100-ppm non-polar oil and grease in the effluent from the peak flow generated by the washing activity. Testing information must be submitted by the manufacturer of the unit that supports the 100-ppm effluent standard at the calculated flow rate. Standard flow from a 5/8-inch hose is estimated to be 10 gpm. For specially designed washing units, check the vendor specifications for maximum flow rates.

(b) Any pumping devices shall be installed downstream of the separator to prevent oil emulsification.

(c) Separator details must be shown on the building plans submitted at the time of building permit application and shall match manufacturer specifications and details, including the unit flow rate, effluent water quality, and maximum process flow rate.

(d) All separators shall be maintained per the manufacture specifications and City approved maintenance plan.

(e) Wilsonville City Code requires that equipment and/or vehicle washing facilities shall be equipped with a water recycling system approved by the Public Works Director. Best available technology shall be utilized for the pretreatment system of any drainage to the public sanitary sewer system.

301.12.13 Land with Suspected or Known Contamination

a. Applicability

1. The requirements in this section apply to all development projects that disturb property at risk, suspected or known, to contain pollutants in the soil or groundwater. This includes development that is surrounded by properties found to have trace pollutants. These requirements will also be applied to any property that is seeking to make a new connection to a public storm system from a property that is at risk, suspected or known, to contain pollutants in the soil or groundwater. To avoid confusion with references to water quality pollutant throughout this manual, this section refers to pollutants as contaminants and/or contamination.

2. Because of local, state, and federal regulations, special handling and management of site soils, groundwater, and surface drainage may be necessary. As a result of these regulations, sites with suspected or known contamination require a more detailed review process and may delay issuance of related stormwater management plans and building permit approvals. Applicants are advised to contact the City's authorized representative early on in the plan design process (before plan submittal) if they are aware or suspect the site has contaminants or is adjacent to a contaminated site.

3. To research contaminant information, refer to ODEQ's Environmental Cleanup Site Information (ECSI) database, which can be found at: **http://www.deq.state.or.us/lq/ecsi/ecsi.htm**

   (a) If records indicate there is a potential of contamination on the site the applicant shall contact ODEQ prior to pre- and post-construction activities to ensure conditions of record are not violated. For technical questions related to site contamination and clean-up, contact the Land Quality Division of ODEQ.

   (b) All regulatory divisions or departments of ODEQ referenced in this section can be reached by calling ODEQ's Northwest Region Portland Office.

   (c) If a Phase 1 ODEQ Site Assessment was required the report shall be submitted to the City for review.

   (d) If contamination is discovered subsequent to stormwater management plan approval the owner shall immediately take steps to protect health and safety, and contact the City and ODEQ. Plan approval is suspended until the contamination is resolved.

   (e) Contaminants have the potential to become entrained and transported through exposure to construction activities and post-construction design elements of a development. The requirements in this section apply to:

      (1) Excavation and stockpiling of contaminated soils (soil management)

      (2) Disposal or re-use facilities related to groundwater, foundation or footing drains, interior floor drains in basements or sub-grade structures, construction dewatering, and surface stormwater treatment and conveyance systems.

b. Requirements

1. Stormwater discharges from sites suspected of contamination, whether proposed as a temporary construction connection or as permanent connection to any public storm or sanitary sewer system, will require a special authorization from the City's authorized representative. After reviewing the proposal and a characterization of the contaminants from the site, the City may make one of the following decisions:

   (a) Approve discharges to the public storm and/or sanitary sewer system with restrictions such as described in this section or as is necessary given the nature of the discharge.

   (b) Require the applicant to obtain an NPDES permit from ODEQ for the anticipated discharge prior to connection to a public system.

   (c) Require that the applicant become part of the City's Industrial Pretreatment Program.

   (d) Deny the request to discharge to the public storm and/or sanitary sewer system.

   (e) Allow unrestricted connection to the public storm and/or sanitary sewer system, with a testing point for future monitoring.

2. Contaminants, media, and site conditions are unique to each parcel of land. Sites at risk for contamination shall therefore be reviewed on a case-by-case basis.

3. Soil Management

   (a) Stockpiles of contaminated soils shall be covered with temporary plastic film or sheeting to prevent stormwater from coming into contact with them.

   (b) Stockpile perimeters shall have a containment barrier on all four sides of every stockpile to prevent stormwater run-on and material runoff. Barriers can consist of concrete curbing, silt fencing, or other berming material, depending on the activity, size, and resources available.

   (c) Areas under stockpiles of contaminated soils are not required to be paved. However, an impervious layer shall be placed beneath the stockpile to protect uncontaminated areas from potential leachate.

   (d) Construction Dewatering

      i. All construction dewatering discharges resulting from groundwater or precipitation (rainfall) will be evaluated for contamination before disposal methods can be approved.

      ii. Laboratory analysis reports will be required, as defined in this section.

iii. A temporary sampling point may be necessary. The temporary sampling point will be agreed upon between the City's authorized representative and the applicant.

iv. Source control requirements will be identified as part of the review process of the laboratory analysis reports and the proposed stormwater management. Source controls, sampling points, and the disposal point shall be identified on the erosion control plan of the within the proposed stormwater management.

(e) If on-site infiltration is the proposed method for disposal, authorizations are required from the City and the Land Quality Division of ODEQ. Private infiltration systems for construction dewatering shall be located and maintained on private property, outside the public rights-of-way.

(f) If a public sanitary system is the proposed method of disposal, authorizations are required from the City's authorized representative, and will be allowed only if extensive pretreatment is implemented and the discharge is approved by the City. All groundwater and surface water discharges to the public sanitary sewer system shall be approved by the Public Works Director and shall meet local discharge limits and will be subject to discharge volume charges.

(g) If a public stormwater system is the proposed method of disposal, evaluations of discharge to the public storm system will be based on whether discharges meet, or can be pretreated to meet, requirements of the City, NPDES Discharge Permit or other state and federal regulations for the receiving surface water.

(h) If a receiving stream is the proposed method for disposal, authorizations are required from the City, and the Land Quality and Water Quality Divisions of ODEQ.

(i) For technical assistance on obtaining a batch discharge approval for construction dewatering activities, contact the City's authorized representative.

4. Post-Construction Surface Drainage Systems

(a) If on-site infiltration is the proposed method for disposal, authorizations are required from the City and the Land Quality Division of ODEQ. Private infiltration systems shall be located and maintained on private property, outside the public rights-of-way.

(b) If a drainageway is the proposed method for disposal, authorizations are required from the City, the Army Corp of Engineers, and both the Land Quality and Water Quality Divisions of ODEQ.

(c) If an off-site public storm or sanitary sewer system is the proposed method for disposal**,** authorization is required from the City. Evaluations for discharges from sites with suspected contamination will be based on the following:

i. Surface drainage systems that are not exposed to industrial activities, contaminated soils, or subsurface discharges are not expected to contain contaminants and do not pose a threat to Public infrastructure. All discharges to a public sanitary sewer system shall be approved by the Public Works Director.

ii. A permanent monitoring point may be required to ensure compliance with local discharge regulations. If monitoring is necessary, a permanent structure (such as a sampling manhole or flow-through vault) shall be installed on the discharge line of the subsurface drainage system.

5. Post-Construction Water Reclamation or Re-use Systems: water reclamation or re-use systems provide innovative ways to use natural resources and save money. However, using groundwater as a resource from sites at risk of contamination may require additional source controls and environmental compliance regulations, depending on the nature of the contaminants and the extent of the remediation that has been completed.

6. Authorizations for re-use systems are required from the City, the Oregon Water Resources Department (OWRD), and ODEQ.

7. If surface drainage systems are the proposed approach, discharges are not expected to contain contaminants and do not pose a threat to public infrastructure. A review will verify that there is no interaction between groundwater and the surface.

   (a) Non-potable uses for plumbing fixtures and industrial equipment (e.g., cooling towers or boilers) will require the following:

      i. For discharge to the public sanitary sewer system requires authorization from the Public Works Director.

      ii. Industrial equipment bleed-offs or drain valves shall have discharges routed to the public sanitary sewer system of the facility.

      iii. Overflows from the re-use system, prior to use, are not considered a wastewater and shall have discharges routed to the storm disposal system of the facility.

   (b) Irrigation systems may facilitate the transportation of contaminants and require authorization from the Land Quality Division of ODEQ prior to installation.

8. If subsurface drainage systems are the proposed approach**,** discharges may contain contaminants and will be evaluated for contamination before disposal methods can be approved

   (a) Non-potable uses for plumbing fixtures and industrial equipment (e.g., cooling towers or boilers) will require the following:

1. For discharge to the public sanitary sewer system requires authorization form the Public Works Director.

2. Industrial equipment bleed-offs or drain valves shall have discharges routed to the public sanitary system of the facility. Discharges to the public sanitary sewer system shall meet local discharge limits and be verified by the industry at their expense before discharge.

3. Because overflows from the re-use system, prior to use, may contain contaminants, the requirements stated under *Post-Construction Subsurface Drainage Systems* apply.

4. A permanent monitoring point may be required to ensure compliance with local discharge regulations. If monitoring is necessary, a permanent structure (such as a sampling manhole or flow-through vault) shall be installed on the discharge line of the subsurface drainage system.

(b) Irrigation systems may facilitate the transportation of contaminants and require authorization from the Land Quality Division of ODEQ prior to installation.

9. If groundwater is proposed for commercial or industrial uses of a development (e.g., non-potable uses or irrigation) authorization or a permit is required from the OWRD prior to use.

10. Minimum requirements that warrant a permit for industrial and commercial groundwater wells include, but are not limited to, irrigation of areas greater than ½ acre and use of more than 5,000 gallons per day of water. Unique groundwater reuse systems (anything other than a standard supply well installation) will be reviewed on a case-by-case basis to determine permitting requirements (if applicable).

11. For assistance in obtaining authorization for the use of groundwater, contact OWRD's Water Master as appropriate. For more information on water rights and groundwater regulations, see the OWRD website at**:** **www.wrd.state.or.us**

12. Post Construction Subsurface Drainage Systems

(a) In an area at risk for contamination, structures proposed below grade can greatly impact and add unexpected costs to the surface drainage systems, water reclamation or re-use systems, and subsurface drainage systems of a project.

(b) All surface, subsurface and re-use systems will be evaluated for contamination risks before disposal and re-use methods can be approved.

13. If on-site infiltration is the proposed method for disposal, authorizations are required from the City and the Land Quality Division of ODEQ.

(a) Private infiltration systems shall be located and maintained on private property, outside the public rights-of-way.

(b) If on-site subsurface injection is the proposed method for disposal, authorizations are required from the City and the Water Quality Division of ODEQ.

(c) If a receiving stream is the proposed method for disposal, authorizations are required from the City, and both the Land Quality and Water Quality Divisions of ODEQ.

(d) If a Public storm and/or sanitary sewer system is the proposed method for disposal, authorization or industrial discharge permitting may be required from the City. A permanent monitoring point may also be required to ensure compliance with local discharge regulations.

14. Laboratory Analysis Reports

(a) Laboratory analysis reports are required to identify the characteristics and levels of contamination in the soils and groundwater of a site.

(b) An additional review process will be applied to these laboratory reports to determine regulatory authority and requirements. Testing and analysis are highly recommended prior to submitting the stormwater management plan. ODEQ permitting and/or review may be required if contaminants are found and the levels of contamination appear to exceed the City's discharge regulations. This may delay issuance of the stormwater management plans and related building permits.

(c) Laboratory analysis reports shall include the following information:

i. Analysis reports shall identify the elevation of the seasonal water table and identify the depth of any perched water aquifers.

ii. Analysis reports shall identify the method of laboratory testing, the detection level and analytical method used for detection, and the depth of any found contaminants in the soils.

iii. Minimum test parameters for baseline contaminants shall include metals (arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, silver, and zinc), TPH (total petroleum hydrocarbons), and BTEX (benzene, toluene, ethyl benzene and xylene).

iv. Test parameters may be required to include other contaminants identified through historical data, research, and environmental assessments (as recommended under Section 301.12.13, "Land with Suspected or Known Contamination").

15. Additional Requirements

All structural controls in this section require a *Source Control Installations Form*. Typical controls that would need City approval include containment areas, shut-off valves, and oil/water separators. If an applicant requests an alternative or exception to any of the source controls identified in this section, the applicant

shall complete the *Special Requests Form*. These types of requests require an additional review process and may delay issuance of the stormwater management plan and related building or development permits.

301.12.14 Covered Vehicle Parking Areas

a. Applicability

The requirements in this section apply to all development with a covered vehicle parking area, except single-family and duplex residential sites. Existing parking structures are not required to retrofit unless the structure is being redeveloped. New parking structures are required to meet these requirements.

b. Requirements

1. Top Floor Drainage of a Multi-Level Parking Structure: Stormwater runoff from the top floor shall be directed to a stormwater disposal point that meets all water quality requirements of these Standards and any other applicable code requirements.

2. Lower Floor Drainage of a Multi-Level Parking Structure: Significant amounts of precipitation are not expected to accumulate in covered vehicle parking areas, and drainage facilities are not required for the lower floors. If the applicant elects to install drainage facilities, the drainage from the lower floors shall be directed to an approved public sanitary sewer system. Prior to discharge all applicable pretreatment requirements shall be met.

3. Adjacent, Uncovered Portions of the Site: The surrounding uncovered portions of the site shall be designed so stormwater does not enter the covered parking areas. This can be accomplished through grading or drains.

c. Exceptions

Single-level covers (canopies, overhangs, and carports) are exempt from the requirements of this section.

301.12.15 Industrial and Commercial High Traffic Areas

a. Applicability

The requirements in this section apply to all new development with vehicle parking areas for developments zoned industrial or commercial with high traffic volumes.

b. Requirements

Industrial and Commercial Activities with an Average Daily count Trip (ADT) of 100 vehicles per 1,000 square feet of gross building area are required to provide additional pretreatment as specified below.

1. Paved traffic areas with a drainage area of over 10,000 square feet directed to a permanent pretreatment facility shall have adequate pretreatment for petroleum products prior to discharging to the stormwater BMP treatment facility. Parking areas of over 10,000 square feet that are broken up into drainage areas of less than 10,000 square feet do not require this pretreatment unless they fall into other categories described in this section or the Standards.

2. An oil/water separator with a coalescing plate shall be installed between the drainage in catchment and the stormwater BMP treatment facility. The purpose of the device is to treat and remove hydrocarbons from entering the stormwater BMP facility. This device shall be maintained per the manufactures specification and the approved maintenance plan.

   (a) Coalescing plate separators shall be designed to achieve 100-ppm non-polar oil and grease in the effluent from the peak flow generated by the washing activity. Testing information must be submitted by the manufacturer of the unit that supports the 100-ppm effluent standard at the calculated flow rate.

   (b) Flow rates will be determined by the drainage area served by the device. The device will be sized to meet the water quality treatment requirements as specified in Section 301.11.02.d.9, "Water Quality Requirements".

   (c) Separator details must be shown on the building plans submitted at the time of building permit application and shall match manufacturer specifications and details, including the unit flow rate, effluent water quality, and maximum process flow rate.

   (d) All separators shall be maintained per the manufacture specifications and the applicant shall submit an Operation and Maintenance Plan to be approved by the City.

301.12.16 ODEQ 1200-Z Permit Requirements and Procedures

The requirements in this section apply to facilities identified in Table 1: Sources Covered by the ODEQ New 1200-Z Industrial Stormwater General Permit Document, which can be found in the Water Quality Permit Program section of the ODEQ website.

Facilities identified in Table 1 that may discharge stormwater from a point source to surface waters or to conveyance systems that discharge to surface waters are required to obtain coverage under the 1200-Z permit. To obtain coverage under the permit, facilities must complete the application and registration procedures listed under the *Permit Coverage and Exclusion of Coverage* portion of the New 1200-Z Industrial Stormwater General Permit Document.

301.13.00 OPERATION AND MAINTENANCE REQUIREMENTS

This section describes operation and maintenance requirements that are generally applicable to all private stormwater management facilities. The person designated by the applicant as the responsible party in the Stormwater Maintenance Requirements and Access Easement shall be responsible for operation and maintenance of private

stormwater management facilities. An operation and maintenance plan (O&M plan) shall be prepared by the applicant for the stormwater management facility and shall be submitted to the City of Wilsonville Natural Resources Program for review and approval. Maintenance activities shall be documented annually by sending a report of what was completed to the City of Wilsonville Natural Resources Program, by May 1st of each year.

301.13.01 Inspection Program

a. Routine facility inspection will provide three major benefits:

   1. Development of a condition history.

   2. Improved scheduling efficiency.

   3. Preventive maintenance opportunities.

b. Inspection records shall be used to:

   1. Determine where special maintenance conditions exist.

   2. Determine optimal frequencies for future inspection and maintenance.

   3. Generate scheduled and unscheduled (i.e., repair) work orders.

   4. Assure facility operation and aesthetics.

301.13.02 Requirements

a. The applicant shall be responsible for having inspections conducted, maintaining stormwater management facilities, and submitting yearly reports documenting inspection and maintenance activities to the City of Wilsonville Natural Resources Program.

b. Proprietary stormwater management facilities shall be maintained in accordance with the manufacturer specifications and requirements.

c. Inspection and maintenance of the facilities, with the record drawing plans in hand, shall be done in compliance with the Stormwater Maintenance Requirements and Access Easement. If applicable to the stormwater management facility, the design and maintenance specifications shall be used.

d. All required inspections and any maintenance activities performed shall be documented in the annual report as required by the City's Stormwater Maintenance Requirement and Access Easement.

e. Inspection reports shall be in a format and accuracy approved by the City of Wilsonville Natural Resources Program. Inspection reports shall be submitted to the City on a yearly basis.

f. The applicant shall keep inspection records to track the progressive development of the system over time. The inspection records shall include:

1. General condition of vegetative area(s) and growing medium, predominant plant species, distribution, and success rate (where applicable).

2. Sediment condition and depth in forebay (or other pretreatment structure), treatment facility, bench planting zones, and other sediment-removal components.

3. Water elevations and other observations (sheen, smell, etc.).

4. Condition of the inlet, outlet, and overflow structures and devices, diversion structures, trash-removal devices, risers, spillway, embankments, and remaining storage capacity.

5. Unscheduled maintenance needs.

6. Components that do not meet the performance criteria and require immediate maintenance.

7. Common problem areas, solutions, and general observations.

8. Aesthetic conditions.

301.13.03 Structures

Applicant shall be responsible for maintaining all facility structures in good working order. Stormwater management facility structures include, but are not limited to, the following: stormwater pipes, stormwater manholes, sand/oil separators, monitoring manholes, flow control devices, energy dissipaters, headwalls, trash grates, underground detention facilities, catch basins, ditch inlets, area drains, clean-outs, access roads, safety fences, sediment fences, and biofiltration bags. Maintenance may consist of cleaning, repairing, and/or replacing structures or portions of structures as needed to maintain their functional purpose.

301.13.04 Planting Bed Soils

a. In areas where greater than 10% of planting bed vegetation has died, have soil tested as recommended by a Professional Landscape Architect registered in the State of Oregon.

b. Amend soil as per recommendations of a Professional Landscape Architect registered in the State of Oregon; if needed redesign plantings to correct problems, and reestablish soil coverage.

301.13.05 Vegetation Management

a. Vegetated stormwater management facilities may require a number of control practices during their initial 2-year period in order to meet the requirements for establishing healthy vegetation.

b. Requirements

1. Maintain plantings for a period of two years after the date of final construction approval by the City's authorized representative. During the establishment period, remove undesired vegetation with minimal (or preferably no) use of toxic

herbicides and pesticides at least three times in year 1, and once or twice in the summer of year 2, unless otherwise approved by the City's authorized representative. Replace plants that die during this period as per recommendations and planting time frame given in Appendix B.2.00, "Landscape Guidelines."

2. At the end of the two-year warranty period, healthy plant establishment shall be achieved for at least 90% of the vegetation (see Section 301.15.02, "Landscape Inspection for Warranty," for landscape survival criteria). The O&M plan shall specify the long-term maintenance schedule after the warranty period.

3. Selectively irrigate if necessary during the establishment period, during times of drought, or until the vegetation becomes established. It is preferred that the facility be designed to sustain its function without a permanent irrigation system.

4. Replenish mulch at least annually, and specify the mulching schedule in the O&M plan. Mulching shall be done to retain topsoil, heat, and moisture, and to inhibit weed growth. Use temporary fencing to protect seedlings from foraging animals.

5. Schedule maintenance outside sensitive wildlife and vegetation seasons. Minimize plant disturbance during maintenance activities.

6. Do not use fertilizers, herbicides, or pesticides for vegetation maintenance, unless it is specifically called for in the O&M plan.

7. Use replacement plants that conform to the initial planting plan and to Appendix B, "Landscape Requirements."

301.13.06 Sediment Management/Pollutant Control

a. Sediment and other pollutants that degrade water quality will accumulate in stormwater management facilities. The contractor shall remove all accumulated pollutants and sediment to maintain proper facility operation. Periodic testing will help determine appropriate sediment-removal schedules.

b. Requirements:

1. Place a sediment marker (see Detail No. S-2260 of these standards) in the forebay or in an area not likely to be damaged by incoming storm flows and where it can be easily seen by maintenance personnel.

2. Remove sediment when accumulations reach 1 foot in depth, 50% of the designed sediment storage depth, or if sediment accumulation inhibits facility operation. The 50% full capacity shall be identified and marked on sediment marker during facility construction.

3. Test sediment before removing it if the stormwater management facility serves a commercial/industrial site or a multifamily structure or development. Sediment shall be tested according to protocol established in the O&M plan, and any additional information resulting from site-specific conditions and use. Testing could include parameters such as oil and grease, heavy metals (lead, zinc, and cadmium), nutrients (e.g., phosphorus), and organics such as pesticides that may accumulate. Testing must be site specific if a commercial/industrial discharger is

being served; City of Wilsonville reserves the right to require testing of specific contaminants. Applicant shall provide the test results to the City of Wilsonville Natural Resources Program prior to excavation and disposal of sediment.

4. Dispose of sediments at the time of excavation in a manner meeting applicable state and federal requirements. If sediment disposal requires special handling, disposal documentation shall be provided to the City of Wilsonville Natural Resources Program.

5. Investigate and control, or report the pollutant source, if sediment or other pollutants are accumulating more rapidly than assumed when the O&M plan was formulated. Direct pollution-control complaints to the City of Wilsonville Natural Resources Program.

301.13.07 Insect/Vector Control

a. Standing water associated with some types of treatment systems can attract insects.

b. The following measures shall be the primary methods of insect control. The method are not presented in order of implementation, but one or all of these methods shall be used before considering any other measures:

   1. Install predacious bird and bat nesting boxes.

   2. Change the water level of ponds every four days or so to disrupt the larval development cycle of mosquitoes.

   3. Stock ponds and other permanent water facilities with fish or other predatory species.

   4. Use mosquito larvicide, such as Bacillus thurengensis or Altoside® formulations, only if absolutely necessary. Any pesticide or larvicide shall be applied by a licensed individual.

c. Additional assistance with vector monitoring and control may be obtained from the local vector control office.

301.13.08 Access and Safety

O&M programs shall provide for safe and efficient access to a facility and shall be in compliance with Section 101.8.09, “Safety Requirements”. The following are general requirements; specific conditions may require site-specific modifications:

a. Secure easements necessary to provide facility and maintenance access (if applicable).

b. Use only trained and certified personnel to access confined spaces.

c. Maintain ingress/egress routes to design standards, in a manner that allows efficient maintenance of the facility.

d. Ensure that fencing is in good repair.

301.14.00 TESTING PROCEDURES

301.14.01 General

a. The contractor shall furnish all necessary testing equipment and perform the tests in a manner satisfactory to the City's authorized representative.

b. All gravity storm systems shall be inspected and tested after backfill has passed the required compaction test(s) based on AASHTO T-180 and roadway base rock has been placed, compacted, and approved. All details of testing procedures shall be subject to approval of the City's authorized representative.

c. If repair work is required on a section of the system, that portion of the system shall be retested.

d. Deflection testing shall be done in the presence of the City's authorized erepresentative.

e. All testing shall be completed and accepted by the City's authorized representative before paving of overlying roadways will be permitted.

f. Prior to the start of storm system testing, all manholes shall be re-numbered as assigned by the City's authorized representative. All testing shall reference the City assigned manhole numbers.

301.14.02 Line Cleaning

Before testing and City inspection of the system, the contractor shall plug the closest downstream manhole, ball and flush, and clean all parts of the system. The contractor shall remove all accumulated construction debris, rocks, gravel, sand, silt, and other foreign material from the system at the plugged manhole using a vacuuming process. At no time, shall any material be flushed into the downstream city storm sewer system. When the City's authorized representative inspects the system, any foreign matter still present shall be removed from the system by repeating the cleaning process. ***No material shall be flushed into the downstream city storm sewer system.***

301.14.03 Deflection Test for Flexible Pipe

Storm systems constructed of flexible pipe shall be deflection-tested by pulling an approved mandrel through the completed pipeline. The diameter of the mandrel shall be 95% of the nominal pipe diameter, unless otherwise specified by the City's authorized representative. The mandrel shall be a rigid, nonadjustable, odd-numbered-leg (9 legs minimum) mandrel having an effective length of not less than its nominal diameter. Testing shall be done manhole-to-manhole and after the line is completely balled and flushed with water, and after compaction tests of backfill are completed and accepted. Testing shall be conducted in the presence of the City's authorized representative. The contractor shall be required to locate and repair any sections that fail the test and to retest those sections. All repairs shall follow and be in compliance with the manufacturer's recommendations. Any mechanical device meant or intended to come into contact with the pipe material in an attempt to re-round the pipe is strictly prohibited.

301.14.04 Video Inspection of Gravity Systems

All storm systems shall be video-inspected and approved prior to City acceptance. Video inspection shall take place after trench backfill and compaction has been completed and accepted, and channels have been poured in manholes. All pipes shall be thoroughly cleaned in accordance with Section 301.14.02, "Line Cleaning" immediately prior to the video inspection; only that water remaining from cleaning shall be present in the system. Video inspection shall be continuous from manhole to manhole without breaks or interruptions in the recording. The camera shall have the ability to tilt up to 90 degrees and rotate 360 degrees on the axis of travel. An inspection of all lateral connections shall be conducted using the tilt capabilities of the camera. A 1/2-inch target ball shall be placed in front of the camera. There shall be no observed infiltration and observed sags must be less than 0.5 inch.

The City's authorized representative shall be notified and shall be present during video-inspection of the system, unless otherwise approved by the City's authorized representative. A copy of the video and a written video inspection report, on a City-approved form, shall be supplied to the City's authorized representative. The video shall be recorded in color CD or DVD format. Video shall include a visual footage meter recording. Problems revealed during the inspection shall be noted on the video and in the written report. After repairs have been made, the line shall be re-inspected and re-tested. If excessive foreign material, in the opinion of the City's authorized representative, is encountered during video inspection, the line shall be cleaned in accordance with Section 301.14.02, "Line Cleaning" and re-video inspected.

301.14.05 Locate Wire Testing

Prior to paving, the contractor shall notify the City's authorized representative that the storm sewer locate wire is ready for testing. City personnel shall connect to the locate wire and attempt to locate storm sewer system piping, including services. All points of the storm sewer system piping shall be located from at least two connection points to be considered to have adequate coverage. The contractor will be required to locate and repair any gaps in the locate wire coverage. Failed sections shall be retested until adequate coverage is obtained.

301.15.00 WARRANTIES AND ACCEPTANCE

301.15.01 Stormwater and Surface Water Acceptance Policy

The City of Wilsonville will accept new stormwater and surface water installations or systems built to the "Public Works Standards," providing that the following conditions are met.

a. Dedication of any required easements or rights-of-way have been recorded with the County Recorder and the Engineering Department receives a reproducible copy of the recorded documents.

b. After completion of construction of the total project, and after all testing has been satisfactorily completed, project closeout shall proceed as outlined in Section 101.8.17.a, "Project Completion."

c. The Contractor or Applicant shall be responsible for providing Maintenance Assurance for Public Improvements as outlined in Section 101.8.17.b, "Maintenance Assurance." Public storm improvements shall be warranted for a minimum of two years.

d. At any time during the warranty period, the City's authorized representative has reason to believe the public stormwater improvements have defects that were the result of faulty workmanship or flaws in construction material, the responsible party shall be required, at that party's own cost, to video-inspect the sewer line and repair any problems or faults revealed during video inspection by replacing those sections. The video inspection shall be done during the winter, if possible, or during the wet weather months, to identify all leaks.

e. Before the end of the Construction Maintenance period, the City's authorized representative shall inspect the project for any remaining deficiencies. If the deficiencies that remain are determined to be the responsibility of the contractor or the applicant, the contractor or applicant shall then make such repairs.

f. The Landscape Maintenance assurance shall be released two years after acceptance of construction, providing the landscaping meets the 90% survival level (see Section 301.15.02, "Landscape Inspection for Warranty").

301.15.02 Landscaping Inspection for Warranty

a. The City's authorized representative shall inspect the condition of all landscaping located within the public right-of-way and/or the stormwater management facility at the end of the first year of the post-construction period. The City's authorized representative shall provide an interim inspection report to the applicant with a specific summary of any deficiencies. Failure of the City to provide the interim report shall not release the applicant from the responsibility for providing established landscaping at the end of the two-year landscaping maintenance period.

b. If at any time during the warranty period the landscaping falls below the 90% survival level, the applicant shall reinstall all deficient planting at the next appropriate planting opportunity. The two-year maintenance period shall begin anew from the date of replanting.

c. The 90% survival level shall meet the following criteria:

1. In the opinion of the City's authorized representative, landscaping is established and healthy.

2. Each plant group (trees, shrubs, herbaceous, and aquatics) shall meet the 90% survival level.

3. Each planting zone (wet, moist, and dry) shall meet the 90% survival level.

d. Areal coverage shall meet the 90% survival level.

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SECTION 1

GENERAL CONSTRUCTION REQUIREMENTS AND ADMINISTRATIVE PROVISIONS

101.1.00 AVAILABILITY

Copies of these "Public Works Standards" for the City of Wilsonville, Oregon, or any subsection of the standards are available from the Wilsonville Community Development Department, given reasonable notice and payment of current reproduction costs, or are available to download from the City of Wilsonville, Engineering website.

Due to its size, Chapter 3 "Stormwater & Surface Water Design and Construction Standards" is provided under separate cover, but is still considered a part of these Public Works Standards.

The "Public Works Standards" are subject to change (see Section 101.3.00.c, "Scope"); check the City of Wilsonville Engineering website or with the City of Wilsonville Engineering Division for revisions or updates.

101.1.01 Reference to Standards

The design engineer may, at his or her sole discretion, use the standards by direct reference in the contract documents prepared for the construction of public streets, storm drainage, water, and sanitary sewer facilities in the City of Wilsonville. If the design engineer incorporates the City's standards in that way, the contract documents shall contain the following statements:

a. Material and workmanship shall be in strict accordance with the standard specifications of the City of Wilsonville. No changes from the approved project plans and specifications shall be made without approval of the City's authorized representative.

b. The standards are in outline form only, and shall not operate to relieve the design engineer of his or her professional responsibilities during project design and construction.

c. These standards represent the minimum requirements for construction in a public right-of-way or public easement to protect the public health, safety and welfare. Any deviation from the standards must be approved, in writing, by the City's authorized representative.

101.2.00 INTENT

101.2.01 Intent of Public Works Standards

These standards for constructing public facilities in the City of Wilsonville are intended to protect the public health, safety, and welfare by:

a. Setting forth uniform material and workmanship standards.

b. Supplementing and completing the public health and safety requirements of Chapter 4 of the Wilsonville Code.

c. Streamlining the administration and construction of public facilities in the City and minimizing repairs to these public facilities.

101.2.02 Interpretation

Where situations arise that are not clearly covered by these Standards, the City's authorized representative will review the issue on a case by case basis to determine the design and/or construction methodology acceptable to the City.

101.2.03 Order of Precedence

All federal, state, county (Clackamas or Washington) or local laws and ordinances are to be adhered to. If there is any conflict between the Standard Specifications and pertinent laws and ordinances, the laws and ordinances shall prevail.

If there is a conflict between approval documents, the document highest in precedence shall control. The order of precedence shall be:

First: Permits from other agencies or jurisdictions, as may be required by law.

Second: Land use decision-making authority's Conditions of Approval.

Third: City of Wilsonville master plans (latest editions): Parks and Recreation Master Plan, Transportation Systems Plan, Storm Water Master Plan, Wastewater Collection System Master Plan, Water System Master Plan.

Note: Permits, Land Use Conditions of Approval, and Master Plans are intended to provide the authority for what public facilities are to be constructed; the below public works detail drawings and standards and the various standards that follow describe how public facilities are to be constructed through the use of the approval component materials equipment, and methods set forth.

Fourth: City of Wilsonville *Standard Detail Drawings*.

Fifth: City of Wilsonville *Public Works Standards*.

Sixth: City of Wilsonville *Planning and Land Development Ordinance.*

Seventh: City of Wilsonville Bicycle and Pedestrian Master Plan, latest edition.

Eighth: *Oregon Standard Specifications for Construction* (current edition) (ODOT, Oregon APWA) and any reference specifications and standard practices adopted by nationally recognized professional societies such as ASCE, AWWA, APWA, ACI, ASTM, and AASHTO, and any reference specifications or guidelines as presented in the latest edition of the MUTCD.

Ninth: *ODOT Pavement Design Guide.*

Tenth: *Uniform Building Code* and City-issued building, mechanical, electrical, and plumbing permits.

Eleventh: Americans with Disabilities Act latest approved standards or guidelines as referenced in the Standard Details of these standards. .

Twelfth: Plans and details prepared by the design engineer.

Supplemental written agreements, franchise agreements, and approved revision to plans and specifications by the appropriate jurisdictions and conforming to local, state, and federal law will take precedence over documents listed above. Detailed plans shall have precedence over general plans. In any event, the determination of the City Engineer shall be final.

101.3.00 SCOPE

These standards for construction of public facilities in the City of Wilsonville:

a. Cover all public streets, storm drainage, water, sanitary sewer, and appurtenant facilities inside the corporate limits of the City that are to be turned over to the City for maintenance and operation.

b. Relate only to public facilities constructed in the City and should not be confused with building codes, zoning ordinances, and other regulations for which the City has established separate procedures and standards.

c. May be amended or updated periodically by ordinance of the City Council on the recommendation of the City Engineer to protect the public health, safety, and welfare.

d. Notwithstanding the foregoing, the City Engineer shall have the authority to modify the Standard Detail Drawings of these standards, as needed to maintain conformance to the periodic changes to national and state design requirements, guidelines, and specifications and industry standards.

101.4.00 DEFINITIONS

The following definitions apply throughout these standards:

AASHTO:	American Association of State Highway and Transportation Officials
AC:	Asphaltic concrete
ACI:	American Concrete Institute
ACPA:	American Concrete Pavement Association
ADA:	Americans with Disabilities Act
ADAAG:	American with Disabilities Act Accessibility Guidelines and Standards
ADT:	Average daily traffic
ANSI:	American National Standards Institute
APWA:	American Public Works Association
ASTM:	American Society for Testing and Materials
AWWA:	American Water Works Association
Act of God:	Earthquake, flood, cyclone, or other cataclysmic natural phenomenon
Addendum:	Written or graphic modification or interpretation of contract documents
Agreement:	Written agreement covering performance of work and furnishing of labor and materials in construction of work
Alley:	Street or road primarily intended to provide secondary access to road or side of lots or buildings and not intended for normal through vehicular traffic

Applicant:	Person, organization, or duly authorized representative identified as such in specifications and in agreement, and referred to throughout contract documents as if singular in number and masculine in gender; means owner or authorized representatives, including parties acting as designated authority for aspects of work
Approve:	"Approved," "approve," "approval," or similar words shall mean to give, in writing, limited, conditional, or qualified permission to use material, equipment, or methods, such conditions being in strict compliance with City's standards; approval will be by the City's authorized representative
ARCPACS:	A federation of certifying boards in agriculture, biology, earth, and environmental sciences. Provides professional certification for soil scientists whose education, experience and career path are in some aspect of the soil science profession and can meet the standards of the ARCPAC program
As-Built Plans/Record Drawing:	Plans signed and dated by the Project Engineer indicating that the plans have been reviewed and revised to accurately depict all known as-constructed details of a particular public works project
As-Constructed Plans/Record Drawing:	See As-Built Plans/Record Drawing
Authorized representative:	Party or parties authorized or employed by applicant to observe, test, or review quality and sufficiency of work performed, materials used, and determine compliance with plans and specification; for the City of Wilsonville, designated authority shall be the City Engineer or one of the City's authorized representatives
Bid bond:	Form of security furnished by contractor, guaranteeing that he/she will enter into a contract in accordance with contract documents if the proposal is accepted
Bidder:	Any individual, firm, or corporation formally submitting a proposal for work contemplated, or any part of it, acting directly or through an authorized representative

Bioengineering:	A construction methodology used to stabilize and conserve soils through the use of live plants alone or in combination with biodegradable material to produce living, functioning systems that can prevent erosion, control sediment, and provide habitat
BPMP:	City of Wilsonville's Bicycle and Pedestrian Master Plan, latest edition
Building Drain:	The building drain is that part of the lowest piping of the sewer system which receives the discharge from waste and other drainage pipes inside the walls of the building and conveys it to the building sewer ,which begins five feet (5') outside the building wall (building foundation)
Building Foundation:	That part of the horizontal piping of the sewer system which extends from the end of the building drain and which receives the discharge of the building drain and conveys it to a public sewer, or privately managed sewage collection system, or other point of disposal
CD:	Construction documents
CDF:	Control density fill
CEC:	Cation exchange capacity
CLSM:	Controlled Low-Strength Material
CN:	Curve number
Certificate of Insurance:	Evidence of insurance coverage of the contractor, furnished to the City
Change order:	Written order to contractor by City Engineer or the City's representative authorizing addition, deletion, or revision of work within general scope of contract, or adjustment in price or time
City:	City of Wilsonville

City Boards and Commissions:

City Council:	Five-member governing body responsible for identifying community problems and needs, and establishing policies and goals to address those needs

Development Review Board:	Empowered to review and take action on land-use applications; decisions are usually binding, but may be appealed to City Council
Planning Commission:	Makes recommendations to City Council regarding City's comprehensive plan, facilities plans, capital improvements program, and planning and zoning ordinances and provide input on traffic-related concerns
Parks & Recreation Advisory Board:	Aids in planning and developing present and future parks and recreation in City and advises City Council on policy matters regarding parks and recreation services
City Engineer:	Professional Engineer registered in the State of Oregon, designated by the City Manager to carry through with planning, designing, and project supervision of public facilities that will be accepted and owned by the City
Contract:	Binding agreement between contractor and applicant covering performance of work and furnishing of labor and materials for construction of public facilities
Contractor:	The person or entity that has entered into contract with the applicant; "contractor," though here used to describe an individual, shall mean contractor, agents, employees, officials, subcontractors, or anyone connected with work set forth on behalf of contractor
Contract documents:	Agreement, addenda, instructions to bidders, contractor's proposal, bonds, notice of award, notice to proceed, general provisions, technical provisions, plans, change orders, field orders, and all other modifications of such documents entered into in accordance with contract
Contract price:	Total amount payable to contractor for work, including all sales, use, and other consumer taxes related to work.
Contract time:	Number of calendar days allowed contractor to complete work
Construction maintenance assurance:	A one-year bond for 10% of the cost to construct public improvements

County road:	Public road incorporated into county roadway system by formal action of Board of County Commissioners; these roads are assigned numbers and county assumes maintenance responsibility
Cut Sheets:	Sheets of tabulated data, indicating stationings, structures, fittings, angle points, beginning of curve, points on curve, end of curves, sewer slope, staking offset, various elevations, offset cuts, and sewer depths
Definition of Words:	Wherever, in these PS & FM Standards, the works directed, required, permitted, ordered, designated, or words of like meaning are used, they shall be understood to mean the direction, requirement, permission, order or designation of the City Engineer. Similarly, the words approved, acceptable, satisfactory, shall mean approved by, acceptable, or satisfactory to the City Engineer
DBH	Diameter at Breast Height: Standard method of determining the size of a tree
DEQ:	Oregon Department of Environmental Quality
Design engineer:	Professional Engineer registered in the State of Oregon responsible for planning, designing, and producing record drawings of public facilities that will be accepted and owned by the City
Detail Drawings:	Construction drawings produced by the City of Wilsonville providing details of acceptable construction standards for public facilities. Drawings may be periodically updated or changed, as needed, by approval of the City Engineer
Development:	Development includes new development, redevelopment, and/or partial redevelopment
Directed, required, etc.:	In these standards, “directed,” “required,” “permitted,” “ordered,” “designated,” or similar words shall mean at the direction, requirement, permission, order, or designation of applicant or City Engineer
Domestic Sewage:	The liquid and water borne waste derived from the ordinary living process, 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

Drainage Waste:	Storm water, ground water, surface drainage, subsurface drainage, spring water, well overflow, roof drainage, or other like drainage other than sewage or industrial waste
Dwelling Unit:	A facility designed for permanent or semi-permanent occupancy and provided with minimum kitchen, sleeping, and sanitary facilities for one family
Easement:	An interest in land owned by another that entitles the easement holder to a specific limited use of the land; however, ownership of the land does not change
Easement, Public Pipeline:	The space identified within the easement document that is in, upon, above, along, across, over or under the publicly owned and maintained storm, sanitary, or water facility
Easement, Public Utility:	The space in, upon, above, along, across, over or under the easement as identified within the easement document. By way of general description, public utility easements are typically created along the border(s) of a tax lot or frontage along public right-of-way and are intended for the use of utility companies and other authorized users to operate, place, relocate and maintain facilities in accordance with city requirements and standards
EPSC Plan:	Erosion Prevention and Sediment Control Plan following recommendations outlined in the Erosion Prevention and Sediment Control Planning and Design Manual, latest edition
EPSC Planning and Design Manual:	Erosion Prevention and Sediment Control Planning and Design Manual developed in partnership between CleanWater Services of Washington County, Water Environment Services of Clackamas County, City of West Linn, ODOT, and Harza Engineering, latest edition
FEMA:	Federal Emergency Management Agency
FHWA:	Federal Highway Administration
Field order:	Written order to contractor, approved by applicant, changing work but not affecting contract price or time

Final completion:	Date when project correction list is completed; a 10% maintenance bond is submitted in accordance with contract documents, as modified by change orders agreed to by parties, or as specified in Section 101.8.17, "Project Closeout;" and the City's authorized representative receives confirmation that all easements and legal documents have been recorded with the County Recorder
First party:	Applicant or duly authorized representative
Flow:	The liquid and water borne waste derived from domestic sewage, industrial wastes, and in some cases drainage waste
Grout:	Thin, fast-setting, high-strength, non-shrink mortar used to fill cracks and joints in masonry
HMAC:	Hot mixed asphalt concrete
ICEA:	Insulated Cable Engineers Association
Inclement weather:	Weather conditions so extraordinary that previous climatic conditions in locality of work give no reasonable warning of them; shall be determined by City Engineer
Indicated, shown, etc.:	"Indicated," "noted," "shown," "called for," or similar words shall mean indicated, noted, shown, or called for in the contract documents for the work referred to
Industrial Waste:	A water borne waste and wastewater from other than domestic users
Intersection:	Area jointed by two or more roads intersecting; for design purposes, intersection is not formed by naming two approaches of continuous street at curve or other point with different street names
Landscape maintenance assurance:	A bond for 100% of the cost to install all required landscaping in water quality/quantity facilities and vegetated corridors, plus 100% of the cost to maintain the landscaping in these areas for the duration of the bond
Large-diameter pipe:	Pipe with diameter larger than 24 inches

Lateral Sewer (Service Lateral):	Any sewer line to which a private building sewer connects or may connect. The lateral sewers are located within public right-of-way or easement, and generally connect to the main sewer and extend to the right-of-way or easement
Letter of commitment:	A letter issued by another jurisdictional agency to the City as performance assurance or maintenance assurance and warranty for public improvements
Main Sewer (Public Sewer):	A public sewer that has been or is being constructed to accommodate more than one lateral sewer or to which a building sewer connects or may connect. (Normally not less than eight inches in diameter)
Maintenance Assurance Bond:	Maintenance assurances required by the City for work performed to ensure post-construction quality and landscape survivability. May consists of both construction maintenance assurance and landscape maintenance assurance
Manager:	The City Manager of the City of Wilsonville or his/her authorized representative
Manufacturer's Name:	Any manufacturer's name, specification, catalog number, or type used herein is specified to make and order to establish the standard requirements of the City. Other equivalent makes will be considered for approval, providing they are comparable with this established standard
Mortar:	Plastic building material of cement or lime, sand, and water that hardens in place and is used in masonry or plastering
MUTCD:	*Manual on Uniform Traffic Control Devices*, latest edition
NAVD 88:	North American Vertical Datum of 1988: the vertical control datum established in 1991 by the National Geodetic Survey
Neighborhood Erosion Control Plan:	An approved erosion-prevention and sediment-control plan for multiple lots
NEMA:	National Electrical Manufacturers Association
NGVD 29:	National Geodetic Vertical Datum of 1929: vertical control datum established for vertical control in the United States by the general adjustment of 1929 (formerly called the "Sea Level Datum of 1929")

NPSH:	Net Positive Suction Head, in association with sanitary sewer pumping units
NRCS:	National Resource Conservation Service
Notice to proceed:	Written notice given by designated authority to contractor fixing date when contractor shall begin to perform the obligations under contract documents
O&M plan:	Operation and maintenance plan for mechanical systems to be operated by the City, or plan designed for stormwater facilities and prepared by the responsible party in the Stormwater Maintenance Covenant and Access Easement
ODFW:	Oregon Department of Fish and Wildlife
ODOT:	Oregon Department of Transportation
ODOT QPL:	Qualified Products List; published twice each year by ODOT's Construction Section
ODOT SSC:	2015 Oregon Department of Transportation Standard Specifications for Construction
OSHA:	Occupational Safety and Health Administration
Or equal:	"Or equal," "or approved equal," or similar words shall mean to possess same performance qualities and characteristics and fulfill utilitarian function without any decrease in quality, durability, or longevity and shall meet with approval of designated authority (no inference is intended that items must be identical in all respects if above conditions are satisfied)
Owner:	Any individual partnership, firm or corporation by whom the Project Engineer has been retained or who, as a property owner, is making arrangements with the City
PCA:	Portland Cement Association
PCC:	Portland Cement Concrete
Payment bond:	Form of security furnished by contractor and their surety guaranteeing payment of all labor, material, equipment, and all other obligations arising from work

Performance bond:	Security furnished by applicant, or such other party acceptable to the City, and their surety guaranteeing complete and faithful performance of all obligations and conditions placed on contractor by contract
Person:	Individual, firm, corporation, association, agency, or other entity
Plans:	Plans, profiles, and detailed drawings showing locations, character, dimensions, and details of work to be done
Plumbing System:	All plumbing fixtures and traps, or soil, waste, special waste, and vent pipes within a building and to a point five fee outside the building foundation thereof
PRMP:	City of Wilsonville's Parks and Recreation Master Plan,latest edition
Predevelopment:	Considered as the natural, unimproved and unaltered state of the land.
Product data:	Complete catalog data for manufactured items of equipment and all component parts, including specific performance data, material description and source, rating, capacity, working pressure, material gauge thickness, brand name, catalog numbers, and other necessary information
Project correction list:	Final project inspection to repair checklist, or punch list, compiled after construction of total project is complete, and after all testing is satisfactorily finished
Project Engineer:	The engineer, licensed by the State of Oregon as a Civil Engineer, under whose direction plans, profiles, and details for the work are prepared and submitted to the City for review and approval
Proposal:	Offer for work made out and submitted on prescribed proposal form and properly signed and guaranteed by bidder
PUE:	Public Utility Easement
Public road:	Road dedicated for use by public; maintained by the City and funded by the road maintenance fee

Public works facility:	Any facility constructed in public right-of-way or public easement that is either immediately or eventually to be taken over by City for maintenance and operation; includes but is not limited to streets, sidewalks, curbs, parking lots, driveways, storm drainage facilities, water system works, and sanitary sewer systems
Public Sewer:	Any sewer in public right-of-way or public easement operated and maintained by the City
Punch list:	Final project inspection to repair checklist, or project correction list, compiled after construction of total project is complete, and after all testing is satisfactorily finished
Representative:	City Engineer or authorized representative
Reserve strip:	A 1-foot wide- section adjacent to or at terminus of right-of-way , to be recorded as a plat restriction with access controlled by the City Engineer.
Residential User:	The owner, lessee, or occupant of a single-family dwelling unit in one structure
Right-of-way:	The space in, upon, above, along, across, over or under the public streets, roads, highways, lanes, courts, ways, alleys, boulevards, sidewalks, bicycle lanes, and places used or intended to be used by the general public for travel as the same now or may hereafter exist, that the City has the right to allow User to use. Right-of-Way shall not include the airspace above the Right-of-Way used for cellular mobile radio service or broadcast television service
Road:	Part of right-of-way used for vehicular traffic, including appurtenances, storm drain system, traffic control devices, etc.
Roadway:	All of the right-of-way dedicated, granted, used or to be used, for vehicle movement
SBUH:	Santa Barbara Unit Hydrograph
SCS:	Soil Conservation Service, U.S. Department of Agriculture
Sensitive areas:	Areas sensitive to environmental degradation, such as existing or created wetlands; rivers, streams, and springs with year round or intermittent flow; and impoundments (natural lakes and ponds). Sensitive areas also include any resource protected within the SROZ

Service Lateral:	See Lateral Sewer
Sewage:	The wastewater derived from human habitation and use of buildings for residential, institutional, or commercial purposes, excluding storm waters and industrial waste
Shop drawings:	Diagrams, drawings, illustrations, brochures, schedules, and all other data submittals required by contractor and furnished by contractor illustrating fabrication, installation, dimensions, and other aspects of work
Specifications:	Directions, requirements, explanations, terms, and provisions in these standards, supplemented by such special conditions as may be necessary pertaining to various features of work to be done, manner and method of performance, and manner and method of measurement and payment; specifications include directions, requirements, and explanations that appear in plans
SROZ:	Significant Resource Overlay Zone: the delineated outer boundary of an identified significant natural resource as defined by Wilsonville's Development Code
Standard specifications:	Codes, rules, and regulations set forth in City of Wilsonville "Public Works Standards" as adopted by City Council and considered to be the latest issue, with all amendments as of date of these standards
Standards:	Specifications in the "Public Works Standards" adopted for use in City of Wilsonville.
Steel plate:	A-36 steel meeting AASHTO H-20 loading specifications
Stock pile:	Temporary staging of construction and/or excavated materials
Streets or Roads:	Any public highway, road, street, avenue, alley, way, easement, or right-of-way used or to be used for vehicle movement
Structures:	Those structures designated on the Standard Drawings as manholes, cleanouts, weirs, etc. Detailed drawings of structures or devices commonly used in City work and mentioned in these PS & FM Standards are included in Section IV, Standard Drawings
Subcontractor:	Any individual, firm, or corporation having contract with contractor or with any other subcontractor for performance of part of work

Substantial completion:	In the opinion of the City's authorized representative, construction is to the point of completion where all facilities are usable for their intended purpose: utilities (storm, sanitary, and water) are tested, approved and connected to public lines, all weather access is completed; roadway striping is completed; street lighting is approved and activated; all fire, life, and safety issues meet code
Substantial progress:	In the opinion of the City's authorized representative, construction work is proceeding at a rate close to that of the submitted construction timetable
Traffic coefficient:	Number used in determining structural section of street
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
TSP:	City of Wilsonville's Transportation Systems Plan, latest edition
TVF&R:	Tualatin Valley Fire and Rescue
Uniform Plumbing Code:	The Uniform Plumbing Code adopted by the International Association of Plumbing and Mechanical Officials, current edition
USCGS:	United States Coast and Geodetic Survey
Wet-season:	For the purpose of monitoring ground water elevations, the "wet-season" is defined as November 1 through April 30
WQV:	Water Quality Volume
WPWS:	Wilsonville Public Works Standards, current edition
Work:	Furnishing of all labor, materials, equipment, and other incidentals necessary or convenient to successfully complete project or part of project, and carrying out of all duties and obligations imposed by contract
Working Day:	Calendar day, any and every day shown on the calendar, excluding Saturdays, Sundays, and legal holidays.

Written notice: Written communication delivered in person to individual or to member of firm or to officer of corporation for whom it is intended. If delivered or sent by mail to last business address known to one who gave notice, it shall be duty of each party to advise other parties to contract of any change in business address until contract is complete

101.5.00 CONTROL OF PUBLIC WORKS CIP PROJECTS

a. All public system improvements and public works facilities, or improvements or facilities to become public, shall be designed by or under the direction of the Project Engineer, a Professional Engineer registered in the State of Oregon. All public system improvements and public works facilities shall be designed and constructed in accordance with all applicable rules and regulations of the City and any City interpretations of those rules and regulations, including applicable technical guidance manuals, and in accordance with all applicable federal, state, and local statutes and rules.

b. Project Engineer Responsibilities.

1. The Project Engineer shall, at a minimum, be available for the following:

(a) Project Orientation

(b) Preliminary Design

(c) Final Design: Includes 50%, 90% and 100% bid design.

(d) Pre-Bid Conference

(e) Construction Management: Includes preconstruction conference, weekly (at a minimum) construction meetings, and completion.

2. The Project Engineer shall prepare agendas and meeting minutes for all project-related meetings unless otherwise directed by the City's authorized representative. Meetings shall be scheduled at least 10 business days in advance. The Project Engineer shall distribute agendas and supporting information through the City's authorized representative to all invited attendees at least 2 business days in advance of any meeting. The Project Engineer shall distribute meeting minutes to all meeting attendees and other interested parties within 5 business days of the meeting date.

3. The Project Engineer shall develop and submit to the City's authorized representative a detailed schedule for the entire project (design, property acquisition, permits and construction) showing major tasks and supporting

activities for completion of the project. The schedule shall account for periods of City review and comment submission where required.

c. Approval of the plans and schedule must be made by the City's authorized representative before construction is permitted. An authorized representative of the City will be available for construction observation during construction of the project.

d. At the completion of construction, the design engineer shall submit a completion certificate to the City stating that all permitted work has been completed in accordance with the approved project plans and specifications, or approved modifications to the plans.

e. All surveys for public works facilities shall be performed under the direction of a Professional Land Surveyor registered in the State of Oregon. A list of acceptable benchmarks is available at the City. It is the surveyor's responsibility to verify the accuracy of these benchmarks. Surveys shall be in compliance with Section 101.7.07, "Surveying and Land Monuments."

f. Materials and workmanship shall meet or exceed the adopted standards and at all times shall be subject to the approval of the City's authorized representative.

g. On completion of projects to become public works, the applicant or their Project Engineer shall submit one complete set of reproducible "record drawings" (see Section 101.8.17.a, "Record Drawings") to the City's authorized representative for future reference. The drawings shall show any deviations from the original construction drawings and shall include sufficient information to accurately locate water, sanitary sewer, and storm sewer service extensions. No bond will be released until the City's authorized representative receives an acceptable set of reproducible record drawings from the design engineer, with his or her stamp of certification.

h. Before the City accepts a public works project for operation and maintenance, a guarantee on all materials and workmanship incorporated in the project shall be provided to the City on one of the acceptable forms described in Section 101.8.18, "Maintenance and Warranty."

101.6.00 PRIVATE DEVELOPMENT PROCESS REQUIREMENTS

101.6.01 Pre-Application Conference

The City of Wilsonville will hold a pre-application conference with the applicant (owner/developer), unless otherwise waived by the Planning Director, before formal application for public works permits and review of site design and construction plans. The pre-application process allows the applicant and the City to discuss the proposed project and the standards and regulations that will apply while the project is still in a preliminary stage. Any specific development standards, regulations, or problem areas can thus be discussed before the applicant makes a substantial investment in the project or proceeds with a formal application unaware of the issues.

101.6.02 Plan Check and Permits

a. Permit required: No work shall be performed, nor materials stored, nor encroachment made on or within a Right-of-Way, Public Easement, or Public Utility Easement without first acquiring a permit from the City's Engineering Division, except as provided by City Ordinance.

b. Plan checks and/or permits are required and issued on all construction projects within public rights-of-way, or easements, which will eventually be maintained and operated by the City of Wilsonville. Any permits required by federal, state, and local governments shall be obtained by the person proposing the improvements.

c. Public Works Permit: Projects requiring Public Works Permits shall include, but not necessarily be limited to, improvements or upgrades to publicly owned and maintained streets, sidewalks, curbs, driveway approaches, water systems, sanitary sewer systems, and storm drainage systems. Projects that also require plan checks and permits include all private storm drainage, sanitary sewer, and water systems that will be connected to or that will discharge into a system under the jurisdictional control of the City of Wilsonville.

d. Utility Construction Permit: The construction, repair, maintenance, or replacement of all other utilities located within a public right-of-way or public easement, including, but not exclusively, power, telephone, gas, and cable television, shall be required to submit for plan check and obtain a Utility Construction Permit.

e. Right of Way Permit: For all other work done within the Right-of-Way that blocks, partially blocks, hinders or impedes the flow of traffic, cyclists, or pedestrians, a Right of Way Permit shall be required.

101.6.03 Plan Check Requirements

At the pre-application conference, the applicant will be given a copy of the Community Development Department Plan Review Checklist**,** which is to be used as a guide during the review of all proposed new, or improvements to, public works facilities.

Along with the items in the plan review checklist, the following requirements shall be met before the City's authorized representative completes a plan check:

a. Satisfy all requirements of Chapter 4 of the Wilsonville Code and other ordinances and regulations pertaining to construction in the City of Wilsonville.

b. Submit detailed plans printed to PDF and combined into a single electronic file and specifications printed to PDF and combine into a single electronic file, with each being stamped and digitally signed by a Professional Engineer registered in the State of Oregon, along with three printed copies. Incorporated within the construction plans and specifications shall be applicable franchise utility installation plans, stamped and signed and prepared by the proper authority.

c. For projects which include street construction, re-construction or expansion, submit two sets of the Street Design Report and a single electronic file in PDF format, stamped and signed by a Professional Engineer registered in the State of Oregon in conformance with Section 201.2.00, "Street Design Standards."

d. Submit two sets of storm water design report and a single electronic file in PDF format, stamped and signed by a Professional Engineer registered in the State of Oregon in conformance with Section 301.3.00, "Submittal Requirements".

e. Submit two sets of design calculations for the water system design or wastewater system design and a single electronic file in PDF format, stamped and signed by a Professional Engineer registered in the State of Oregon, where applicable or as required.

f. A plan check fee must be paid before a plan review will be started. The amount of the fee will be established by resolution of the City Council.

g. Plans deemed incomplete by the City's authorized representative may be returned without a full plan review being completed. An explanation will be provided by the City indicating sections of the plans deemed incomplete. Once all items are addressed, plans may be resubmitted for review.

h. Plans shall include all necessary current City details and City Construction Note Sheet.

101.6.04 Plan Review

a. If all conditions of the plan check requirements as specified in Section 101.6.03, "Plan Check Requirements," are met, and no additional information is requested by the City's authorized representative, the plan review will be commenced. The City's authorized representative will prepare a plan review redline comments list, to be sent to the appropriate permit applicant or responsible party. The list will indicate any deficiencies in the construction plans and specifications. The proper party shall then make the corrections and resubmit the plans and specifications for review.

b. The plan check fee submitted as per Section 101.6.03.f, "Plan Check Requirements," covers the City's first and second plan reviews. An additional plan review fee shall be required for the third, fifth, and every other plan review performed by the City. A partial plan review or plans deemed incomplete as per Section 101.6.03.g, "Plan Check Requirements," will be considered as a full plan review in respect to the plan check fee. The amount of the additional fee will be established by resolution of the City Council.

c. Once the plans and specifications are approved for construction, the City's authorized representative shall issue a written notice of plan approval. The written notice of plan approval shall remain in effect for 90 calendar days from the date of approval. If the applicant cannot proceed with the project within the 90-day limit, a 180-calendar-day

extension can be applied for. If no substantial progress has been made within the allotted time, no further plan approval extension will be granted, the plan review fee shall be forfeited to the City, and the plan approval will expire. Plans may be resubmitted, subject to payment of new plan review fees.

101.6.05 Record Drawings, Maps, and Plans Not Guaranteed

Record drawings, maps and plans stamped and signed by the Project Engineer, a Professional Engineer registered in the State of Oregon, shall be provided to the City by the Owner/Developer upon completion of development and/or improvement projects within the City. The City does not guarantee the accuracy of measurements, elevations, locations, or other information on such maps and plans. All information should be independently verified by the Project Engineer, as part of their due diligence, via survey, potholing, or other appropriate means prior to conducting any improvement or development.

101.6.06 Permit and Assurances

a. Before any public construction begins, a letter of commitment, letter of credit, assignment of deposit, bond, or cash deposit in form and substance satisfactory to the City and meeting the requirements in Section 101.6.08, "Qualifications of Insurance and Bonding Companies" shall be submitted by the applicant as a performance assurance for such construction. The amount of the performance assurance for private development projects shall be 150% of the design engineer's estimate or bid total on public improvements and shall be conditional on the performance of all terms and conditions of the permit and these standards. The guarantee shall include, but not be limited to, restoration of settled fills, trenches, pavement, and surfaces. The amount of the performance assurance for public projects financed by the City shall be 100% of the full contract price in accordance with ORS 279C.380. Additionally, a payment bond in the amount of 100% of the full contract price shall be submitted in accordance with ORS 279C.380 unless exempted by the Local Contract Review Board in accordance with ORS 279C.390..

b. When all requirements stipulated here are met and the construction plans are stamped and signed by the City's authorized representative, a Public Works Permit can be issued on payment of the Public Works Permit fee. The amount of the fee will be established by resolution of the City Council.

c. The Public Works Permit shall be valid for one year from the date of issuance. If time elapses on the permit, the applicant can request, in writing, a permit extension from the City Engineer or the City's authorized representative. If the request is approved, the permit holder then has 180 calendar days to begin construction on permitted projects and shall show substantial progress during this permit extension, as determined by the City. If no substantial progress is made within the allotted time, no further permit extension will be granted, the permit will expire, and the permit fees will be forfeited to the City. Plans may be resubmitted, subject to payment of new

fees. Resubmitted plans shall be reviewed to determine compliance with the Public Works Standards, including any newly approved codes and/or regulations.

101.6.07 Insurance Requirements

The City requires additional assurances from the applicant/contractor including, but not limited to, Certificates of Insurance from insurance companies or entities acceptable to the City meeting the requirements of Section 101.6.08, "Qualifications of Insurance and Bonding Companies." The Certificate shall specify all of the parties who are Additional Insureds. The contractor shall be responsible for paying all deductibles, self-insured retentions and/or self-insurance included under these provisions. For City financed projects, a Certificate of Insurance shall be executed by the successful bidder and their insurance company prior to the execution of the contract by the applicant.

101.6.08 Qualifications of Insurance and Bonding Companies

a. **Minimum requirement:** All bonding and insurance companies providing insurance or bonds required by the City must meet certain minimum financial security requirements. These requirements conform to the rating published by A.M. Best & Co. and a current Bests Key Rating Guide Property Casualty. All companies providing bonds or insurance must meet the following requirements.

   1. Have a current Bests Rating not less than A.

   2. Have a current Bests Financial Size Category not less than Class IX.

   3. Be authorized to conduct and transact insurance and surety contracts in the State of Oregon.

   4. Be a U.S. Treasury Circular 570 listed company, if providing payment or performance bonds.

b. **Failure to meet minimum requirements**: If the issuing company does not meet these minimal requirements, or for any other reason is unsatisfactory to the City, written notification will be made by the City to the Applicant, who must promptly obtain and submit to the City a new policy or bond issued by an insurer/surety acceptable to the City.

101.6.09 Indemnification

The applicant/contractor shall indemnify and hold harmless the City of Wilsonville and its officers, agents, and employees; Wilsonville City Council; City of Wilsonville Urban Renewal Agency and its officers, agents, and employees; and Wilsonville Urban Renewal Board from and against all claims, demands, penalties, damages, losses, expenses, including attorney's fees, and causes of action of any kind or character, including the cost of defense thereof, arising or alleged to have risen in favor of any person on account of personal injury, death, or damage to property arising out of or resulting from, or alleged to have risen out of or resulted from, in whole or in part, any act or omission of the

applicant, the applicant's design engineer, the applicant's contractor, or anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable.

101.7.00 CONSTRUCTION PROCEDURAL REQUIREMENTS

101.7.01 General Procedure and Requirements

a. During the construction period, the City will maintain two sets of approved plans and specifications. The permit holder or contractor shall retain one set of approved, stamped, and signed plans and specifications at the construction site at all times. Any modification to the approved plans shall be first approved, stamped, and signed by the City's authorized representative prior to construction of the modification.

b. A pre-construction conference with the City's authorized representative and the applicant, contractor, design engineer, and other parties requested to attend or having an interest in the project will meet to discuss the project before any construction begins. The pre-construction conference will discuss the role of the City's inspection team and the team's relation to the contractor and applicant.

c. The permit holder or contractor shall submit material cut sheets to the City's authorized representative for review against City standard and project specific specifications. All material submittals must be approved by the City's authorized representative prior to the material's use or installation within the project.

d. An inspection criteria checklist shall be provided to the contractor outlining the necessary inspections. The customary inspections are generally as follows:

    1. All underground utilities, including water, sanitary sewers, and storm sewers.

    2. All subgrade preparation, fill placement, base rock, and leveling rock.

    3. All concrete pours, such as driveways, sidewalks, curbs, catch basins, manholes, and cleanouts.

    4. Asphaltic or Portland cement concrete pavement.

e. The City's authorized representative shall at all times have access to the project and will make routine inspections. Should any inspection reveal that the construction of the improvements is not proceeding according to the approved plans and the specifications in this document, the City Engineer may order all work stopped, all defective work removed, or both.

f. The contractor shall give the City's authorized representative a minimum of 24 hours' (one working day) advance notice before a required inspection. It is the responsibility of the permit holder or contractor to obtain inspections and approvals for all work installed.

g. Failure to give advance notice to the City's authorized representative for inspections, receive adequate inspections, or violation of other regulations, ordinances, resolutions, rules, and City codes as outlined in these standards can result in one or more of the following, as determined by the City:

1. Stoppage of work until problem is resolved.

2. Suspension of future inspections.

3. Withholding certification of projects as complete, which will delay the start of the warranty period and City acceptance for maintenance and operation.

4. Citation for violation of the Wilsonville Code and its penalties and provisions.

5. Uncovering or removal of work not inspected.

101.7.02 Testing of Construction

a. The applicant shall be responsible for providing the name of a compaction-testing firm that will be paid by the permit applicant and that will supply the City's authorized representative with the compaction tests needed to certify that the soils, aggregate, and surface materials meet the minimum requirements of these standards. The testing firm hired by the permit applicant shall be required to be under the direct supervision of a Professional Engineer registered in the State of Oregon whose area of expertise is geotechnical engineering.

b. The applicant shall also be responsible for providing the name of a materials-testing firm that will be paid by the permit applicant and that will supply the City's authorized representative with the concrete-strength tests and other materials tests required to certify that the materials meet the minimum requirements of these standards. The testing firm hired by the permit applicant shall be required to be under the direct supervision of a Professional Engineer registered in the State of Oregon.

c. City reserves the right to direct testing agency on frequency of testing.

101.7.03 Right of Entry to Work

Representatives of the City and any federal, state, or local agencies having jurisdiction over the work shall have right of entry to any and all parts of the work at reasonable times. The contractor shall cooperate in all respects with such agencies and shall provide proper facilities for access and inspection.

101.7.04 Suspension of Work

The City Engineer may suspend the work and give written notice to the applicant/contractor of such suspension when the contractor is using material that does not conform to the requirements of the contract documents or when the contractor is improperly performing the work, and neglects or refuses to replace or reconstruct such

work. The suspension shall remain in effect until appropriate corrections are made. Review of the City Engineer's decision shall be made, on request, by the City Manager within 48 hours of the initial suspension. Regardless of the decision, the City shall not incur pecuniary liability for an incorrect suspension of work, unless such suspension was a willfully malicious act of the City.

101.7.05 Protection of Existing Facilities

a. The approximate location of underground City water, sewer, and storm drainage facilities are available at the City Engineer's office. The approximate locations of underground power, gas, telephone, and cable facilities are available from the serving utility companies. The location of existing facilities shall be shown on the construction drawings for public works projects.

b. Appropriate and timely notice shall be given to all public and private utility companies in advance of construction, for the purpose of protecting or relocating existing facilities. The exact location of underground facilities shall be verified in advance of public works construction, in cooperation with the public or private utilities involved.

c. When the contractor is physically locating underground utilities in roadways, the Portland cement concrete (PCC) or asphalt concrete (AC) roadway surfaces shall be cored and not square-cut. PCC roadway cores shall be repaired in accordance with Section 201.7.04.b, "Coring." Asphalt roadway cores shall be repaired in accordance with Section 201.7.02.d, "Asphalt Concrete Replacement."

d. All existing underground and surface facilities shall be protected from damage or degradation during construction of public works facilities.

e. Any existing facilities not specifically designated for alteration or removal that are damaged or degraded during construction shall be restored or replaced to an "in kind" or better condition at the contractor's expense.

f. Turf damaged during utility construction shall be replaced with sod in a timely manner acceptable to the City's authorized representative.

101.7.06 Protection of Property

The contractor shall protect stored materials, cultivated trees and crops, and other items next to proposed construction. Property owners likely to be affected by the construction activities, as determined by the City's authorized representative shall be notified at least 48 hours in advance of the time construction begins. During construction, no person shall be without access to their place of residence or business for a period exceeding 8 hours, unless the contractor has made special arrangements in writing with the affected person(s).

101.7.07 Surveying and Land Monuments

a. **NAVD 88 Datum**: All elevations on design plans and record drawings shall be based on NAVD 88 Datum. Each page of the plans and drawings shall state the benchmark datum information. Note that City of Wilsonville control points are based on NGVD 29 datum and that necessary adjustments will need to be made by the applicant's surveyor to meet NAVD 88 requirements.

b. **Permanent Survey Markers:** Before beginning any construction activity, the applicant's engineer/surveyor shall adequately reference all permanent survey monuments, property corners, stakes, or benchmarks on the subject site, or markers that may be subject to disturbance in the construction area or during the construction of any off-site improvements. It shall be the responsibility of the contractor to protect survey monuments throughout the construction process. The contractor shall not disturb permanent survey monuments without written consent from the City's authorized representative.

c. **Disturbed, Destroyed, or Lost Monuments:** If any survey monument is disturbed, moved, relocated, or destroyed as a result of construction activity, the contractor shall, at contractor's cost, retain the services of a Professional Land Surveyor registered in the State of Oregon to restore the monument to its original condition and shall file all documentation required by Oregon law. A copy of the recorded documentation shall be submitted to the City Engineer.

101.7.08 Railroad Crossings

a. Crossings of railroad rights-of-way shall be done in a manner that conforms to the requirements of ODOT Rail Division and the railroad having jurisdiction. If any bonds or certificates of insurance protection are required, they shall be furnished by the contractor or applicant to the railroad company concerned, with the City as an additionally named insured. Costs for railroad flagging shall be the responsibility of the applicant, unless specifically stated otherwise in the City's Contract Documents.

b. Permits or easements for such crossings shall be obtained by the applicant, unless specifically stated otherwise in the City's Contract Documents. All the terms of such permits or easement shall be met by the applicant and contractor. In some locations, the railroad may require casing pipe.

101.7.09 Criteria for Stream-Road Crossings

a. Stream crossings shall be avoided whenever possible, whether by roads, utilities, or other development. If streams must be crossed, impacts shall be minimized by preferring bridges or arch spans to culverts, and by designing bridges and culverts to pass at least the 100-year flood and meet the Oregon Department of Fish and Wildlife (ODFW) *Fish Passage Criteria*, or latest edition.

b. Before any work may be performed in any stream, the method of operation and the schedule of such work shall be approved in writing by the City's authorized representative. The timing of in-water work shall comply with the guidelines established by the ODFW. Mechanized equipment shall enter streams only when necessary and only within the immediate work area.

c. The contractor shall comply with the regulatory requirements of the Oregon Department of State Lands, ODFW, U.S. Fish and Wildlife Department, U.S. Army Corps of Engineers, National Marine Fisheries Service, and any other state and federal agencies having jurisdiction.

101.8.00 CONSTRUCTION

101.8.01 Construction Commencement

a. The contractor shall not undertake nor instruct the subcontractor(s) to undertake any portion of the work without notifying the City's authorized representative 24 hours in advance of beginning work. At the time of this notice to the City, unless otherwise specifically waived, in writing, by the City, the applicant shall have submitted to the City, as applicable, a performance, payment, and/or completion assurances (in the form of cash deposit, a letter of credit, or bonds approved as to form, content and issuer by the City), construction contract, development agreement, and/or public works permit, appropriate plan check and permit fee, certificate of insurance, and any necessary off-site easements.

b. Contractor shall conduct construction activities only during the hours of work established by the City.

101.8.02 Scheduling

a. **Sequence of Operations:** The contractor shall plan construction work and execute operations with a minimum of interference to the operation of existing City facilities and the traveling public. It may be necessary to do certain parts of the construction work outside normal working hours to avoid undesirable conditions, and it shall be the obligation of the contractor to make this change to the work schedule. Such scheduling, however, is subject to approval of the City's authorized representative, and does not relieve the contractor from making their work available for inspection.

b. **Progress of Construction**

1. Construction shall proceed in a systematic manner that will result in minimum inconvenience to the public.

2. Contractor shall pothole and verify existing utilities and facilities prior to commencing proposed work.

3. Tree protection fencing shall be installed and inspected prior to erosion control measure installation.

4. Erosion control measures shall be installed and inspected, as per Section 101.9.06, "Inspection," prior to commencing work.

5. Construction staking for the work being performed shall be completed before the start of excavation. The contractor shall limit their operations to a small work area per crew.

6. The trench shall be backfilled in conformance to Section 6, "Trench Excavation and Backfill." The length of open trench shall be limited to the requirements of Section 601.3.01.e, "Open Trench Limit."

7. Where Steel Plates are used as a temporary road surface they shall comply with the following:

   (a) Steel Plates shall be minimum ¾" thick, A-36 steel meeting AASHTO HS-20 traffic loading specifications.

   (b) Steel plates shall be centered over the cut and adequately secured to prevent any movement for the AASHTO HS-20 traffic loading specifications. No more than ½ of the plate shall span a trench that has been completely backfilled, or no more that ⅓ of the plate shall span a trench that has not been completely backfilled.

   (c) At locations where an excavation will remain open for more than 24 hours, steel plates shall be installed with transition ramps manufactured specifically for the intended use per **Detail No. S-2146** of these standards.

   (d) At locations where an excavation will remain open for less than 24 hours, steel plates shall be installed as follows:

      i. Uneven pavement surfaces must first be leveled with cold mix before laying steel plates over trench.

      ii. Steel plates shall be secured to the roadway with a minimum of two ½-inch or larger steel pins driven a minimum of 6 inches below the surface and at least 18 inches from the edge of the roadcut.

      iii. Cold patch shall be used to ramp up to the steel plate edges; minimum 6-inch ramp per ½-inch difference in grade change between road surface and Steel Plate.

   (e) Contractor is responsible for maintaining transition ramps and cold mix around Steel Plates.

   (f) Use of plates in travel lanes shall require contractor to place a 30-inch by 30-inch "BUMP" warning sign for each affected travel direction.

(g) Plates shall not be left in the travel lane for longer than 5 working days unless approved in writing by the City's authorized representative.

c. **Connections:** Any connections to existing public utilities or newly constructed facilities proposed to be public utilities shall be made only with approval of the City's authorized representative. Public utilities shall be placed into service only after all testing is completed on the new work and it is found to conform in all respects to the requirements of the plans and specifications, unless otherwise approved by the City's authorized representative. Prior to making connection(s) to existing facilities, contractor shall have all necessary pipe and fittings available and on-site.

d. **Cleanup:** Cleanup of all construction debris, excess excavation, and excess materials and complete restoration of all fences, mailboxes, ditches, culverts, signposts, and similar items shall be completed according to Section 101.8.16, "Preservation, Restoration, and Cleanup."

101.8.03 City Inspection

a. The City's authorized representative shall inspect the project as necessary and shall check materials, equipment, and the construction of the project to determine whether the work is proceeding in accordance with the City's standards. The contractor shall notify the City's authorized representative at least 24 hours (one working day) to request City inspection. No such inspection, however, shall relieve the contractor of their duties under these standards.

b. The City's authorized representative shall have the authority to direct replacement of defective material and uncovering work not inspected as required. Material rejected by the City's authorized representative shall be removed from the job site by the contractor immediately after its rejection and shall not be used on the project.

c. Instructions given by the City's authorized representative shall be respected and executed by the contractor. The City's authorized representative, however, shall not have the power to waive the obligations of the contractor to furnish high-quality equipment, supplies, and materials, or to perform good work.

d. Should a contractor encounter a condition different than that indicated by the construction documents, the contractor shall notify the City's authorized representative in writing of the changed condition and shall not precede with any work associated with the changed condition until a written response is received from the City. The City's authorized agent shall review the change with the contractor and the Project Engineer and issue a written directive to the contractor Any work commenced prior to the issuance of a written directive from the City will be at the contractor's risk.

101.8.04 Change in Plans or Standards

The City's authorized representative shall have the right to make changes in the plans or in these standards to protect the public interest or the normal operations of the City. Such changes shall be made at the sole discretion of the City's authorized representative and may include, but are not limited to, the allowance of new or different materials for products that are equivalent to, or better than, the products specified in the plans or standards.

101.8.05 Interferences, Obstructions, Abandoned Utilities

a. **Utility Notification:** The contractor shall comply with the rules and regulations of the Oregon Utility Notification Center: OAR 952-001-0010 through 952-001-0090 and ORS 757.993. At least 48 hours' notice shall be given to all utility offices that may be affected by the construction operation.

b. **General:** Various obstructions may be encountered during the course of the work. Maps and information regarding underground utilities shall be obtained from the utility owning and operating such utilities, but the location of such utilities is not guaranteed. If the services of any utility are interrupted because of the construction operation, the contractor shall notify the utility owner and the City's authorized representative immediately.

c. **Protection:** The contractor shall exercise all due care in protecting existing underground and surface facilities and property along the route of the improvement in compliance with City of Wilsonville Code Chapter 4 and Ordinance 464. This protection shall include, but not be limited to, trees, yards, fences, drainage lines, mailboxes, driveways, shrubs, and lawns. Any existing facilities not specifically designated for alteration or removal that are damaged during construction shall be restored or replaced to an "in kind" or better condition, at the expense of the contractor.

d. **Access:** The contractor shall maintain access to all mail boxes; access to all property entrances shall be in conformance with Section 101.7.06, "Protection of Property."

e. **Abandoned Utilities:** All abandoned utilities shall be properly removed, grouted, or plugged at the discretion of the City's authorized representative. Sewer facilities shall be abandoned in accordance with Section 401.5.05, "Abandon Sewer Facilities." Water systems shall be abandoned in accordance with Section 501.5.05, "Abandon Water Facilities." Storm facilities shall be abandoned in accordance with Section 301.10.05, "Abandon Storm Facilities."

101.8.06 Contaminated Soil

If during construction contaminated soil, hazardous materials or chemicals are encountered, the Contractor shall follow the procedures specified in Section 101.9.02, "Contaminated Soils or Hazardous Materials."

101.8.07 Guarantee

a. The applicant/contractor shall furnish high-quality equipment, supplies, and materials and perform the work in accordance with these specifications. Any failure or omission by the City's authorized representative to condemn any defective equipment, supplies, materials, or work shall not be construed as an acceptance thereof nor release the contractor from their obligations.

b. On notification of any deficiency by the City's authorized representative, the contractor shall properly reconstruct or replace any defective equipment, supplies, materials, or work at their own cost any time on discovery of the defect during the period of construction and for the full guarantee period after acceptance of the work, and shall indemnify the City from any claims resulting from the defect.

c. The applicant/contractor shall guarantee all materials and equipment furnished and work performed in conformance with Section 101.8.18, "Maintenance and Warranty."

d. The applicant/contractor shall further warrant and guarantee that the completed system is free from all defects due to faulty materials or workmanship in conformance with Section 101.8.18, "Maintenance and Warranty." The applicant/contractor shall promptly make such corrections as may be necessary by reason of such defects, including the repair of any damage to other parts of the system resulting from such defects.

e. If the applicant/contractor, after notice, fails within 10 days to proceed to comply with the terms of this guarantee, the City may have the defects corrected, and the applicant and the applicant's surety shall be liable for all expense incurred. However, in case of an emergency where, in the opinion of the City Engineer, delay would cause serious loss or damage, repairs may be made without notice being given to the applicant/contractor and the applicant/contractor shall pay the cost thereof.

101.8.08 Substitution of Materials

Whenever any material, article, device, product, fixture, form, type of construction, or process is indicated or specified by patent or proprietary name, by name of manufacturer, or by catalog number, such specifications shall be for the purpose of establishing a standard of quality and facilitating the description of the material or process desired. Such specification is not to be construed as eliminating from competition other products of equal or better quality made by other manufacturers and that are fully suitable in design, and shall be deemed to be followed by the words "or as approved" or "approved equal." The contractor may, in such cases, submit complete data to the City Engineer for consideration of another material, type, or process that shall be substantially equal in every respect to the one indicated or specified. Substitute materials shall not be used unless approved in writing by the City's authorized representative.

101.8.09 Safety Requirements

a. The contractor shall at all times conduct work in such a manner as to comply with all Occupational Safety and Health Administration (OSHA) requirements, shall minimize the possibility of accident or injury of any workers or the general public, and shall conduct the work, maintain operations, and provide all reasonable safeguards so as to protect public and private property as well as to protect persons from injury.

b. If in the opinion of the City's authorized representative the contractor is in violation of the above safety practices, the City's authorized representative may issue and post a stop-work order if the contractor, after being informed of such violation, refuses to comply immediately. The City's authorized representative will also notify the OSHA of such action.

c. The City's authorized representative's role is not one of supervision or safety management, but of observation only. Nothing contained in this section or elsewhere in this document shall be interpreted to obligate the City to act in any situation, nor shift the applicant's responsibility for safety compliance to the City. No responsibility for the safety of the work or for construction means, methods, techniques, sequences, or procedures shall attach to the City by virtue of its action or inaction.\

101.8.10 Traffic Maintenance and Safety

a. The contractor shall comply with all rules and regulations of City, county, or state authorities and applicable fire protection and law enforcement agencies regarding the closure of public streets or highways to public traffic. No public road shall be closed to the public except by express permission of the public agency responsible for the road.

b. The contractor shall conduct their operations so as to assure the least possible obstruction to traffic, including vehicular, bike, and pedestrian and normal commercial pursuits. Traffic control in work zones shall conform to the *Manual on Uniform Traffic Control Devices* (MUTCD, latest edition), published by the Federal Highway Administration, U.S. Department of Transportation.

c. The contractor shall be required to submit a traffic control plan to the appropriate jurisdiction for review and approval before beginning construction.

d. The contractor shall provide and be responsible at all times for flaggers, signs, and other devices not otherwise specified to be furnished by the applicant. The contractor shall erect and maintain all barricades, guards, lights, variable message boards, standard construction signs, warning signs, and detour signs as are necessary to warn and protect the public at all times from injury or damage as a result of work operations on highways, roads, streets, bike lanes, sidewalks, multi-use paths, or recreational trails affected by such operations.

e. If the applicant or contractor fails to immediately provide the necessary flaggers or to provide, erect, maintain, and remove barricades, guards, lights, variable message boards, standard construction signs, warning signs, and detour signs when so ordered, the City's authorized representative shall be at liberty, without further notice to the contractor or applicant, to do so and to deduct all costs from the applicant's/contractor's performance assurance.

f. When traffic will pass over backfilled trenches before they are paved, the top of the trench shall be maintained with cold patch or hot patch, to be removed later, and shall allow normal vehicular movement to continue. Access driveways shall be provided where needed. Cleanup operations shall follow immediately behind backfilling. The work site shall be kept orderly at all times.

101.8.11 Access for Police, Fire, and Postal Service

a. No closure of a part of a street shall be made without first requesting and receiving approval from the City's authorized representative. Closure of public streets shall be in conformance with Section 101.8.10.a, "Traffic Maintenance and Safety." The contractor shall conduct operations so as to cause the least interference with emergency vehicle access.

b. The contractor shall comply with all requirements of the U.S. Postal Service with regard to the location of mailboxes that must be disturbed during construction. Mailboxes may be moved to temporary locations designated by the Postal Service. At the completion of work in each area, the contractor shall replace the mailboxes in their original location and in a condition satisfactory to the Postal Service.

101.8.12 Compliance with Applicable Laws

a. The contractor shall keep fully informed of all local ordinances, including those of Tualatin Valley Fire and Rescue (TVF&R) and state and federal laws and regulations that in any manner affect the work specified herein.

b. The contractor shall at all times comply with said ordinances, laws and regulations, and shall protect and indemnify the applicant and his/her officers and agents against any claim or liability arising from or based on the violation of any such laws, ordinances, or regulations.

c. All permits, licenses, and inspection fees necessary for prosecution and completion of the work shall be secured by the applicant/contractor.

101.8.13 Work in Public Rights-of-Way

a. Closure of public streets shall be in conformance with Section 101.8.10.a, "Traffic Maintenance and Safety," and Section 101.8.11.a, "Access for Police, Fire, and Postal Service." Construction operations and traffic control shall be in conformance with Section 101.8.10.b, "Traffic Maintenance and Safety."

b. The contractor shall use every reasonable precaution to safeguard the persons and property of the traveling public. It shall be the sole responsibility of the contractor to furnish, place, and maintain barricades, barriers, lights, flares, danger signals, signs, and security guards as necessary to protect the persons and property of the traveling public. All barricades and obstructions shall be protected at night by signal lights that shall be suitably distributed and kept burning from sunset to sunrise.

c. When working in the public right-of-way, the contractor shall maintain the construction area in the interest of public health, safety and welfare, including, without limitation, maintenance of proper steel plates, trench backfill, patching, signage, and lighting. It is the City's right, but not its obligation, to monitor contractor's compliance with this subsection. Upon discovery of non-compliance, or upon notice by the City's authorized representative, the contactor shall take immediate corrective action. If the contractor is not on site, and if, in the sole judgment of the City, conditions impose an immediate or eminent threat to public health, safety and welfare, the City has the right to perform emergency repairs or cause the repairs to be made, without notice and with all costs of such work being the responsibility of the contractor. Within sixty days of receipt of a detailed invoice for payment from the City, the contractor shall reimburse the City for costs incurred.

d. In the event of interruption to domestic water, sewer, storm drain, or other utility services as a result of accidental breakage, or as the result of being exposed or unsupported, the contractor shall promptly notify the proper authority, cooperate with said authority in restoring the service as promptly as possible, and bear all costs of providing temporary service measures and repairs. In no case shall interruption of any water or utility services be allowed to exist outside working hours, unless prior approval by the City's authorized representative is received.

e. Work site cleanup shall conform to Section 101.8.16, "Preservation, Restoration, and Cleanup."

101.8.14 Easements

a. Public utility easements shall be provided along all lot lines fronting a public street according to **Table 1.1**.

Table 1.1 PUBLIC UTILITY EASEMENT WIDTH REQUIREMENT

Street Classification	Easement Width
Local	6-foot
Collector	8-foot
Arterial	10-foot

b. When it is not possible or practical to install the public sanitary, storm sewer, or water line in a dedicated public street, a minimum 15-foot wide permanent, public pipeline shall be granted to the City for utilities that meet all of the following criteria:

   1. Single utility.

   2. Utility pipe less than 24" in diameter.

   3. Utility pipe less than 10 feet in depth.

   4. Utility located on a cross slope less than 10%.

   Where the utility(s) do not meet the criteria above, the easement width shall be determined by the Engineer of Record and reviewed for approval by the City's authorized representative. The easement width determination shall consider the number, depth, and size of utilities, the ground cross slope, soil stability, required vertical and horizontal separation between utilities, work zone width, and all other relevant information.

c. All easements shall be shown on the approved construction plans.

d. No permanent structures shall be allowed within an easement area.

e. Certain types of wooden fences, chain link fences, or other similar structure acceptable to the City's authorized representative may be allowed to be installed across and/or within easements.

101.8.15 Sanitation

Contractors shall provide and maintain adequate sanitary/sanitation facilities for employees.

101.8.16 Preservation, Restoration, and Cleanup

a. **Site Restoration and Cleanup**

   1. The contractor shall keep the premises clean and orderly at all times during the construction period and leave the project free of rubbish or excess materials of any kind on completing the work. The contractor shall immediately replace mailboxes and signposts disturbed by construction activities.

   2. During construction, the contractor shall stockpile the excavated trench materials so as to do the least damage to adjacent lawns, grassed areas, gardens, shrubbery, trees, or fences, regardless of the ownership of these areas. These surfaces shall be left in a condition equivalent to their original condition or better and free from all rocks, gravel, boulders, or other foreign material.

3. If damaged or altered during construction, existing trenches, drainage ditches, and culverts shall be re-graded, and original drainage tiles and sewer laterals shall be repaired expeditiously. Within 500 feet of pipe-laying and backfilling operations in any trench section, the contractor shall rake and drag all disturbed areas and leave them free of rocks, gravel, clay, or any other foreign material and ready, in all respects, for seeding. The finished surface shall conform to the original surface, and shall be free-draining and free from holes, rough spots, or other surface features detrimental to a seeded area.

4. After backfilling the trenches, the contractor shall restore all public and private irrigation and/or utility systems that were destroyed, damaged, or otherwise modified during construction to their original condition or better.

5. All areas disturbed by the contractor's operations inside dedicated rights-of-way or easements shall be returned to their original condition or better. Areas outside the easements or rights-of-way that are disturbed by the contractor's operations shall be returned to their original condition or better.

6. All site restoration and cleanup work as described above shall be performed by the contractor within 5 working days of substantial completion of the work associated with the disturbance.

b. **Street Cleanup**

1. The contractor shall clean spilled soil, mud, rock, gravel, or other foreign material caused by construction operations from all sidewalks, gutters, streets, and roads at the conclusion of each day's operation.

2. Cleaning shall be by grader and front-end loader, power brushing, vacuuming, and hand labor, unless otherwise approved by the City's authorized representative. At no time shall any such material be washed or flushed into any part of the stormwater and surface water system If the contractor does not follow these standards, the City may exercise its option to have the street(s) cleaned and bill the contractor for such service.

3. When directed by the City's authorized representative, the contractor shall, within 5 working days of notice, remove all erosion-control materials and thoroughly remove all dirt, mud, rock, gravel, and other foreign material from sidewalks, gutters, catch basins, curb inlets, area drains, manholes, and paved surfaces.

c. **Preservation of Irrigation and Drainage Ditches**

1. The contractor shall arrange schedules so that construction will not interfere with the irrigation of cultivated lands or pasturelands. Construction may proceed during the irrigation season provided the contractor constructs, at their own expense, temporary irrigation ditches, turnouts, and miscellaneous structures

acceptable to the owner of the land in question that shall permit the land to be irrigated by others during construction.

2. After backfilling the trenches, the contractor shall restore all irrigation and storm drain ditches destroyed, damaged, or otherwise modified during construction to a condition equivalent, in the opinion of the City's authorized representative, to the condition of the ditches before construction. Ditches shall be built in their original locations, unless specified otherwise on the construction plans.

101.8.17 Project Closeout

At the conclusion of the project, the applicant shall notify the City's authorized representative in writing that the project is ready for final inspection. On receipt of this notice, the City's authorized representative will request the following:

a. **Record Drawings:** At the completion of the installation of any required public improvements, and before final inspection, in accordance with Section 101.8.17.b, "Final Inspection," is scheduled, the Project Engineer shall perform a record survey. The record survey shall be the basis for the preparation of record drawings that will serve as the physical record of changes made to the approved plans and/or specifications during construction. Using the record survey as a guide, the appropriate changes shall be made to the construction plans and/or specifications and a complete revised set, the record drawings, shall be submitted. The initial set of record drawings shall be submitted to the City for review and approval and consist of a set of paper drawings and an electronic copy in PDF format. Once the record drawings are approved, a final set of record drawings on approved 3 mil Mylarä material , an electronic copy in the City's current edition of AutoCAD, and a digitally signed PDF shall be submitted to the City. The initial set of record drawings must be received before the City's authorized representative issues a project correction list (punch list) in accordance with Section 101.8.17.c, "Project Correction List." Record drawings shall include all work done within the public right-of-way or public easements.

b. **Final Inspection:** Once the City's authorized representative receives the initial set of paper and electronic PDF format record drawings, a final inspection of the project will be conducted by the City's authorized representative.

c. **Project Correction List:** After this inspection, a project correction/repair list (punch-list) will be issued by the City's authorized representative to the applicant and contractor. The project correction/repair list will include any items either damaged or improperly placed during construction, and any item(s) that, in the opinion of the City's authorized representative, need repair.

d. **Project Corrections:** Contractor shall perform correction/repair work as required on the project correction/repair list. The City encourages the contractor to complete all correction/repair work as expeditiously as possible, the City will retain the performance assurance until the project correction list has been completed, and

inspected and approved by the City's authorized representative, and the contractor submits all maintenance and landscape maintenance assurances to the City.

e. **Completion:** The City's authorized representative will consider the project complete and shall so state in writing when all of the following items are complete.

1. All items of the project correction list are completed, inspected and approved by the City's authorized representative.

2. Final set of Mylar, AutoCAD, and digitally signed PDF record drawings are submitted to the City and approved by the City's authorized representative.

3. Confirmation that all easements and legal documents have been recorded with the County Recorder.

4. Contractor submits approved maintenance assurances and warranty as specified in Section101.8.18, "Maintenance and Warranty."

At this time, the warranty period will go into effect on written notice from the Engineering Division.

101.8.18 Maintenance and Warranty

a. **Maintenance Assurance Required:** Contractor shall fully warrant all work from defect, for a period of time as determined by the type of work. The warranty shall be required for work to ensure post-construction quality and landscape survivability. If defective or negligent work is discovered and repaired, this warranty will automatically be extended from the date the repair is made and accepted by the City. This warranty by the Contractor is in addition to and not in lieu of any other warranties provided by various suppliers or manufacturers. Such warranty shall be guaranteed in the form of maintenance assurance.. Assurances shall be in the form of a letter of commitment, letter of credit, assignment of deposit, bond, or cash deposit, in form and substance satisfactory to the City and meeting the requirements of Section 101.6.08, "Qualifications of Insurance and Bonding Companies." Assurances shall remain in place until a written release is issued from the City. This provision of the Maintenance Assurance is to help secure the Contractor's performance of any corrective work that may need to be performed within the warranty period of the Project, but in no way limits the Contractor's liability therefore.

b. **Construction Maintenance Assurance:** Maintenance assurance shall be required for all public improvements constructed by the Contractor. The construction maintenance assurance shall be for 10% of the cost to construct the public improvements and be in place for a period of not less than 2 years from the date of Final Acceptance. Prior to the end of the two-year assurance, the City will provide contractor with a maintenance project corrections list; the City reserves the option to video inspect the sanitary and/or storm sewer lines, if any were constructed, repaired or installed as part of the contract. Contractor shall make all necessary repairs and

replacements to remedy any and all defects, breaks, or failures of the public improvements as identified by the City and having occurred within two years following the date of Final Acceptance due to faulty or inadequate materials or workmanship, in a manner satisfactory to the City's authorized representative and at no cost to the City. Contractor shall repair damage or disturbances to other improvements under, within, or adjacent to the public improvements, whether or not caused by settling, washing, or slipping, when such damage or disturbance is caused, in whole or in part, from activities of the Contractor in performing his/her duties and obligations when such defects or damage occur within the warranty period. Construction maintenance assurance shall be released two years after acceptance of any corrective work performed during the maintenance assurance period.

c. **Landscape maintenance assurance:** Landscape maintenance assurance shall be for 100% of the cost to install all required landscaping in water quality/quantity facilities and vegetated corridors, *plus* 100% of the cost to maintain the landscaping in these areas and be in place for a period of not less than 2 years from the date of Final Acceptance. The assurance shall be released two years after acceptance of construction, providing the landscaping meets the 90% survival level (see Section 301.15.02, "Landscape Inspection for Warranty").

d. **Prompt Compliance**: If Contractor, after written notice, fails within 10 days to proceed to comply with the terms of this section, Owner may have the defects corrected, and Contractor and Contractor's Surety shall be liable for all expenses incurred. If the assurance is in the forms of cash or letter of credit, the City may immediately draw upon such amount. In case of an emergency where, in the opinion of the Engineer, delay would cause serious loss or damage, repairs may be made without notice being given to Contractor and Contractor or Surety shall pay the cost of repairs. Failure of the Engineer to act in case of an emergency shall not relieve Contractor or Surety from liability and payment of all such costs.

e. **Water Lines**: In addition to provisions a and b above, City of Wilsonville water line facilities installed by the contractor under the Public Works Permit contract that require repair or replacement during the maintenance period shall be repaired by the City or under direct supervision of the City and the Contractor and Contractors surety will be liable for prompt reimbursement of all labor costs and expenses incurred by the City in making the repair.

101.9.00 ENVIRONMENTAL PROTECTION, EROSION PREVENTION, AND SEDIMENT CONTROL

101.9.01 Introduction

This section identifies requirements for erosion prevention and sediment control. The provisions are intended to prevent or reduce adverse impacts to the City's drainage system and water quality. In combination with other federal, state, and local laws and ordinances, the requirements are intended to protect the beneficial uses of state waters.

101.9.02 Contaminated Soils or Hazardous Materials

If construction reveals soils contaminated with hazardous materials or chemicals, or if soil is suspected to be contaminated, the contractor shall cease earthwork activity immediately, ensure that no contaminated material is hauled from the site, remove their workforce from the immediate vicinity of the contaminated area (leaving all machinery and equipment), and secure the area from access by the public until an OSHA certified HAZMAT response team has relieved them of that responsibility. The contractor shall immediately notify the City's authorized representative, the design engineer, and the Oregon Department of Environmental Quality (DEQ) of the situation.

101.9.03 General Policy

a. **Erosion Prevention Techniques and Measures**

1. The use of erosion prevention techniques shall be emphasized, rather than measures to control sediment. This shall be especially important on construction sites immediately before and during the rainy season. Erosion prevention techniques are designed to protect soil particles from the force of rain and wind so they shall not erode. When land is disturbed at a construction site, the erosion rate accelerates dramatically.

2. Erosion prevention techniques include, but are not limited to, construction scheduling, ground cover, and matting. Sediment control measures are designed to capture soil particles after they are dislodged and to retain the soil particles on site.

3. Erosion prevention measures include, but are not limited to, silt fences, sediment barriers, and settling basins. Both erosion prevention techniques and sediment control measures have appropriate uses. Studies have shown, however, that sediment control measures are less effective than erosion prevention techniques in preventing soil movement.

4. Permanent vegetation or seeding shall be established only between March 1 through May 15 and September 1 through October 15. If an irrigation system is installed, vegetation or seeding may be established from March 1 through November 15. If an area falls under definition of a wetland, permanent vegetation or seeding shall be established only between March 1 through April 30 and September 1 through October 15 and in a manner satisfying applicable local, state and federal requirements.

5. Permanent vegetation or seeding shall meet the 90% survival level as detailed in Sections 301.15.02.c and d, "Landscape Inspection for Warranty".

b. **Existing Vegetation**

1. Existing vegetation shall be protected and left in place whenever practicable. Work areas shall be carefully located and marked to reduce potential damage to

trees and existing vegetation. Trees shall not be used as anchors for stabilizing working equipment. Where required, trees and existing vegetation shall be protected with a non-movable, chain link fence (see **Detail No. RD-1230** of these standards).

2. Where existing vegetation has been removed, or the original land contours have been disturbed, the site shall be re-vegetated, and the vegetation established, as soon as practicable.

c. **Enforcement**

Failure to comply with any provision of this section or with any term of an erosion-prevention and sediment-control permit shall be deemed a violation and subject to enforcement action pursuant to applicable City ordinance and resolutions, and orders, including all implementing rules and regulations.

101.9.04 Erosion Prevention and Sediment Control

a. **Application and Purpose**

1. It is a City goal to eliminate or minimize to the extent feasible all sediment and other pollutants reaching the public storm and surface water system resulting from development, construction, grading, excavating, clearing, and any other activity that accelerates erosion, to the limits prescribed in these standards.

2. It is the policy of the City to require temporary and permanent measures for all construction projects to lessen the adverse effects of construction on the environment. All projects shall include properly installed, operated, and maintained temporary and permanent erosion-control measures as provided in these standards or in an approved plan, designed to protect the environment during the term of the project. Compliance with the measures prescribed here or in an approved plan does not lessen the necessity to provide effective and comprehensive erosion prevention and sediment control.

3. Nothing in this section shall relieve any person of the obligation to comply with the regulations or permits of any federal, state, or local authority.

b. **Erosion Prohibited**

1. Visible or measurable erosion that enters, or is likely to enter, the public or private stormwater and surface water system or other properties is hereby prohibited, and is a violation of these standards. An offsite sedimentation control facility may be utilized if it has been identified and approved in writing by the City's authorized representative, written approval is obtained from the respective property owner, and a written agreement for rehabilitation of the facility by the applicant or contractor is submitted to the City. The owner of the property or the applicant under a Public Works Permit, together with any person or persons, including but

not limited to the contractor or the design engineer causing such erosion, shall be held responsible for violation of the City's standards.

2. No person shall create physical erosion by dragging, dropping, tracking, or otherwise placing or depositing, or permitting to be deposited, mud, dirt, rock, or other such debris on a public street, or into any part of the public stormwater and surface water system, or into any part of a private stormwater and surface water system that drains or connects to the public stormwater and surface water system. Any such deposited material shall be immediately removed by hand labor or mechanical means. No material shall be washed or flushed into any part of the stormwater and surface water system until all mechanical means to remove the debris are exhausted and preventive sediment filtration is in place.

3. The owner of the property or the applicant under a Public Works Permit, together with any person or persons, including but not limited to the contractor or the design engineer who causes such erosion, shall be held responsible for violation of these Standards.

c. **Erosion-Prevention Techniques and Methods**

The techniques and methods described in the latest edition of the Clackamas County Water Environment Services "Erosion Prevention and Sediment Control Planning and Design Manual" (www.clackamas.us/wes/designmanual.html) shall be used to control and prevent erosion in addition to the following procedures:

1. **Gravel Construction Entrance and Wheel Wash**

(a) A gravel construction entrance is required as per **Detail No. S-2240** of these standards. If there is more than one vehicle access point, a gravel construction entrance shall be required at each entrance.

(b) For project sites 5 acres or greater in size, a wheel wash as per **Detail No. S-2235** of these standards will be required to be constructed. For sites less than 5 acres in size, a wheel wash may be required if, in the opinion of the City's authorized representative, excess tracking of soil occurs.

(c) The responsibility for design and performance of the driveway remains with the applicant. Vehicles or equipment shall not enter a property next to a stream, watercourse, stormwater or surface water facility, or wetlands unless adequate measures are installed to prevent physical erosion into the water or wetland.

2. **Erosion Control**

(a) During periods of wet weather, disturbed areas of the site and/or stockpiled soil shall be covered by tarps or straw at the end of each day's operations; all disturbed, unworked areas of the site shall be protected from erosion.

(b) Temporarily seed disturbed soils and slopes that are not at finished grade and which will be exposed for two months or longer before being disturbed again.

(c) Where seeding is used for erosion control, Regreen® or equivalent, or sterile wheat shall be used to stabilize slopes until permanent vegetation is established.

(d) Temporary seeding shall establish a minimum of 90% coverage of the ground surface with uniform healthy plants. If this coverage is not achieved, or if the City determines that it is not effective in stabilizing the soil from erosion, the contractor, at their expense, shall stabilize the area with other temporary stabilization methods as approved by the City's authorized representative.

(e) Biodegradable fabrics (Coir/Jute Matting), reinforced turf mats, or straw mulch can be used to stabilize slopes and channels. The fabrics can also be used to hold plugs in place and discourage floating upon inundation. Consult the *Erosion Prevention and Sediment Control (EPSC) Planning and Design Manual* for additional information.

(f) Permanent vegetation shall be established as outlined in Section 101.9.03.a.4, "Erosion Prevention Techniques and Measures."

3. **Bioengineering Techniques**

(a) Any person performing work in a watercourse or in an environmentally sensitive area (e.g., essential salmonid habitat, wetlands, steep slopes) shall employ bioengineering techniques whenever feasible.

(b) Bioengineering techniques include, but are not limited to, contour wattling, brush layering or matting, live cuttings, fascines, and stakes.

4. **Sediment filters/barriers**

(a) Using straw bales as a sediment filter or barrier is not allowed.

(b) A filter system may not be used on catch basins in public streets as part of erosion-prevention and sediment-control plans for single-family dwellings.

5. **Plastic Sheeting:** Plastic sheeting shall generally not be used as an erosion-control measure for single-family house construction. Plastic sheeting may be used to protect small, highly erodible areas or temporary stockpiles of material. If plastic sheeting is used, the path of concentrated flow from the plastic must be protected.

6. **Protection Measure Removal:** The erosion-prevention and sediment-control measures shall remain in place and be maintained in good condition until all

disturbed soil areas are permanently stabilized by installation and establishment of landscaping, grass, or mulching, or are otherwise covered and protected from erosion.

7. **Wet Weather Measures:** On sites where vegetation and ground cover have been removed, vegetative ground cover shall be planted on or before September 1, with the ground cover established by October 15. As an alternative if ground cover is not established by October 15, the open areas shall be protected through the winter with mulch, erosion blankets, or other method(s) approved by the City's authorized representative.

8. **Exceptions to Sediment Barrier Requirements:** Sediment barriers are not required on a site in the following circumstances:

   (a) Where a Neighborhood Erosion Control Plan is in effect, for a maximum of four lots.

   (b) Where there are no concentrated flows and the slope being protected has a grade of less than 2%.

   (c) Where flows are collected by using temporary or permanent grading or other means, such that the flows are routed to an approved settling pond, filtering system, or sediment barrier.

   (d) Where there are no concentrated flows, where slopes are less than 10%, and where the runoff passes through a grassed area that is either owned by the applicant or where such use is allowed, by written agreement, by the owner of the grassed area. The grass area shall be at least equal in dimension to the project area.

   (e) Where the surface is protected by ground cover or matting approved by the City's authorized representative.

d. **Dust Prevention**

During all phases of the work, the contractor shall take precautions to abate any dust nuisance. Dust-prevention measures shall be continuous until final inspection by the City's authorized representative. Dust shall be minimized to the extent practicable, using all measures necessary to accomplish results satisfactory to the City's authorized representative, including, but not limited to:

1. Sprinkling haul and access roads and other exposed dust-producing areas with water.

2. Applying City-approved dust palliatives on access and haul roads.

3. Establishing temporary vegetative cover.

4. Placing wood chips or other effective mulches on vehicle- and pedestrian-use areas.

5. Maintaining proper moisture conditions on all fill surfaces.

6. Prewetting cut and borrow area surfaces.

7. Using covered haul equipment.

e. **Neighborhood Erosion Control Plan**

1. Any individual or group may submit an erosion-prevention and sediment-control plan for multiple lots. Plans shall be submitted to City of Wilsonville for review and approval. This shall be referred to as a "Neighborhood Erosion Control Plan." In such case, the group of lots will be evaluated as if they were one lot.

2. If an individual lot in a Neighborhood Erosion Control Plan is sold to new owners, the new owners may either join the neighborhood plan (with the approval of the other neighborhood owners), or will need to submit their own erosion control plan if erosion potential still exists on the parcel. If a lot is sold and the new owner does not join the Neighborhood Erosion Control Plan, then the plan must be revised and the new owner must submit an individual plan.

101.9.05 Maintenance

a. The applicant shall maintain the facilities and techniques contained in the approved erosion-prevention and sediment-control plan so they will continue to be effective during the construction phase, post construction phase, establishment of permanent vegetation, or any other permitted activity.

b. If the facilities and techniques approved in an erosion-prevention and sediment-control plan are not effective or sufficient as determined by the City site inspection, the applicant shall submit a revised plan within three working days of written notification by the City's authorized representative. On approval of the revised plan by the City's authorized representative, the applicant shall immediately implement the additional facilities and techniques included in the revised plan.

c. In cases where erosion is likely to occur, the City's authorized representative may require the applicant to install interim control measures before submitting a revised erosion-prevention and sediment-control plan.

101.9.06 Inspection

a. **City Initial Inspection:** On a site development or any other type of project, the erosion-prevention and sediment-control measures shall be installed before the start of any permitted activity. The applicant shall schedule an inspection by using the City's 24-hour Inspection Request Line at (503) 682-4159, or submit a request online or by e-mail, for an initial inspection before beginning any site clearing or grading. If

necessary, tree protection shall be installed and inspected by the Planning Division before any erosion-prevention and sediment-control measures are installed.

b. **Applicant Inspections**: The applicant shall be required to inspect erosion-prevention and sediment-control measures as outlined in the approved Grading and Erosion Control Plan (as required by City's current erosion control ordinance) and to provide information to the City's authorized representative. Inspections shall be completed as required by the latest edition of the Clackamas County Water Environment Services "Erosion Prevention and Sediment Control Planning and Design Manual" and the minimum erosion prevention and sediment control plan monitoring requirements. Inspection information is to be maintained on-site and available to City's authorized representative on request.

c. **Final Inspection:** A final erosion control inspection shall be required before the sale or conveyance to new property owner(s) or before the removal of erosion-prevention and sediment-control measurements.

SECTION 2

TRANSPORTATION DESIGN AND CONSTRUCTION STANDARDS

201.1.00 ENGINEERING

201.1.01 Introduction

This section outlines design and construction requirements for all public transportation construction. The provisions and technical specifications herein set forth the requirements of the City of Wilsonville for constructing transportation facility improvements. Interpretations of such provisions and their application in specific circumstances shall be made by the City's authorized representative, unless specifically stated otherwise. Refer to Section 1 of the "Public Works Standards" for general provisions and requirements.

201.1.02 Extension of Public Transportation Systems

a. The extension, addition, or widening of public transportation facilities to serve any adjacent parcel or tract of land, shall be done by the property owner or permit applicant and may be subject to applicable System Development Charge (SDC) credits, as determined by the City's authorized representative.

b. The City reserves the right to perform the work or cause it to be performed and bill the owner for the cost of the work or to pursue special assessment proceedings.

c. The public transportation system shall extend to the most distant parcel boundary, to facilitate future extension, unless otherwise approved by the City's authorized representative.

d. Where public infrastructure improvements paid for by the property owner or permit applicant directly benefit adjacent properties, the property owner or permit applicant may pursue establishment of a reimbursement district per Section 3.116 of the City Code.

201.1.03 Alternative Design and Construction Standards

a. If approved by the Development Review Board and City Engineer, alternative roadway design standards may be substituted for the standards specified herein. Any requests for substitution must be in writing, stamped by a Professional Engineer registered in the State of Oregon at the time of submittal, and submitted as part of the Land Use process. The City Engineer may request submission of any additional information deemed necessary to properly evaluate an alternative roadway design standard.

b. If approved by the City's authorized representative, alternative construction standards may be substituted for the standards specified herein. Any requests for substitution must be in writing, stamped by a Professional Engineer registered in the State of Oregon, and submitted at least three weeks prior to the start of any work associated with the construction standard. The City's authorized representative may request submission of any additional information deemed necessary to properly evaluate an alternative construction standard.

201.1.04 General Requirements

a. **Functional Classification:** The functional classification of existing and proposed roads is established by the City of Wilsonville's Transportation Systems Plan (TSP). Where the functional classification of a road is not defined by the TSP, the existing land use and existing operational characteristics shall be used by the City's authorized representative to determine the functional classification of the road in question.

b. **Access:** Access to city, county, and public roads shall conform to the City of Wilsonville TSP and Section 201.2.23, "Driveways."

c. **Width:** The width of the streets shall be in compliance with the City of Wilsonville TSP.

d. **Number of Lanes:** The number of lanes for each class of road is defined by the City of Wilsonville TSP.

e. **On-Street Parking:** Streets shall be provided with on-street parking strips as specified in the City of Wilsonville TSP and Section 201.2.26, "On-Street Parking."

f. **Sidewalks and Planter Strips:** Streets shall be provided with sidewalks and planter strips as specified in the City of Wilsonville TSP and Section 201.2.25, "Sidewalks."

g. **Design Speed:** Design speed is the maximum safe speed that can be maintained over a specified section of roadway when traffic, weather, and other conditions are so favorable that the design features of the roadway govern.

1. The target design speed shall be as follows:

(a)	Arterials	45 miles per hour
(b)	Commerical/Industrial	35 miles per hour
(c)	Collectors	35 miles per hour
(d)	Local	25 miles per hour

2. The City Engineer may approve a lower alternative design speed where it can be shown that the 85th percentile speed of traffic of traffic will be lower than the design speed standard during all hours. The design speed is the minimum speed

that shall be used in design of safe road geometry. The design speed shall not prohibit the use of traffic calming features or signing where approved to encourage lower traffic speed.

3. The City Engineer may approve a design speed of 20 miles per hour in accordance with Oregon Revised Statute (ORS) 810.180 (10) as follows:

   (a) The section of roadway is located within a residential district.

   (b) The section of roadway has an average volume of fewer than 2,000 motor vehicles per day.

   (c) The section of roadway has more than 85 percent of motor vehicles traveling less than 30 miles per hour.

   (d) The section of roadway includes traffic control devices that indicate the presence of pedestrians or bicyclists.

   (e) The section of roadway is posted with speed zone signs giving notice of the designated speed at each end of the portion of roadway where the designated speed is imposed and at such other locations on the roadway as may be necessary to inform the public.

4. The roadway design speed is not the same as the posted speed. The posted speed shall be determined in accordance with the most current Oregon Department of Transportation Speed Zone Manual.

201.1.05 Street Plans

a. It is the design engineer's responsibility to ensure that engineering plans are sufficiently clear and concise to construct the project in proper sequence, using specified methods and materials, with sufficient dimensions to fulfill the intent of the design guidelines in these standards.

b. All elevations on design plans and record drawings shall be based on the NAVD 88 Datum, as specified in Section 101.7.07.a, "NAVD 88 Datum."

c. Existing conditions and facilities on design plans and record drawings shall be shown in light, gray print. Proposed conditions and facilities on design plans and record drawings shall be shown in bold, black print.

d. All engineering street plans shall be stamped by a Professional Engineer registered in the State of Oregon. At a minimum the street plan shall contain the following:

   1. At least one sheet showing a plan view of the entire project site. If the project site is sufficiently large that detailed street plans on any given sheet do not encompass the entire project site, then a sheet showing the plan view of the entire site must serve as an index to subsequent detailed plans sheets.

2. A topographic map showing existing conditions for the site, including:

   (a) Existing topography for the site. Plan views showing existing features may be required for a distance of up to 100 feet (or further if warranted) beyond the proposed improvement in order to prevent future grade conflicts and will be determined on a case-by-case basis by the City's authorized representative.

   (b) Adjacent streets, trails, multi-use paths, and rail lines, including the respective names.

   (c) Existing utilities, including franchised utilities located above or below ground and drainage facilities that transport surface water onto, across, or from the project site. Existing drainage pipes, culverts, and channels shall include the invert or flow line elevations.

   (d) Existing vegetation, including denoting the type, DBH, and canopy size of trees within the construction limits.

   (e) Existing environmentally sensitive areas (e.g., ravines, swales, steep slopes, wells, springs, wetlands, creeks, lakes). For natural drainage features, show direction of flow, drainage hazard areas, and 100-year floodplain boundary (if applicable).

   (f) Adjacent existing features that are within 25 feet outside of the site boundary, including but not limited to construction activities that will potentially compromise the structural stability or condition of off-site features, such as cultivated vegetation, landscaping and trees, buildings, fences, decks, walls, slabs, and pavements. Denote the type, DBH, and canopy size of all trees.

3. Plans for proposed street improvements shall include the following:

   (a) Grading and erosion control plan.

   (b) Finished grades, showing the extent of cut and fill by existing and proposed contours, profiles, or other designations. Plan views showing existing features may be required for a distance of up to 100 feet (or further if warranted) beyond the proposed improvement in order to prevent future grade conflicts and will be determined on a case-by-case basis by the City's authorized representative.

   (c) Horizontal stationing along centerline, showing points of tangency and curvature, including centerline stationing of all intersecting streets. Curve data shall show tangent length, radius distance, centerline curve length, and delta angle.

(d) Curb alignment and elevation data, including table showing curve and segment station and offset, curb length, tangent length, radius distance, curve length, delta angle, and elevations. Curb elevations at all horizontal alignment break points, quarter-deltas, and low points.

(e) ADA ramp and driveway elevation data for all corners of the ramp and wings; also for connecting sidewalks up to a maximum distance of 15 feet out from ramp or driveway wing when running slopes exceed the general grade established for the adjacent street.

(f) Proposed structures, including roads and road improvements, parking surfaces, building footprints, walkways, landscaped areas, street lighting, public and private utilities, etc.

(g) Signing and striping plan.

(h) Lighting and illumination plan.

(i) Applicable detail drawings.

(j) Existing and proposed property lines, right-of-way lines, survey monuments, and easements.

(k) Setbacks from environmentally sensitive areas or resource areas protected within the Significant Resource Overlay Zone (SROZ).

(l) Any proposed phasing of construction. (Note: water quality and quantity facilities must be constructed before completion of any phased construction)

(m) Any additional information that the City's authorized representative deems necessary.

4. Profiles for construction plans will be provided at the same horizontal scale as the plan sheets and a 1" = 5' vertical scale. Profile drawings shall be drawn below the plan view or immediately following the associated plan view sheet. Profile views showing existing features may be required for a distance of up to 100 feet (or further if warranted) beyond the proposed improvement in order to prevent future grade conflicts and will be determined on a case-by-case basis by the City's authorized representative. The profiles shall include the following:

   (a) Existing ground along centerline and the edges of the right-of-way, if grade differences are significant.

   (b) Existing street centerline and gutter flow lines, including intersecting streets.

   (c) Proposed street centerline and gutter flow lines showing stationing, elevations, and slopes for beginning and end of vertical curves, point of vertical intersection, high and low points, and grade breaks. Vertical curves

shall be labeled with vertical curve length, algebraic grade difference, and K values.

(d) Proposed vertical alignment for stub streets that may be extended in the future, a minimum 300 feet beyond the construction limits. The City's authorized representative may request additional design information deemed necessary to properly evaluate the vertical alignment design of future street extensions.

(e) Any additional information that the City's authorized representative deems necessary.

5. Detailed grading and landscape plans will be provided. The plans shall include the following:

(a) Existing ground contours (shaded) and proposed ground contours at a minimum of a 2 foot contour interval. Slopes steeper than 6H: 1V shall be identified.

(b) Location of all drainage structures as well as any other piped utilities in vicinity (i.e., at 0.1-foot detail).

(c) Landscape planting plan. Show all sewer laterals, water services, fire hydrants, and street lighting as per **Detail No. RD-1240** of these standards.

(d) Irrigation plan to achieve the required plant survival rate.

(e) Maintenance access, as applicable.

6. Cross-sections shall be provided for at least the following:

(a) All street sections or amended soil sections, as applicable.

(b) Proposed ditches and swales, including vegetated swales.

201.1.06 Surveying

a. The design engineer shall be responsible for establishing the location of the street by means of reference stakes offset along the centerline. No construction shall be allowed to begin before construction staking. All staking shall be performed by or under the direction of a Professional Land Surveyor registered in the State of Oregon.

b. Reference stakes shall be set at 25-foot station intervals along the centerline. Stakes shall, at a minimum, reference the following:

1. Point of Curvature (PC), quarter-deltas, Point of Tangency (PT) for horizontal curves.

2. Begin Vertical Curve (BVC) point, low/high point, End Vertical Curve (EVC) point for vertical curves.

3. Beginning and ending point of super-elevation.

4. Beginning and ending of full super-elevation.

5. Centerline of intersecting street.

6. PC, quarter-deltas, and PT for curb returns.

7. All corners of ADA ramps.

8. Centerline of driveways.

9. Curb scoring for match into concrete street joints.

c. The design engineer shall also be responsible for identifying and staking easements during construction.

201.2.00 STREET DESIGN STANDARDS

Street design shall be documented in a Street Design Report prepared, stamped and signed by a Professional Engineer registered in the State of Oregon. The Street Design Report shall include pavement designs, including geotechnical investigations and testing, prepared by an Oregon registered Professional Engineer experienced in pavement design. The report shall include sufficient design documentation regarding site conditions, design assumptions and design parameters to allow for independent peer review of the design recommendations. Two copies of the stamped and signed Street Design Report shall be provided to the City.

201.2.01 Subgrade Evaluation

a. Subgrade evaluation and recommendations shall be prepared, stamped and signed by a Professional Engineer registered in the State of Oregon whose area of expertise is geotechnical engineering and shall be included in the Street Design Report.

b. Soil testing to obtain the strength of the soil is required for all roads to analyze and design the road structural section. Soil tests are needed on samples of subgrade materials that are expected to be within 3 feet of the planned subgrade elevation. At least one sample is needed for each 500 feet of roadway and for each visually observed soil type. Soil tests are required for at least three locations.

c. The selected design structural strength of the soil must be consistent with subgrade compaction requirements. That is, the strength and compaction moisture content at optimum to slightly over optimum must be specified. The Street Design Report shall address subgrade drainage and groundwater considerations for year-round conditions.

Recommendations for both dry-weather and wet-weather construction shall be included.

d. Test the subgrade and determine the modulus of subgrade reaction, k, or the resilient modulus (M_R) to design the street structure. The procedure for determining M_R is given in AASHTO T-292. Alternately, these soil strength criteria can be based on either the California Bearing Ratio (CBR) or H-veem resistance testing (R-value). The CBR will be determined in accordance with AASHTO T-193, based on the modified proctor (AASHTO T-180). R-values shall be determined at 300-psi exudation pressure in accordance to AASHTO T-190.

1. A correlation of M_R to CBR is given by the following relationship (Heukelom and Klomp, 1962):

   M_R (psi) = 1,500 x CBR

2. A correlation of M_R to R-value is given by the following relationship (Asphalt Institute, 1982):

   M_R (psi) = A + B x (R-value)

   Where: A = 772 to 1,155, B = 369 to 555

3. A correlation of M_R to R-value for fine-grained soils (R-value $\leq$ 20) is given by the following correlation (AASHTO, 1993):

   M_R = 1,000 + 555 x (R-value)

4. A correlation of CBR to k may be made using **Table 2.1**.

Table 2.1. RELATIONSHIP BETWEEN k AND CBR

CBR Value	Modulus of Subgrade Reaction (k) (psi/in.)
3	100
5.5	150
10	200
20	250
50	500
80	710

SOURCE: Portland Cement Association (PCA).

201.2.02 Subsurface Drainage

Subsurface street drainage must be considered in the design of each street:

a. Subsurface drains shall be designed and constructed according to the recommendations of the Street Design Report. Generally, subsurface drainage at the low point of each sag vertical curve shall be managed through the use of weep holes installed in adjacent catch basins. For pervious street sections, a transverse perforated drainpipe with a minimum diameter of 4 inches shall be installed below the base rock at the point of each sag vertical curve.

b. The subsurface drains are for the purpose of collecting and conveying subsurface water only, not surface runoff. They are not to be considered part of the storm drainage system for purposes of sizing storm drain pipe.

c. Subsurface drains shall connect and drain into the storm drainage system at catch basins, curb inlets, manholes, or roadside ditches. Surcharge from the storm drainage system shall not be allowed to back up into the subsurface drains.

d. Alternative subsurface drainage measures may be used if approved by the City's authorized representative.

201.2.03 Structural Section

a. Arterial or Collector Streets may be constructed of:

   1. AC with crushed aggregate base and/or treated bases, or

   2. PCC with crushed aggregate base.

b. Residential Streets may be constructed of:

   1. AC with crushed aggregate base and/or treated bases, or

   2. Standard or permeable segmental concrete unit pavers, or

   3. A combination of the two methods above, with the concrete pavers separated from the AC by a flush curb.

   4. Arterial or Collector Roundabouts may be constructed of PCC with crushed aggregate base only.

201.2.04 Crushed Aggregate Design

a. When crushed aggregate is included in the pavement design section, it shall consists of 2-inch thick leveling course of ¾" – 0 crushed aggregate placed over 1 ½" – 0 crushed aggregate.

b. Crushed aggregate shall meet the requirements of Section 201.3.01 "Granular Fill" of these standards.

c. Crushed aggregate shall be separated from native subgrade soils using a geotextile fabric to prevent fine material from migrating up into the base rock.

201.2.05 Asphalt Pavement Design

a. AC pavement shall be designed using nationally recognized procedures: the AASHTO method or the Asphalt Institute method.

b. The wearing surface of AC pavement shall conform to the Oregon Department of Transportation Standard Specifications for Construction (ODOT SSC) Section 00745, "Asphalt Concrete Pavement (ACP)," for ½" Hot Mix Asphalt Concrete, unless otherwise specified by the design engineer and approved by the City's authorized representative.

c. The base courses for AC pavement shall conform to ODOT SSC Section 00745, "Asphalt Concrete Pavement (ACP)," for ¾" Hot Mix Asphalt Concrete, unless otherwise specified by the design engineer and approved by the City's authorized representative.

d. Generally, Level 2 ACP mix design shall be used on local and collector streets. Level 3 ACP mix design shall be used on arterial streets. The City's authorized representative shall make the final determination on mix design level on a case-by-case basis.

e. Warm Mix Asphalt Concrete (WMAC) may be used as a substitute for Hot Mix Asphalt Concrete (HMAC) on all paving with approval by the City's authorized representative. WMAC shall conform to all requirements for HMAC in Section 2, "Transportation Design & Construction Standards" of these standards and ODOT SSC Section 00745, "Asphalt Concrete Pavement (ACP)", as modified in Section 201.3.02, "Asphalt Concrete" and Section 201.6.02, "Asphalt Pavement."

f. Asphalt thickness shall be determined by the approved Street Design Report. The minimum total thickness of AC shall be the following:

1. Local Streets: 4 inches (4.5 inches winter construction)
2. Collector Streets: 5 inches
3. Arterial Streets: 6 inches

g. The minimum total thickness of asphalt concrete constructed between October 15th and March 15th (winter construction) shall be 4.5 inches.

h. The asphalt lift thickness shall be a minimum of 2-inch and a maximum of 3-inch.

i. Pavement thickness design criteria shall be accomplished in accordance with the AASHTO method or the Asphalt Institute method, using soil strength criteria based on either the CBR or R-value (see Section 201.2.01, "Subgrade Evaluation.")

j. Use a minimum 20-year design period. Design using an initial ride index of 4.2 and a terminal serviceability index of 2.5.

201.2.06 Portland Cement Concrete Design

a. At the direction of the City's authorized representative, certain streets may be required to be designed and constructed using PCC.

b. PCC pavement shall be designed using nationally recognized procedures: the PCA method or the AASHTO method.

c. Use a minimum 40-year design period.

d. Minimum thickness of PCC shall be 7 inches.

e. Minimum thickness of crushed rock base shall be 6 inches.

f. Design of concrete joints shall follow the guidelines and requirements outlined in the American Concrete Pavement Association (ACPA) publication, "Design and Construction of Joints for Concrete Streets," except for the following:

1. Maximum joint spacing shall be 12 feet.

2. Joints shall be designed to be skewed 6:1 when meeting the edge of pavement.

3. For doweled contraction joints, do not lubricate the dowels.

4. Isolation joints shall be used around manhole covers. Isolation joints shall be circular with 2-foot spacing from the manhole cover.

g. All castings for manholes in concrete streets shall be standard type.

h. PCC for pavement, impact slab and concrete crosswalks construction shall conform to ODOT Class 4000 – 1½, Paving Concrete.

i. PCC for curbs, sidewalks, driveways and miscellaneous construction shall conform to ODOT Class 3300 – ¾, Commercial Grade Concrete.

201.2.07 Segmental Concrete Paver Design

a. Concrete Unit Pavers

1. Provide the City with paver manufacturer's/installation subcontractor's drawings and details: indicate perimeter conditions, junction with other materials, expansion and control joints, paver layout, patterns, color arrangement,

installation and setting details. Indicate layout, pattern and relationship of paving joints to fixtures, and project formed details.

2. Furnish and install pavers meeting the ASTM C936 with an average compressive strength of 8,000 PSI with no less than 7,300 PSI when tested to ASTM C140 standards. The pavers shall be 3-1/8" (80mm), minimum thickness.

3. A submittal shall be provided to the City which includes:

   (a) Paver manufacturer's catalog sheets with product specifications.

   (b) Four representative full-size samples of each paver type, thickness, color, and finish. Submit samples indicating the range of color expected in the finished installation.

   (c) Laboratory test reports certifying compliance of the concrete pavers with ASTM C 936.

   (d) Minimum 3 lb. samples of subbase, base and bedding aggregate materials.

   (e) Sieve analysis of aggregates for subbase, base and bedding materials per ASTM C 136.

   (f) Project specific or producer/manufacturer source test results for void ratio and bulk density of the base and subbase aggregates.

4. Prior to beginning construction, the contractor shall provide to the City's authorized representative proof of representative tests confirming compliance to the minimum requirements. If the tests reflect failure to meet the requirements then the whole lot will be rejected.

5. The city reserves the right to determine the suitability of some concrete pavers for use on exposed faces, edges or corners.

6. Concrete containment edge restraints shall be required with all concrete paver street installations in compliance with **Detail No. RD-1290** of these standards.

7. Segmental Concrete Pavers shall be designed with a minimum 1" layer of bedding sand, over a minimum 8" layer base of ¾"-0 fractured rock; a greater thickness may be required based on the soils conditions as provided in the Street Design Report. Crushed aggregate shall be separated from native subgrade soils using a geotextile fabric to prevent fine material from migrating up into the base rock

8. Sand for the leveling (bedding) course shall be sound, sharp, washed, natural sand or crushed stone complying with gradation requirements shown in **Table 2.2**; sand for joint filler material shall comply with the gradation requirements shown in **Table 2.3**.

Table 2.2. ASTM NO. 8 BEDDING & JOINT OPENING FILLER GRADING REQUIREMENTS

Sieve Size	ASTM No. 8 Percent Passing
1/2 in.	100
3/8 in.	85 – 100
U.S. No. 4 sieve	10 – 30
U.S. No. 8 sieve	0 – 10
U.S. No. 16 sieve	0 – 5

Table 2.3. ASTM No. 89 and No. 9 JOINT OPENING SAND GRADING REQUIREMENTS

Sieve Size	ASTM No. 89 Percent Passing	ASTM No. 9 Percent Passing
1/2 in.	100	--
3/8 in.	90 - 100	100
U.S. No. 4 sieve	20 - 55	85 - 100
U.S. No. 8 sieve	5 - 30	10 - 40
U.S. No. 16 sieve	0 - 10	0 - 10
U.S. No. 50 sieve	0 - 5	0 - 5

9. On large projects, a 10’ x 10’ mock up area may be used to review quality control. Upon acceptance of the mock up area, all future work will be compared to this mock up for acceptance on the project.

10. The contractor shall supply the City with a minimum of 100 s.f. of additional material of each type, color and/or thickness of pavers for use by the city for maintenance and repairs. The additional pavers shall be delivered on a pallet and be wrapped in plastic.

b. Permeable Concrete Unit Pavers

1. For Permeable Concrete Pavers the submittals shall be as outlined above.

2. Compliance shall generally follow the Concrete Unit Paver specification listed above with revisions as listed below.

3. Permeable Concrete Pavers shall be designed with a minimum 2” layer of bedding sand, over a minimum 4” base layer of ASTM No. 57 stone, over ASTM No. 2 stone sub-base of sufficient thickness to hold the design storm and as provided in

the Street Design Report. The No. 2 Stone shall be separated from native subgrade soils using a geotextile fabric to prevent fine material from migrating up into the rock.

4. The crushed stone shall have 90% fractured faces, LA Abrasion < 40 per ASTM C 131, with a minimum CBR of 80% per ASTM D1883.

5. Round river rock will not be allowed on applications subject to vehicular traffic.

6. All stone material shall be washed with less than 1% passing the No. 200 sieve.

7. Sand for the leveling/bedding course and for the joint/opening filler, shall conforming to ASTM No. 8 gradation as shown in **Table 2.2**,

8. Gradation requirements for the ASTM No. 57 stone and ASTM No. 2 stone shall be in conformance with **Table 2.4**, and **Table 2.5**, respectively:

Table 2.4. ASTM NO. 57 BASE AGGREGATE GRADING REQUIREMENTS

Sieve Size	ASTM No. 57 Percent Passing
1 1/2 in.	100
1 in.	95 – 100
1/2 in.	25 - 60
U.S. No. 4 sieve	0 – 10
U.S. No. 8 sieve	0 – 5

Table 2.5. ASTM NO. 2 SUB-BASE AGGREGATE GRADING REQUIREMENTS

Sieve Size	ASTM No. 2 Percent Passing
3 in.	100
2 1/2 in.	90 – 100
2 in.	35 - 70
1 1/2 in.	0 – 15
3/4 in.	0 – 5

9. Gradation criteria for the bedding and base:

   (a) D_{15} base stone / D_{15} bedding stone <5

(b) D_{50} base stone / D_{50} bedding stone > 2

201.2.08 Subgrade Geotextile

Separate the base rock from native subgrade soils using a geotextile fabric to prevent fine material from migrating up into the base rock. Subgrade geotextile shall conform to Oregon Department of Transportation Standard Specifications for Construction (ODOT SSC) Section 00331.

201.2.09 Pavement Transition – Portland Cement Concrete to Asphalt

Where AC paving abuts PCC paving, concrete crosswalks, flush curbs or lateral concrete bands used as edge restraints for segmental concrete pavers, there shall be a lateral transition zone extending 3 feet, with a cross-section designed according to **Detail No. RD-1175** of these standards.

201.2.10 Pavement Overlay Design

Pavement overlays shall be designed using nationally recognized procedures: the Asphalt Institute method, PCA method, or AASHTO method.

201.2.11 Horizontal Alignment

Alignments shall meet the following requirements:

a. Centerline alignment of improvements should be parallel to the centerline of the right-of-way. The centerline of a proposed street extension shall be aligned with the existing street centerline. Intersections shall align in accordance with Section 201.2.15, "Intersections."

b. Horizontal curves in alignments shall meet the minimum radius requirements shown in **Table 2.6**, unless otherwise directed by the City's authorized representative.

c. Cross-slope of the street section shall be no less than 2% and no greater than 4%, unless otherwise approved by the City's authorized representative.

d. The use of superelevation is subject to approval by the City's authorized representative. Where superelevation is used, street curves should be designed for a maximum superelevation rate of 4 percent. If terrain dictates sharp curvature, a maximum superelevation of 6 percent is justified if the curve is long enough to provide an adequate super elevation transition.

e. Off right-of-way runoff shall be controlled to prevent concentrated cross flow in superelevated sections.

Table 2.6. DESIGN SPEED / CENTERLINE RADIUS—MINIMUMS

Design Speed (mph)	Friction Factor (F)	Slope/R min.					
		(e*) - 4%	(e) - 2.5%	(e) 0%	(e) + 2.5%	(e) + 4%	(e) + 6%
15	.330	55’	50’	45’	45’	40’	40’
20	.300	105’	100’	90’	85’	80’	75’
25	0.252	195'	185'	165'	150'	145'	135'
30	0.221	330'	305'	270'	245'	230'	215'
35	0.197	520'	475'	415'	370'	345'	320'
40	0.178	775’	700’	600’	525’	490’	450’
45	0.163	870’	980’	830’	720’	665’	605’

NOTE: *e = rate of superelevation (tanB)

f. On local streets, requests for design speeds less than 25 miles per hour shall be based on topography, right-of-way, or geographic conditions and in accordance with Section 201.1.04.g.3, “Design Speed.” Requests must show that a reduction in centerline radius will not compromise safety.

201.2.12 Vertical Alignment

Alignments shall meet the following requirements:

a. Minimum tangent street gradients shall be 1% along the crown and curb.

b. Maximum street centerline gradients shall be 8% for collector and local streets, and 6% percent for arterial streets. Grades in excess of 8% but not more than 12% may be permitted for short distances and must be approved by the City’s authorized representative on an individual basis.

c. At street intersections, the crown of the major (higher classification) street shall continue through the intersection. The roadway section of the minor street will flatten to match the longitudinal grade of the major street at the projected curb line.

d. Local streets intersecting with a collector or greater functional classification street or streets intended to be posted with a stop sign shall provide a landing that averages 5% gradient or less. Landings are that portion of the street within 20 feet of the edge of the intersecting street at full improvement or from the extended curb line.

e. Grade changes of more than 1% shall be accomplished with vertical curves.

f. Street grades, intersections, and superelevation transitions shall be designed not to allow concentrations of storm water to flow over the pavement.

g. Offset crowns may be allowed and must be approved by the City's authorized representative on an individual basis.

h. Streets intersected by streets not constructed to full urban standards shall be designed to match both present and future vertical alignments of the intersecting street. The requirements of these standards shall be met for both present and future conditions.

i. Vertical curves shall conform to the values listed in **Table 2.7** and **Table 2.8**.

j. Slope easements shall be dedicated or obtained for the purposes of grading outside the right-of-way.

Table 2.7. DESIGN CONTROLS FOR MINIMUM CREST VERTICAL CURVES BASED ON STOPPING SIGHT DISTANCE

Design Speed	K
15	3
20	7
25	12
30	19
35	29
40	44
45	61
50	84
55	114

Where: K = L / A = feet / percent.

L = length of vertical curve (feet).

A = algebraic difference in grades (percent).

Table 2.8. DESIGN CONTROLS FOR MINIMUM SAG VERTICAL CURVES BASED ON STOPPING SIGHT DISTANCE

Design Speed	Without Street Lighting - K	With Street Lighting - K
15	10	5
20	20	10
25	30	15
30	40	20
35	50	30
40	60	35
45	70	45
50	90	55
55	100	65

Where: K = L / A = feet / percent.

L = length of vertical curve (feet).

A = algebraic difference in grades (percent).

201.2.13 Transitions

The following specify the minimum requirements for street transitions:

a. Street width transitions from a narrower width to a wider width shall be designed with a 5:1 taper. Delineators, as approved by the City's authorized representative, shall be installed to define the configuration.

b. For street width transitions from wider to narrower, the length of the transition taper shall be determined as follows:

$$L = S \times W, \text{ for } S \geq 45 \text{ mph}$$

$$L = \frac{W \times S^2}{60}, \text{ for S less than 45 mph}$$

Where L = minimum length of taper (feet).

S = design speed (mph).

W = edge of pavement offset (feet).

c. Delineators, as approved by the City's authorized representative, shall be installed to define the configuration. Maximum spacing of delineators shall be the numerical value of the design speed, in feet (i.e. 35-foot spacing for a 35 mph speed).

d. In situations where tapered transitions occur on both sides of the roadway, both transitions will taper at the same rate in accordance with subsection b above, unless otherwise approved by the City Engineer.

e. In situations where a tapered transition cannot be provided, a Type III barricade shall be installed at the end of the wider section of the street and a taper shall be appointed and delineated as approved by the City's authorized representative. The barricade shall conform to **Detail No. RD-1220** of these standards; diagonal striping shall slope down in the direction of the taper. If the wider section does not provide an additional travel lane, only a barricade is required without the transition.

201.2.14 Superelevation Cross-Sections

a. Design elements for superelevation shall be based on AASHTO design guidelines.

b. Offset crown cross-sections are not acceptable as superelevation sections.

201.2.15 Intersections

The following specifies the minimum requirements for intersections:

a. The interior angle at intersecting streets shall be kept as near 90 degrees as possible, unless existing development or topography make it impracticable. Where intersecting streets cannot be kept at right angles, the interior angle shall in no case be less than 75 degrees. A tangent section shall be carried a minimum of 25 feet each side of intersecting right-of-way lines.

b. Intersection spacing shall conform to the values in **Table 2.9**. The distance between streets is measured from the centerline of the subject street to the centerline of the adjacent street.

c. At intersections, including alleyways, opposing street centerlines shall be in the same alignment. If in the opinion of the City Engineer, opposing street centerlines cannot align due to topography, existing features, or geographic conditions, the opposing street centerlines shall be in alignment as close as possible. Offset intersections that create danger to the traveling public, such as over-lapping left turn movements, will not be allowed under any circumstances.

d. The minimum curb radii at intersections shall be as shown in **Table 2.10** for the various function classifications with exceptions subject to approval by the City's authorized representative. The right-of-way radii at intersections shall be sufficient to maintain at least the same right-of-way-to-curb spacing as the lower classified street.

e. The City Engineer may require turning radii larger than shown in **Table 2.10** in locations where larger design vehicles need to be accommodated.

Table 2.9. STREET INTERSECTION SPACING

Street Functional Classification	Distance Between Intersections Along The Street Shall be at Least	Distance Between Intersections Along the Street Shall Not Exceed
Major Arterial	1000 feet	N/A
Minor Arterial	600 feet	1000 feet
Collector	300 feet	600 feet
Local	100 feet	600 feet
Bike & Pedestrian Facilities	100 feet	300 feet

f. The minimum turning curb radii shown in **Table 2.10** may be reduced by the distance between the edge of the travelled way and the adjacent curb face, up to 10 feet. The curb radii reduction is limited to the road width with the least distance between the edge of the travelled way and the adjacent curb face.

Table 2.10. MINIMUM TURNING RADII FROM EDGE OF PAVEMENT OR CURB (feet)

Street Classification	Arterial Street	Commercial Industrial	Collector Street	Residential* Street	Rural Street
Arterial Street	55’	40’	30’	28’	28’
Commercial Industrial	40’	40’	30’	28’	28’
Collector Street	30’	30’	30’	28’	28’
Residential* Street	28’	28’	28’	28’	28’
Rural Street	28’	28’	28’	28’	28’

* The Residential Streets classification includes collector streets that are located in residential neighborhoods

g. Curbs shall be designed to minimize the length of pedestrian crossings. Streets with on-street parking shall have intersections designed with curb extensions to reduce pedestrian crossing lengths, where the design turning radius allows. The City Engineer may require/approve the use of compound curves and other methods to minimize intersection width.

h. Sidewalk access (wheelchair) ramps shall be in conformance with Section 201.2.25, "Sidewalks," and to **Detail No. RD-1110** – **Detail No. RD-1140** of these standards.

201.2.16 Cul-de-Sacs, Eyebrows, Turnarounds

The design engineer's plans must be approved by TVF&R and the City's authorized representative. The following specifies the minimum requirements for cul-de-sacs, eyebrows, and turnaround areas. Other turnaround geometrics for alternative design vehicles, such as a single-unit truck, garbage truck, street sweeper, etc., may be used when conditions warrant and when the City's authorized representative approves the design and application of its use.

a. Cul-de-sacs and other turnaround areas shall be allowed only on residential streets and commercial/industrial streets. Cul-de-sacs shall not be more than 200 feet long, unless approved by the Development Review Board. The length of cul-de-sacs shall be measured along the centerline of the cul-de-sac roadway from the nearside right-of-way of the nearest through-traffic intersecting street to the farthest point of the cul-de-sac right-of-way.

b. The minimum curb radius for cul-de-sac bulbs shall be 48 feet, and the right-of-way radius shall be sufficient to maintain at least the same right-of-way-to-curb spacing as in the adjacent part of the road.

c. Cul-de-sacs and other turnaround areas shall have a 6-foot public utility easement extending outside the right-of-way around the cul-de-sac continuously. The minimum curb radius for transitions into cul-de-sac bulbs shall be 28 feet. The right-of-way radius shall be sufficient to maintain the same right-of-way-to-curb spacing as in the adjacent part of the road.

d. An eyebrow corner may be used on a local street where expected average daily traffic (ADT) counts will not exceed 500 vehicles. Eyebrow geometry shall be evaluated on the basis of turning requirements for Fire Department vehicles.

201.2.17 Stub Streets

Stub streets allow for future extension of the roadway. A note shall be added to the plat restricting access at the terminus of the right-of-way. The access restriction shall extend the full width of the right-of-way; access control shall be governed by the City. A Type III Street Barricade conforming to **Detail No. RD-1220** of these standards shall be erected at the edge of pavement of the stub street and "No Parking" signs installed on the barricade; a Type III Sidewalk Barricade conforming to **Detail No. RD-1220** of these standards shall be erected at the end of any sidewalks on the stub street. Additionally, a

sign shall be installed stating the street will be extended in the future, per **Detail No. RD-1225** of these standards. Streets 50 feet in length or greater shall provide a garbage/recycling vehicle turn around approved by the City's authorized representative.

201.2.18 Half-Streets

To allow for reasonable development, half-street improvements may be approved by the Planning Commission and the Development Review Board. Whenever a half-street improvement is approved, it shall conform to the following:

a. Street section design and construction shall be in conformance with these standards

b. Minimum pavement width shall be 24 feet for arterial and collector streets, and 20 feet for residential and rural streets as measured from face of curb.

c. Intersectional improvements shall be adequate to provide turn lanes.

   1. Arterials and collectors: 40 feet paved for 250 feet as measured from centerlines of intersecting streets.

   2. Residential and rural: 36 feet paved for 150 feet as measured from centerlines of intersecting streets.

d. A note shall be added to the plat restricting access at the limits of the right-of-way. The access restriction shall extend the full width of the right-of-way; access control shall be governed by the City.

201.2.19 Private Access Drives

With prior approval of the Development Review Board a private access drive may be allowed for ingress and egress to two to four residential units and where there is no possibility of future extensions of the drive.

a. Private access drives shall meet the requirements of the City of Wilsonville Planning Division and TVF&R.

b. Private access drives shall not be used for ingress and egress into mixed use developments.

c. Private access drives shall be designed with the same structural section as the adjacent residential street, or designed in conformance with these Standards.

d. Private access drives shall be constructed and inspected in conformance with these Standards.

e. Private access drives shall be signed with a blue street name sign in conformance with Section 201.8.01.b, "Street Name Signs" and **Detail No. RD-1255** of these standards;

in addition all private access drives shall be signed with a blue sign stating, "Not maintained by the City of Wilsonville."

201.2.20 Raised Medians and Traffic Separators

The following specify the minimum requirements for raised medians:

a. Raised center medians and landscape medians are allowed and encouraged where feasible on certain arterial and collector streets as defined in the City of Wilsonville TSP.

b. Where raised medians are allowed, the following criteria must be met:

   1. Street lighting shall be sufficient to provide illumination of the raised median.

   2. Objects, such as trees, shrubs, signs, light poles, etc., shall not physically or visually interfere with vehicle or pedestrian traffic in the travel way.

   3. Raised medians shall incorporate pedestrian refuge areas at locations of pedestrian street crossings in order to reduce pedestrian crossing lengths.

   4. The style and design of the raised median shall be site specific. The raised median shall be safe for the design speed. Raised medians shall be designed in conformance with AASHTO guidelines.

   5. Design shall be in conformance to Section 201.2.24.b, "Curb and Gutter Style" and consider the use of appropriate surface loading for emergency vehicle left-turn access. Raised median designs shall be subject to City approval.

c. Concrete traffic separators shall be designed where they are needed as determined by the City's authorized representative; concrete traffic separators shall conform to **Detail No. RD-1070** of these standards.

201.2.21 Transit Turnout Design

The need for transit turnouts shall be determined by South Metro Area Regional Transit (SMART) in coordination with the City Engineering Division. Transit turnouts shall be provided where required by the City Engineering Division

a. Transit turnouts shall conform to **Detail No. RD-1160** of these standards.

b. Transit pad sections shall be a minimum thickness of 9 inches of PCC over 6 inches of compacted base rock.

c. Transit pad shall be reinforced with No. 4 reinforcement steel bar, placed 1-foot on center each way, 2 inches above base rock.

d. Transit pad shall be doweled into adjacent PCC gutter; dowels spaced 3-feet on center and centered on face of gutter. If adjacent street is PCC, transit pad shall be doweled into the street as shown in **Detail No. RD-1180** of these standards.

e. PCC for transit pad construction shall conform to ODOT Class 4000 – 1 ½, Paving Concrete.

f. Base rock shall conform to Section 201.3.01, "Granular Fill."

g. Design of concrete joints shall follow the guidelines and requirements outlined in the ACPA publication, "Design and Construction of Joints for Concrete Streets," except for the following:

   1. Maximum joint spacing shall be 12 feet.

   2. Joints shall be designed to be skewed 6:1 when meeting the edge of pavement.

   3. For transit pads adjoining PCC streets, joints shall match street jointing.

   4. For doweled contraction joints, do not lubricate the dowels.

   5. Isolation joints shall be used around manhole covers. Isolation joints shall be circular with 2-foot spacing from the manhole cover.

201.2.22 Sight Distance

A clear vision area shall be maintained on each corner of property at the intersection of any two streets, a street and a railroad, or a driveway and a street. Clear vision area shall be in conformance with Section 4.177 of the City Code and this standard. The following specifies the minimum requirements for sight distance for roads that intersect each other, and for driveways that intersect roads:

a. The minimum intersectional sight distances shall be based on the higher of the following: the design speed, the posted speed, or the measured 85% percentile speed of the road. The intersectional sight distance shall be

   1. Based on an eye height of 3.5 feet and an object height of 3.5 feet above the road surface.

   2. Measured at the center of the drive lane 15 feet from the nearest edge of the nearest travel lane of the intersecting street.

b. No structures, plantings, or other obstructions shall be allowed that would impede visibility between the height of 30 inches and 10 feet, as measured from the top of curb, or in absence of a curb, from the established street centerline elevation.

c. Trees placed in sidewalk planting areas must be located at least 30 feet from the nearest intersection and 10 feet from driveways per **Detail No. RD-1240** of these standards.

d. Minimum intersectional sight distance for railroad and street intersections shall be in conformance with AASHTO design guidelines.

e. Minimum intersectional sight distance shall be equal to 10 times the posted speed of the road for grades of 3% or less, as shown in **Table 2.11.** For grades in excess of 3%, sight distances must be adjusted and shall be in conformance with AASHTO design guidelines. For significant road improvement projects, the following intersectional standards shall be met in addition to the AASHTO remaining sight distance standards.

Table 2.11. INTERSECTIONAL SIGHT DISTANCE

Design Speed (mph)	Distance Along Crossroads (feet)
25	250
30	300
35	350
40	400
45	450
50	500

201.2.23 Driveways

Access to private property shall be permitted with the use of driveway curb cuts. The following specifies the minimum requirements for driveways:

a. Driveways shall conform to **Detail No. RD-1090, Detail No. RD-1095,** or **Detail No. RD-1100** of these standards; or to **Detail No. RD-1085** of these standards on non-curbed streets.

b. Driveways shall be designed to meet all applicable rules and regulations of Title III of the Americans with Disabilities Act of 1990 (ADA).

c. Driveways shall not be permitted on streets with existing non-access reserve strips, or where plat restrictions limit access to the right-of-way, or as set forth in the TSP and Planning Code.

d. For commercial or industrial developments, driveway access shall be a minimum of 100 feet from the nearest intersection (as measured from near edge of driveway drop

to near face of curb at intersection), unless otherwise approved in writing by the City's authorized representative.

e. For residential developments, driveway access from the nearest intersection shall be a minimum of 50 feet (as measured from near edge of driveway drop to near face of curb at intersection) unless otherwise approved in writing by the City's authorized representative.

f. Driveways on arterial and collector streets shall be minimized, where practicable, and shall be placed first on a lower classification street.

g. Access spacing, including driveways alleys, & streets, shall be in conformance with **Table 2.12.**

1. Spacing between driveways is measured between the nearest edges of driveway drops.

2. The desired access spacing shall be adhered to unless otherwise approved by the City's authorized representative. Deviating from the desired access spacing may be allowed by the City's authorized representative when aligning with existing driveways, topography constraints, property limitations and safety related issues.

Table 2.12. ACCESS SPACING STANDARDS

Roadway Functional Classification	Access Spacing Desired	Access Spacing Minimum
Major Arterial	1320 feet	1000 feet
Minor Arterial	1000 feet	600 feet
Collector	300 feet	100 feet
Local Street	Access to Each Lot	

3. To modify the minimum access spacing, the City Engineer may require an access study prepared and certified by a professional Traffic Engineer registered in the State of Oregon. The access study shall include, at a minimum, the following:

(a) Review of site driveway spacing and design.

(b) Evaluation of traffic impacts adjacent to the site within a distance specified by the City Engineer.

(c) Review of all modes of transportation to the site.

(d) Mitigation measures where access spacing standards are not met, including but not limited to medians, turning restrictions, driveway consolidation, and shared driveways.

h. Driveways and alleys shall be constructed to align with existing or planned streets, if the driveway intersects with a street controlled with an existing or planned traffic signal, intersects with an existing or planned arterial or collector street, or would be an extension of an existing or planned street or major driveway. If in the opinion of the City's authorized representative, the driveway and opposing street cannot align due to topography, existing features, or geographic conditions, the driveway and opposing street shall be in alignment as close as possible. Offset alignment that creates danger to the traveling public, such as over-lapping left turn movements, will not be allowed under any circumstances.

i. The City's authorized representative may limit the number or location of connections to a street, impose access restrictions where the roadway authority requires mitigation to alleviate safety or traffic operations concerns.

j. Driveways shall not be wider than necessary to safely accommodate projected peak hour trips and turning movements, and shall be designed to minimize crossing distances for pedestrians in accordance with **Detail No. RD-1080**, **Detail No. RD-1085**, **Detail No. RD-1090**, **Detail No. RD-1095**, and **Detail No. RD-1100** of these standards. The City's authorized representative shall make the final determination of maximum driveway width on a case-by-case basis.

k. The City's authorized representative may require a driveway to extend to one or more edges of a parcel and be designed to allow for future extension and inter-parcel circulation to allow access to adjacent parcels as part of future development. The owner(s) of the subject site may be required to record an access easement for future joint use of the approach and driveway.

l. Access driveways shall have a minimum width of 12 feet for one-way traffic and 20 feet for two way traffic. Driveway widths shall meet requirements of TVF&R.

m. Parking lot drive aisles shall align with the approved access driveway. A clear drive aisle, containing no parking spaces or intersecting drive aisles, shall be provided at all parking lot access driveways in accordance with **Detail No. RD-1105** of these standards and as follows:

1. Within 50 feet of the back of sidewalk or right-of-way boundary, whichever is greater, for access driveways with less than 100 Average Daily Trips (ADT).

2. Within 100 feet of the back of sidewalk or right-of-way boundary, whichever is greater, for access driveways with 100 or more Average Daily Trips (ADT).

3. The clear drive aisle shall not have a width greater than the approved access driveway.

4. The City Engineer may reduce the clear drive aisle length to not less than 20 feet from the back of sidewalk or right-of-way boundary, whichever is greater. The City Engineer may require submission of additional information, including but not limited to a traffic study prepared and certified by a registered professional Traffic Engineer in the State of Oregon. Any reduction in the required clear drive aisle length shall be based on the following:

   (a) Queuing areas are designed such that vehicles do not obstruct a driveway, fire access lane, walkway, or public right-of-way.

   (b) On-site circulation is designed in such a way as to not create a safety hazard by reducing the clear drive aisle length.

n. Detectable warning surfaces shall be provided at the junction between the pedestrian route and the vehicular route where driveways have yield or stop control or incorporate curb ramps or blended transitions into the driveway design.

o. Grading on driveway approaches shall not exceed 5H:1V within the PUE.

p. Concentrated surface runoff shall not be allowed to flow from private commercial/industrial property, private access drives, or private alley accessways across public sidewalk and into the public right-of-way.

q. Driveways intersecting with roads shall meet the minimum sight distance requirements as specified in Section 201.2.22, "Sight Distance."

r. Where the addition or modification of a driveway access requires the removal of center landscape median, a new center landscape median shall be constructed at a different location within the City of Wilsonville. The new center landscape median shall be equal in length to the removed center landscape median. The City's authorized representative shall determine the appropriate location for construction of the new center landscape median.

s. Where driveway requirements and standards cannot be met due to the location or configuration of an existing building, structure, topography or geographic feature, the existing driveway shall be brought into conformance to the greatest extent feasible as determined by the City's authorized representative.

201.2.24 Curbs and Grading

The following specifies the requirements for curbs and cross-slope grading for streets:

a. **Location and Design:** Arterial collector and residential streets shall include curb and gutters on both sides, except in some situations of interim width improvements. Interim designs shall be reviewed and approved on a case by case basis by the City's authorized representative. Non-mountable curb and gutters shall be required on arterial, collector and residential streets.

b. **Curb and Gutter Style:** On edges of streets or where designed to carry water, curb and gutter shall be designed in conformance to **Detail No. RD-1055** of these standards for AC streets or **Detail No. RD-1060** of these standards for PCC streets; at street medians or where designed to spill water, curb shall be provided for AC streets and curb and gutter shall be provided for PCC streets in conformance with **Detail No. RD-1065** of these standards. In all cases the gutter shall be a minimum depth of 6 inches or shall match the design depth of the AC or PCC street section.

c. **Shoulders:** Rural streets or interim width urban streets shall have minimum 6-foot-wide shoulders next to the street, at 2% cross-slope, and roadside ditches next to the shoulders, with a maximum side slope of 2H: 1V. The 6-foot shoulder area shall consist of a minimum of 4 feet of pavement and 2 feet of crushed aggregate.

d. **Gutter Stamping:** Newly constructed public or private curb and gutters or replaced curb and gutters shall be stamped on the outer face of the gutter pan with the capitol letters "SS" at the location of each sanitary lateral crossing, the capital letters "SD" at the location of each storm drain lateral crossing, the capital letter "W" at the location of each water line crossing, the capital letter "C" at the location of each conduit crossing, and the capital letter "F" at the location of each City fiber crossing. Letters shall be 3 inches in height and embossed a minimum of ⅛-inch deep.

e. **Root Barriers:** Where trees are located within 8 feet of public curbs, the curb shall be protected from root intrusion with a root control barrier system designed by a Professional Landscape Architect registered in the State of Oregon; root control barrier shall be approved by the City's authorized representative before installation. Generally, the root control system should be installed a minimum of 24 inches deep, with a minimum 20-foot length centered on the root source. Installation of such systems shall be done so as to not disturb the existing finish materials or base rock previously installed. Provide landscaping plan showing location of root control barrier system.

f. **Grading, Collector and Arterial Streets:** Grading outside the improved areas shall be as follows: Minor collector or higher functional classification shall have a 2% upward grading to the right-of-way line, a 5H:1V upward or downward grading within the public utility easement, and no steeper than 1½H:1V up or 2H:1V down outside the right-of-way. Retaining walls shall be used if slopes are greater than the 1½H: 1V to a height where the slope is no more than 1½H: 1V.

g. **Grading, Residential and Rural Streets:** Residential streets and rural roads beyond the swale shall have a 2% upward grading to the right-of-way line, a 5H:1V upward or downward grading within the public utility easement, and no steeper than 1½H:1V up or 2H:1V down, outside the public utility easement. Retaining walls shall be used if slopes are greater than the 1½H: 1V to a height where the slope is no more than 1½H: 1V.

h. **Cross- slope:** Cross-slope of the street section shall be in conformance with Section 201.2.11.c, "Horizontal Alignment."

201.2.25 Sidewalks

The following specifies the requirements for sidewalks:

a. **Location and Design:** The location of sidewalks shall be based on the City of Wilsonville TSP, the City's Bicycle and Pedestrian Master Plan, and as required by the Planning Department, in accordance to subsection 4.177, "Street Improvement Standards," of the Wilsonville Code.

1. A pedestrian access route shall be provided within sidewalks, pedestrian street crossings, curb ramps and other pedestrian circulation paths located in the public right-of-way. The pedestrian access route shall connect to all accessible elements, spaces, and facilities that connect building and facility entrances to public streets and sidewalks.

2. The pedestrian access route shall be designed and constructed in accordance with the rules and regulations of Title III of the Americans with Disabilities Act of 1990 (ADA).

3. Sidewalks shall be designed with a minimum width of 5 feet and clear width of 4 feet or as designated in the TSP, whichever is greater, exclusive of curb and obstructions. Sidewalk width may be required to be wider than 5 feet in Commercial Zones. Actual designed sidewalk width shall be determined by the City Engineer.

4. Sidewalk thickness, slope, finish work, and location of expansion and contraction joints shall be as specified in **Detail No. RD-1075** of these standards.

5. Final facility location and design are subject to the approval of the City's authorized representative, unless otherwise stated.

6. Sidewalks shall have a light broom finish transverse to the line of travel.

(a) Sidewalk joints in new construction shall be finished with a 3-inch wide shine for sidewalks less than and including 6 feet in width.

(b) Sidewalk joints in areas of infill and replacement shall be finished to match existing adjacent sidewalk.

b. **Separation:** Sidewalks shall be separated from the roadway through the use of landscape strips in accordance with the City of Wilsonville TSP. Sidewalk separation from the street shall be provided in accordance with **Table 2.13**.

1. The combined planter strip and sidewalk width shall not be less than the minimum provided in the Require Planter Strip + Sidewalk Width column of **Table 2.13**.

2. In cases of extreme topography, protection of existing trees, and existing structures, the City Engineer may reduce the combined planter strip and sidewalk width to no less than the Minimum Sidewalk Width column of **Table 2.13** or require that the sidewalk to swing curb tight or outside of the right-of-way in a public easement. The length and reduction of the combined width and change in alignment shall be the minimum necessary to bypass the conflicting topography, tree, and/or structure,

Table 2.13. SIDEWALK SEPARATION FROM ROADWAY

Street Classification	Required* Planter Strip + Sidewalk Width	Minimum Sidewalk Width	Minimum** Planter Strip Width	Combine to Full Sidewalk Width with Tree Wells
Major Arterial	13.5' – 16.5'	5'	6'	Yes
Minor Arterial	13.5' – 15.5'	5'	6'	Yes
Collector	11.5' – 13.5'	5'	5'	Yes
Local	10.5' – 12'	5'	5'	No
LID Local	10.5' - 12'	5'	5'	No

* Width includes the width of the curb.

** The minimum planter width that incorporates a water quality swale is 6.5'.

c. **Easements:** All public-owned pedestrian facilities shall be constructed within a public right-of-way or an easement. All new development or redevelopment shall consider access to adjacent properties in their development plans, especially schools, retail, and commercial areas. Easements shall be provided as necessary for compliance with the ADA Standards for Accessible Design.

d. **Access Ramps:** Access ramps shall be included in the design of sidewalks at all corners of all intersections, regardless of curb type or terrain.

1. A curb ramp shall connect the pedestrian access route to each pedestrian street crossing. For example, a street intersection with pedestrian street crossings in each direction shall have two separate curb ramps, one for each pedestrian street crossing.

2. The curb ramp, excluding flared sides, shall be contained wholly within the width of the pedestrian street crossing served.

3. In alterations where existing physical constraints prevent compliance with this requirement, the City's authorized representative may approve use of a single diagonal curb ramp to serve both pedestrian street crossings.

4. Ramps shall conform to **Detail No. RD-1110** – **Detail No. RD-1140** of these standards and shall have a smooth transition at the gutter line.

e. **Pedestrian Street Crossings:** Pedestrian street crossings shall be included in the design of sidewalks and street intersections, regardless of terrain.

1. The location of a pedestrian street crossings shall be determined by the City's authorized representative.

2. Where pedestrian street crossings at intersections are prohibited, "No Pedestrian Crossing" signs shall be provided along with detectable features. Signage is not required where location of urban design features and/or landscaping clearly indicates a street crossing is not allowed.

3. The pedestrian street crossing distance shall be minimized whenever possible through the installation of curb extensions, center median refuge, island refuge, and other devices as approved or required by the City's authorized representative.

f. **Thickened Design:** At all intersections adjacent to the curb radius, curb-tight sidewalks and sidewalk ramps shall be constructed with a similar section as shown for a residential driveway (see **Detail No. RD-1090** of these standards).

g. **Root Barriers:** Where trees are located within 8 feet of public sidewalks, the sidewalk shall be protected from root intrusion with a root control barrier system in accordance with Section 201.2.24.e "Root Barriers".

h. **Urban Design Features:** Urban design features including, but not limited to street trees, furniture, kiosks, trash receptacles, directional signage, and bicycle amenities, shall be provided when required by the City Engineer. Urban design features will be provided, located, and installed in accordance with the rules and regulations of Title III of the Americans with Disabilities Act of 1990 (ADA).

201.2.26 On-Street Parking

The following specifies the requirements for on-street parking:

a. The location of on-street parking shall be based on the City of Wilsonville TSP and where directed by the City's authorized representative.

b. On-street parking shall not be permitted on arterial roadways.

c. On-street parking is permitted on one or both sides of collector roadways. The minimum width of an on-street parking strip on a collector road is 7 feet.

d. On-street parking is required on local streets, on one or both sides, as determined by the City Engineer. The minimum street width (curb to curb) for a local street is 32 feet for parking on both sides and 28 feet for parking on one side.

e. On-street parking is permitted on Low Impact Development (LID) local streets, on one or both sides, as determined by the City Engineer. The minimum street width (curb to curb) for a LID local street is 28 feet for parking on both sides, 24 feet for parking on one side, and 20 feet for no on-street parking.

f. On-street parking shall be located outside the curb return radii of intersections and pedestrian street crossings, whichever is furthest from the intersection.

g. 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 2.14**.

Table 2.14. ACCESSIBLE ON-STREET PARKING SPACES

Total Number Marked or Metered On-Street Parking Spaces	Minimum Required Number of Accessible On-Street 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% of total

201.2.27 Bicycle and Shared-Use Path Facilities

The following specifies the requirements for bicycle and shared-use path facilities:

a. **Types:** Bicycle routes throughout the City shall consist of the following types of facilities.

1. Bike lanes adjacent to motor vehicle travel lanes and local street bikeways that share the travel lane with motor vehicle traffic.

2. Alternative bicycle facilities consist of buffered bike lanes, cycle tracks, and other bike facilities that provide buffers between bike and motor vehicle travel lanes typically on roadways with high traffic volumes.

3. Shared-use paths, including regional trails, consist of facilities for multiple non-motorized users, typically within a separate right-of-way, with minimal conflicts with automobile traffic.

b. **Location:** The location of bicycle and shared-use path facilities shall be based on the City of Wilsonville TSP, the City's Bicycle and Pedestrian Master Plan, and as required by the Planning Department, in accordance to subsection 4.177, "Street Improvement Standards," of the Wilsonville Code.

   Alternative bicycle facilities, such as buffered bike lane and cycle tracks, shall be considered for incorporation into design of Arterial streets in place of typical bike lanes. The City Engineer shall determine locations where alternative bicycle facilities will be utilized in consultation with the National Association of City Transportation Officials (NACTO) Urban Bikeway Design Guide.

c. **Design Standards:** Bicycle and shared-use path facilities shall be designed in accordance with 2011 ODOT Bicycle and Pedestrian Design Guide, 2012 AASHTO Guide for the Development of Bicycle Facilities, NACTO Urban Bikeway Design Guide, and the City of Wilsonville Bicycle and Pedestrian Master Plan.

   Bicycle and shared-use path facilities shall be designed and constructed in accordance with the rules and regulations of Title III of the Americans with Disabilities Act of 1990 (ADA). The City authorized representative may allow nature trails to be designed to Accessibility Guidelines for Outdoor Developed Areas when applicable.

d. **Drainage Grates:** The following specify the minimum design requirements for drainage grates on bike facilities and shared use paths.

   1. Curb inlets shall be utilized to the extent possible on streets designated for bicycle facilities.

   2. Where grated inlets are necessary, the grates shall be installed flush with the adjacent street surface and drainage grates shall be bicycle safe and hydraulically efficient.

   3. Grate inlets shall be identified with a pavement marking in accordance with Section 201.2.27.g, "Signage and Pavement Markings".

e. **Railroad Crossings:** The following specify the minimum design requirements for bike facilities and shared use paths crossing railroad tracks.

   1. Bicycle facilities and shared-use paths should be designed to cross railroad tracks at right angles.

   2. Where the crossing angle is less than 45 degrees, bicycle facilities and shared-use paths shall be designed with additional width to allow bicyclists to cross the tracks close to a 90 degree angle. The additional width can be provided within the

bike lane or by providing access onto an adjacent wide sidewalk to make the crossing.

3. Where additional lane width to provide a crossing close to a 90 degree angle cannot be provided, commercially available compressible flange fillers shall be installed.

f. **Root Barriers**: Where trees are located within 8 feet of bicycle facilities and shared-use paths, the surface material shall be protected from root intrusion with a root control barrier system in accordance with Section 201.2.24.e "Root Barriers".

g. **Signage and Pavement Markings:** The following specify the minimum signage and pavement marking requirements for bike facilities and shared use paths.

1. Signage and pavement markings for bicycle facilities and shared-use paths shall be provided in accordance with the most current edition of the MUTCD, Part 9.

2. Shared-use paths shall be striped in accordance with **Detail No. RD-1165** of these standards.

3. Striping and pavement markings shall be skid resistant.

h. **Bicycle Facility Design:** The following specify the minimum design requirements for bicycle facilities.

1. Bike Lanes

(a) Bike lanes shall be one-way facilities and carry bicycle traffic in the same direction as adjacent motor vehicle traffic.

(b) Bike lanes shall be 6 feet in width. In alterations of existing streets, the City's authorized representative may reduce the required bike lane width to 5 feet when the existing street is physically constrained or when a bike buffer line is added.

(c) A minimum clear riding zone width of 4-feet shall be maintained between the longitudinal joint of the asphalt pavement and concrete gutter. In alterations of existing streets, the City's authorized representative may reduce the required clear riding zone width to 3 feet when the existing street is physically constrained or when a bike buffer line is added.

2. Local Street Bikeways

(a) Local street bikeways shall incorporate design elements recommended in the design standards referenced in Section 201.2.27.c, "Design Standards."

(b) The City's authorized representative shall determine the required design elements that include, but are not limited to, sharrows, traffic calming devices, and wayfinding signage.

3. Roadway Speed Reduction

On residential streets with designated pedestrian and/or bike facilities, the design and posted speed may be reduced to 20 miles per hour in accordance with Section 201.1.04.g.3, "Design Speed."

i. **Shared-Use Path Design:** The following specify the minimum design requirements for shared use path facilities.

1. Dimensions

(a) Shared-use paths located in exclusive right-of-way shall have a right-of-way or public easement a minimum width of 18 feet. In locations that are physically constrained, the City's authorized representative may reduce the right-of-way / easement width to a minimum 14 feet.

(b) Shared-use paths adjacent to roadways shall be separated by a minimum 5-foot wide landscaped buffer. The City Engineer may allow vertical separation between the shared-use path and adjacent roadway in lieu of the landscape buffer at locations that are physically constrained.

(c) Shared-use paths shall be constructed of asphalt concrete or portland cement concrete surface, as determined by the City's authorized representative.

(d) Shared-use paths shall be 12 feet wide with a clear distance width of 3 feet on each side of the path. In locations that are physically constrained, the City's authorized representative may reduce the shared-use path width to a minimum 10 feet and the clear distance width to 2 feet.

(e) Natural trails shall be constructed of materials that are firm and stable, including asphalt concrete, portland cement concrete, compacted gravel and soil, and wood boardwalk.

(f) Nature trails shall have a right-of-way or public easement width between 12 feet and 15 feet.

(g) The surface of nature trails shall have a width between 3 feet and 12 feet, to be determined by the City Engineer based on the type and volume of expected uses.

(h) The minimum overhead clearance, excluding trees and vegetation, along shared-use paths is 10 feet. Provide landscaping clearances in accordance with Section 201.2.27.i.5.(c).ii, "Landscaping."

(i) Regional trails shall be constructed to the dimensions identified in the associated Master Plan for each individual trail.

2. Grade

(a) The running grade of a shared-use path adjacent to a street shall not exceed the general grade established for the street.

(b) The running grade of a shared-use path within an exclusive right-of-way or easement shall not exceed 5%. Compliance to the extent practicable is required when compliance with the maximum allowed grade is not practicable due to:

i. Existing terrain or infrastructure

ii. Right-of-way availability

iii. Notable natural feature

iv. Precluded by federal, state, or local laws the purpose of which is to preserve threatened or endangered species, environment, and archaeological, cultural, historical, or significant natural features, compliance is required to the extent practicable.

(c) In areas of steep terrain, the shared-use path shall meander along the path alignment to attain reasonable grades for steep slope ascent. In no case shall the downhill approach grade of a shared-use path exceed 5% for a distance of 50 feet before an intersection.

(d) The cross slope of a shared-use path shall not exceed 2%.

(e) The gradient of the side clear areas shall not exceed 6H:1V.

3. Materials

(a) The City Engineer may require subgrade to be sterilized with a suitable non-environmentally hazardous herbicide that is approved by the City of Wilsonville Public Works Department, in cooperation with the Natural Resources Program.

(b) The wearing surface of AC pavement shall conform to the Oregon Department of Transportation Standard Specifications for Construction (ODOT SSC) Section 00745, "Asphalt Concrete Pavement(ACP)," for Level 2 - ½" Hot Mix Asphalt Concrete (HMAC). The pavement design shall be a minimum 3 inches of HMAC over a 4-inch thick base consisting of ¾"-0 crushed aggregate backfill, meeting the requirements of Section 201.3.01, "Granular Fill". Where shared-use paths provide occasional vehicular access, the City's authorized representative shall require minimum 4-inches

of HMAC or thicker pavement design where anticipated loading conditions warrant.

(c) The wearing surface of PCC pavement shall conform to the ODOT Class 3300 – ¾, Commercial Grade Concrete. The pavement design shall be a minimum 6 inches of PCC over a 6-inch base consisting of ¾"-0 crushed aggregate backfill, meeting the requirements of Section 201.3.01, "Granular Fill". At locations where shared-use paths provide occasional vehicular access, the City's authorized representative shall require a thicker pavement design based on anticipated loading conditions

(d) Shared-use path finish work and location of expansion and contraction joints shall be as specified in **Detail No. RD-1165** of these standards.

(e) Where trees are located within 8 feet of a shared-use path, the shared use path shall be protected from root intrusion with a root control barrier system in accordance with Section 201.2.24.e, "Root Barriers".

4. Handrails

Shared-use paths constructed adjacent to slopes greater than 3H:1V and a change of elevation greater than 18 inches shall be protected with an approved system to be reviewed and approved by the City's authorized representative.

5. Landscaping

(a) Landscaping shall be provided along multi-use paths and recreational trails. Selection of trees, shrubs, and ground cover should include low-maintenance varieties that are drought tolerant and require little pruning. Shrubs should be low growing (under 3 feet at mature height). Location and placement of plant materials should not result in growth over or onto the path surface.

(b) All proposed plant materials shall be approved by the City of Wilsonville. All landscaping, signs, and other potential obstructions shall be set back a minimum of 1 foot from the edge of the pathway surface. No exposed rock shall be permitted within 2 feet of the pathway surface. All exposed earth within 2 feet of the pathway surface shall be planted with grass, sod, or covered with 2" of bark dust.

(c) A number of important design considerations should be reviewed when selecting materials and planning planting schemes. Trees are of primary concern regarding location and variety. Specifically, placement and selection of trees should evaluate the following:

i. Tree rooting characteristics - to avoid potential path surface upheaval.

ii. Tree size - trees shall be of satisfactory caliper to permit a minimum vertical clearance of 8 feet to the lowest branch. The clearance shall be a minimum of 10 feet where vehicular traffic is expected.

iii. Tree placement - to avoid creating hiding areas or permitting foliage to block path lighting, trees shall be located a minimum of 10 feet from path lighting fixtures.

6. Urban Design Features

Urban design features including, but not limited to street trees, furniture, kiosks, trash receptacles, directional signage, and bicycle amenities, shall be provided when required by the City Engineer. Urban design features will be provided, located, and installed in accordance with the rules and regulations of Title III of the Americans with Disabilities Act of 1990 (ADA).

7. Lighting

Lighting shall be provided on shared-use paths, excluding locations as determined by the City Engineer. The City Engineer shall determine when nature trails shall have lighting based on the type and volume of expected uses. Lighting shall meet the requirements of Section 201.9.02, "Shared-Use Path Lighting."

201.2.28 Street Trees

The following specify the minimum requirements for the location and placement of street trees:

a. Street trees shall be provided in accordance with Section 4.176.06(D) of the Wilsonville Code.

b. Street trees shall be located in accordance with **Detail No. RD-1240** of these standards.

201.2.29 Guardrails

The following specify the minimum requirements for the location and type of guardrails:

a. The decision whether to install a guardrail shall be based on information in the AASHTO Roadside Design Guide.

b. Guardrails shall be designed in conformance with AASHTO design guidelines and constructed according to ODOT SSC Section 00810, "Metal Guardrail."

201.2.30 Roadside ditches

Roadside ditches shall be designed in conformance with Section 301.6.02.i, "Channel Design."

201.2.31 Utilities

The following specifies the minimum requirements for utilities:

a. Franchised utilities shall be located underground, preferably in a public utility easement, outside the paved road and sidewalk if possible, to avoid future cuts in paved roads.

b. A Public Utility Easement (PUE) shall be required adjacent to right-of-ways on all frontages to public roadways; PUE widths shall be as provided in Section 101.8.14, "Easements," and the detail drawings. PUE's may cross or run parallel to City pipeline easements, but shall not coincide with a City pipeline easement. PUE's shall be graded as per Section 201.2.24, "Curbs and Grading," from back of curb or sidewalk unless otherwise approved by the City's authorized representative. Earthen berms or any other encroachments are not allowed within a PUE.

c. On all phased (interim) road improvements, the necessary utilities shall be stubbed across the interim improvement to assure that cuts are not necessary when the road is expanded to its full width. A 5-year moratorium will prohibit street cuts on all projects. The moratorium begins when a project is complete and the warranty begins. Check with the City Engineering Division for a current list of streets on the 5-year moratorium.

d. Except for sanitary sewers, storm drainage and water mains, underground utilities intended to provide direct service to adjacent properties with future connections shall not be located in the full-width paved section of a street to be constructed. If all service connections are installed and extended beyond the full-width section before the street is paved, franchised utilities can be located in the paved section, if approved by the City's authorized representative.

e. Underground utilities being constructed along existing paved streets shall not be located under the existing pavement, unless approved by the City's authorized representative. Underground utilities that must cross an existing paved street shall not be installed by any method that cuts the pavement, unless approved by the City's authorized representative.

f. Underground utilities shall be buried a minimum depth of 36 inches, measured from finished grade to top of utility.

g. Streetlights shall be located as required to provide proper illumination but shall not physically or visually interfere with vehicle or pedestrian traffic. All installation of streetlights shall be done in accordance with Section 201.9.00, "Lighting."

201.2.32 Traffic Signals

Traffic signals shall be designed in accordance with Section 260.2 of the most current Clackamas County Roadway Standards. In addition to these standards, the Project

Engineer shall design traffic signal infrastructure to accommodate installation of the City's fiber/communications network.

201.3.00 MATERIAL SPECIFICATIONS

201.3.01 Granular Fill

a. Crushed aggregate for base rock, leveling course, and surface replacement shall consist of an aggregate base as specified by the design engineer, with approval of the City's authorized representative, and shall be in conformance with ODOT SSC Section 02630, "Base Aggregate," for gradation, fractured faces, and durability.

b. The leveling course shall consist of ¾"-0" grade crushed aggregate material, and be a minimum thickness of 2 inches when compacted.

c. The aggregate shall consist of uniform-quality, clean, tough, durable fragments of rock or gravel, free from flat, elongated, soft, or disintegrated pieces, and other objectionable matter occurring either free or as a coating on the stone.

d. Gradation requirements of the crushed aggregate shall be in conformance with ODOT SSC Section 02630, "Dense-Graded Aggregate," as indicated in **Table 2.15**. Sieve analysis shall be determined according to AASHTO T-27.

201.3.02 Asphalt Concrete

a. Courses of asphalt concrete pavement shall consist of the following unless otherwise specified by the design engineer and approved by the City Engineer.

   1. The wearing surface of AC pavement shall consist of ½" Hot Mixed Asphalt Concrete (HMAC), conforming to ODOT SSC Section 00745; "Asphalt Concrete Pavement (ACP)".

   2. The base courses for AC pavement shall consist of ¾" Hot Mixed Asphalt Concrete (HMAC) conforming to ODOT SSC Section 00745, "Asphalt Concrete Pavement (ACP)".

   3. The AC pavement shall be either Level 2 or Level 3 ACP, as determined by Section 201.2.05, "Asphalt Pavement Design".

b. Asphalt cement shall be 85-100 penetration paving asphalt conforming to ASTM D-946.

c. Liquid asphalt for use as a prime coat under AC shall be RC-70 rapid-curing liquid asphalt conforming to AASHTO M-81, or MC-70 medium-curing liquid asphalt conforming to AASHTO M-82.

d. Warm Mix Asphalt Concrete (WMAC) shall incorporate the additives or processes listed in **Table 2.16**.

Table 2.15. GRADATION REQUIREMENTS FOR GRANULAR FILL

Sieve Size	2 ½" - 0	2" - 0	1 ½" - 0	1" - 0	¾" - 0
	Percent Passing				
2 ½"	95 – 100	100			
2"	--	95 – 100	100		
1 ½"	--	--	95 – 100	100	
1 ¼"	55 – 75	--	--	--	
1"	--	55 – 75	--	90 – 100	100
¾"	--	--	55 – 75	--	90 – 100
½"	--	--	--	55 – 75	--
3/8"	--	--	--	--	55 – 75
¼"	30 – 45	30 – 45	35 – 50	40 – 55	40 – 60
U.S. No. 10 sieve	12 – 27	12 – 27	14 – 30	16 – 33	16 – 36
U.S. No. 40 sieve	0 – 16	0 – 16	3 – 18	8 – 24	8 – 24
U.S. No. 200 sieve (wet sieving)	0 – 9	0 – 9	0 – 8	0 – 8	0 – 10

Note: All percentages are by weight. Material passing the U.S. No. 200 sieve shall have a maximum plasticity index of 6 when tested according to AASHTO T-90.

Table 2.16. WMAC ADDITIVES AND PROCESSES

WMAC Technology	Process Type	Supplier
Advera (Synthetic Zeolite)	Foaming Process	PQ Corporation
Aspha-min (Synthetic Zeolite)	Foaming Process	Aspha-Min
Evotherm	Chemical Additive	Mead Westvaco Asphalt Innovations
Redi-Set WMX	Chemical Additive	Akzo Nobel Surfactants, Inc.
Sasobit	Organic Additive	Sasol Wax Americas, Inc.
Plant Foaming Equipment	Foaming Process	Various Suppliers

201.3.03 Portland Cement Concrete

a. PCC for concrete pavement shall conform to Section 201.2.06.h, "Portland Cement Concrete Design."

b. PCC for curbs, sidewalks, driveways and miscellaneous construction shall conform to Section 201.2.06.i, "Portland Cement Concrete Design."

c. All forms for curbs and sidewalks shall be 2-inch dimensioned lumber, plywood, or metal forms. Forms for curb and sidewalk radii shall consist of bender board as approved by the City's authorized representative. Forms on the face of the curb shall have no horizontal form joints within 7 inches of the top of the curb. All forms shall be approved by the City's authorized representative.

d. Reinforcement steel shall conform to ASTM A-615, Grade 40, deformed bars.

201.3.04 Segmental Concrete Pavers

Materials for segmental concrete paver streets shall be in conformance with Section 201.2.07, "Segmental Concrete Paver Design."

201.4.00 CONSTRUCTION SPECIFICATIONS

201.4.01 General Provisions

The specifications in this chapter and any other applicable requirements of the City shall govern the character and quality of material, equipment, installation, and construction procedures for roadway construction or improvements.

201.4.02 Scheduling

The contractor shall plan their construction work in conformance with Section 101.8.02, "Scheduling."

201.4.03 Environmental Protection, Erosion Prevention, and Sediment Control

The contractor shall take all appropriate measures and precautions to minimize their impact on the environment and control erosion, as outlined in Section 101.9.00, "Environmental Protection, Erosion Prevention, and Sediment Control."

201.4.04 Interferences and Obstructions

Various obstructions may be encountered during the course of the work. The contractor shall follow the guidelines established in Section 101.8.05, "Interferences, Obstructions, Abandoned Utilities."

201.4.05 Contaminated Soil or Hazardous Material

If during construction contaminated soil, hazardous materials or chemicals are encountered, the Contractor shall follow the procedures specified in Section 101.9.02, "Contaminated Soils or Hazardous Materials."

201.4.06 Trench Excavation, Preparation, and Backfill

Trench excavation, preparation, and backfill shall conform to the requirements of Section 6, "Trench Excavation and Backfill."

201.4.07 Steel Plates

Where excavated trenches located in the right-of-way are not backfilled at the end of the construction day, the trench shall be covered with Steel Plates, in accordance with **Detail No. S-2146** of these standards. Use of Steel Plates shall conform to Section 101.8.02.b.7, "Progress of Construction."

201.4.08 Preservation, Restoration, and Cleanup

Cleanup of all construction debris, excess excavation, and excess materials and complete restoration of all fences, mailboxes, ditches, culverts, signposts, and similar items shall be completed according to Section 101.8.16, "Preservation, Restoration, and Cleanup."

201.5.00 WORKMANSHIP

201.5.01 Demolition

Debris from the demolition of pavement, sidewalks, curbs, or gutters shall be ground and recycled or hauled off site and disposed of in a manner approved by the City's authorized representative.

201.5.02 Clearing and Grubbing

a. Brush shall be cut as near to the ground surface as practicable and removed to a disposal site approved by the City's authorized representative. Under no condition shall excavated materials be permitted to cover brush before the brush is cleared and disposed of. Ground surface shall be stripped of all organic soil and unsuitable material as recommended in the Street Design Report. Stripping operations shall be approved by the City's authorized representative prior to proceeding with any construction activity.

b. Erosion-prevention and sediment-control measures shall be installed before the start of clearing and grubbing (see Section 101.9.00, "Environmental Protection, Erosion Prevention, and Sediment Control"). The applicant shall call the City's authorized representative for inspection and approval of all erosion-prevention and sediment-control measures before beginning any site clearing, grubbing, or grading.

201.5.03 Subgrade

Subgrade shall be prepared according to the recommendations in the Street Design Report and must be approved by the City's authorized representative.

a. The subgrade shall be firm and free of roots and deleterious materials.

b. A proof-roll of the subgrade using a 10 cubic yard dump truck, fully loaded with rock, or equivalent loaded vehicle shall be observed by the City's authorized representative and the geotechnical engineer of record. Soft areas shall be repaired or replaced and re-proof rolled until the subgrade is deemed satisfactory by the City's authorized representative and approved by the geotechnical engineer of record. During periods of wet weather, the proof-roll shall occur after placement of the base course material in accordance with Section 201.5.04, "Base and Leveling Course."

201.5.04 Base and Leveling Course

Base and leveling course shall consist of crushed aggregate as specified in Section 201.2.04, "Crushed Aggregate Design" and Section 201.3.01, "Granular Fill."

a. Base and leveling aggregate material shall be placed and compacted to the required depth of finished pavement and for proper matching with the adjacent existing pavement.

b. Material shall be compacted to 95% of the maximum dry density, as determined by AASHTO T-180 and acceptable testing reports provided to the City.

c. A proof-roll of the base and leveling courses using a 10 cubic yard dump truck, fully loaded with rock, or equivalent loaded vehicle shall be observed by the City's authorized representative. Soft areas shall be repaired or replaced and re-proof rolled until the base and leveling courses are deemed satisfactory by the City's authorized representative.

201.6.00 CONSTRUCTION PROCEDURE

a. The geotechnical engineer reserves the right to vary the classes of backfill and the type of resurfacing as best serves the interest of the City, with the approval of the City's authorized representative. Subgrade shall be approved in conformance to Section 201.5.03, "Subgrade". Base rock shall be approved by the City's authorized representative prior to placement of asphalt concrete, Portland cement concrete or Segmental Concrete Pavers.

b. A state approved mix design for asphalt concrete or Portland cement concrete shall be submitted to the City's authorized representative for approval a minimum of seven calendar (7) days prior to placement taking place.

c. PCC for concrete pavement shall conform to Section 201.2.06.h, "Portland Cement Concrete Design."

d. PCC for curbs, sidewalks, driveways and miscellaneous construction shall conform to Section 201.2.06.i, "Portland Cement Concrete Design."

e. Testing shall be in conformance with Section 201.6.07, "Testing."

f. Portland cement concrete whose batch time exceeds 90 minutes and has not yet been placed may be refused by the City's authorized representative.

g. Segmental concrete pavers, bedding sand, joint sand, base aggregate and sub-base aggregate shall conform to Section 201.2.07, "Segmental Concrete Paver Design."

201.6.01 Curb and Gutter

a. Curb and gutter shall be installed as per **Detail No. RD-1055** of these standards with asphalt pavement, or **Detail No. RD-1060** of these standards with PCC pavement.

b. When medians are specified, curb and gutter shall be installed as per **Detail No. RD-1065** of these standards.

c. At no time shall construction equipment or traffic be allowed on new curb and gutter until laboratory tests indicate that at least 90% specified design strength (Section 201.2.06.i, "Portland Cement Concrete Design") has been attained; this includes installation of adjacent asphalt pavement.

d. Curb and gutter jointing shall match adjacent PCC street pavement jointing. Joint locations shall be installed per **Detail No. RD-1060** of these standards and staked per Section 201.1.06, "Surveying."

201.6.02 Asphalt Pavement

a. **Prime Coat**: After the leveling course is compacted, an asphalt prime coat, as specified in Section 201.3.02, "Asphalt Concrete," shall be applied to the edges of the existing pavement and curb and gutter. Also, cast iron manhole frames and cleanout frames shall be tack-coated below grade.

b. **Temperature:** The temperature of the HMAC during mixing, placement, or while in storage shall not exceed 350°F and shall not be less than 240°F as per ODOT SSC Section 00745.43, "Drying and Heating Aggregates."

For Warm Mix Asphalt Concrete (WMAC), complete breakdown and intermediate compaction before the WMAC temperature drops below the threshold recommended by the additive supplier or equipment manufacturer. The temperature of the WMAC shall not be less than 215°F as per ODOT SSC Section 00745.43, "Drying and Heating Aggregates."

c. **Storage:** Asphalt storage shall meet requirements of ODOT SSC Section 00745.44, "Asphalt Concrete Pavement Storage."

d. **Thickness:** Minimum total thickness of AC shall be 4 inches placed in two 2-inch lifts. Place AC after the prime coat has set. If the thickness is greater than 6 inches, place the asphalt in three lifts. Maximum lift thickness shall be 3 inches. Spread and level the AC with use of a self-propelled machine or hand tools, depending on the size of the area to be paved. Bring the AC to the proper grade and compact by rolling, or use hand tampers where rolling is not possible.

e. **Placement:** Asphalt concrete shall be placed according to the following minimum requirements.

1. Prior to placing asphalt concrete, all cold edges of existing asphalt concrete shall be sawcut to provide a clean joint to pave against.

2. Lay the AC mixture in strips of such width as to hold to a practical minimum the number of longitudinal joints required. Joints shall not be located in wheel paths.

3. The longitudinal joints in any layer of pavement shall be offset from those joints in layers below by not less than 1-foot.

4. The lateral joints in any layer of pavement shall be offset from those joints in layers below by not less than 3 feet. Where new AC ties into existing asphalt concrete, the existing AC shall be ground the thickness of the new AC lift along the lateral joint a minimum of 3 feet in width for each lift of new AC installed.

f. **Compaction:** Compact asphalt concrete in accordance with the following minimum requirements.

1. Roll asphalt concrete with power rollers capable of providing compression of 350 pounds per linear inch.

2. Begin rolling from the outside edge of the replacement and progress toward the existing surfacing, lapping the existing surface at least half the width of the roller. If the existing surfacing bounds both edges of the replacement, begin rolling at the edges of the replacement, lapping the existing surface at least half the width of the roller and progressing toward the center of the replacement area. Overlap each proceeding track by at least half the width of the roller and make sufficient passes over the entire area to produce the desired result.

3. AC pavement shall be compacted to a minimum of 92% relative density, based on the theoretical maximum density determined in accordance with ASTM D-2041, “Rice Gravity.”

g. **Finished surface:** The finished surface of the new compacted paving shall be flush with the existing surface and shall conform to the grade and crown of the adjacent pavement.

201.6.03 Portland Cement Concrete Pavement

a. Construction of PCC pavement shall be in conformance with the guidelines in ODOT SSC Section 00756, "Plain Concrete Pavement."

b. Construction of concrete joints shall follow the guidelines and requirements outlined in the ACPA publication, "Design and Construction of Joints for Concrete Streets," except for the following:

   1. Maximum joint spacing shall be 12 feet.

   2. Transverse joints shall be designed to be skewed 6:1 when meeting the edge of pavement, at the gutter line.

   3. For doweled contraction joints, do not lubricate the dowels.

   4. Staking of curb joints shall be required and performed by or under the direction of a Professional Land Surveyor registered in the State of Oregon.

   5. Isolation joints shall be used around manhole covers. Isolation joints shall be circular with 2-foot spacing from the manhole cover.

c. All joints shall be hot air lanced and moisture evaporated prior to sealing of joints.

d. All joints shall be sealed in conformance with the ACPA publication, "Design and Construction of Joints for Concrete Streets."

e. The surface finishing and smoothness of PCC surfaces shall follow the guidelines outlined in ODOT SSC Section 00756.49, "Surface Finishing" and ODOT SSC Section 00756.55, "Surface Tolerance, Testing, and Correction."

f. At no time shall construction equipment or traffic be allowed on the new pavement until laboratory tests indicate that at least 90% specified design strength (Section 201.2.06.h, "Portland Cement Concrete Design") has been attained and the City's authorized representative and the design engineer agree that the street is ready for traffic and construction loads.

201.6.04 Segmental Concrete Pavers Installation

a. The installer shall have a minimum of two years of experience with similar installations and provide to the City job references from projects of a similar size and complexity. Provide Owner/Client/General Contractor names, postal address, phone, and email address and location of previous jobs. The contractor shall present this list of similar installations to the City for approval a minimum of seven days before starting work.

b. The installer shall provide a written Method Statement and Quality Control Plan that describe material staging and flow, paving direction and installation procedures,

including representative reporting forms that ensure conformance to the project specifications.

c. The maximum allowable chipping on the paver edges and corners shall be ¼". The cumulative length of chips on the exposed face of a single unit shall not exceed 1 percent of the perimeter of the exposed face of the paver, and no single chip shall exceed ½- inch in length.

d. Other than chips, the paver shall be free of cracks, color and other imperfections detracting from the appearance of a designated sample when viewed from a distance of 5 feet away.

e. Installation shall include preparing the base by removing unstable or unsuitable material a minimum of 6", compacting and grading the soil, draining or stabilizing weak or saturated soils and taking measures to prevent water penetration and mitigation of bedding sand. The sub base shall be compacted to a minimum of 95% of the T-99 density value.

f. Preparation of the subgrade shall be as described for the Unit Pavers section above.

g. Install the concrete perimeter edge restraints.

h. Install the sub base in 4-6" lifts to the specified thickness. Moisten, spread and compact the base layer in 4" lifts. For segmental concrete pavers test compaction of the base lift in conformance to Section 201.5.04, "Base and Leveling Course".

i. For permeable concrete pavers, install the sub-base and base rock per the manufacture's recommendation.

j. Check grade of base rock with a 10' straight edge. The tolerance shall be within 1" over 10'.

k. Install the bedding layer and compact making at least two passes, or per manufacturer's recommendation. Recheck grade and adjust as necessary. The tolerance shall be within 3/8 "over 10'. Place the pavers and begin infilling the gaps with the joint material. Sweep excess joint material away and compact with a plate compactor, making at least two passes, or per manufacturer's recommendation. Apply additional material in the low areas as needed and compact.

l. After sweeping the surface, check the grade. The final surface shall be within 1/8" of the adjacent drainage inlets, concrete collars or channels. Bond lines for pavers are +/- ½ inch. over a 50' string line

201.6.05 Driveways

a. Construct residential driveways in accordance to Section 201.2.06.i, "Portland Cement Concrete Design" and **Detail No. RD-1090** of these standards.

b. Construct commercial driveways in accordance to Section 201.2.06.i, "Portland Cement Concrete Design" and **Detail No. RD-1095** or **Detail No. RD-1100** of these standards.

c. At no time shall construction equipment or traffic be allowed on the new concrete driveway until laboratory tests indicate that at least 90% specified design strength (Section 201.2.06.i, "Portland Cement Concrete Design") has been attained; this includes installation of adjacent asphalt pavement.

201.6.06 Sidewalks

a. Construct new sidewalks in conformance with Section 201.2.06.i, "Portland Cement Concrete Design" and **Detail No. RD-1075** of these standards.

b. Sidewalk repairs, replacement or reconstruction shall be in conformance with Section 201.2.06.i, "Portland Cement Concrete Design" and **Detail No. RD-1075** of these standards. Sidewalk shall be finished in accordance with Section 201.2.25.a.6, "Sidewalks."

c. ADA ramp repairs, replacement or reconstruction shall be in conformance with Section 201.2.25, "Sidewalks" and to **Detail No. RD-1110 – Detail No. RD-1140** of these standards.

d. At all intersections adjacent to the curb radius, curb-tight sidewalks and sidewalk ramps shall be constructed with a similar section as shown for a residential driveway (see **Detail No. RD-1090** of these standards.)

e. Root Barriers shall be installed in conformance with Section 201.2.24.e, "Root Barriers."

201.6.07 Testing

a. **Asphalt pavement:** Asphalt pavement shall have minimum density testing performed every 100 ft. of each lift and panel width installed. The pavement shall be compacted to a minimum of 92% relative density, based on the theoretical maximum density determined in accordance with ASTM D-2041, "Rice Gravity."

b. **PCC pavement:** Portland cement concrete shall be tested at a minimum of once per every 4 hours of work or 100 cubic yards of concrete installed. Testing shall include temperature, slump, air content, and minimum of 4 test cylinders. If water or other additives are added to the concrete load after the testing samples have been taken, an additional 4 test cylinders of the modified concrete mix shall be taken and tested. The

28-day compressive strength shall exceed 4,000 psi; a minimum compressive strength of 3,600 psi is required to allow traffic on the pavement.

c. **Curb, gutter, and driveways:** Portland cement concrete shall be tested a minimum of once per 4 hours of work. Testing shall include temperature, slump, air content, and minimum of 4 test cylinders. If water or other additives are added to the concrete load after the testing samples have been taken, an additional 4 test cylinders of the modified concrete mix shall be taken and tested. The 28-day compressive strength shall exceed 3,300 psi. A minimum compressive strength of 2,970 psi is required to allow traffic.

d. **Testing Frequency:** City reserves the right to direct testing agency on frequency of testing.

201.6.08 Weather Conditions

a. AC pavement shall not be placed during periods of rainfall, sand or dust storms, or any imminent storms that might adversely affect the finished pavement quality. AC material shall not be applied over frozen surfaces or standing water. AC shall be placed at temperatures not colder that the minimum atmospheric temperatures specified in **Table 2.17.** Temperature of the AC material shall be in conformance with Section 201.6.02.b, "Temperature."

Table 2.17. ATMOSPHERIC TEMPERATURE REQUIREMENTS

Individual Lift Thickness	Atmospheric Temperature
2" to 2 ½"	50° F
2 ½"+ to 3"	40° F

b. PCC pavement shall not be placed during periods of rain or on frozen bases. PCC placement shall not occur when descending air temperature falls below 40°F, nor shall it resume until ascending air temperature reaches 35°F. The contractor shall protect PCC from weather damage. The contractor shall protect unhardened PCC from precipitation with protective material. If PCC is being placed during cold weather, and the air temperature is forecast to drop below 35°F, the contractor shall prevent the PCC from freezing for at least 7 days.

c. The base aggregate shall be thoroughly watered to the satisfaction of the City's authorized representative immediately prior to the placement of PCC when the measured or forecasted ascending air temperature is 80°F or greater.

201.6.09 Protection of Structures

a. Provide whatever protective coverings may be necessary to keep oil or asphalt from splashing on the exposed parts of bridges, culverts, curbs, gutters, posts, guardrails, road signs, and any other structures during paving operations. Remove any oil, asphalt, dirt, or any other undesirable matter from these structures that resulted from the paving operations.

b. Where water valve boxes, manholes, catch basins, or other underground utility appurtenances are situated in the area to be surfaced, the resurfacing shall be level with the top of the existing finished elevation of the appurtenances. If it is evident that an appurtenance does not match the proposed finished grade, notify the proper authority to have the item altered before proceeding with the resurfacing around the obstruction, unless otherwise approved by the City's authorized representative. Protect all covers during asphalt application.

201.6.10 Excess Materials and Trench Settlement Repair

Contractor shall dispose of excess materials. Contractor shall be responsible for repairing all settlement of pavement over trenches for a 1-year period.

201.6.11 Rock Surfacing

Where gravel shoulders have been disturbed, place ¾"–0" crushed aggregate backfill (see Section 201.3.01, "Granular Fill") as surfacing material for the full width of all streets, driveways, parking areas, street shoulders, and other areas disturbed by the construction. Spread the material by "tailgating" and supplement by hand labor when necessary. Level and grade the aggregate to conform to existing grades and surfaces.

201.7.00 SURFACE RESTORATION

201.7.01 Scope

This section covers the work necessary for all required replacement of pavement, curbs, sidewalks, rock surfacing, and drainage facilities that were removed during construction. Replacement pavement and base course thickness design shall conform to current City standards.

201.7.02 Asphalt Concrete Replacement

a. Base, subbase, or subgrade material that has been removed shall be replaced with ¾"–0" crushed aggregate backfill (see Section 201.3.01, "Granular Fill") or control density fill (CDF, minimum 28 day compressive strength shall be 200 psi). Bring the trench or excavation to a smooth, even grade at the correct distance below the top of the existing pavement surface so as to provide adequate space for AC pavement. Crushed aggregate trench backfill placed within 3 feet of finished grade shall be compacted to 95% of the maximum dry density, as determined by AASHTO T-180. Crushed aggregate backfill placed below 3 feet of finished grade shall be compacted

to 90% of the maximum dry density. Place the leveling course for the full width of the trench where pavement was disturbed, including bituminous surface shoulders.

b. Compact the base rock and leveling course material to 95% of the maximum dry density, as determined by AASHTO T-180. At the conclusion of each day's operation, the contractor shall patch or place steel plates in accordance with Section 101.8.02.b.7, "Progress of Construction" over all trench or excavation areas. Cold-patch asphalt mix may be used as a temporary patch.

c. The contractor shall grind edges and make a minimum 1-foot T-cut in the existing pavement surrounding a trench or excavation as shown on **Detail No. S-2145** of these standards. Trim existing pavement to a straight line to remove any pavement that has been damaged or that is broken and unsound to create a smooth, sound edge for joining the new pavement.

d. Within 5 working days, weather permitting, after completion of all paving or utility work, the contractor shall repair all trench or excavation areas with asphalt concrete. AC pavement thickness shall be a minimum of 4 inches or match existing pavement depth, whichever is greater. AC pavement shall be compacted to a minimum of 92% relative density, based on the theoretical maximum density determined in accordance with ASTM D-2041, "Rice Gravity."

    1. When the pavement surface has been cored, the area shall be repaired as follows: At the conclusion of each day's operation, the contractor shall patch all cored areas. Cold-patch asphalt mix may be used as a temporary patch.

    2. Within 5 working days after completion of all paving or utility work, the contractor shall repair all cored areas with hot-patch asphalt mix.

e. All joints and sawcuts shall be sand sealed within 24 hours of trench and excavation areas repaired with asphalt concrete. Seal material shall consist of hot-applied emulsified asphalt slurry seal, supplied and installed in accordance with ODOT SSC Section 00706, "Emulsified Asphalt Slurry Seal Surfacing."

201.7.03 Asphalt Restoration for Streets Listed on 5-Year Moratorium

When emergencies or special circumstances require access to underground utilities, the City may allow street cuts in streets listed on the 5-year moratorium (see Section 201.2.31.c, "Utilities"). In addition to the repair work outlined in Section 201.7.02, "Asphalt Concrete Replacement," an additional minimum 1-foot wide, 2-inch grind out around the T-cut perimeter shall be required per **Detail No. S-2145** of these standards.

201.7.04 Portland Cement Concrete Replacement

a. **Trenching or Excavation in Pavement and Driveways**: The City Engineer encourages directional boring under existing concrete streets and discourages trenching or excavation work in streets or driveways. When this is unavoidable, the contractor shall remove and replace all panels that have been cut or damaged within 5

working days, weather permitting, after completion of all paving or utility work. New panels shall be connected into the adjacent existing panels per **Detail No. RD-1180** of these standards. Tie-bars shall be epoxied in place using an epoxy bonding agent as provided in the ODOT QPL. Bring the trench to a smooth, even grade at the correct distance below the top of the existing pavement surface so as to provide adequate space for the base, leveling course, and PCC pavement.

b. **Coring:** When the pavement surface has been cored, the area shall be repaired as follows:

   1. Base, subbase, or subgrade material that has been removed shall be replaced with ¾"–0" crushed aggregate backfill (see Section 201.3.01, "Granular Fill") or CLSM (see Section 601.2.03.c, "Class E Backfill." Bring to a smooth, even grade at the correct distance below the top of the existing pavement surface so as to provide adequate space for PCC pavement.

   2. At the conclusion of each day's operation, the contractor shall patch all cored areas within roadways with concrete having a minimum 4,000-psi compressive strength at 28 days (concrete with a minimum 3,300-psi compressive strength may be used in driveways).

c. **Surface Smoothness:** The surface smoothness of the replaced pavement shall be such that when a straightedge is laid across the patched area between the edges of the old surfaces and the surface of the new pavement, the new pavement shall not deviate from the straightedge by more than ¼ inch.

d. **Curbs and Gutters:** Remove existing damaged curbs and gutters to the nearest joint, unless otherwise directed by the City's authorized representative. Replace concrete curbs and gutters to the same section, width, depth, line, and grade as that removed or damaged. Cut the ends of existing curb to a vertical plane. Before replacing the sections, properly backfill and compact the trench to prevent subsequent settlement. Where the section of curb and/or gutter replacement is less than 10 feet in length, connect new curbs and gutters to existing curbs and gutters with No. 4 reinforcement tie-bars. A minimum of 2 tie bars shall be used for curbs and a minimum of 2 tie bars used for gutters. Tie bars shall be epoxied in place to a minimum depth of 1 foot using an epoxy bonding agent as provided in the ODOT QPL.

e. **Catch Basins:** Reinstall catch basins as a curb inlet in their original locations and reconnect them to the drainage system in a manner equal to the original. If the existing catch basins are damaged beyond repair by operations, construct new basins in accordance with these specifications. The new basin shall have a volume equal to or greater than the damaged catch basin, unless otherwise approved by the City's authorized representative.

201.7.05 Sidewalk Replacement

a. Construct sidewalks in accordance to Section 201.2.06.i, "Portland Cement Concrete Design" and **Detail No. RD-1075** of these standards

b. Match finish work to existing panels; re-compact base rock if disturbed. Replace base rock if insufficient depth or contaminated with soil.

c. Replacement ADA ramps shall meet current standards as per **Detail No. RD-1110 – Detail No. RD-1140** of these standards.

201.8.00 STREET NAMES AND TRAFFIC CONTROL SIGNAGE AND STRIPING

201.8.01 Street Name Signs and Posts

All newly platted streets shall be signed with the name as shown on the approved or proposed county plat; proposed county plats shall show street names as approved by the Design Review Board (DRB). Signs are to conform to **Detail No. RD-1250** and **Detail RD-1255** and to these standards, as follows.

a. **Posts**

1. Materials

(a) A minimum of 2 x 2-inch x 10-foot, 14-gauge galvanized "quick-punch" or 12-gauge perforated posts, or approved equal, shall be used.

(b) A 2 x 2-inch x 12-foot, 14-gauge galvanized "quick-punch" or 12-gauge perforated posts, or approved equal, shall be used when a combination of signs is more than 36 inches high.

(c) Signposts are made of 2-inch square tubing and must be embedded 18 inches into the base.

2. Base

The breakaway post base shall consist of a 2.25 x 2.25 inch (I.D.) x 36-inch galvanized base with a 2.5 x 2.5 inch (I.D.) x 18-inch sleeve placed flush with the base. All sleeves and bases shall be 14-gauge "quick punch" or 12-gauge perforated material, or approved equivalent.

3. Fastening

Drive rivets shall be used to fasten signs onto metal signposts, except for street name signs, which shall be attached by hex nuts. Washers shall be used behind all drive rivets used to affix signs to posts. Two drive rivets at right angles shall be used to fasten the post to the base.

b. **Street Name Sign**

1. In business districts and on principal arterials, street name signs shall be placed in diagonally opposite corners so that they will be on the right hand side of the intersection for traffic on the major street.

2. To optimize visibility at signaled intersections, street name signs shall be mounted overhead. In residential districts, at least one street name sign shall be mounted at each intersection.

3. On T-intersections, the street name signs shall be designated at two locations. One street name sign shall be placed at the end of a T- intersection, and the second placed at the right-hand corner of the intersecting street.

4. Signs naming both streets shall be installed at each street sign location.

201.8.02 Traffic Control Signage and Striping

Traffic control signing and striping shall be in conformance with **Detail No. RD-1265, Detail No. RD-1270**, **Detail No. RD-1275**, **Detail No. RD-1280**, and **Detail No. RD-1285** of these standards and the MUTCD. A "Signage and Striping Plan" shall be included with plan submittals for new street construction and street improvements.

201.9.00 LIGHTING

201.9.01 Roadway and Intersection Lighting

a. Street lighting shall be designed in accordance with the most current American National Standard Practice for Roadway Lighting (RP-8-00) prepared by the Illuminating Engineering Society (IES).

b. Installation of streetlights shall be in accordance with the City's most current policies/agreements regarding the installation and maintenance of street lights.

c. In addition to these requirements the air gap between the top of pedestal and bottom of light pole shall be grouted with a high-strength, non-shrinking grout meeting ODOT SSC Section 02440.50(b), "Non-Shrink Grout," such as Alcrete Twenty Minute Fast Setting Grout®, or approved equal.

d. Selection and installation of street lighting luminaires shall be in conformance with the City's most current "Dark Sky" policies.

e. The warranty for public works projects shall include streetlights.

201.9.02 Shared-Use Path Lighting

a. Lighting of shared-use paths, including pedestrian tunnels shall be designed to provide at least 0.4 average foot candles, depending on the location, with a minimum average lighting uniformity of 3.0.

b. The City Engineer may reduce the lighting standards or not require lighting of shared-use paths in designated natural resource and wildlife areas.

c. Lighting provided along shared-use paths shall be pedestrian scale with a mounting height no greater and no less than 10 feet. A clearance of 10 feet shall be provided from the path surface for street lighting overhanging a shared-use path. Pedestrian level lighting, such as bollards, shall not be permitted.

d. Installation of shared-use path streetlights shall be in accordance with the City's most current policies/agreements regarding the installation and maintenance of street lights.

f. In addition to these requirements the air gap between the top of pedestal and bottom of light pole shall be grouted with a high-strength, non-shrinking grout meeting ODOT SSC Section 02440.50(b), "Non-Shrink Grout," such as Alcrete Twenty Minute Fast Setting Grout®, or approved equal.

g. Selection and installation of street lighting luminaires shall be in conformance with the City's most current "Dark Sky" policies.

h. The warranty for public works projects shall include streetlights.

201.10.00 STREET ACCEPTANCE POLICY

The City of Wilsonville will accept new public street installations or systems built to the "Public Works Standards," providing that the following conditions are met.

201.10.01 Legal Recordings

All plats are recorded with the County Surveyor, all easements and dedications are recorded with the County Recorder and the Engineering Department receives a reproducible copy of the recorded documents.

201.10.02 Project Completion

After completion of construction of the total project, and after all testing has been satisfactorily completed, project closeout shall proceed as outlined in Section 101.8.17, "Project Closeout."

201.10.03 Maintenance Period

a. The Contractor or Applicant shall be responsible for providing Maintenance Assurance for Public Improvements as outlined in Section 101.8.18, "Maintenance and Warranty."

b. At any time during the warranty period, the City's authorized representative has reason to believe the public street improvements have defects that were the result of faulty workmanship or flaws in construction material, the responsible party shall be required, at that party's own cost, to repair any faults to the public street improvements deemed necessary by the City's authorized representative.

c. Before the end of the Construction Maintenance period, the City's authorized representative shall inspect the project for any remaining deficiencies. If the deficiencies that remain are determined to be the responsibility of the contractor or the applicant, the contractor or applicant shall then make such repairs.

SECTION 3

STORMWATER & SURFACE WATER DESIGN AND CONSTRUCTION STANDARDS – Bound Separately

The Storm Drainage Design & Construction Standards with Appendices A and B are bound in a separate document.

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SECTION 4

SANITARY SEWER DESIGN AND CONSTRUCTION STANDARDS

401.1.00 ENGINEERING

401.1.01 Introduction

This section outlines design and construction requirements for all public sanitary sewers. The provisions and technical specifications herein set forth the requirements of the City of Wilsonville for constructing sanitary sewer improvements. Interpretations of such provisions and their application in specific circumstances shall be made by the City's authorized representative, unless specifically stated otherwise. Refer to Section 1 of the "Public Works Standards" for general provisions and requirements.

401.1.02 Extension of Public Sewer Systems

a. The extension or upsizing of the public sewerage facilities in excess of 8 inches in diameter or as shown in the Wilsonville Wastewater System Master Plans to serve the ultimate development density of the contributing area shall be done by the property owner or permit applicant and may be subject to applicable System Development Charge (SDC) credits.

b. The City reserves the right to perform the work or cause it to be performed and bill the owner for the cost of the work or to pursue special assessment proceedings.

c. The public sanitary sewer system shall extend to the most distant parcel boundary and be designed at a size and grade to facilitate future extension to serve development of the entire contributing area.

d. Where public infrastructure improvements paid for by the property owner or permit applicant directly benefit adjacent properties, the property owner or permit applicant may pursue establishment of a reimbursement district per Section 3.116 of the City Code.

401.1.03 Sanitary Plans

a. It is the design engineer's responsibility to ensure that engineering plans are sufficiently clear and concise to construct the project in proper sequence, using specified methods and materials, with sufficient dimensions to fulfill the intent of these design standards.

b. All elevation on design plans and record drawings shall be based on the applicable NAVD 88 Datum specified in Section 101.7.07.a, "NAVD 88 Datum."

c. Existing conditions and facilities on design plans and record drawings shall be shown in light, gray print. Proposed conditions and facilities on design plans and record drawings shall be shown in bold, black print.

d. All engineering sanitary plans shall be stamped by a Professional Engineer registered in the State of Oregon. At a minimum, the sanitary plans shall contain the following:

1. At least one sheet shall show a plan view of the entire project site. If the project site is sufficiently large that detailed sanitary plans on any given sheet do not encompass the entire project site, then a sheet showing the plan view of the entire site must serve as an index to subsequent detailed plan sheets.

2. A topographic map showing existing conditions for the site, including the following:

(a) Existing topography for the site. Plan views showing existing features may be required for a distance of up to 100 feet (or further if warranted) beyond the proposed improvement in order to prevent future grade conflicts and will be determined on a case-by-case basis by the City's authorized representative.

(b) Adjacent streets, trails, multi-use paths, and rail lines, including the respective names.

(c) Existing utilities, including franchised utilities located above or below ground and drainage facilities that transport surface water onto, across, or from the project site. Existing drainage pipes, culverts, and channels shall include the invert or flow line elevations.

(d) Existing vegetation, including denoting the type, DBH, and canopy size of trees within the construction limits.

(e) Existing environmentally sensitive areas (e.g., ravines, swales, steep slopes, wells, springs, wetlands, creeks, lakes). For natural drainage features, show direction of flow, drainage hazard areas, and 100-year floodplain boundary (if applicable).

(f) Adjacent existing features that are within 25 feet outside of the site boundary, including but not limited to construction activities that will potentially compromise the structural stability or condition of off-site features, such as cultivated vegetation, landscaping and trees, buildings, fences, decks, walls, slabs, and pavements. Denote the type, DBH, and canopy size of all trees.

3. Plans for proposed sanitary improvements shall include the following:

(a) Grading and erosion control plan.

(b) Finished grades, showing the extent of cut and fill by existing and proposed contours, profiles, or other designations. Plan views showing existing

features may be required for a distance of up to 100 feet (or further if warranted) beyond the proposed improvement in order to prevent future grade conflicts and will be determined on a case-by-case basis by the City's authorized representative.

(c) Horizontal stationing along centerline, showing points of tangency and curvature, including centerline stationing of all intersecting streets.

(d) Proposed structures, including roads and road improvements, parking surfaces, building footprints, walkways, landscape areas, etc.

(e) Sanitary facilities, including pipe sizes, pipe types and materials, lengths, and all sanitary system structures and appurtenances, including but not limited to manholes, clean outs, and service laterals. Notes shall be included for referencing details, cross-sections, profiles, etc.

(f) Existing and proposed utilities, showing exact line and grade of all utilities crossing the proposed sanitary system.

(g) Applicable detail drawings.

(h) Existing and proposed property lines, right-of-way lines, survey monuments, and easements.

(i) Setbacks from environmentally sensitive areas or resource areas protected within the Significant Resource Overlay Zone (SROZ).

(j) Maintenance access, as applicable (see Section 401.2.03, "Access").

(k) Any proposed phasing of construction.

(l) Any additional information that the City's authorized representative deems necessary.

4. Profiles for proposed sanitary improvements will be provided at the same horizontal scale as the plan sheets and a 1" = 5' vertical scale. Profile drawings shall be drawn below the plan view or immediately following the associated plan view sheets. Profile views showing existing features may be required for a distance of up to 100 feet (or further if warranted) beyond the proposed improvement in order to prevent future grade conflicts and will be determined on a case-by-case basis by the City's authorized representative. The profiles shall include the following:

   (a) Existing and proposed ground along the proposed sanitary main alignment.

   (b) Sanitary facilities, including pipe sizes, pipe types and materials, lengths, backfill material, and all sanitary system structures and appurtenances, including but not limited to manholes, fittings, and clean outs. Notes shall be included for referencing details, cross-sections, etc.

(c) Existing and proposed utilities, showing exact line and grade of all utilities crossing the proposed sanitary system, specifically water lines. The vertical separation from existing and proposed utilities shall be labeled for all proposed utility crossings.

(d) Any additional information that the City's authorized representative deems necessary.

5. Design Submittals

(a) A manhole detail may be required to be submitted for each new manhole and each existing manhole being worked on. The manhole details shall include rim elevation, number and size of grade rings, manhole frame type, cone or flat slab top with dimensions, each manhole section with dimensions, manhole base type with dimensions, step location, ledge elevation, and invert elevation(s), pipe size(s), pipe direction(s) with angle(s) noted for each pipe connection.

(b) Where a manhole pipe connection is larger than 24 inches or where more than four mainline connections are approved, the manufacturer or design engineer shall submit supporting calculations, stamped by a Professional Engineer registered in the State of Oregon, documenting the structural integrity of the manhole. The supporting documents shall be submitted with the manhole detail submittal.

401.1.04 Surveying

a. The design engineer shall be responsible for establishing the location of the sewer line by means of reference stakes offset along the centerline of the sewer line. No construction shall be allowed to begin before construction staking. All staking shall be performed by or under the direction of a Professional Land Surveyor registered in the State of Oregon.

b. Stakes shall locate all public tees, cleanouts, manholes, water line crossings, and pump stations. Maximum spacing for reference stakes is 50 feet. Stakes shall reference cuts or fills to all invert elevations and rim grades. The design engineer shall also be responsible for identifying and staking easements during construction.

401.1.05 Sewage Flow Determination

a. A map is required that shows the drainage basin in which the project is located. The map shall show the major basin that is consistent with the City's current Wastewater Collection System Master Plan and any applicable amendments and updates to it

b. Population density figures shall be obtained from the most recent information available for use by the Planning Division of the City of Wilsonville. If those figures vary from those of the applicable master plan estimates, the difference must be noted in the design calculation.

c. When required by the City's authorized representative, the design engineer shall prove to the City that all necessary methods of determining present and future capacity of the sanitary sewer have been considered. For flow parameters and peaking factor, accepted flow design practice must be employed. The flow parameters and peaking factor must coincide with the method used in the City's Sanitary Sewer Master Plan unless directed by the City's authorized representative to use more current information particular to the basin in which the project is located is available. Infiltration and inflow must be represented in flow calculations in the design of the sanitary system. Infiltration and inflow figures shall be obtained from the City's Sanitary Sewer Master Plan or more current data as approved by the City's authorized representative.

d. Sewage flows must reflect any reasonably anticipated increase due to the development of the drainage basin upstream of the project being considered. Design engineers are cautioned not to specify sewers of sizes that are obviously larger than necessary to achieve satisfactory carrying capacity, but which are specified to meet grade requirements.

401.1.06 Interference with City Sewer System Prohibited

No person shall block, obstruct, or interfere with any portion of the City sanitary sewer system without a diversion plan being submitted and approved by the City's authorized representative. This prohibition includes, but is not limited to, the obstruction of the flow of sewage from, and to any point within, the City sewer system.

401.2.00 SANITARY SEWER DESIGN STANDARDS

The following design standards are intended only as a guide for the design of sanitary sewer improvements. All designs shall conform to the most current requirements of the Oregon state plumbing laws and rules of the Oregon DEQ, except where the City's standards exceed those of the state.

401.2.01 Manhole Design

a. Manholes shall be provided at least every 400 feet, unless otherwise approved by the City's authorized representative. Manholes shall be located at every grade change, change in pipe size, change in alignment, and at the end of main lines not to be extended in the future. Manhole lids shall be located as indicated in the street detail drawings of these standards unless an exception is approved by the City's authorized representative.

b. A shallow manhole with precast grooves shall be provided for manholes 4 feet deep from crown of pipe and less. The shallow manhole top shall consist of a short eccentric cone as shown in **Detail No. S-2025** of these standards. Where the short eccentric cone top is not feasible as determined by the City's authorized representative, a flat slab top may be permitted as shown in **Detail No. S-2030** of these standards.

c. Flat-top manholes shall be designed to be installed at an elevation to permit construction of the full street section, allowing for the design gradients.

d. Manholes shall be designed such that the manhole cover is flush with the surrounding grade in paved areas, set 1-foot above grade in landscape areas unless otherwise directed by the City's authorized representative, and set at an elevation of at least 2 feet greater than the 100-year storm event in designated floodplain areas.

e. Manhole grade rings shall be concrete, key-lock joint designed to withstand AASHTO H-20 loadings. Grade rings shall not exceed 12 inches in height.

f. The minimum manhole size shall be as follows:

1. 48-inch diameter manhole for pipe equal to or less than 24 inch diameter

2. 60-inch diameter manhole for pipe between 27-inch and 36-inch diameter

3. 72-inch diameter manhole for pipe equal to or greater than 42-inch diameter.

g. Suburban style manholes frames shall not be used in PCC streets.

h. There shall be a maximum of 4 pipes entering/exiting a manhole unless otherwise approved by City's authorized representative.

i. Sewer lateral connections to manholes are prohibited except where required under Section 401.2.02.a.3, "Pipe Size" or where constrained by manhole placement as determined by the City's authorized representative.

j. The manufacturer or design engineer shall provide supporting structural calculations for manholes with pipe connections larger than 24 inches or where more than four mainline connections are approved, in accordance with Section 401.1.03.d.5, "Design Submittals."

k. All precast manhole bases and sections shall be manufactured with smooth, clean openings at the design inlet and outlet points for the size of pipe specified. Manholes shall be core drilled to field adjust the design connection points. Openings shall not be sawcut or broken out.

l. A minimum of 8 inches shall separate connections, measured from the outside diameter of the core holes.

m. All manhole bases shall be properly channelized.

n. All manholes shall have inlets at a minimum 90-degree angle in relation to the outlet, as measured from the center of the manhole base.

o. The crowns of all incoming pipes shall be at least as high as the crown of the outgoing pipe.

p. Manholes shall have a minimum free drop of 0.20 feet. Any drop greater than 0.20 feet shall only be allowed when existing utilities or physical obstructions prevent a connection from being made within this specification as determined by the City's authorized representative. Where allowed, the maximum free-drop shall be 1.5 feet.

q. Where services lateral connections to manholes are allowed in accordance with 401.2.01(i), "Manhole Design", service laterals 6" and less in diameter shall have an invert elevation a minimum 0.50 feet above the main line outlet invert elevation.

r. When more than 18 inches of drop is allowed, an inside drop manhole shall be provided in accordance with **Detail No. S-2042** of these standards. Outside drop manholes are not allowed.

s. All manholes shall be provided manhole cover inserts in accordance with **Detail No. S-2005** of these standards.

401.2.02 Sanitary Pipe Design

a. **Pipe size:**

1. Pipe size shall be determined by the design depth of flow (d) over the pipe inside diameter (D) is 0.67.

$$D = d / 0.67$$

2. Public sanitary sewers shall be 8 inches in diameter or larger, unless otherwise specified by the City's authorized representative. Sewer laterals for residential service shall be 4-inch inside diameter. All other sewer laterals shall be sized to accommodate the anticipated flow, but no less than a 4-inch inside diameter.

3. Sewer laterals tapped into existing sanitary lines shall be no larger than 50% of the diameter of the main line, unless otherwise approved by the City's authorized representative. Sewer laterals larger than 50% of the diameter of the main line shall be connected through the installation of a manhole in accordance with Section 401.4.01.c.2, "Pipe Connections."

b. **Materials:**

1. Generally, sanitary sewer mains and laterals shall be Polyvinyl Chloride Pipe (PVC) pipe, ASTM D-3034, SDR 35 or lower, unless otherwise recommended by the Engineer of Record and directed by the City's authorized representative.

2. Pipe materials shall conform to the specifications in Section 401.4.02.b "Materials" unless otherwise approved by the City's authorized representative.

3. Pipe and fittings shall consist of one type of material throughout and no interchanging of pipe and fitting material is allowed.

c. **Location:** Sanitary sewers will normally be placed on the north and west side of the street, outside the bike lane and vehicle wheel path, as indicated in the street detail

drawings of these standards. Sanitary pipe shall be located not closer than 5 feet to face of curb, unless an exception is approved by the City's authorized representative. In any event, all sewer locations shall be approved by the City's authorized representative.

d. **Easements:** Piped sewer systems shall generally be located in the right-of-way. When it is not possible or practical to install Public sewer facilities in a dedicated public street, the facilities shall be located within a sanitary sewer easement granted to the City. Sanitary sewer easements typically be exclusive and conform to Section 101.8.14, "Easements."

e. **Alignment:** Public sanitary pipe shall be laid on a straight alignment and at uniform grade.

f. **Connections:** Lateral connections on new construction work shall be done using manufactured tees installed at surveyed locations. Lateral connections to existing sanitary lines may be done using either saddle tees as per Section 401.4.02.b.5(a), "PVC Tee Saddle" or by using Inserta Tee® as per Section 401.4.02.b.5(c), "Inserta Tee." Lateral connections to manholes are prohibited in accordance with Section 401.2.01(i), "Manhole Design."

g. **Laterals:** Sanitary laterals shall be provided as shown in **Detail No. S-2175** of these standards.

h. **Curb Marking:** Newly constructed curbs or replaced curbs shall be stamped with the capitol letter "SS" at the location of each sanitary lateral crossing. Letters shall be 3 inches in height and embossed a minimum of ⅛-inch deep.

i. **Locating Wire and Tape:** Sanitary mains and laterals shall have tracer wire installed beside the pipe and plastic caution tape installed 1-foot above the pipe crown as shown in **Detail No. S-2175** of these standards. Main line tracer wire shall be connected to service lateral tracer wire using solderless connection kit suitable for direct burial that joins wires mechanically and electrically and seals out moisture, GelCap or approved equal. Tracer wire shall be 12-gauge stranded or solid copper insulated High Molecular Weight Polyethylene (HMW-PE) with a green insulated cover a minimum 45 mil in thickness and the wire UL rated for 140°F. Surface locating wire at cleanouts; tape shall be tied off to the 2 x 4 marker.

j. **Grade:** Sanitary sewers shall be laid on a grade that maximizes the serviceable area to facilitate future extension of the sanitary sewer system as determined by the City's authorized representative. The maximum serviceable area shall be based on the future development within the contributing area as identified by the Wilsonville Wastewater System Master Plans. The use of drop manholes in the design of new sanitary sewers shall be restricted as necessary to maximize the serviceable area.

All sanitary sewers shall be laid on a grade that will produce a mean velocity of at least 2 feet per second when flowing full or half-full. The minimum grades for various sizes of pipe are listed in **Table 4.1**.

Table 4.1. MINIMUM GRADIENT FOR SANITARY SEWERS

Inside Pipe Diameter (inches)	Grade (%) (feet per 100 feet)
Sanitary Laterals	
4	2.00
6	2.00
Sanitary Mains	
8	0.40
10	0.28
12	0.22
15	0.15
18	0.12
21	0.10
24	0.08
27	0.07
30	0.06

The minimum slope of sanitary sewer laterals may be reduced to 1.00% in unusual conditions upon review and approval of a sewer lateral report by the City's authorized representative. The report shall be prepared by the Engineer of Record and shall include documentation of the unusual conditions causing the need for slope reduction and analysis documenting the reduced slope will not impact the function of the sewer lateral for the intended use.

k. **Steep Slopes:** Sewers pipes on slopes in excess of 20% gradient shall be secured with approved concrete anchor walls as shown in **Detail No. S-2195** of these standards or other approved anchor systems as approved by the City's authorized representative. Where construction access is limited as determined by the City's authorized representative, steel anchor systems as shown in **Detail No. S-2196** may be used. Spacing for concrete anchors shall be as shown in **Table 4.2**.

Table 4.2. SECURING SEWERS ON SLOPES

Minimum Anchor Spacing Sewer Gradient >20%

Grade (%)	Center to Center (feet)
<35	35
35-50	25
>50	15 (or concrete encasement)

l. **Pipe Cover:** All sanitary sewer pipes shall be laid at a depth sufficient to drain building sewers, including basements where practical. Typically, sanitary sewers shall be placed with mains at 8 feet of cover and service laterals at property lines at 6 feet of cover. The City's authorized representative may approve shallow sanitary sewers upon verification that the typical depths cannot be met. Where shallow sewers are approved and a cover of 5 feet is not possible, ductile iron pipe, AWWA C-900, or concrete encasement or other material approved by the City's authorized representative shall be used.

m. **Sewer in Vicinity of Water Supplies:** No existing or proposed pressured sanitary sewer shall be permitted within 100 feet of any well, spring, or other source of domestic water supply. No existing or proposed gravity sewer line shall be permitted within 50 feet of any well, spring, or other source of domestic water supply.

n. **Water and Sewer Lines**

1. Sanitary sewers and domestic water lines shall not be laid in the same trench and shall comply with OAR 333-061-0050(9).

2. Parallel water and sewer lines shall have a minimum horizontal clearance of at least 5 feet when the bottom of the water pipe is higher in elevation than the top of the parallel sewer pipe. Parallel water and sewer lines shall have a minimum horizontal clearance of at least 10 feet horizontally when the bottom of the water pipe is lower in elevation than the top of the parallel sewer pipe. See Zone 1 of **Detail No. S-2150** of these standards.

3. When there is more than 18 inches of vertical clearance between water and sewer, but less than 5 feet of horizontal clearance, then pressure pipe with watertight joints, such as class 50 ductile iron pipe, C-900 PVC pipe, reinforced concrete encasement, or other pipe approved by the City's authorized representative shall be required. See Zone 2 of **Detail No. S-2150** of these standards.

4. Wherever it is necessary for sewer and water lines to cross each other, the crossing shall be at an angle of approximately 90 degrees. The sewer line shall have a minimum vertical clearance of 18 inches below the water line and one full length of water pipe shall be centered on the crossing.

5. Where a sewer line has less than 18 inches of vertical clearance below a crossing water line, the water line shall be replaced with one full length of water pipe centered on the crossing. Also, the sewer line shall be encased in a reinforced

concrete jacket 10 feet on each side of the crossing. In lieu of a concrete jacket, the sewer line may be replaced with one full length of sewer pipe centered on the crossing. The sewer pipe shall be pressure pipe, such as class 50 ductile iron pipe, C-900 PVC pipe, or other pipe approved by the City's authorized representative.

401.2.03 Access

Access roads are for maintenance and inspection purposes. All-weather access shall be provided to every manhole. Access roads shall be constructed as per Section 301.11.05, "Access Road Design."

401.3.00 WASTEWATER PUMP STATION DESIGN STANDARDS

401.3.01 General Provisions

a. **Applicability**

These standards are applicable to construction, installation, or modification of any wastewater pump station system requiring a City of Wilsonville Public Works Permit.

b. **Scope**

Pursuant to City of Wilsonville Development Code Section (July 2013) 4.262.04 Sanitary Sewers:

In order to accomplish the orderly and desirable development of land within the corporate limits of the City and to limit the costs associated with the operation and maintenance of wastewater pump stations borne by the City, the City Engineer deems it reasonable and necessary to restrict the installation of the wastewater pump stations. Therefore, wastewater pump stations will not be allowed in areas: where gravity sewer service is programmed for construction in an applicable capital improvement plan, where improvements are recommended in the City of Wilsonville Wastewater Collection System Master Plan, or where sewers are available within three thousand (3,000) feet.

Temporary pump stations will be allowed in areas where future development will require extension of gravity sewers and the City's authorized representative determines that the temporary station is economically justified. Design life must be less than ten (10) years, as determined in the preliminary design report, and have a capacity requirement of less than four hundred (400) gallons per minute (gpm).

Permanent pump stations will be allowed in areas where future development does not require extending gravity sewers, as determined in the design report and the applicable master plan for the area.

c. **Reviewing Authority**

The Oregon Department of Environmental Quality is the final reviewing authority. All plans and specifications for a wastewater pump station shall be reviewed and approved by the Oregon Department of Environmental Quality (DEQ). The basis for

review by DEQ review engineers is Oregon Administrative Rule 340 Division 52 (OAR 340-52), Review of Plans and Specifications. To that extent, all plans and specifications shall follow the guidelines and criteria set forth in *the Oregon Standards for Design and Construction of Wastewater Pump Stations*, Oregon Department of Environmental Quality, May 2001 (DEQ Standards). (The DEQ Standards may be found at: http://www.deq.state.or.us/wq/rules/div052/guidelines/designwwps.pdf)

The standards in this Wastewater Pump Station Design Standards chapter (City Standards) of the Public Works Standards are developed as supplemental standards to address local needs, preferences, and existing equipment. Conflicts between the City Standards and the DEQ Standards shall be resolved by first following that standard which is more stringent and/or specific; second, by the determination by the City's authorized representative as to which standard or guideline is advantageous to or in the best interests of the City.

d. **Variance**

When engineering justification satisfactory to the City's authorized representative is provided that substantially demonstrates that variation from the DEQ Standards or City Standards will result in either: at least equivalent effectiveness while significantly reducing costs, or improved effectiveness, such a variation from the DEQ Standards or City Standards may be accepted as determined by the City's authorized representative.

401.3.02 General Requirements

a. **Administration**

The design engineer in charge must be a Professional Engineer registered in the State of Oregon and have had previous experience designing similar facilities, including but not limited to; mechanical piping and appurtenances, pumps, buildings, site improvements, odor control, plumbing, HVAC, electrical, telemetry, and control systems. The engineer's qualifications shall be submitted prior to initiation of the preliminary design report and shall be acceptable to the City's authorized representative. An authorized representative of the City may be available for construction observation during construction of the project. The design engineer's responsibilities for construction management, inspections, testing, start-up and project closeout are outlined in the DEQ Standards. The availability of the City's on-site representative does not relieve the design engineer of any responsibilities as required in the DEQ standards.

b. **Flood Protection**

The pump station building finish floor elevation and electrical and mechanical equipment shall be located at an elevation that is at least two feet above the FEMA one-hundred (100) year flood elevation and shall be located above the FEMA five-hundred (500) year flood elevation. In addition, the rim elevation of the wet well and any vault or structure that drains back to the wet well shall also meet the requirements

listed above. The station shall be designed to remain operational and accessible during the one-hundred (100) year flood. In the absence of official FEMA maps to establish the one-hundred (100) year and five-hundred (500) year flood elevations, the best available local information should be used.

c. **Siting**

Pump stations shall be located as far as practical from present or proposed built-up residential areas and off the traffic way of streets and alleys. Noise control, odor control, station architectural design and other aesthetic items shall be taken into consideration and reviewed by the Design Review Board. Sites for stations shall be of sufficient size for future expansion or addition, if applicable.

d. **Safety**

It is the design engineer's responsibility to ensure that the Occupational Safety and Health Administration (OSHA), the National Electric Code (NEC), and all other applicable building and construction codes and requirements are met during construction. Adequate provision shall be made to protect construction and, subsequently, maintenance and operation personnel from hazard. Equipment and training for confined space entry in accordance with OSHA and regulatory agency requirements shall be provided for all wastewater pumping stations.

401.3.03 Preliminary Design Report

A preliminary design report prepared and stamped by the design engineer as a basis for design for the wastewater pumping station shall be submitted to the City's authorized representative and DEQ for review and approval. The report shall follow the design report guidelines listed in section IV of the DEQ Standards. Additional requirements are listed below:

a. **Site Selection**

1. The City of Wilsonville's comprehensive plan designation shall be considered during pump station site selection, in addition to guidelines in the DEQ and City Standards.

2. If the selected location is not currently owned by the City, the City's acquisition process must be started as soon as the parcel is selected and approved by City. In the case of a pump station being planned/designed as a condition of a private development, it shall be the developer's obligation to see that the appropriate site needs are acquired and conveyed to the City. If the pump station is a City-led project, the City will pursue all necessary property acquisition.

b. **Preliminary Design Report Contents**

1. Population: Present and future population and/or industrial/commercial usage projections for present, design and ultimate buildout of all areas that could be served by the pump station.

2. Average and, peak flow, daily and peak instantaneous calculations, unit for present, design and ultimate flows. Average residential per capita flows and, peaking factors and infiltration/inflow allowances for present and future design conditions shall follow the recommendations of the City's current Wastewater Collection System Master Plan and/or subsequent sewer basin studies.

3. Wet well configuration and size.

4. Number, type, capacity, motor horsepower and Net Positive Suction Head (NPSH) requirement of proposed pumping units.

5. System head curve and head computations for design conditions of pumping system. System head calculations shall include the size and length of force main, static head, and all dynamic losses. System curves shall be developed using the Hazen-Williams equation, and for assumed "c" factors of 100, 120, and 150.

6. Description of primary and back-up power sources.

7. Other hydraulic computations to include, but not be limited to, pump cycling time, wet well capacity, flushing velocity, force main detention time and surge analysis.

8. Downstream collection system analysis as described herein.

c. **Preliminary Plans**

Shall be in conformance with Section 401.1.03, "Sanitary Plans", and, in addition, shall show the following:

1. A contour map of the proposed site, service area, and force main with elevations referenced in accordance with Section 101.7.07.a, "NAVD 88 Datum."

2. Proposed pump station, including structure, site layout and piping, landscaping, street connection, and provisions for future pumps, if necessary.

3. Demolition or modifications to existing pump station, if applicable.

4. The 100-year and 500-year flood plain elevation at the site.

5. Location and elevation of sewage overflow point in the collection system and the location of the receiving stream for sewage overflow.

6. Process and Instrumentation diagrams for electrical and control systems. Electrical site plan and one line diagrams.

7. Force main in both plan and profile views to the connection at the receiving location.

d. **Final Design Report**

Final design report and final construction plans shall be prepared and stamped by the design engineer, reviewed and approved by the City prior to submittal to DEQ for review and approval. Final design shall be in conformance with preliminary design report as approved by the City and DEQ, and shall conform to applicable land use decisions.

401.3.04 Construction Plans

Construction drawings shall be in conformance with Section 401.1.03, "Sanitary Plans," and include, but not be limited to, the following as applicable by the design engineer unless otherwise directed by the City's authorized representative:

a. General sheets - Cover sheet, Symbols & Legend, Location and Vicinity Map, General Notes and Abbreviations.

b. Civil Sheets - Demolition plan, Site Layout, Grading, Drainage, Paving, Site Piping Plans and Profiles, and Details.

c. Landscaping Sheets - Landscaping, Planting, and Irrigation.

d. Architectural Sheets - Architectural Plans, Roof Plans, Door and Window Schedules, Elevations, Sections and Details.

e. Structural Sheets – Structural Plans, Foundation Plans, Sections, and Details.

f. Mechanical Sheets – Mechanical Pump and Piping Plans, Pump Station Design Data, Temporary Pumping Plan, Piping Schematics, HVAC and Plumbing, Sections, and Details.

g. Electrical Sheets – Electrical Symbols and Legend, Electrical Site Plan and Power Plan, One-Line Diagrams, Lighting Plans, Motor Control Center Elevations, Miscellaneous Devices/Panels One-Line Diagrams, Panel Schedules and Layout, Circuit Schedule.

h. Instrumentation Sheets - Instrumentation Symbols and Legend, Instrumentation Plan, Process and Instrumentation Diagram.

i. Other construction drawings as may be required.

401.3.05 Pump Station Design Criteria

The design criteria shall follow the guidelines in Section III of the DEQ Standards, except as additionally required or modified below:

a. **General**

1. All sewage pump stations shall be designed as submersible pump style pump stations with an above grade control building to house electrical equipment, instrumentation and control equipment, odor control equipment, backup power

equipment, and other applicable equipment, unless otherwise approved by the City.

2. The electrical and mechanical equipment systems, including but not limited to pumps, motors, valves, electrical and instrumentation equipment shall be designed and specified for a minimum 25-year design life. Structures and piping shall be designed for a minimum 75-year service life.

3. The pump station shall be designed with a firm capacity to continuously pump the peak instantaneous flow associated with the 10-year, 24-hour storm intensity (see **Table 3.2.** Rainfall Distribution) of its service area, without overflow from the station or the contributing collection system. Firm capacity is defined as the ability to continuously discharge the design flow with the largest pump unit out of service. The design flows shall be based on projected development of the service area associated with the 25-year design life of the pumping equipment.

4. Future pumping capacity requirements and potential changes to the force main configuration required for ultimate buildout of the pump station service area shall be considered in sizing the wet well and pumping equipment. The pump station facility shall be capable of accommodating future components that may be needed for projected growth in the service area beyond the identified design period. The wet well shall be sized for ultimate buildout, with space available for installation of additional pumps or larger pumps as needed to meet ultimate buildout flows.

5. Design shall be consistent with EPA Class I reliability standards for mechanical and electrical components and alarms.

6. A paved access road for maintenance vehicles shall be provided. The access road shall be at least 12 feet wide. Access roads longer than 50 feet shall be provided with an additional paved area for turning around maintenance vehicles. The maximum access road grade shall be 12 percent and the maximum turning area grade shall be 2 percent. Pavement section shall be approved by City's authorized representative.

7. The site shall be fenced with a minimum six (6) foot high chain link fence. A minimum of one locking access gate shall be provided, consisting of rolling gates 16 feet in width or as required by site constraints and approved by the City's authorized representative. Fence shall be galvanized steel fabric with bonded vinyl coating. Vinyl coating shall be a color designed to blend with the surrounding area (green, brown, or black), as approved by the City. All fence posts, cross bars and gates shall be painted or coated same color as the fence. The access gate shall be provided with an intrusion alarm that is tied into the City's SCADA notification system.

8. Landscaping shall be provided around the pump station building and associated site improvements and shall be compatible with the character of the surrounding properties. The landscaping shall be designed by a registered landscape architect and include low maintenance and low irrigation type trees and shrubs. Permanent automatic irrigation shall be provided to all planted areas, unless otherwise

approved by the City. Landscaping shall meet all applicable City Codes and Standards.

9. The existing downstream sanitary sewer collection system shall be evaluated by the design engineer to determine the impact of the increase in flow (i.e. peak pumping capacity) from the proposed pump station. Evaluation shall be performed under the design flow condition for all pumped and gravity connections to the receiving system. Sanitary sewer system shall be evaluated downstream to a point where no surcharging (caused by the increase in flow from the pump station) above the top of the pipe occurs. Hydraulic profile and downstream collection system analysis shall be provided in the design report. The City reserves the right to require upgrades to the downstream receiving system to mitigate the impact of the increased flow.

10. Adequate piping, valves, and appurtenances for isolation and removal of equipment shall be provided. A bypass pumping port on the force main shall be provided to allow for temporary bypass pumping operations. The bypass connection shall be located downstream of the common force main isolation valve, and be provided with an independent isolation valve.

11. Capability for pig launching and retrieval shall be included at all pump stations for cleaning of the force main. The system shall utilize the station's sewage pumps to propel the pig, unless otherwise approved by the City.

12. Federal and State OSHA regulations and guidelines, and any other relevant state, federal and local safety regulations and guidelines shall be followed and adhered to.

13. An emergency overflow path shall be provided as necessary to prevent property damage and sewer backups, or as required by the City and DEQ. The overflow point shall be reviewed and approved by the City and DEQ. A dedicated overflow alarm shall be provided in the wet well or collection system and tied to the City's SCADA notification system.

14. All wastewater pump stations shall be supplied with a back-up standby generator or alternate power source.

b. **Submersible Pumps and Wet Well**

1. Submersible pumps and motors shall be designed specifically for raw wastewater use, including totally submerged operation during a portion of the pump cycle.

2. Pumps shall be sized to pump the required flow when the force main is in a degraded condition, with a Hazen-Williams 'C' value of 120 for force mains with no sags in its profile, or 110 for force mains with a sag in the profile. The pumps shall be selected so as to operate within the manufacturer's recommended operating range under the full range of normal operating conditions anticipated during the service life of the pump.

3. Submersible pumps shall be readily removed and replaced on two stainless steel guide rails without de-watering the wet well or disconnecting any piping in the wet well. Guide rails shall be secured to the wet well lid. Guide rail supports shall be as recommended by pump manufacturer and shall not interfere with pump removal or re-installation.

4. Each pump assembly shall be provided with a stainless steel lifting chain and stainless steel lifting knuckles of adequate strength to support 150% of the entire assembly weight. Chain links shall be minimum 5/16-inch inside diameter and lifting knuckles shall be provided every 3 feet.

5. Wet well and vault access shall be provided through a minimum double door with 3-foot square opening. The door shall be aluminum, diamond plated, H20 rated, and spring assisted. The door shall be provided with a recessed padlock hasp for locking with a standard padlock.

6. An on-site hoist and crane shall be provided for pump assembly and removal. The crane shall be load rated for 150% of the maximum weight of the pump assembly.

7. Check valves and isolation valves for submersible pumps shall be located in a separate valve vault chamber. The check valve shall be located between the pump and the shutoff valve. Check valves shall be suitable for the material being handled, and shall be placed on the discharge line in a horizontal position. Swing check valves shall have outside levers.

8. Vaults shall be no deeper than five feet from the rim to the vault floor, unless otherwise approved by the City's authorized representative. Vaults shall be large enough to allow for a worker to enter and perform routine maintenance. Accumulated water shall drain to the wet well with a minimum 2-inch diameter drain line and shall be primed and trapped as required plumbing codes. Wastewater and gases from the wet well shall be prevented from entering the valve vault.

9. Valves shall not be located in the wet well.

10. The wet well shall have sufficient operating volume to maintain individual pump cycle times that comply with NEMA and pump manufacturer requirements for motor starts per hour. In addition, additional wet well space shall be provided for future pumps, as applicable. The floor shall be sloped for proper installation and function of the pumps inlets. Influent flow shall enter the wet well above the pump operating level.

11. Wet well shall be provided with a corrosion resistant cementitious coating, Strong Seal or approved equal. Corrosion resistant coating shall be reviewed and approved by the City's authorized representative.

12. Motors shall be protected from over-current, over-temperature and voltage imbalance. Minimum number of pumps shall be two, unless otherwise approved by the City.

c. **Control Building Features**

1. The control building shall consist of a control room that houses all electrical and control equipment, and the generator. As applicable, an additional space may be required for odor control chemical feed or air compressor equipment.

2. Building shall be a low-maintenance above-grade structure that is architecturally compatible with the surrounding area and constructed using materials meeting City Code and approved by the City's authorized representative. The building shall be of adequate size with equipment clearances provided that meet applicable code requirements and for operation and maintenance of all systems. Building structure and site layout shall be designed in accordance with the current International Building Code (IBC) and applicable energy codes and noise codes.

3. Pump station building shall generally consist of reinforced-concrete floor slab and foundation and be constructed of durable materials that accommodate the intended uses of the building. Doors shall be metal and any glazing shall be safety glass. The structure shall be secure and provided with intrusion alarms on all doors and shall otherwise be resistant to vandalism. All exterior building materials and colors shall be approved by the City's authorized representative.

4. Doors shall be sized, as applicable based on equipment sizes, for removal of all equipment located within the control building. Where required, overhead doors shall be of heavy-duty construction, roll-up style, with insulated panels, and shall provide a minimum of 9-feet of vertical clearance. Adequate clearances, sufficient anchorage, and hoists must be provided to remove, replace and maintain all major and minor equipment.

5. Pump station noise sources that may create noise problems include, but are not limited to, electrical equipment, engine-generator sets, fans and air compressors. Design engineer shall provide at minimum acoustic style louvers and sound dampeners at all wall and/or roof penetrations. Noise suppression mufflers shall be provided for the generator. The design engineer shall incorporate all applicable and reasonable control measures to and comply with all applicable noise regulations.

d. **Electrical and Instrumentation**

1. Permanent back-up standby power shall be provided for each pump station and shall be approved by the City's authorized representative. Alternatively a secondary power source may be acceptable, as approved by the City's authorized representative. Generator systems shall be as required by the DEQ Standards.

   For pump stations located in residentially zoned areas the generator shall be housed inside the pump station control building, unless otherwise approved by the City's authorized representative. In commercial or industrial zoned areas, the generator may be allowed outside based on City Code requirements and approval by the City's authorized representative.

Where required by the City, the generator shall be located in a separate room from the control and electrical equipment. The generator room shall be provided with a louver sized for removal of the generator from the building. The room shall be sized adequately for maintenance access to the generator.

2. Electrical supply, power, control, alarm circuits, and lines shall be designed to provide strain relief and to allow for disconnection and de-energizing outside the wet well. Terminals and connectors shall be protected from corrosion by location outside the wet well. All penetrations of the wet well shall be watertight. Provisions shall be made to prevent wet well gases from entering cabinets and equipment located in the control building. The design shall provide a method to allow for disconnection of the pump from the motor control center without destroying conduit seals.

3. A remote telemetry unit shall be installed and integrated with the City's programmable logic controller/SCADA system. The telemetry panel shall be designed and programmed by the City's systems integrator, unless otherwise approved by the City, and furnished and installed by the pump station electrical contractor. Local control shall be provided in case of telemetry failure.

   At a minimum, the following alarm signals shall be made available from the pump station control panel to the telemetry/SCADA system: pump #1 on, pump #2 on, pump #1 fail, pump #2 fail, motor #1 high temperature, motor #2 high temperature, phase fail, low water alarm, high water/pumps call (float), overflow alarm, intrusion and smoke detection. For stations with more than two pumps, alarm signals shall be expanded to include all pumps. All appropriate alarms shall be wired and tested for accuracy before they are accepted.

4. Pump station level sensing and control shall be provided by an integrated controller and level sensor in addition to back-up control system. All pump station control systems must be listed as intrinsically safe by a nationally recognized testing laboratory.

   (a) Primary controls shall include a pulse radar level sensor to measure wet well levels. The radar level sensor shall be a Vegapuls 65, unless otherwise approved by City's authorized representative. Sensor shall be rated for explosive environments and an accuracy of +/- 8mm.

   (b) Controller for primary controls shall be designed to operate integrally with the level sensor. Controller shall have a minimum of 5 relay contacts assignable as alarms and pump controls. Controller shall be provided with an LCD display.

   (c) Backup level control shall be provided with floats for high level wet well and low level wet well for use in the event of primary level control system failure. High level float shall signal high water alarm and a call for both pumps; low level float shall signal low water alarm and turn both pumps off. Alternatively, a timed relay can be provided in lieu of the low level float. Intrinsically safe relays shall be supplied in a separate enclosure.

5. Pump stations shall be provided with a red alarm lamp mounted to and visible from the nearest public roadway. Red alarm lamp shall be energized in conjunction with any pump station alarm. No local audible alarms shall be installed. A red light test switch shall also be installed.

6. Control panel construction, electrical wiring, and equipment shall be in strict conformance with the National Electric Code, State and Local Codes, and in conformance with applicable specifications of NEMA, ANSI, UL, and ICEA. Inside panels shall be NEMA 12; outside panels shall be NEMA 4X.

7. All electrical equipment shall be mounted inside an electrical panel that is placed at safe operating levels and shall not be subject to flooding. Panels shall be located so they are out of the way of maintenance operations for equipment. Control panel shall include the following monitoring devices: phase monitor (with switch to allow for checking all three phases); elapsed time meter; pump start counter; voltmeter and ammeter. Uninterruptible Power Supply (UPS) – Install a UPS in the control panel to prevent control system failure in the event of a voltage dip (up to 35%) at generator startup. The UPS must be compatible with the generator operations.

401.3.06 Operation and Maintenance Manual

a. The design engineer shall prepare an Operations and Maintenance (O&M) Manual for the completed project. All required information shall be provided in both hard-copy and electronic format. Three copies of the O&M is required to provided, reviewed and accepted by the City's authorized representative and DEQ prior to initial station startup. The City project number and the name/address of the pump station shall be noted on each manual. Binding of each hard-copy shall be by locking three-ring binder. System operation and equipment literature shall be in separate volumes. A table of contents shall be included.

b. The design engineer shall shall include, but not be limited to, the following information that is to be provided in the O&M:

    1. Sequence of operations including description of the operation and interaction of systems and subsystems during startup, operation in automatic mode, operation in manual mode, and operation with backup power. This includes, but is not limited to, equipment, pumps, pipng, valves, HVAC, generator, electrical, controls, and instrumentation. Provide both simplified and detailed system schematics, as required.

    2. List of contacts including, but not be limited to, design engineer, contractors and subcontractors, utility companies, pump equipment supplier, instrumentation equipment supplier.

    3. Station operation and controls, including updated information on the actual pumps installed.

    4. On-site utilities.

5. A consolidated summary of required routine maintenance and scheduled preventative and predictive maintenance for all station equipment along with references to the location within the manual where detailed information may be found.

6. Safety procedures.

7. Emergency plans and procedures.

8. Design engineer's certification of construction.

c. The Contractor shall be required by the project specifications to include, at a minimum, the following information in the equipment literature section of the O&M:

1. Disassembly and reassembly instructions.

2. Parts list including part numbers.

3. Name, location, and telephone number of nearest supplier and spare parts warehouse.

4. Manufacturer's certifications, including calibration data sheets and specified calibration procedures and/or methods for installed equipment.

5. Warranty forms and information for all installed equipment as provided by the contractor.

6. Test results of all equipment installed and tested.

401.4.00 MATERIAL AND TECHNICAL SPECIFICATIONS

401.4.01 Manholes and Structures

a. General

Manholes shall be constructed at locations shown on the plans and in compliance with the design requirements of Section 401.2.01, "Manhole Design", or as required by the City's authorized representative.

b. Materials

1. **Aggregate and Cement:** Aggregate shall meet the standards set forth in ODOT SSC Section 02690, "PCC Aggregates"; Portland cement shall meet the standards set forth in ODOT SSC Section 02010, "Portland Cement."

2. **Concrete:** PCC for poured in place manholes and structures shall conform to ODOT Class 3000 – 1½, Commercial Grade Concrete. Slump shall be between 2 and 4 inches.

3. **Manhole Frames and Covers:**

(a) Casting shall be of new material, tough, close-grained gray iron conforming to ASTM A-48, Class 30B and AASHTO M 105, Class 30B. Where the ASTM and AASHTO specifications differ, the more stringent shall apply. Casting shall be smooth and clean, free of blisters, blowholes, and all defects. Bearing surfaces shall be planed or ground to ensure flat, true surfaces. Covers shall be true and set within rings at all points.

(b) Rings shall be grouted in place and made watertight with a high-strength, non-shrink grout meeting ODOT SSC Section 02440.50(b), "Non-Shrink Grout," such as Alcrete Twenty Minute Fast Setting Grout®, or approved equal. Unused grout shall be discarded after 20 minutes and shall not be used. Rings shall not be brought to grade with lumber.

(c) Frames and covers shall be standard or suburban, depending on the manhole location and as approved by the City's authorized representative. Suburban style manhole frames shall not be installed in PCC streets or arterial roadways.

(d) Manholes installed outside of paved street or sidewalk areas shall be installed with a tamperproof frame and cover as shown in **Detail No. S-2060** of these standards.

4. **Manhole Types:** Manholes shall be preformed rubber O-ring gasket design only and conform to the following:

(a) **Precast 48-Inch-Diameter Manholes:** Materials shall conform to the requirements of ASTM C-478. Minimum wall thickness shall be 5 inches.

(b) **Precast Large-Diameter (60-inch or larger) Manholes:** Materials shall conform to the requirements of ASTM C-478. Manhole structural dimensions shall be reviewed and approved on a case by case basis in accordance with Section 401.1.03.d.5, "Design Submittals."

(c) **Precast Manhole Tops:** Standard eccentric cone, short eccentric cone, and flat slab tops shall be provided in accordance with Section 401.2.01.b, "Manhole Design" Eccentric cones shall conform to all requirements of ASTM C-478, with the exception of the steel reinforcement requirement. Precast manhole tops shall be designed to withstand AASHTO H-20 loadings.

(d) **Permeability Testing:** Before precast manhole sections of any size are delivered to the job site, the sections shall meet the permeability test requirements of ASTM C-14 and ASTM C-497.

(e) **Precast Bases:** Precast manhole bases shall be used, except when placing a manhole over existing pipe. Precast bases shall conform to the requirements of ASTM C-478. The base riser section shall be integral with the base slab.

(f) **Poured-in-place Bases**: Poured-in-place manhole bases may only be used when placing a manhole over an existing pipe.

5. **Manhole Pipe Connectors**: Connections to manholes shall be made with an approved flexible connector specifically manufactured for the intended use, conforming to ASTM C923, and in accordance with **Detail No. S-2010** of these standards. Field fabricated waterstops or improvised adapters, such as gaskets stretched over the pipe, will not be allowed.

   Connections to existing manholes may be made with a sand collar fabricated of the same material as the connecting pipe by an approved manufacturer in accordance with **Detail No. S-2010**. Sand collars shall be constructed with a gasketed joint located within 12" or half the pipe diameter, whichever is greater, from the manhole wall. Sand collars shall not be fabricated in the field.

6. **Pipe Stub outs for Future Sewer Connections:** Pipe stub outs shall be the same type as approved for use in the lateral, main, or trunk sewer construction. Strength classifications shall be the same class as in adjacent trenches. Where two or more different classes of pipe exist at a manhole, the City's authorized representative shall determine the strength classification. Connect stub outs to manholes as specified in Section 401.4.01.e.1, "Connection to Existing Manholes." Rubber-gasketed, watertight plugs shall be furnished with each stub out and shall be adequately braced against air test pressures.

7. **Gaskets:** Manhole sections shall be installed with preformed rubber O-ring gaskets only. Rubber gaskets shall conform to AASHTO M 315 and ASTM C-443.

8. **Manhole Steps:** Steps shall be required and shall be constructed as specified and shown in **Detail No. S-2080** of these standards, unless otherwise approved by the City's authorized representative. When pipe is 24 inches in diameter or smaller, steps shall be located as indicated in **Detail No. S-2065** of these standards. For pipe larger than 24 inches in diameter, steps shall be located over a bench as coordinated with the City's authorized representative.

c. Workmanship

1. **Foundation Stabilization:** If, in the opinion of the geotechnical engineer or the City's authorized representative, unstable subgrade material exists that will not support the manhole or other structure, the contractor shall excavate below grade and backfill with foundation-stabilization material in accordance with the standards of Section 601.3.02.d, "Trench Foundation."

2. **Pipe Connections:** All rigid pipes, such as concrete, entering or leaving the manhole shall be provided with flexible joints within 1 foot or half the pipe diameter, whichever is greater, of the manhole structure and shall be placed on firmly compacted bedding. All flexible pipe, such as PVC, shall connect to manholes using connectors as specified in Section 401.4.01.b.5, "Manhole Pipe

Connectors." Special care shall be taken to see that the openings through which pipes enter the structure are completely watertight.

3. **Flexible Joints:** At rigid pipe connections, such as concrete, where a flexible joint cannot be provided within the greater of 1 foot or half the pipe diameter from the manhole, a 6-inch concrete encasement shall be constructed around the entire pipe, from the manhole base to within 1 foot of the pipe joint, at the discretion of the City's authorized representative. The pipe encasement shall be constructed integrally with the manhole base. Pipes laid out of the manhole shall be shortened to ensure that the first flexible joint is no more than 1 foot from the manhole base.

4. **Manhole Connections:** The contractor shall connect sewer pipe to manholes as specified in Section 401.4.01.e, "Types of Connections."

5. **Concrete Bases (Poured-in-Place):** Poured-in-place bases shall be used over existing pipelines in accordance with **Detail No. S-2015** of these standards for 48" diameter manholes. For manholes greater than 48" in diameter, poured-in-place bases shall be provided in accordance with **Detail No. S-2040** of these standards. The contractor shall remove water from the excavated area, place the compacted, aggregate base, construct the concrete base, and set the first precast manhole section before the concrete has set. The first precast manhole section shall be properly located and plumb and have a uniform bearing throughout the full circumference. The contractor shall deposit sufficient concrete on the base to assure a watertight seal between base and manhole wall. Twenty-four hours shall be allowed to elapse before the remaining manhole sections are placed on the base, unless otherwise approved by the City's authorized representative. Where poured-in-place concrete bases are used to construct manholes over existing sewers, comply with Section 401.4.01.e.2, "Manholes Over Existing Sewers."

6. **Drop Manholes**

   (a) The maximum free drop in a manhole shall be 18 inches. See Section 401.4.01.e.3, "Shallow Inside Drop Manhole," for construction of this connection.

   (b) When more than 18 inches of drop exists, a drop manhole shall be provided in accordance with Section 401.2.01.r, "Manhole Design."

7. **Placing Manhole Section:** The contractor shall clean the end of each sections of foreign material. Manholes shall be installed with watertight rubber O-ring gaskets only. The inside seams shall be grouted with a high-strength, non-shrink grout meeting ODOT SSC Section 02440.50(b), "Non-Shrink Grout," such as Alcrete Twenty Minute Fast Setting Grout®, or approved equal. Unused grout shall be discarded after 20 minutes and shall not be used. All grouted joints and pick holes shall be troweled smooth. Manholes will be visually inspected for water leakage by the City's authorized representative. Any leakage observed shall be repaired at the contractor's expense, and the manhole re-inspected.

8. **Manhole Inverts:** The contractor shall construct manhole inverts in conformance with **Detail No. S-2005** or **Detail No. S-2015** of these standards. Inverts shall have smooth transitions to ensure an unobstructed flow through the manhole. The contractor shall remove all sharp edges or rough sections that tend to obstruct flow.

9. **Manhole Stub outs:** The contractor shall install stub outs from manholes for sewer extensions, as shown in these standards or as required by the City's authorized representative. A watertight flexible connection shall be provided in all new manholes. The contractor shall construct invert channels in accordance with **Detail No. S-2005** or **Detail No. S-2015** of these standards. The minimum length of stub outs in existing manholes shall be 12 inches outside the manhole wall. Pipes shall be grouted in precast walls or the manhole base to create a watertight seal around the pipes. The contractor shall install compacted base rock, as specified in these standards, over undisturbed earth under all stub outs.

d. Manhole Extensions, Rings, and Covers: The contractor shall install rings and covers on top of manholes to positively prevent all infiltration of surface water or groundwater into manholes. Rings shall be set in a bed of high-strength, non-shrink grout meeting ODOT SSC Section 02440.50(b), "Non-Shrink Grout," such as Alcrete Twenty Minute Fast Setting Grout®, or approved equal, with the grout carried over the flange of the ring, and shall be set so that tops of covers are flush with the surface of the adjoining pavement, or 1 foot above the natural ground, unless otherwise directed by the City's authorized representative. Unused grout shall be discarded after 20 minutes and shall not be used. Grouted surfaces shall be troweled smooth. Total thickness of grade rings shall not exceed 12 inches; rings shall be grouted watertight. Drop from rim to first manhole step shall not exceed 27 inches.

e. Types of Connections

1. **Connection to Existing Manholes:** The contractor shall connect sewers to existing manholes at the locations shown on the plans. Contractor shall submit a plan for diversion control and receive written approval from the City's authorized representative before proceeding with construction. The contractor shall provide all diversion facilities, and shall perform all work necessary to maintain sewage flow in existing sewers while connections are being made to the manholes. Connections to existing manholes shall be core-drilled, and the bases shall be grouted as necessary to allow a smooth flow into and through the existing manholes.

2. **Manholes Over Existing Sewers:**

(a) The contractor shall construct manholes over existing operating sewer lines at the locations shown on the plans.

(b) Manholes constructed over existing sanitary sewers shall have all portions of the pipe to be in contact with the manhole cleaned and:

i. Concrete Pipe Connections: An approved commercial concrete bonding agent shall be applied to the pipe prior to placement of concrete.

ii. PVC Pipe Connections: A dense coating of clean mortar sand shall be applied to the pipe using PVC solvent cement. After the cement has cured, an approved commercial concrete bonding agent shall be applied to the sand prior to placement of concrete. Water as a substitute for commercial bonding agent will not be allowed.

(c) The contractor shall construct a poured-in-place base under the existing sewer and the precast sections as specified.

(d) The contractor shall not cut into any existing lines until the new manhole(s) are grouted and pressure tested, the new lines are balled, cleaned, deflection tested, and pressure tested, and all portions of the sewer have been approved and accepted by the City's authorized representative.

(e) After acceptance, the contractor shall saw cut into the existing line; cut edges of concrete pipe shall be covered with grout and troweled smooth; with ductile iron or plastic pipe, grout shall be applied up to cutout and troweled smooth.

3. **Shallow Inside Drop Manhole:** Where the invert of the connecting pipe is above the manhole shelf and less that 18 inches above the outlet, an inside drop shall be constructed utilizing Portland cement concrete. The sewage entering the manhole shall follow a smooth concrete channel transitioning evenly from the invert of the inlet pipe into the main channel. Sewage shall not be allowed to fall freely to the manhole base.

401.4.02 Gravity Sewer Pipe

a. General

1. It is not intended that the materials listed herein are to be considered equal or to be generally interchangeable for all applications. The material suitable for project conditions shall be determined by the Engineer of Record and approved by the City's authorized representative.

2. Sanitary sewer pipe shall have flexible gasket joints. Joints on all fittings shall be the same as the joints used on the pipe. Caps or plugs shall be furnished with each fitting, outlet, or stub, as required, and shall have the same type of gasket or joint as the pipe.

3. Each piece of pipe and fitting shall be clearly identified as to strength, class, and date of manufacture.

b. Materials

Materials shall be the following types or approved equal:

1. Reinforced Concrete Pipe

   (a) Reinforced concrete, non-pressure pipe shall conform to the requirements of ASTM C-76 and shall be of the class specified. Unless otherwise specified, pipe shall meet the design requirements of Wall B.

   (b) Gaskets shall conform to the requirements of ASTM C-443.

   (c) All steam-cured concrete pipes must be at least seven days old before it can be used. If the pipe has not been steam-cured, it must not be used before it has cured for 28 days.

   (d) Fittings shall be manufactured integrally and be of a class at least equal to that of the adjacent pipe. Field taps shall be machine-drilled.

   (e) Mortar used shall be standard nonshrink premixed mortar conforming to ASTM C-387 or in a proportion of one part Type II Portland cement to two parts clean, well-graded sand that will pass a ⅛-inch screen. Mortar mixed for longer than 30 minutes shall not be used.

2. Ductile Iron Pipe (D.I.)

   (a) Ductile iron pipe shall be cement mortar lined with push-on joints conforming to the requirements of AWWA C-151/ ANSI A21.51 and AWWA C-104/ANSI A21.4. The minimum thickness class shall be Class 50 (up through 12-inch diameter pipe) and Class 51 (for 14-inch diameter and larger pipe). .

   (b) Fittings shall be mechanical or push-on and be of a class at least equal to that of the adjacent pipe. Mechanical joint ductile iron fittings shall conform to AWWA C-110/ANSI A21.10. Push-on joint fittings shall be gray iron, with body thickness and radii of curvature conforming to ANSI A-21.10. Rubber gasket joints shall conform to AWWA C-111/ ANSI A-21.11.

3. Polyvinyl Chloride Pipe (PVC)

   Polyvinyl Chloride Pipe (PVC) pipe and fittings shall conform to ASTM D-3034 (SDR 35 or lower) and ASTM F-679. Where added pipe strength is required, PVC pipe shall conform to AWWA C-900 and AWWA C-905.

4. Fittings

   (a) General

      i. Manufactured tee fittings shall be provided in the sewer main for side sewers. Fittings shall be of sufficient strength to withstand all handling and load stresses encountered.

      ii. Fittings shall be of the same materials as the pipe. Material joining the fittings shall be of the same material as the pipe.

iii. Material joining the fittings to the pipe shall be free from cracks and shall adhere tightly to each joining surface.

iv. All fittings shall be capped or plugged, and shall be gasketed with the same gasket material as the pipe joint, fitted with an approved mechanical stopper, or have an integrally cast knockout lug. The plug shall be able to withstand all test pressures without leaking. When later removed, the plug shall permit continuation of piping with jointing similar to joints in the installed line.

(b) Mechanical Couplings: Mechanical couplings shall be wrought steel. Installation procedures must meet the manufacturers' recommendations.

5. Line Tap Saddle

(a) PVC Tee Saddle: manufactured in accordance with ASTM D-3034 (SDR 35 or lower) with minimum cell classification of 12454B-C or 12364-C as defined in ASTM D-1784. Elastomeric seals shall meet ASTM F-477 specifications; locate seals at both the lead and skirt ends of the saddle. Saddles shall be banded to pipe with #316 Stainless Steel bands, 9/16-inch wide. This saddle is allowed on PVC, clay, IPS, concrete, asbestos cement, and PE pipe.

(b) Romac Style "CB" Saddle shall be made of casting of ductile iron, which meets ASTM A-536, grade 65-45-12. Rubber gaskets shall conform to AWWA C-111/ANSI A21.11. The band shall be stainless steel with Teflon coated nuts and bolts. This saddle is not allowed on plastic pipe except C-900.

(c) Inserta Tee®, or approved equal: hub adaptor shall be manufactured in accordance with ASTM D-3034; elastomeric seals shall meet ASTM F-477 specifications. This connection is allowed only on thick wall pipe material, e.g., concrete, ductile iron, rib type plastic. Connection point shall be core drilled. The hole diameter shall be cut to manufacturer's specifications. Hub adaptor shall be connected to rubber sleeve with #316 Stainless Steel band (9/16-inch wide), screw, and housing. Inserta Tee® connection shall have a gasketed bell for use with sanitary sewers.

c. Proof Tests

The intent of this requirement is to prequalify a joint system, components of which meet the joint requirements, for water tightness capability of the joint system. The proof test shall be understood to apply to sanitary sewers that are to be tested for water tightness before acceptance. Material and test equipment for proof-testing shall be provided by the manufacturer. When approved, internal hydrostatic pressure may be applied by a suitable joint tester. Each pipe material and joint assembly may be subject to the following three proof tests, at the discretion of the City's authorized representative:

1. **Pipe in Straight Alignment:** No less than three or more than five pipes selected from stock by the City's authorized representative shall be assembled according to the manufacturers' installation instructions, with the ends suitably plugged and restrained against internal pressure. The pipe shall be subjected to 10-psi hydrostatic pressure for 10 minutes. Free movement of water through the pipe joint wall shall be grounds for rejecting the pipe.

2. **Pipe in Maximum Deflected Position:** A test section is described below for each pipe material. The pipe shall be subjected to 10-psi hydrostatic pressure for 10 minutes. Free movement of water through the pipe joint or pipe wall shall be grounds for rejecting the pipe.

3. **Joints Under Differential Load:** The test section shall be supported on blocks or otherwise, as described below for each pipe material. There shall be no visible leakage when the stressed joint is subjected to 10-psi internal hydrostatic pressure for 10 minutes.

   (a) **Concrete Pipe:** For a deflected position, a position ½ inch wider than the fully compressed position shall be created on one side of the outside perimeter. For a differential load, one pipe shall be supported so that it is suspended freely between the adjacent pipe, bearing only on the joints. In addition to the weight of the suspended pipe, a test load shall be added, as shown in **Table 4.3**.

Table 4.3. TEST LOADS FOR CONCRETE PIPES UNDER DIFFERENTIAL LOAD

Pipe Size (inches)	Load per Foot, Laying Length Up to 4 Feet (pounds)	Total Load, Pipe 4 Feet and Over (pounds)
Sanitary Laterals		
4	650	2,600
6	1,000	4,000
Sanitary Mains		
8	1,300	5,200
10	1,400	5,600
12	1,500	6,000
15	1,850	7,400
18	2,200	8,000
21	2,500	10,000
24 and over	2,750	11,000

   (b) **Ductile Iron Pipe:** For the deflected position, a position ½ inch wider than the fully compressed section shall be created on one side of the outside perimeter. For a differential load, one of the pipes shall be supported so that it is suspended freely between the adjacent pipe, and bearing only on the

joints. A force shall be applied along a longitudinal distance of 12 inches beside one of the joints, as specified in **Table 4.4**.

(c) **PVC Pipe:** For the deflected position, two 12½-foot lengths shall be joined, then deflected along an arc of 720-foot radius (0.11 feet offset at the end of each length from a tangent at the joint). For a differential load, two lengths shall be joined and uniformly supported for at least 2 feet on both sides of the joint and the adjacent pipe to 95 percent of its vertical diameter.

Table 4.4. TEST LOADS FOR DUCTILE IRON PIPES UNDER DIFFERENTIAL LOAD

Pipe Size (inches)	Load (pounds)	Pipe Size (inches)	Load (pounds)
4	600	15	3,700
6	900	18	4,400
8	1,200	21	5,000
10	1,500	24 and over	5,500
12	1,800	--	--

d. Workmanship

1. **Line and Grade**

(a) Survey control hubs for both line and grade shall be provided by the design engineer in accordance with Section 401.1.04, "Surveying."

(b) Variance from the established line and grade shall not be greater than ¼ inch for grade and ½ inch for line, provided that such variation does not result in a level or reverse-sloping invert.

(c) The contractor shall check line and grade as necessary. If the limits prescribed in these standards are not met, the work shall be immediately stopped; the City's authorized representative notified, and the cause remedied before proceeding with the work.

(d) Variation in the invert elevation between adjoining ends of pipe, due to non-concentricity of joining surface and pipe interior surfaces, shall not exceed 1/64 per inch of pipe diameter, or ½ inch maximum.

2. **Pipe Handling**

(a) The contractor shall unload pipe only by approved means. Pipe shall not be unloaded by dropping it to the ground and shall not be dropped or dumped into trenches.

(b) Pipe shall not be unloaded or stored within the public right-of-way unless approved by the City's authorized representative.

(c) The contractor shall inspect all pipe and fittings before lowering them into trenches to ensure that no cracked, broken, or otherwise defective materials are used.

(d) The contractor shall clean the ends of pipe thoroughly, remove foreign matter and dirt from inside the pipe, and keep it clean during laying and joining.

(e) The contractor shall lower the pipe into the trench in such a manner as to avoid any physical damage to the pipe.

(f) The contractor shall remove all damaged pipe from the job site.

3. **Tying In**

(a) Where poured-in-place manhole bases are installed, the contractor shall not break into an existing sewer line until just before the project is finalized and the manhole has been tested and approved by the City's authorized representative.

(b) When a contractor ties into a "live" line, the contractor shall keep the new line plugged at the downstream end of the construction to prevent groundwater from entering the City's sewage system.

4. **Foreign Material**

(a) The contractor shall take all necessary precautions to prevent excavated or other foreign material from entering the pipe during the laying operation.

(b) At all times, when laying operations are not in progress, the contractor shall use a mechanical plug at the open end of the last laid section of pipe, to prevent entry of foreign material or creep of the gasketed joints.

5. **Pipe Laying**

(a) Trench excavation shall be in accordance with Section 6, "Trench Excavation and Backfill."

(b) Pipe laying shall proceed upgrade, with the spigot ends pointing in the direction of flow.

(c) After a section of pipe is lowered into the prepared trench, the contractor shall clean the end of the pipe to be joined, the inside of the joint, and the rubber ring (if required) immediately before joining the pipe.

(d) At the location of each joint, dig bell (joint) holes of ample dimensions in the bottom of the trench and at the sides, where necessary, to permit the joint to be made properly.

(e) The joint shall be assembled according to the recommendations of the manufacturer. The contractor shall provide all special tools and appliances required for the jointing assembly. The contractor shall take care to properly align the pipe before forced entirely home.

(f) Upon completion of pipe laying, all pipe joints shall be in the "home" position, which is defined as the position where the least gap (if any) exists when the pipe components that comprise the joint are fitted together as tightly as the approved joint design will permit. Gaps at pipe joints shall not exceed that allowed by the manufacturer's recommendations.

(g) Joints that exceed the manufacturers allowed gap shall be repaired as required by the City's authorized representative at no cost to the City. Where 3 or more joint gaps between two structures exceed that recommended by the manufacturer, then all pipe from the first gap to the structure shall be properly re-laid at the Contractor's sole expense.

(h) After the joint is made, the pipe shall be checked for alignment and grade.

(i) The trench bottom shall form a continuous and uniform bearing and support for the pipe at every point between joints.

(j) After installation, the contractor shall backfill the trench to the extent necessary to prevent pipe movement from any cause, including uplift or floating. Upon inspection and approval by the City's authorized representative, the contractor shall complete backfill of the trench.

(k) Do not lay pipe in water or when, in the opinion of the City's authorized representative, trench conditions are unsuitable.

6. **Movable Shield:** When pipe is laid in a movable trench shield, the contractor shall take all necessary precautions to prevent the pipe joints from pulling apart when the shield is moved ahead. The bottom of the shield shall not extend below the spring line of the pipe without recompacting the pipe zone.

7. **Cutting Pipe:** When cutting or machining the pipe is necessary, the contractor shall use only the tools and methods recommended by the pipe manufacturer and approved by the City's authorized representative. The contractor shall cut ductile iron pipe using a method approved by the City's authorized representative; all burrs or rough edges shall be removed before joining pipe. The contractor shall not flame-cut the pipe.

8. **Transition Fittings:** When joining different types of pipes, the contractor shall use approved ridged fittings. Where ridged fittings are not available, flexible fittings with No. 305 stainless steel bands, such as Fernco, Caulder, or approved

equal, may be considered upon approval of the City's authorized representative; flexible fittings may require additional support under the coupling. Bell type couplings are considered flexible.

(a) Shear ring/ridge transition couplings meeting the ASTM C-564 or equal shall be used.

(b) PVC couplers or adapters shall meet the specifications for ASTM D-3034, SDR 35 pipe fittings.

(c) Ductile iron transition couplings shall be manufactured from ductile iron conforming to ASTM A-536, grade 65-45-12, for center and end rings. Rubber gaskets, bolts, and nuts shall conform to AWWA C-111/ANSI A21.11.

9. **Concrete Closure Collars**

(a) The contractor shall pour closure collars against undisturbed earth, remove all water from the excavation, and construct suitable forms to create shapes that will provide full bearing surfaces against undisturbed earth, as indicated in **Detail No. S-2190** of these standards.

(b) Closure collars shall be used only when approved by the City's authorized representative, and then only to make connections between dissimilar pipe and where standard rubber-gasketed joints are impractical.

(c) Before the closure collars are installed, the contractor shall wash the pipe to remove all loose material and soil from the surface where they will be placed.

10. **Trench Backfill:** The contractor shall place trench backfill in accordance with Section 6, "Trench Excavation and Backfill."

11. **Sanitary Sewer Laterals and Tees**

(a) Lateral sewers shall be connected to new sanitary sewer mains with manufactured tee fittings per Section 401.4.02.b.4, "Fittings", except where sewer laterals are larger than 50% of the diameter of the main line. Such sewer laterals shall be connected to the main line through the installation of a manhole. Line taps in new mains are not permitted.

(b) Install sanitary sewer laterals and tee fittings in accordance with **Detail No. S-2175** of these standards.

(c) Lateral pipe and fittings shall consist of one type of material throughout and no interchanging of pipe and fitting material is allowed.

12. **Line Taps**

(a) Line taps are allowed on existing sanitary lines only and shall be core drilled unless approved otherwise by the City's authorized representative. Core drilled holes shall be done using a cylinder-style hole saw for only plastic pipe material or a diamond core bit for concrete and D.I. pipes.

(b) Line tap connections to sanitary lines shall be located a minimum 12" from the sanitary mainline pipe bell.

(c) Line tap connections to existing sanitary lines may be done using either saddle tees as per Section 401.4.02.b.5.(a), "PVC Tee Saddle" or by using Inserta Tee® as per Section 401.4.02.b.5(c), "Inserta Tee®".

(d) PVC tee saddles shall be installed in accordance with **Detail No. S-2155** of these standards. Inserta Tee® shall be installed in accordance with **Detail No. S-2160** of these standards.

(e) The area around the line tap installation site shall be cleaned and free of all rough edges before installing fittings.

(f) While installing the connection, no rock, dirt, or debris shall be allowed to enter the main sewer line from the core hole.

(g) The contractor shall install ¾"-0" crushed aggregate in the pipe zone around the line tap, from 6 inches below the pipe to 12 inches above the pipe.

(h) Laterals shall have tracer wire installed beside the pipe and plastic caution tape installed 1-foot above the pipe crown as shown in **Detail No. S-2175** of these standards.

401.4.03 Pressure Mains

a. General Provisions

These specifications, together with all other applicable requirements of federal, state, and local law, shall govern the character and quality of material, equipment, installation, and construction procedures for pressurized sanitary sewer work.

b. Materials

1. **Ductile Iron Pipe:** Ductile iron pipe shall be lined with cement mortar and seal-coated and shall conform to applicable portions of the following specifications: ASTM A-536, AWWA C-104/ANSI A21.4, AWWA C-111/ANSI A21.11, and AWWA C-151/ANSI A21.51.

2. **PVC Pipe**: PVC pipe with diameters of 4 inches through 12 inches shall conform to the requirements of AWWA C-900. Joints shall be elastomeric gasketed and shall conform to the requirements of ASTM D-3139.

3. **High Density Polyethylene Pipe (HDPE):** HDPE pipe with diameters of 4 inches through 63 inches shall conform to the requirements of AWWA C-906.

Joints shall be joined by thermal heat fusion and shall conform to the requirements of ASTM D-2683 for socket-type fittings, ASTM D-3261 for butt-type fittings, or ASTM F-1055 for electrofusion-type fittings.

c. Workmanship and Pipe Installation

1. All pipe shall be laid to the specified lines and grades. The minimum depth of the pipe cover shall be as specified in Section 401.2.02.l, "Pipe Cover." Pipes shall not be deflected either horizontally or vertically beyond the limits established and recommended by the pipe manufacturer.

2. Pipeline shall be laid to a grade that results in the minimum number of high points, based on terrain and economic considerations. Abrupt transitions and sharp peaks shall be avoided.

3. All tees, elbows, or other fittings shall be produced by the pipe manufacturer and shall be properly braced, anchored, or blocked.

4. Automatic air and vacuum release valves with a bleed-off port shall be installed at all high points or locations in the pipeline where air pockets would be expected to accumulate. Valves shall be installed in a vault, so as to provide accessibility for service and repair. Sumps shall be required for holding excess liquid discharged from the bleed-off port.

401.5.00 CONSTRUCTION SPECIFICATIONS

401.5.01 General Provisions

The specifications detailed here, together with the standards established by the Oregon DEQ, the U.S. Environmental Protection Agency, and any other applicable requirements of the City, shall govern the character and quality of material, equipment, installation, and construction procedures for mainline sanitary sewer work of gravity-flow systems.

401.5.02 Scheduling

a. The contractor shall plan their construction work in conformance with Section 101.8.02, "Scheduling."

b. Newly installed sanitary sewer lines shall not be placed in service until necessary testing is complete and system has been approved by the City's authorized representative.

401.5.03 Environmental Protection, Erosion Prevention, and Sediment Control

The contractor shall take all appropriate measures and precautions to minimize the work's impact on the environment and shall control erosion, as outlined in Section 101.9.00, "Environmental Protection, Erosion Prevention, and Sediment Control."

401.5.04 Interferences and Obstructions

Various obstructions may be encountered during the course of the work. The contractor shall follow the guidelines established in Section 101.8.05, "Interferences, Obstructions, Abandoned Utilities."

401.5.05 Abandon Sewer Facilities

a. **Sanitary Sewer Pipe**: Sanitary sewer pipe facilities to be abandoned shall be cut off and completely removed at 48-inches minimum below finish grade, unless specifically stated otherwise. Sanitary sewer pipe to be abandoned shall be removed or completely filled with a flowable, Controlled Low-Strength Material (CLSM) as directed by the City's authorized representative.

b. **Manholes**: Manholes to be abandoned shall have manhole frame, cover, grade rings, cone section or flat slab top removed and manhole sections cut and removed at 48-inches minimum below finish grade, unless specifically stated otherwise. The manhole base shall be rubblized or perforated to prevent the entrapment of water. The remaining portion of manhole shall be backfilled with Class B material in accordance with Section 6, "Trench Excavation and Backfill."

401.5.06 Contaminated Soil or Hazardous Material

If during construction contaminated soil or hazardous materials or chemicals are encountered, the Contractor shall follow the procedures specified in Section 101.9.02, "Contaminated Soils or Hazardous Materials."

401.5.07 Trench Excavation, Preparation, and Backfill

Trench excavation, preparation, and backfill shall conform to the requirements of Section 6, "Trench Excavation and Backfill."

401.5.08 Preservation, Restoration, and Cleanup

Cleanup of all construction debris, excess excavation, and excess materials and complete restoration of all fences, mailboxes, ditches, culverts, signposts, and similar items shall be completed according to Section 101.8.16, "Preservation, Restoration, and Cleanup."

401.5.09 Bores

Bores shall conform to the requirements of Section 301.10.09, "Bores."

401.6.00 TESTING PROCEDURES

401.6.01 General

a. **Locate Wire Testing:** Prior to paving, the contractor shall notify the City's authorized representative that the sanitary sewer locate wire is ready for testing. City personnel shall connect to the locate wire and attempt to locate sanitary sewer main line and services. The sewer main line and sewer services shall be located from at

least two connection points to be considered to have adequate coverage. The contractor will be required to locate and repair any gaps in the locate wire coverage. Failed sections shall be retested until adequate coverage is obtained.

b. **Testing Order:** Prior to the start of sanitary system testing, all manholes shall be re-numbered as assigned by the City's authorized representative. All testing shall reference the City assigned manhole numbers.

Sanitary systems and appurtenances shall pass a deflection test and an air test before acceptance, and shall be free of visible leakage. Information about air testing may be obtained from the City's authorized representative. Individual joints on pipe 54 inches in diameter or larger may be tested by an approved joint-testing device. All details of testing procedure shall be subject to approval of the City's authorized representative. Testing of sanitary systems shall be conducted in the following order.

1. Deflection testing of pipelines.

2. Air pressure testing of pipelines.

3. Video-inspection of pipelines.

4. Vacuum testing of manholes

c. If repair work is required on a section of the system, that portion of the system shall be retested in the testing order given above.

d. Deflection testing, air pressure testing, and video-inspection shall be done only after backfill has passed the required compaction test(s) based on AASHTO T-180 and roadway base rock has been placed, compacted, and approved.

e. The sanitary system must pass deflection testing, air pressure testing, and video-inspection before paving of overlying roadways will be permitted.

f. Vacuum testing of manholes shall be performed only after paving is completed and approved, or finish grading is completed and approved for manholes installed outside of paved areas. If paving occurs around existing manholes, those manholes shall be vacuum tested and repaired, as needed, in accordance with Section 401.6.03.a, "Vacuum Testing" after paving is completed and approved.

401.6.02 Gravity System Testing

a. **Cleaning Before Test:** Before testing and City inspection of the system, the contractor shall plug the closest downstream manhole, ball and flush, and clean all parts of the system. The contractor shall remove all accumulated construction debris, rocks, gravel, sand, silt, and other foreign material from the system at the plugged manhole using a vacuuming process. At no time, shall any material be flushed into the downstream city sewer system. When the City's authorized representative inspects the system, any foreign matter still present shall be removed from the system by repeating the cleaning process. **Test Equipment:** The contractor shall furnish all necessary test equipment and perform the tests in a manner satisfactory to the City's

authorized representative. Any arrangement of test equipment shall be permitted that will provide observable and accurate measurements of air leakage under the specified conditions. Gauges for air testing shall be calibrated with a standardized test gauge.

b. **Deflection Test for Flexible Pipe:** Sanitary sewers constructed of flexible pipe shall be deflection-tested by pulling an approved mandrel through the completed pipeline. The diameter of the mandrel shall be 95% of the nominal pipe diameter, unless otherwise specified by the City's authorized representative. The mandrel shall be a rigid, nonadjustable, odd-numbered leg (9 legs minimum) mandrel having an effective length of not less than its nominal diameter. Testing shall be done manhole-to-manhole after the line has been completely balled and flushed with water and after compaction tests of backfill have been completed and accepted. Testing shall be conducted in the presence of the City's authorized representative. The contractor will be required to locate and repair any sections that fail the test and to retest those sections. All repairs shall follow, and be in compliance with, the manufacturer's recommendations.

c. **Air Pressure Testing**

1. **General:** After the system is complete, including service connections and backfilling, the contractor shall conduct a low-pressure air test. The contractor shall provide all equipment and personnel for the test. The method, equipment, and personnel shall be subject to approval of the City's authorized representative. Testing shall be conducted in the presence of the City's authorized representative. The City's authorized representative may, at any time, require a calibration check of the instrument used. The pressure gauge shall have minimum divisions of 0.10 psi and an accuracy of 0.0625 psi (one ounce per square inch). All air shall pass through one control panel.

2. **Safety Precautions:** All plugs used to close the sewer for the air test must be capable of resisting the internal pressures and must be securely braced. All air-testing equipment must be placed above ground. No one shall be permitted to enter a manhole or trench where a plugged line is under pressure. All pressure must be released before the plugs are removed. The testing equipment must include a pressure-relief device designed to relieve pressure in the line under test at 10 psi or less, and must allow continuous monitoring to avoid excessive test pressure. The contractor shall use care to prevent the air inlet from flooding with infiltrated groundwater. The contractor shall inject air at the upper plug if possible. Only qualified personnel shall be permitted to conduct the test.

3. **Method:** Air testing shall be by the time pressure drop method, as follows:

   (a) Clean the lines to be tested and remove all debris.

   (b) Wet the lines before testing (optional).

   (c) Plug all open ends with suitable test plugs; brace each plug securely.

(d) Check the average height of groundwater over the line. Add air slowly to the section of the system being tested until the internal air pressure is 3.5 psi higher than the average pressure of groundwater (0.433 psi for each foot of average water depth over the line).

(e) After the internal test pressure is reached, allow at least two minutes for the air temperature to stabilize, adding only the amount of air required to maintain pressure.

(f) After the temperature stabilization period, disconnect the air supply.

(g) Determine and record the time (in seconds) required for the internal air pressure to drop from 3.5 psi to 2.5 psi.

(h) Compare the time recorded in step (g) above with the time required, as determined below.

4. **Passing test:** A passing test shall be based on meeting or exceeding the requirements below. The test method depends on the type of pipe material. If a line fails to meet the requirements, the contractor shall repair or replace all defective materials or workmanship.

(a) Concrete pipe

Air pressure drop method: The tested section, when tested by the air pressure drop method, will be acceptable if the time required for the pressure to drop from 3.5 psi to 2.5 psi is not less than the time (T) in seconds (**Table 4.5**) computed by the following formula:

$$T = K/C$$

Where: $K = 0.011 \times d^2L$.

$C =$ 1 or $0.0003882 \times dL$, whichever is greater.

$d =$ inside diameter of pipe (inches).

$L =$ length of pipe (feet).

(b) PVC, HDPE, and ductile iron pipe

The minimum duration for the prescribed low-pressure exfiltration pressure drop between two consecutive manholes shall not be less than that shown in **Table 4.6** or **Table 4.7**. The Tables list test duration values for pressure drops of 1.0 psi and 0.5 psi in excess of groundwater pressure above the top of the sewer pipe. Values accommodate both an allowable average loss per unit of surface area and an allowable maximum total leakage rate.

(c) Record the diameter (inches), length (feet), end manhole number, time, pressure drop, and groundwater level of the test on an inspection form. The form shall become part of the permanent record for the project.

Table 4.5. AIR TESTING OF CONCRETE PIPE

	Pipe Diameter (inches)										
Pipe Length (ft)	4.0 Time (sec)	6.0 Time (sec)	8.0 Time (sec)	10.0 Time (sec)	12.0 Time (sec)	15.0 Time (sec)	18.0 Time (sec)	21.0 Time (sec)	24.0 Time (sec)	30.0 Time (sec)	36.0 Time (sec)
10	1.8	4.0	7.0	11.0	15.8	24.8	35.6	48.5	63.4	99.0	142.6
20	3.5	7.9	14.1	22.0	31.7	49.5	71.3	97.0	126.7	198.0	285.1
30	5.3	11.9	21.1	33.0	47.5	74.3	106.9	145.5	190.1	297.0	427.7
40	7.0	15.8	28.2	44.0	63.4	99.0	142.6	194.0	253.4	396.0	570.2
50	8.8	19.8	35.2	55.0	79.2	123.8	178.2	242.6	316.8	495.0	712.8
60	10.6	23.8	42.2	66.0	95.0	148.5	213.8	291.1	380.2	594.0	855.4
70	12.3	27.7	49.3	77.0	110.9	173.3	249.5	339.6	443.5	693.0	997.9
80	14.1	31.7	56.3	88.0	126.7	198.0	285.1	388.1	506.9	792.0	**1020.1**
90	15.8	35.6	63.4	99.0	142.6	222.8	320.8	436.6	570.2	**850.1**	*same. after 72 ft.*
100	17.6	39.6	70.4	110.0	158.4	247.5	356.4	485.1	633.6	*same. after 86 ft.*	
110	19.4	43.6	77.4	121.0	174.2	272.3	392.0	533.6	**680.1**		
120	21.1	47.5	84.5	132.0	190.1	297.0	427.7	582.1	*same. after 108 ft.*		
130	22.9	51.5	91.5	143.0	205.9	321.8	463.3	**595.1**			
140	24.6	55.4	98.6	154.0	221.8	346.5	499.0	*same. after 123 ft.*			
150	26.4	59.4	105.6	165.0	237.6	371.3	**510.0**				
160	28.2	63.4	112.6	176.0	253.4	396.0	*same. after 144 ft.*				
170	29.9	67.3	119.7	187.0	269.3	420.8					
180	31.7	71.3	126.7	198.0	285.1	**425.0**					
190	33.4	75.2	133.8	209.0	301.0	*same. after 172 ft.*					
200	35.2	79.2	140.8	220.0	316.8						
210	37.0	83.2	147.8	231.0	332.6						
220	38.7	87.1	154.9	242.0	**340.0**						
230	40.5	91.1	161.9	253.0	*same. after 215 ft.*						
240	42.2	95.0	169.0	264.0							
250	44.0	99.0	176.0	275.0							
260	45.8	103.0	183.0	**283.4**							
270	47.5	106.9	190.1	*same. after 258 ft.*							
280	49.3	110.9	197.1								
290	51.0	114.8	204.2								
300	52.8	118.8	211.2								
310	54.6	122.8	218.2								
320	56.3	126.7	225.3								
330	58.1	130.7	**226.7**								
340	59.8	134.6	*same. after 322 ft.*								
350	61.6	138.6									
360	63.4	142.6									
370	65.1	146.5									
380	66.9	150.5									
390	68.6	154.4									
400	70.4	158.4									
410	72.2	162.4									
420	73.9	166.3									
430	75.7	**170.0**									
440	77.4	*same. after 430 ft.*									
450	79.2										
460	81.0										
470	82.7										
480	84.5										
490	86.2										
500	88.0										

Table 4.6. AIR TESTING OF PVC, HDPE, AND DUCTILE IRON PIPE – 1.0 PSIG PRESSURE DROP[1].

Specification Time Required for a 1.0 psig Pressure Drop for Size and Length of Pipe Indicated for Q = 0.0015*

Pipe Diameter	Minimum Time	Length for Minimum Time	Time for Longer Length	Specified Minimum for Length (L) Shown (min:sec)							
(inches)	(min:sec)	(feet)	(sec)	100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	3:46	597	0.380L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	0.854L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.647L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	31:10	72	25.852L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	34:00	66	30.768L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46
42	39:48	57	41.883L	69:48	104:42	139:37	174:30	209:24	244:19	279:13	314:07
48	45:34	50	54.705L	91:10	136:45	182:21	227:55	273:31	319:06	364:42	410:17

*Q is the allowable leakage rate in cubic ft/min/ft^2 of inside surface area of pipe.

1. Data from the UNI-Bell® PVC Pipe Association.

Table 4.7. AIR TESTING OF PVC, HDPE, AND DUCTILE IRON PIPE – 0.5 PSIG PRESSURE DROP[1].

Specification Time Required for a 0.5 psig Pressure Drop for Size and Length of Pipe Indicated for Q = 0.0015*

Pipe Diameter	Minimum Time	Length for Minimum Time	Time for Longer Length	Specified Minimum for Length (L) Shown (min:sec)							
(inches)	(min:sec)	(feet)	(sec)	100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	1:53	597	0.190L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	398	0.427L	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12
8	3:47	298	0.760L	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42
10	4:43	239	1.187L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54
12	5:40	199	1.709L	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50
15	7:05	159	2.671L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02
18	8:30	133	3.846L	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51
21	9:55	114	5.235L	9:55	13:05	17:27	21:49	26:11	30:32	34:54	39:16
24	11:20	99	6.837L	11:24	17:57	22:48	28:30	34:11	39:24	45:35	51:17
27	12:45	88	8.653L	14:25	21:38	28:51	36:04	43:16	50:30	57:42	64:54
30	14:10	80	10.683L	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07
33	15:35	72	12.926L	21:33	32:19	43:56	53:52	64:38	75:24	86:10	96:57
36	17:00	66	15.384L	25:39	38:28	51:17	64:06	76:55	89:44	102:34	115:23
42	19:54	57	20.942L	34:54	52:21	69:49	87:15	104:42	122:10	139:37	157:04
48	22:47	50	27.352L	45:35	68:23	91:11	113:58	136:46	159:33	182:21	205:09

*Q is the allowable leakage rate in cubic ft/min/ft^2 of inside surface area of pipe.

1. Data from the UNI-Bell® PVC Pipe Association.

d. **Video Inspection of Gravity Systems:** All sanitary systems shall be video-inspected and approved prior to City acceptance. Video inspection shall take place after trench backfill and compaction has been completed and accepted, and channels have been poured in manholes. All pipes shall be thoroughly cleaned in accordance with Section 401.6.02.a, "Cleaning Before Test" immediately prior to the video inspection; only that water remaining from cleaning shall be present in the system. Video inspection shall be continuous from manhole to manhole without breaks or interruptions in the recording. The camera shall have the ability to tilt up to 90 degrees and rotate 360 degrees on the axis of travel. An inspection of all lateral connections shall be conducted using the tilt capabilities of the camera. A 1/2-inch target ball shall be placed in front of the camera. There shall be no observed infiltration and observed sags must be less than 0.5 inch.

The City's authorized representative shall be notified and shall be present during video-inspection of the system, unless otherwise approved by the City's authorized representative. A copy of the video and a written video inspection report, on a City-approved form, shall be supplied to the City's authorized representative. The video shall be recorded in color CD or DVD format. Video shall include a visual footage meter recording. Problems revealed during the inspection shall be noted on the video and in the written report. After repairs have been made, the line shall be re-inspected and re-tested. If excessive foreign material, in the opinion of the City's authorized representative, is encountered during video inspection, the line shall be cleaned in accordance with Section 401.6.02.a, "Cleaning Before Test" and re-video inspected.

401.6.03 Manhole Testing

Sanitary sewer manholes shall be tested for acceptance after the trench is backfilled, compaction requirements are met, the road base rock is installed and the street paved, and chimney seals or concrete manhole closure collars are installed. If the manholes pass the tests but the castings were disturbed by construction and must be reinstalled, the manholes shall be retested.

a. **Vacuum Testing:** All manholes being constructed or rehabilitated shall be vacuum-tested. The test shall consist of plugging all inlets and outlets. The test head shall be placed at the inside of the top of the cone, and shall include grade rings and casting. The seal shall be inflated in accordance with the manufacturer's recommendations. A vacuum of 10 inches of mercury shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to 9 inches. The manhole shall pass if the time for the vacuum reading to drop to 9 inches meets or exceed the values listed in **Table 4.8**. The contractor shall repair all manholes that fail to pass the vacuum test; manholes shall be retested to verify the repair.

Table 4.8. VACUUM TESTING OF MANHOLES

Depth of Manhole (feet)	Diameter of Manhole		
	48 Inch	60 Inch	72 Inch
	Allowable Time (seconds)		
8	20	26	33
10	25	33	41
12	30	39	49
14	35	46	57
16	40	52	65
18	45	59	73
20	50	65	81
22	55	72	89
24	59	78	97
26	64	85	105
28	69	91	113
30	74	98	121

b. **Hydrostatic Testing:** When, in the opinion of the City's authorized representative, the groundwater table is too low to visually detect leaks, manholes may be hydrostatically tested. The test shall consist of plugging all inlets and an outlet, then filling the manhole with water to a height determined by the City's authorized representative. Leakage in each manhole shall not exceed 0.2 gallons per hour per foot of head above the invert. Leakage will be determined by refilling to the rim using a calibrated or known volume container. A manhole may be filled 24 hours before the test, if desired, to permit normal absorption into the pipe walls to take place. The contractor shall repair all manholes that fail to pass the leakage test; manholes shall be retested to verify the repair.

401.6.04 Pressure Main Testing

Field testing of the force main and appurtenances shall be completed by a hydrostatic test that meets the following requirements. Contractor shall be responsible for making all necessary provisions for conveying water to the points of use and for disposal of the test water, including temporary taps and plugs.

a. Prior to the start of the hydrostatic test, all trenching shall be backfilled, compacted, and accepted per the requirements of Chapter 6, "Trench Excavation and Backfill."

b. When concrete thrust blocks are used, the hydrostatic test shall be conducted after at least five days elapse from when the concrete thrust blocking was installed. If high-

early cement is used for the concrete thrust blocking, the time may be cut by two days.

c. Seal pipe ends and secure pipe with temporary thrust restraint, as required, to maintain line and grade and to prevent damage.

d. Fill the test section with water and allow it to stand at two-thirds of the test pressure for a minimum of 12 hours. All air shall be purged from the pipeline before it is checked for leaks or pressure or acceptance tests are performed on the system.

e. Furnish all equipment and materials and perform testing in conformance with Section 501.9.01, "Hydrostatic Testing."

f. If a large amount of water is required to increase the pressure during testing, entrapped air, leakage at joints, or a broken pipe can be suspected. In such cases, tests shall be discontinued until the source of trouble is identified and corrected.

g. Visible leaks in the wet well and vaults shall be eliminated regardless of the leakage amount.

401.7.00 SANITARY SEWER LINE ACCEPTANCE POLICY

The City of Wilsonville will accept new sanitary installations or systems built to the "Public Works Standards," providing that the following conditions are met.

401.7.01 Legal Recordings

Dedication of any required easements or rights-of-way have been recorded with the County Recorder and the Engineering Department receives a reproducible copy of the recorded documents.

401.7.02 Project Completion

After completion of construction of the total project, and after all testing has been satisfactorily completed, project closeout shall proceed as outlined in Section 101.8.17, "Project Closeout."

401.7.03 Maintenance Period

a. The Contractor or Applicant shall be responsible for providing Maintenance Assurance for Public Improvements as outlined in Section 101.8.18, "Maintenance and Warranty." Public sanitary improvements shall be warranted for a minimum of two years.

b. At any time during the warranty period, the City's authorized representative has reason to believe the public sanitary improvements have defects that were the result of faulty workmanship or flaws in construction material, the responsible party shall be required, at that party's own cost, to video-inspect the sewer line and repair any

problems or faults revealed during video inspection by replacing those sections. The video inspection shall be done during the winter, if possible, or during the wet weather months, to identify all leaks.

c. Before the end of the Construction Maintenance period, the City's authorized representative shall inspect the project for any remaining deficiencies. If the deficiencies that remain are determined to be the responsibility of the contractor or the applicant, the contractor or applicant shall then make such repairs.

SECTION 5

WATER SYSTEM DESIGN AND CONSTRUCTION STANDARDS

501.1.00 ENGINEERING

501.1.01 Introduction

This section outlines design and construction requirements for all public water system improvements. These provisions and technical specifications set forth the requirements of the City of Wilsonville for constructing water system improvements. Interpretations of such provisions and their application in specific circumstances shall be made by the City's authorized representative, unless specifically stated otherwise. Refer to Section 1 of the "Public Works Standards" for general provisions and requirements.

501.1.02 Extension of Public Water Systems

a. Except as to meet minimum fire flow requirements, the extension or upsizing of the public water systems in excess of 8 inches in diameter or as shown in the Wilsonville Water System Master Plan to serve any adjacent parcel or tract of land, shall be done by the property owner or permit applicant and may be subject to applicable System Development Charge (SDC) credits.

b. The City reserves the right to perform the work or cause it to be performed and bill the owner for the cost of the work or to pursue special assessment proceedings.

c. The public water system shall extend to the most distant parcel boundary, to facilitate future extension, unless otherwise approved by the City's authorized representative.

d. Where public infrastructure improvements paid for by the property owner or permit applicant directly benefit adjacent properties, the property owner or permit applicant may pursue establishment of a reimbursement district per Section 3.116 of the City Code.

501.1.03 Water Plans

a. It is the design engineer's responsibility to ensure that engineering plans are sufficiently clear and concise to construct the project in proper sequence, using specified methods and materials, with sufficient dimensions to fulfill the intent of these design standards.

b. All elevations on design plans and record drawings shall be based on the applicable NAVD 88 Datum specified in Section 101.7.07.a, "NAVD 88 Datum."

c. Existing conditions and facilities on design plans and record drawings shall be shown in light, gray print. Proposed conditions and facilities on design plans and record drawings shall be shown in bold, black print.

d. All engineering water plans shall be stamped by a Professional Engineer registered in the State of Oregon. At a minimum, water plans shall contain the following:

1. At least one sheet shall show a plan view of the entire project site. If the project site is sufficiently large that detailed water plans on any given sheet do not encompass the entire project site, then a sheet showing the plan view of the entire site must serve as an index to subsequent detailed plan sheets.

2. A topographic map showing existing conditions for the site, including the following:

(a) Existing topography for the site. Plan views showing existing features may be required for a distance of up to 100 feet (or further if warranted) beyond the proposed improvement in order to prevent future grade conflicts and will be determined on a case-by-case basis by the City's authorized representative.

(b) Adjacent streets, trails, multi-use paths, and rail lines, including the respective names.

(c) Existing utilities, including franchised utilities above or below ground and drainage facilities that transport surface water onto, across, or from the project site. Existing drainage pipes, culverts, and channels shall include the invert or flow line elevations.

(d) Existing vegetation, including denoting the type, DBH, and canopy size of trees within the construction limits.

(e) Existing environmentally sensitive areas (e.g., ravines, swales, steep slopes, wells, springs, wetlands, creeks, lakes, etc.). For natural drainage features, show direction of flow, drainage hazard areas, and 100-year floodplain boundary (if applicable).

(f) Adjacent existing features that are within 25 feet outside of the site boundary, including but not limited to construction activities that will potentially compromise the structural stability or condition of off-site features, such as cultivated vegetation, landscaping and trees, buildings, fences, decks, walls, slabs, and pavements. Denote the type, DBH, and canopy size of all trees.

3. Plans for proposed water improvements shall include the following:

(a) Grading and erosion control plan.

(b) Finished grades, showing the extent of cut and fill by existing and proposed contours, profiles, or other designations. Plan views showing existing features may be required for a distance of up to 100 feet (or further if warranted) beyond the proposed improvement in order to prevent future grade conflicts and will be determined on a case-by-case basis by the City's authorized representative.

(c) Horizontal stationing along centerline, showing points of tangency and curvature, including centerline stationing of all intersecting streets.

(d) Proposed structures, including roads and road improvements, parking surfaces, building footprints, walkways, landscape areas, etc.

(e) Water facilities, including pipe sizes, pipe types and materials, lengths, joint restraints, and all water system appurtenances, including, but not limited to valves, hydrants, fittings, vaults, meters and thrust blocks. Notes shall be included for referencing details, cross-sections, profiles, etc.

(f) Existing and proposed utilities, showing exact line and grade of all utilities crossing the proposed water system.

(g) Connection details at all locations of water system appurtenances, including the size, type, spacing, and connection style of valves, bends, tees, crosses, reducers, thrust blocks and other water system appurtenances as required by the City's authorized representative.

(h) Applicable detail drawings.

(i) Existing and proposed property lines, right-of-way lines, survey monuments, and easements.

(j) Setbacks from environmentally sensitive areas or resource areas protected within the Significant Resource Overlay Zone (SROZ).

(k) Any proposed phasing of construction.

(l) Any additional information that the City's authorized representative deems necessary.

4. Profiles for proposed water improvements will be provided at the same horizontal scale as the plan sheets and a 1" = 5' vertical scale. Profile drawings shall be drawn below the plan view or immediately following the associated plan view sheets. Profile views showing existing features may be required for a distance of up to 100 feet (or further if warranted) beyond the proposed improvement in order to prevent future grade conflicts and will be determined on a case-by-case basis by the City's authorized representative. The profiles shall include the following:

   (a) Existing and proposed ground along the proposed water main alignment.

(b) Water facilities, including pipe sizes, pipe types and materials, lengths, backfill material, joint restraints, and all water system appurtenances, including, but not limited to valves, hydrants, fittings, vaults, meters and thrust blocks. Notes shall be included for referencing details, cross-sections, etc.

(c) Existing and proposed utilities, showing exact line and grade of all utilities crossing the proposed water system. The vertical separation from existing and proposed utilities shall be labeled for all proposed utility crossings.

(d) Any additional information that the City's authorized representative deems necessary.

501.1.04 Surveying

a. The design engineer shall be responsible for establishing the location of the water line by means of reference stakes offset along the centerline of the water line. No construction shall be allowed to begin before construction staking. All staking shall be performed by or under the direction of a Professional Land Surveyor registered in the State of Oregon.

b. Stakes shall locate all public tees, crosses, bends, fire hydrants, blow offs, isolation valves, vaults, and booster pump stations. Maximum spacing for reference stakes is 50 feet. Stakes shall reference cuts and fills to the finished grade of the ground, asphalt, or concrete surface at that location to maintain minimum cover requirement. The design engineer shall also be responsible for identifying and staking easements during construction.

501.2.00 WATER DESIGN STANDARDS

The following design standards are intended only as a guide for the design of water system improvements. All designs shall conform to the latest adopted revision of the Oregon Administrative Rules, Chapter 333, "Public Water Systems," except where the City's standards exceed those of the state.

501.2.01 Pipe Location

a. Water lines are considered public, and are subject to these standards, up to the backflow prevention device or to the backside of a City of Wilsonville issued water meter. Beyond such point the contractor shall follow the adopted Oregon State Plumbing Specialty Code for domestic water services and the National Fire Protection Association (NFPA) standard 24 for private fire Service Protection piping, which is under the jurisdiction of City of Wilsonville Building Division.

b. Easements: Piped water systems shall generally be located in the right-of-way. When it is not possible or practical to install Public water distribution facilities in a dedicated public street the facilities shall be located within a water system easement granted to the City. Water system easements shall typically be exclusive and conform to Section 101.8.14, "Easements."

c. Where water lines are planned in the vicinity of sanitary sewer lines, design engineer and contractor shall follow guidelines established in Section 401.2.02.n, "Water and Sewer Lines."

d. Water mains will normally be placed on the south and east side of the street, outside the bike lane and vehicle wheel path, as indicated in the street detail drawings of these standards.

e. Valves shall be installed a minimum of 3 feet off face of curb and 6 feet off face of curb for streets with bike lanes.

f. Fire hydrants shall be located in compliance with TVF&R fire prevention ordinance. Generally, fire hydrants shall be placed as follows:

   1. The radius point of curb returns at street intersections.

   2. At the end of a water line to be extended in the future in place of a blow-off.

   3. Midblock installations are not preferred, but where necessary, place at a property line between adjacent lots.

   4. Locate as shown, or as directed, to provide complete accessibility and to minimize the possibility of damage from vehicles or injury to pedestrians.

   5. The maximum distance from a TVF&R approved driving surface to a fire hydrant is 15 feet.

501.2.02 Pipe Size

a. Minimum-size mains shall be 8 inches; all water mains shall be sized at 8, 12, 18, or 24 inches or as approved by the City's authorized representative. With prior approval of the City's authorized representative, 4-inch or 6-inch lines may be permitted provided there is no possibility of future extensions; 4-inch lines shall be limited to runs of less than 300 feet, no more than eight services, and no need for a fire hydrant.

b. An approved water system capable of supplying the required fire flow for fire protection shall be provided to all premises on which buildings are to be constructed.

   1. For areas of single-family residential, the required fire flow shall be a minimum of 1,500 gallons per minute (gpm) while maintaining a minimum residual pressure of 20 pounds per square inch (psi)

   2. For all other areas the required fire flow shall be a minimum of 3,000 gpm while maintaining a minimum residual pressure of 20 psi.

   3. The City's authorized representative may require modifications for a particular project.

c. The engineer for the project should meet with the City Engineering Department before design to discuss the size of mains and any other matters specific to the project. The City Engineer will make the final determination on the size of new water mains.

d. All water system tees and crosses shall be of the same size as the larger of the connecting water mains. The connecting water main shall not reduce to a smaller diameter to connect to a water system tee, cross, valve, or other water system fitting.

e. No fire hydrant shall be connected to a main of less than 8 inches diameter.

501.2.03 Pipe Material

Generally, all pipe shall be ductile iron (D.I.) restrained joint pipe.

a. All water mains 12-inch or less shall be minimum class 52 ductile iron pipe.

b. All water mains 18-inch to 36-inch shall be minimum class 51 ductile iron pipe.

c. All water mains larger than 36-inch shall be of material as required by the City's authorized representative.

501.2.04 Dead End Mains

a. Generally, permanent dead-end water mains will not be allowed. Water mains shall be looped wherever possible as determined by the City's authorized representative.

b. Water mains to be extended in the future shall have a fire hydrant installed at the temporary dead-end.

c. Water mains will be required to extend to the boundaries of new subdivisions.

501.2.05 Water System Appurtenances

a. Fittings shall be mechanical joint, unless otherwise specified.

b. Vertical bends shall be avoided for 12" water lines and larger.

c. Valves 12 inches and larger shall be butterfly valves.

d. Valves shall be the same size as the connecting water main.

e. Valves shall be located at intersections whenever possible. In general, spacing between isolation valves shall not exceed 800 feet.

f. Valves shall be required on all branches of tees and crosses on mainline intersections. At service line connections, valves shall be required at the service line connection only.

g. Valves shall be flanged by mechanical joint; valves shall be flanged to all tees and crosses.

h. Automatic air and vacuum release valves with a bleed-off port shall be installed at all high points or locations in the pipeline where air pockets would be expected to accumulate. Valves shall be installed as indicated in **Detail No. WT-3090** of these standards.

501.2.06 Thrust Restraint

a. All pipe joints shall be restrained by the installation of restraining gaskets, as approved by the pipe manufacturer.

b. All mechanical joints shall be restrained by a joint restraint system such as Megalug® Series 1100 retainers as manufactured by EBAA Iron, Inc., or approved equal.

c. Thrust blocks shall be provided for additional thrust restraint at all fire hydrants, wet tap locations, and existing water system appurtenances. In all other cases where flange connections, mechanical joint restraint systems and restrained gaskets are not feasible, thrust blocks may only be used with prior authorization by the City's authorized representative.

501.2.07 Water Service

Separate, individual water services and meters are required for domestic and irrigation water service, excluding individual single-family residences. Water services shall be connected to the main line per **Detail No. WT-3030** for ¾" – 1" water services and **Detail No. WT-3045** for 1 ½" – 2" water services. Deduct meters will not be allowed.

501.2.08 Cathodic Protection

The City's authorized representative may require cathodic protection of pipelines of certain sizes and materials or for pipe and fittings.

a. Prior to pipeline design and construction, the City's authorized representative may require soil sampling and testing for corrosivity.

b. Testing requirements shall be determined on a case-by-case basis.

c. If soil conditions are found to be possibly corrosive to buried pipe and fittings, cathodic protection measures such as bonded pipe coatings, bonded pipe joints, sacrificial anodes, alternate pipe materials, or other measures may be required by the City's authorized representative.

501.3.00 OPERATION OF VALVES IN CITY

Contractor shall request City operation of valves at least 2 business days in advance. At no time shall the contractor undertake to close off or open valves or take any other action that would affect the operation of the existing water system, unless specifically approved by City's authorized representative.

501.4.00 MATERIALS AND TECHNICAL SPECIFICATONS

501.4.01 Push-On Ductile Iron Pipe

Push-on joint D.I. pipe shall be cement mortar lined and shall conform to AWWA C-104/ANSI A21.4 and AWWA C-151/ANSI A21.51 as manufactured by U.S. Pipe and Foundry Company, American Pipe, or approved equal. Rubber ring gaskets shall conform to Section 501.4.06, "Gaskets," and shall be furnished with the pipe. A nontoxic vegetable soap lubricant (meeting the requirements of AWWA C-111/ ANSI A21.11) shall be supplied with the pipe in sufficient quantities for installing the pipe furnished.

501.4.02 Joints

Pipe joints shall be push-on joints with joint restraints such as U.S. Pipe Tyton™, American Fastite™ or approved equal, except where specifically shown or detailed otherwise.

a. Fitting joints shall be mechanical joint ends, except where specifically shown or detailed otherwise.

b. All valves joined to tees and crosses shall be flanged by mechanical joint.

501.4.03 Ductile Iron Fittings

Ductile iron fittings shall conform to AWWA C-110 / ANSI A21.10 and/or AWWA C-153 / ANSI A21.53. All ductile iron fittings shall be Class 350. Fittings hall be furnished with flanged or mechanical joints as specified on the plans.

501.4.04 Mechanical Joint Fittings

Mechanical joint D.I. fittings shall conform to the latest revision of AWWA C-110/ ANSI A21.10 and shall be of a class at least equal to that of the adjacent pipe. Bolts and nuts shall conform to AWWA C-111/ANSI A21.11. Mortar lining for fittings shall be the same thickness specified for pipe.

501.4.05 Flanged Ductile Iron Fittings

a. Flanged fittings shall be ductile iron conforming to ANSI/AWWA C-110/A21.10 and shall be faced and drilled Class 125 flanges that match ANSI B16.1 fittings. Flanges shall have flat faces and attached with bolt holes straddling the vertical axis of the pipe.

b. Bolts for assembly of flanged joints shall be of the size and quantity shown in the latest version of AWWA C-110. As stated in AWWA C-110, bolts shall conform to ANSI B18.2.1, Square and Hex Bolts and Screws Inch Series, Including Hex Cap Screws and Lag Screws. Nuts shall conform to ANSI B18.2.2, Square and Hex Nuts. Threads shall conform to ANSI B1.1 Standard for Unified Inch Screw Threads (UN and UNR Thread Form), Class 2A external and Class 2B internal. Bolts and nuts shall be of low-carbon steel conforming to the requirements of ASTM A-307 Standard Specifications for Carbon Steel Bolts and Studs, 60,0000 psi Tensile Strength Grade B.

c. The fittings shall be cement-mortar lined to same thickness specified for pipe.

501.4.06 Gaskets

a. **Restraining gaskets:** Push-on joints shall utilize restraining gaskets as approved by the pipe manufacturer. The restraining gaskets shall consist of stainless steel locking segments vulcanized into the gasket to grip the pipe and prevent joint separation, such as U.S. Pipe Field Lok™, American Fast-Grip®, or approved equal Gaskets shall conform to AWWA C-111/ ANSI A21.11 and shall be suitable for the specified pipe size and pressures.

b. **Flanged gaskets:** Gaskets shall be suitable for the specified pipe sizes and pressures. Flanged gaskets shall consist of 1/8-inch thick, full-face one-piece rubber gaskets, full-cut with holes to pass bolts conforming to ANSI/AWWA C-207 and ANSI B16.21. Gasket material shall be free from corrosive alkali or acid ingredients.

501.4.07 Mechanical Couplings

Mechanical couplings, clamps, or sleeves, not part of the pipe itself, shall be D.I. or steel with rubber rings or gaskets. Gaskets, bolts, and nuts shall conform to AWWA C-111/ANSI A21.11. Couplings, clamps, or sleeves shall be Dresser®, or approved equal.

501.5.00 CONSTRUCTION SPECIFICATIONS

501.5.01 General Provisions

All installation and testing of water system improvements shall conform to the latest adopted revision of the Oregon Administrative Rules, Chapter 333, "Public Water Systems," except where the City's provisions exceed those of the state.

501.5.02 Scheduling

a. The contractor shall plan their construction work in conformance with Section 101.8.02, "Scheduling."

b. Newly installed water lines shall not be placed in service until necessary testing and sterilization are complete and system has been approved by the City's authorized representative.

501.5.03 Environmental Protection, Erosion Prevention, and Sediment Control

The contractor shall take all appropriate measures and precautions to minimize their impact on the environment and control erosion, as outlined in Section 101.9.00, "Environmental Protection, Erosion Prevention, and Sediment Control."

501.5.04 Interferences and Obstructions

Various obstructions may be encountered during the course of the work. The contractor shall follow the guidelines established in Section 101.8.05, "Interferences, Obstructions, Abandoned Utilities."

501.5.05 Abandon Water Facilities

Water facilities to be abandoned shall be cut off and completely removed at 24-inches minimum below finish grade, unless specifically stated otherwise. Water valves shall be cut and completely removed from abandoned lines, unless otherwise directed by the City's authorized representative. Water mains to be abandoned shall be removed or completely filled with a flowable, Controlled Low-Strength Material (CLSM) as directed by the City's authorized representative.

501.5.06 Contaminated Soil or Hazardous Material

If during construction contaminated soil or hazardous materials or chemicals are encountered, the Contractor shall follow the procedures specified in Section 101.9.02, "Contaminated Soils or Hazardous Materials."

501.5.07 Trench Excavation, Preparation, and Backfill

Trench excavation, preparation, and backfill shall conform to the requirements of Section 6, "Trench Excavation and Backfill."

501.5.08 Preservation, Restoration, and Cleanup

Cleanup of all construction debris, excess excavation, and excess materials and complete restoration of all fences, mailboxes, ditches, culverts, signposts, and similar items shall be completed according to Section 101.8.16, "Preservation, Restoration, and Cleanup."

501.6.00 DUCTILE IRON PIPE—INSTALLATION

501.6.01 Suitable Conditions for Laying Pipe

a. Provide and maintain ample means and devices at all times to remove and dispose of water seepage and runoff entering the trench excavation during the process of laying pipe. Water in the trench shall not be allowed to enter the pipe and fittings.

b. Do not lay pipe in water or when, in the opinion of the City's authorized representative, trench conditions are unsuitable.

501.6.02 Handling

a. **Distributing Pipe:** Distribute material on the job from cars, trucks, or storage yard no faster than it can be used to good advantage. In general, distribute no more than one week's supply of material in advance of the laying.

b. **Handling Pipe and Fittings:** Provide and use proper implements, tools, and facilities for safe and proper work. Lower all pipe, fittings, and appurtenances into the trench, piece by piece, by means of a crane, sling, or other suitable tool or equipment, to prevent damage to the pipeline materials and protective coatings and linings. Do not drop or dump pipeline materials into the trench.

501.6.03 Cleaning Pipe and Fittings

a. Remove all lumps, blisters, and excess coating from the bell and spigot ends of each pipe. Wire-brush the outside of the spigot and the inside of the bell and wipe them clean, dry, and free from oil and grease before the pipe is laid.

b. Wipe clean all dirt, grease, and foreign matter from the ends of mechanical joint and rubber gasket joint pipe and fittings.

501.6.04 Placing Pipe in Trench

a. At the location of each joint, dig bell (joint) holes of ample dimensions in the bottom of the trench and at the sides, where necessary, to permit the joint to be made properly and to permit easy visual inspection of the entire joint.

b. Unless otherwise directed, lay pipe with the bell end facing in the direction of the laying.

c. For lines on slopes greater than 20%, face bells upgrade, unless otherwise directed by the City's authorized representative.

d. Do not allow foreign material to enter the pipe while it is being placed in the trench. At the end of each work day or during suspension of the work, securely close the pipe ends by means of a secure plug or approved equivalent.

e. Lay and join pipe with push-on, restrained type joints in strict accordance with the manufacturer's recommendations. Provide all special tools and devices, such as jacks, chokers, and similar items required for the installation. Lubricant for the pipe gaskets shall be furnished by the pipe manufacturer, and no substitutes shall be permitted under any circumstances.

f. After the first length of push-on, restrained joint pipe is installed in the trench, secure the pipe in place with approved backfill material that is tamped under and along the spring line to prevent movement. Keep the ends clear of backfill. After each section is joined, place backfill as specified in Section 6, "Trench Excavation and Backfill" to prevent movement.

g. Mechanical joint fittings vary slightly with different manufacturers. Install the furnished fittings in accordance with the manufacturer's recommendations. In general, the procedure shall be as specified here.

1. Clean the ends of the fittings of all dirt, mud, and foreign matter by washing with water and scrubbing with a wire brush.

2. Slip the gland and restraining gasket on the plain end of the pipe. If necessary, lubricate the end of the pipe to ease sliding the gasket in place.

3. Guide the fitting onto the spigot of the laid pipe.

501.6.05 Cutting Pipe

a. Cut pipe for inserting valves, fittings, or closure pieces in a neat and workmanlike manner, without damaging the pipe or lining and leaving a smooth end at right angles to the axis of the pipe.

b. The contractor shall cut ductile iron pipe using a method approved by the City's authorized representative; all burrs or rough edges shall be removed before joining pipe. The contractor shall not flame-cut the pipe.

c. Dress cut ends of push-on joint pipe by beveling with a heavy file or grinder as recommended by the manufacturer.

501.6.06 Permissible Deflection of Joints

Wherever it is necessary to deflect the pipe from a straight line either in a vertical or horizontal plane, to avoid obstructions, or where long-radius curves are permitted, the amount of deflection allowed shall not exceed the values shown in **Table 5.1** or the manufacturer's recommendations, whichever is less.

Table 5.1. MAXIMUM PERMITTED DEFLECTION, 18-FOOT-LONG PIPE

Mechanical Joint			Push-On Joint	
Diameter (inches)	**Max. Defl. Angle (degrees-minutes)**	**Deflection[1] (inches)**	**Max. Defl. Angle (degrees)**	**Deflection[1] (inches)**
4	4° – 09¢	15	3°	10
6	3° – 33¢	13	3°	10
8	2° – 40¢	10	3°	10
12	2° – 40¢	10	3°	10

Note: Maximum deflection shall be the lesser value between the deflection table and recommendations by the pipe manufacturer.

[1]Safe deflection shown is for 150 psi of pressure. For higher pressure, reduce tabulated deflection 10% for each 150 psi of added pressure.

501.6.07 Alignment

Pipelines intended to be straight shall not deviate from the straight line at any joint in excess of 1 inch horizontally or 1 inch vertically.

501.6.08 Anchorage and Restraint

All pipelines 4 inches in diameter or larger shall be secured with a suitable mechanical joint restraint system (such as Megalug® Series 1100 as manufactured by EBAA Iron, Inc or approved equals) at all tees, plugs, caps, and bends, and at other locations where unbalanced forces exist. Where required, provide thrust restraint as specified in Section 501.2.06, "Thrust Restraint." Gaskets shall be installed in accordance with Section 501.4.06, "Gaskets."

501.6.09 Construction of Blow-offs

Blow-offs shall be constructed as shown in **Detail No. WT-3075** or **Detail No. WT-3085** of these standards. Straddle blocks shall be constructed of reinforced concrete; the concrete mix shall be commercially produced and have a compressive strength of not less than 3,000 psi at 28 days, unless otherwise approved by the City's authorized representative. Blow-offs shall not be flushed or pressurized until a minimum of 7 days after concrete is installed. If high-early cement is used for the straddle block, the time may be cut by two days. Fire hydrants shall be installed in place of blow-offs at dead end water lines intended to be extended in the future.

501.6.10 Locating Wire Specifications

a. Install tracer wire beside the pipe and plastic caution tape 1-foot above the pipe crown.

b. Tracer wire connections shall occur at all junctions and be connected using a solderless connection kit suitable for direct burial that joins wires mechanically and electrically and seals out moisture, GelCap or approved equal.

c. Surface tracer wire at fire hydrants, blow-offs, and water services only. Tracer wire shall not be accessed through water valves.

d. Tracer wire shall be 12-gauge stranded or solid copper insulated High Molecular Weight Polyethylene (HMW-PE) with a blue insulated cover a minimum 45 mil in thickness and the wire UL rated for 140°F.

501.7.00 VALVES AND VALVE BOXES

501.7.01 Scope

This section covers the work necessary for furnishing and installing gate valves, butterfly valves, and valve boxes, complete.

501.7.02 Materials

a. **Gate Valves:**

1. Gate valves shall be resilient seated with ductile iron body, sized 3 inches through 8 inches, and shall conform to AWWA Standard C-509 and C-515 for ductile iron body valves. The manufacturer's name, the model, and the year of manufacture are to be cast on each valve.

2. Valve ends are to be flanged or mechanical joint by flanged, as shown on the plans, and conform to AWWA C-111 and ANSI Class 125. Buried service valves shall open with a counterclockwise rotation of a 2-inch operating nut.

3. All internal parts shall be accessible without removing the body from the line. The one-piece wedge shall be completely encapsulated by resilient material. The resilient sealing material shall be permanently bonded to the wedge with a rubber tearing bond meeting the requirements of ASTM D-429.

4. Valves shall have nonrising stems (NRS) and shall be cast bronze with integral collars in compliance with AWWA C-509 and C-515. The NRS shall have two O-ring seals above the thrust collar and one below. The two top O-rings are to be field replaceable (in the full open position) without removing the valve from service. Low-friction thrust bearings shall be placed above and below the stem collar. The stem nut shall be bronze and independent of the wedge.

5. Outside screw and yoke valves shall have a bronze stem attached to the disc assembly. An adjustable follower gland shall be incorporated to compress braided packing and seal the stem.

6. The waterway in the seat area shall be smooth, unobstructed, and free of cavities. The ductile iron body and bonnet shall be fully coated, both interior and exterior, with a fusion-bonded, heat-cured thermo setting material meeting all the application and performance requirements of AWWA C-550.

7. Gate valves shall meet the testing requirements as presented in AWWA C-509 and C-515.

b. **Butterfly Valves:**

1. Butterfly valves shall be the rubber-seated type, suitable for direct-burial service. They shall withstand 250 psi working pressure and a 250 psi pressure differential across the valve. Except as noted, the butterfly valve shall conform to AWWA C-504 for Class 250B.

2. Valve ends are to be flanged or flanged by mechanical joint, as shown on the plans, and conform to AWWA C-111 and ANSI Class 125.

3. All joint accessories shall be furnished with valves.

4. Valves shall be equipped with an ASTM A536 ductile iron body and 304 stainless-steel circular shaft. Shaft and disc seals shall be designed for a bubble-tight seal. The valve disc shall be ductile iron ASTM A536 and a stainless-steel edge with Buna N rubber seat bonded to the valve body.

5. The butterfly valve shall be furnished with a totally enclosed, integral valve operator design to withstand a minimum of 300 foot-pound input torque without damage to the valve or operator. Operators shall be fully gasketed and greased-packed and designed to withstand submersion in water to a pressure of 10 psi. Valves shall open with a counterclockwise rotation of a 2-inch operating nut. A minimum of 30 turns of the operating nut shall be required to move the disc from a fully opened position to a fully closed position.

6. Butterfly valves shall meet the testing requirements as presented in AWWA C-504.

c. **Extension Stems for Valve Operators:**

1. Where the depth of the operating nut is more than 3 feet, operating extensions shall be provided to bring the operating nut to a point 18 inches below the surface of the ground or pavement (see **Detail No. WT-3015** of these standards).

2. Where the depth of the operating nut is more than 6 feet, install a second rock guard plate equidistant between the first rock guard plate and the 2-inch operating nut.

3. The extension shall be constructed of solid steel rod and approved by the City's authorized representative. Cut extensions to the proper length so the valve box does not ride on the extension when set at grade.

501.7.03 Workmanship

a. **Valves:**

1. Valves shall be installed in accordance with **Detail No. WT-3020** of these standards. Valves shall be flanged by mechanical joint; valves shall be flanged to all tees and crosses.

2. Before installation, the valves shall be thoroughly cleaned of all foreign material. Valves shall be inspected for proper operation, both opening and closing, and to verify that the valves seat properly.

3. Valves shall be installed so that the stems are vertical, unless otherwise directed.

4. Jointing shall conform to AWWA C-600 or AWWA C-603, whichever applies. Joints shall be tested with the adjacent pipeline. If joints leak under test, valves shall be disconnected and reconnected, and the valve or the pipeline or both shall be retested.

b. **Valve Boxes:**

1. Valve boxes shall be installed in conformance with **Detail No. WT-3020** of these standards.

2. Center the valve boxes and set plumb over the wrench nuts of the valves. Set valve boxes so they do not transmit shock or stress to the valves. Set the valve box covers flush with the surface of the finished pavement, as shown in **Detail No. WT-3020** of these standards or to another level as may be required.

3. Where the depth of the operating nut is more than 3 feet, operating extensions shall be provided in accordance to Section 501.7.02.c, "Extension Stems for Valve Operators."

4. Valve boxes shall be cast iron "Vancouver" pattern with 18-inch tall casting. The letter W shall be cast into the top of the lid. Valve riser pipe from the valve to the cast iron top shall be 6-inch PVC sewer pipe ASTM D3034, SDR35. The valve riser pipe shall be one-piece and have sufficient length depending on the depth to the operating nut.

5. Backfill shall be the same as specified for the adjacent pipe. Place backfill around the valve boxes and thoroughly compact it to a density equal to that specified for the adjacent trench and in such a manner that will not damage or displace the valve box from the proper alignment or grade. Misaligned valve boxes shall be excavated, plumbed, and backfilled at the contractor's expense.

6. In non-paved areas, the valve box shall be set in a concrete collar as shown in **Detail No. WT-3020** of these standards.

501.8.00 FIRE HYDRANTS

501.8.01 Scope

This section covers the work necessary for furnishing and installing the fire hydrants, complete. Fire hydrants shall be installed as shown in **Detail No. WT-3060** of these standards.

501.8.02 Hydrants

a. Hydrants shall have a nominal 5¼-inch main valve opening with 6-inch bottom connections. The main valve shall be equipped with O-ring seals and shall open when turned counterclockwise.

b. The operating nut shall be a 1½-inch national standard pentagon nut.

c. Hydrants shall be equipped with two 2½-inch hose nozzles and one 4½-inch pumper nozzle with a Storz HPHA50–45NH permanent hydrant adapter.

d. Hydrants shall conform to AWWA C-502 and have a self-lubricating rising stem. The normal depth of bury shall be 4 feet. Nozzle threads shall be American National

Standard. The inlet connection shall be mechanical joint, restrained by a mechanical joint restraint system such as Megalug® Series 1100 as manufactured by EBAA Iron, Inc., or approved equal.

e. Hydrants shall be Mueller Centurion, Waterous Pacer, or approved equal.

f. Hydrants shall be painted Yellow in accordance with **Detail No. WT-3060** of these standards.

501.8.03 Base Block

The base block shall be solid precast concrete pier block with nominal dimensions of 8-inch thickness and 12-inch-square base.

501.8.04 Workmanship

Construction and installation shall conform to these standards and to the provisions of AWWA C-600, except where otherwise specified.

501.8.05 Location and Position

a. Fire hydrants shall be located in compliance with TVF&R requirements. Improperly located hydrants shall be disconnected and relocated at the contractor's expense.

b. When the hydrant is placed behind the curb or sidewalk, set the hydrant barrel so that no part of the pumper or hose nozzle cap is less than 24 inches from the face of the curb or the backside of the sidewalk.

c. Set all hydrants plum with nozzles parallel with the curb, or at right angles to it. With the pumper nozzle facing the curb, set hydrants so that the safety flange is at least 3 inches and at most 6 inches above the finished ground or sidewalk level, to clear bolts and nuts.

d. No concrete, fencing, or other obstructions interfering with the hydrant operation shall be installed in the hydrant clear zone. The clear zone is a triangular area that extends 3 feet behind a hydrant, 5 feet on each side.

e. Bollards may be required to be placed around hydrants located in areas exposed to vehicular traffic at the direction of the City's authorized representative.

f. Install an approved blue bi-directional, reflectorized button in the center of the near travel lane using an approved fast-setting bonding agent.

501.8.06 Excavation

Do not carry excavation below the subbase grade. Refill over excavated areas with Class "B" Backfill material in accordance with Section 6, "Trench Excavation and Backfill" compact to create a firm foundation.

501.8.07 Base Rock

Place Class "B" Backfill material in accordance with Section 6, "Trench Excavation and Backfill" on a firm, level subbase or subgrade to assure uniform support.

501.8.08 Installation of Hydrants

a. Fire hydrants shall be connected to the main with 6-inch ductile iron pipe in accordance with per the same requirements for water main pipe of Section 5. The connecting pipe shall be continuous piping with no sleeves allowed.

b. Fire hydrants installed on existing mains shall be installed with a standard wet tapping sleeve and gate valve per **Detail No. WT-3025** of these standards. Tapping sleeve shall be flange x MJ gate valve and shall match hydrant line size.

c. Fire hydrants installed with new main construction shall be connected to the main with MJ x MJ x flange tee fitting and flange x MJ gate valve.

d. Place the hydrant carefully on the base block to prevent the base block from breaking. After the hydrant is in place and is connected to the pipeline, place temporary blocks to maintain the hydrant in a plumb position during subsequent work.

501.8.09 Gravel for Drainage

Gravel for drainage shall be washed 1½" – ¾" aggregate or graded river gravel free of organic matter, sand, loam, clay, or other small particles that will restrict water flow through the gravel. Place gravel around the base block and hydrant bottom after the hydrant is blocked in place. Top of gravel shall be not less than 6 inches above the hydrant drain opening. Do not connect the drainage system to the sewer.

501.8.10 Thrust Blocking and Restraint

a. Fire hydrants shall be secured by thrust blocking. Provide reaction or thrust blocking, as shown in **Detail No. WT-3060** of these standards, or as directed. Place blocking between the undisturbed ground and the fitting to be anchored. Blocking bearing surface shall be as shown in **Detail No. WT-3000** of these standards.

   1. Place the blocking so that the pipe and fitting joints will be accessible to repairs by wrapping all joints and fittings in new plastic sheeting (minimum 8 mil thickness).

   2. The concrete mix shall be commercially produced and have a compressive strength of not less than 3,000 psi at 28 days, unless otherwise approved by the City's authorized representative.

b. Mechanical joint fittings at all hydrants, valves, and bends shall be restrained by a joint restraint system such as Megalug® Series 1100 retainers as manufactured by EBAA Iron, Inc., or approved equal.

c. Push-on joints shall utilize restraining gaskets in accordance with Section 501.4.06.a "Restraining Gaskets."

501.8.11 Thrust Ties

Stainless Steel thrust ties may be used with concrete thrust blocking, with prior approval of the City's authorized representative, when the top of the existing ground behind the fire hydrant is less than 2 feet above the top of the hydrant base or where unsuitable ground prevents proper anchorage.

501.9.00 HYDROSTATIC TESTING AND STERILIZATION OF NEWLY INSTALLED PIPE

501.9.01 Hydrostatic Testing

a. Contractor shall make pressure and leakage tests on all newly laid pipe; follow the procedures specified in AWWA C-600, Section 5.2, "Hydrostatic Testing." The new mains being tested shall remain isolated from the existing water system.

b. Contractor shall furnish all necessary equipment and material, make all taps in the pipes as required, and conduct the tests.

c. Contractor shall notify the City's authorized representative a minimum of 2 business days prior to testing. The City's authorized representative will monitor the tests and assure that all taps are installed and service pipe extended.

d. Furnish equipment and materials for the tests as shown in **Table 5.2**.

Table 5.2. HYDROSTATIC TESTING EQUIPMENT & MATERIALS

Amount	Description
2	Pressure gauges
1	Hydraulic force pump approved by the City's authorized representative
1	Suitable hose and suction, as required

e. Conduct the tests after the trench is backfilled and compacted to required specifications and approved by the City's authorized representative. Where any section of pipe has concrete thrust blocking, do not take the pressure tests until at least five days elapse after the concrete thrust blocking is installed. If high-early cement is used for the concrete thrust blocking, the time may be cut by two days.

f. Conduct pressure tests in the following manner, unless otherwise approved by the City's authorized representative. After the trench is backfilled or partially backfilled as specified here, fill the pipe with water, expelling all air during the filling. The minimum test pressure shall be 150 psi. For lines working with operating pressures in excess of 100 psi, the minimum test pressure shall be 1½ times the operating pressure at the point of testing. The test pressure shall not exceed pipe or thrust-restraint design pressures. The duration of each pressure test shall be 2 hours, unless otherwise directed by the City's authorized representative.

1. **Procedure:** Fill the pipe with water and apply the specified test pressure by pumping, if necessary. Then valve off the pump and hold the pressure in the line for the test period. Test pressure shall not vary by more than ±5 psi for the duration of the test. At the end of the test period, operate the pump until the test pressure is again attained. The pump suction shall be in a barrel or similar device, or metered so that the amount of water required to restore the test pressure can be measured accurately.

2. **Leakage:** Leakage shall be defined as the quantity of water necessary to restore the specified test pressure at the end of the test period. No pipe installation will be accepted if the leakage is greater than the number of gallons per hour, as determined by the following formula:

$$L = \frac{SD(P)^{1/2}}{148{,}000}$$

Where: L = allowable leakage (gallons per hour).

S = length of pipe to be tested (feet).

D = nominal diameter of pipe (inches).

P = average test pressure during the leakage test (psi).

3. **Correction of Excessive Leakage:** Should any test of laid pipe disclose leakage greater than that allowed, locate and repair the defective joints or pipe until leakage in a subsequent test is within the specified allowance.

4. **Valve Testing**: Once the system has passed the pressure test, the Contractor shall proceed testing each individually closed valve within the tested system. Individually closed valves shall be pressure tested for a minimum of 15 minutes using the same rate of loss criteria stated above. If any valves are found to not hold pressure, they shall be operated, repaired or replaced, and retested until they pass.

501.9.02 Sterilization

Pipeline intended to carry potable water shall be sterilized before it is placed in service. Disinfection by chlorination for pipelines shall be accomplished according to AWWA C-651, as modified or expanded below, and City requirements. Disinfection of water-storage

facilities, water treatment plants, and wells shall be accomplished according to the appropriate sections of AWWA C-652, AWWA C-653, and AWWA C-654.

a. **Flushing:** Before sterilizing, flush all foreign matter from the pipeline. Contractor shall provide hoses, temporary pipes, ditches, etc., as required to dispose of flushing water without damaging adjacent properties. The Contractor shall provide the minimum temporary blowoff/inlet sizes as shown in **Table 5.3** to adequately flush the pipeline. If flushed into a sewer system, the contractor shall provide screening and remove all accumulated construction debris, rocks, gravel, sand, silt, and other foreign material from the system at or near the closest downstream manhole; no material shall be flushed into the downstream city sewer system. Flushing velocities shall be at least 2.5 feet per second (fps). For large-diameter pipe that is impractical or impossible to flush at 2.5 fps, clean the pipeline in place from the inside by brushing and sweeping, then, flush the line at a lower velocity.

Table 5.3. REQUIRED OPENINGS TO FLUSH PIPELINES

Nominal Pipe Size (inches)	Flow Required to Produce 2.5 FPS Velocity (GPM)	Minimum Inlet & Outlet Pipe Size Required (inch)
4	110	2
6	240	2
8	430	4
12	950	4
18	2140	6
24	3800	6

b. **Sterilizing Mixture:**

1. Sterilizing mixture shall be a chlorine-water solution having a free chlorine residual of 40 to 50 parts per million (ppm). The sterilizing mixture shall be prepared by injecting (a) a liquid chlorine-water mixture or (b) a calcium sodium hypochlorite and water mixture into the pipeline at a measured rate, while fresh water is allowed to flow through the pipeline at a measured rate so that the chlorine-water solution is of the specified strength.

2. The liquid chlorine-water mixture shall be applied by means of an approved solution-feed chlorinating device. Chlorinating devices for feeding solutions of the chlorine itself must provide a means of preventing the backflow of water.

3. If the calcium hypochlorite procedure is used, first mix the dry powder with water to make a thick paste, then, thin to approximately a 1% solution (10,000 ppm chlorine). If the sodium hypochlorite procedure is used, dilute the liquid with water to obtain a 1% solution. Add the 1% solution to water to obtain a final sterilizing solution of 40 to 50 ppm. **Table 5.4** shows the correct proportions of hypochlorite to water.

Table 5.4. RATIO OF HYPOCHLORITE TO WATER

Product	Quantity	Water
Calcium hypochlorite[1] (65%-70% Cl)	1 lb.	7.5 gal
Sodium hypochlorite[2] (5.2% Cl)	1 gal	4.25 gal

[1]Comparable to commercial products known as HTH®, Perchloron®, and Pittchlor®.

[2]Liquid laundry bleach, such as Clorox® or Purex®.

501.9.03 Point of Application

a. Inject the chlorine mixture into the pipeline to be treated within 5 feet of the beginning of the line through a corporation stop or a suitable tap in the top of the pipeline. Water from the existing system or other approved source shall be controlled to flow slowly into the newly laid pipeline during the application of chlorine. The proportion of the flow rate of the chlorine mixture to the rate of water entering the pipe shall be such that the combined mixture shall contain 40 to 50 ppm of free available chlorine.

b. Valves shall be manipulated so that the strong chlorine solution in the line being treated will not flow back into the line supplying the water. Use check-valves if necessary.

c. Operate all valves, hydrants, services and other appurtenances during sterilization to assure that the sterilizing mixture is dispersed into all parts of the line, including dead ends, new services, and similar areas that otherwise may not receive the treated water.

d. Do not place the concentrated quantities of commercial sterilizer in the line before it is filled with water.

e. After chlorination, flush the water from the line (see Section 501.9.05, "Disposal of Flushing and Sterilizing Water") until the water through the line is equal chemically and bacteriologically to the permanent source of supply.

NOTE: When testing and sterilizing procedures are complete, remove the testing corporation stop and replace it with a threaded brass plug.

NOTE: The practice of adding a small amount of chlorine powder or tablets at each joint as the main is being laid is *not* an acceptable method of chlorinating a pipeline. The procedure does not permit preliminary flushing, nor does it distribute chlorine uniformly.

501.9.04 Retention Period

Treated water shall be retained in the pipeline long enough to destroy all non-spore-forming bacteria. With proper flushing and the specified solution strength, 24 hours is adequate. At the end of the 24-hour period, the sterilizing mixture shall have a strength of at least 10 ppm of chlorine. To minimize damage to cement mortar lining in ductile iron pipe and fittings, chlorine solution contact time shall not exceed 60 hours.

501.9.05 Disposal of Flushing and Sterilizing Water

a. Dispose of flushing and sterilizing water in a manner approved by the City's authorized representative. If the volume and chlorine concentration is such as to pose a hazard to the City's Wastewater Treatment Plant operation, the sterilizing water shall be metered into the system per direction of the City's authorized representative. Notify the City of Wilsonville Utility Division 2 business days before disposing of sterilizing water into the City sanitary system.

b. Do not allow sterilizing water to flow into a waterway or storm line without reducing the chlorine to a safe level via adequate dilution or another neutralizing method, as approved by the City's authorized representative.

501.9.06 Bacteriological Testing

a. City Utility staff, with the assistance of the contractor's representative, will obtain water samples for the first of two bacteriological samples 24 hours after the contractor flushes the water line.

b. Following a 24-hour retention period, City Utility staff will obtain the second bacteriological sample.

c. Both water samples must pass the bacteriological tests before the water facilities will be accepted.

d. Contractor shall request the City Utility staff to sample lines at least 2 business days in advance. Applicant shall reimburse the City for the cost of collecting and testing each water sample. Fee for water collection and testing is provided on the Engineering Department's Public Works Permit.

501.10.00 WATER SERVICE CONNECTIONS

501.10.01 Scope

The work includes trench excavation and backfill, furnishing and installing service saddles, corporation or valves, meter vaults or boxes, meters, service connection piping, fittings, and appurtenances within the designated limits, testing, flushing, and other incidental work as required for a complete installation.

501.10.02 Hydrostatic Test and Leakage

Test service connections and service connection pipe in conjunction with the main, as detailed in Section 501.9.00, "Hydrostatic Testing and Sterilization of Newly Installed Pipe."

501.10.03 Materials

a. **Service lines: ¾- and 1-inch:** Service connections shall be tapped directly into the ductile iron pipe. Corporation stops for ¾-inch (single service) and 1-inch copper service lines shall have AWWA thread inlet and compression connect outlet.

b. **Service lines: 1 ½-inch and 2-inch:** Service connections h shall attach to the water main using a 2-inch tee or service saddle, 2-inch gate valve and 2-inch copper tubing to the angle valve per **Detail No. WT-3045** of these standards.

c. **Meter Boxes and Covers:** Generally, meter boxes and covers are installed in landscape areas and shall be pedestrian rated per **Detail No. WT-3035** through **Detail No. WT-3037** of these standards for ¾" and 1" water meters and **Detail No. WT-3050** through **Detail No. WT-3052** of these standards for 1 ½" and 2" water meters. Occasionally, with the approval of the City's authorized representative, installation of meter boxes in driveway areas may be allowed. In these cases, meter boxes and covers shall be traffic rated per **Detail No. WT-3038** through **Detail No. WT-3040** of these standards for ¾" and 1" water meters and **Detail No. WT-3053** through **Detail No. WT-3055** of these standards for 1 ½" and 2" water meters.

d. **Corporation Stops:** Corporation stops for ¾-inch and 1-inch services shall be provided per **Detail No. WT-3030** of these standards.

e. **Angle Valves:** Angle valves shall be provided per **Detail No. WT-3030** of these standards for ¾-inch and 1-inch service lines and **Detail No. WT-3045** of these standards for 1½-inch and 2-inch service lines.

f. **Copper Tube:** Copper tube used for ¾-inch to 1-inch service connections shall be soft temper Type K, conforming to ASTM B-88. Copper pipe used for 1½-inch to 2-inch service connections shall be (hard) drawn temper Type K, conforming to ASTM B-88. If sleeved in a rigid casing, use soft temper, type "K" copper tubing.

501.10.04 Workmanship

a. **Trench Excavation, Preparation, and Backfill:** Trench excavation, preparation, and backfill shall conform to the requirements of Section 6, "Trench Excavation and Backfill. The trench shall be backfilled to within 6 inches of the service connection pipe or line. Cover over pipe shall be as indicated in **Detail No. S-2140** of these standards.

b. **Connection to Main:** The City's authorized representative shall be notified and shall be present during tapping of City water main, unless otherwise approved by the City's authorized representative. Service connections shall be installed as shown in **Detail No.WT-3030** or **Detail No. WT-3045** of these standards and as follows:

   1. Taps shall be made in the pipe by experienced workmen, using tools in good repair, with proper adapters for the size of pipe being tapped.

   2. Line taps shall be 30° above the horizontal for ¾-inch or 1-inch service connections

   3. Line taps shall be centered on the spring line of the pipe being tapped for 1½-inch or 2-inch service connections.

   4. Tap shall be made no closer than 18 inches from the outside edge of the sleeve to the beginning of the bell flare or end of the MJ fitting.

c. **Copper Tubing:** The copper tubing shall be cut with square ends, reamed, cleaned, and made up tightly. Care shall be taken to prevent the tube from kinking or buckling on short radius bends. Kinked or buckled sections of copper tube shall be cut and the tube spliced with the proper brass fittings, at the contractor's expense.

d. **Installation of Meters and Meter Boxes:**

   1. Meters and meter boxes or vaults shall be installed as shown in **Detail No. W-3030** or **Detail No. W-3045** of these standards, or as directed by the City's authorized representative.

   2. City of Wilsonville Utility Division shall install all meters 2 inches in diameter or less. Meters larger than 2 inches in diameter shall be installed by the contractor under the supervision of City of Wilsonville Utility Division.

   3. Meters shall not be installed until the entire water system is ready for operation, the system has been tested and approved, and water meter permit(s) have been obtained from the City of Wilsonville Building Division.

   4. The remainder of the service connection, excluding the meter, may be installed at any time during or after construction of the main. Before the meter is connected, the angle valve shall be opened and the service line flushed of all foreign materials, and shall be properly tested and chlorinated.

5. The finish grade of the completed meter enclosure shall allow a minimum of 6 inches and a maximum of 12 inches of clearance from the top of the meter to the meter box. Meter boxes or vaults shall be set or constructed plumb, with the top set horizontally. Lightly compacted earth backfill shall be placed inside the meter boxes to the bottom of the meter stop. Grade adjustments of the meter boxes or vaults shall be made by using standard extension sections for the specified box or vault. Backfill around meter vaults shall be as specified for adjoining pipe. Provide adequate space to allow for sidewalk installation. Under no circumstances shall meter boxes be placed in the sidewalk.

6. Depending on the elevation difference between the meter and the main line water system working pressure, the City may require a backflow-prevention valve and/or a pressure reducing valve on the customer side of the meter, at the meter box. Installation shall be approved by the City's authorized representative.

501.11.00 WATER LINE ACCEPTANCE POLICY

501.11.01 Water Line Activation

The City of Wilsonville will provide water to the project when the following are complete.

a. Compliance with these standards.

b. Installation of the materials and workmanship as described herein.

c. A successful hydrostatic pressure tests, as witnessed and approved by the City's authorized representative.

d. Adequate flushing and chlorination of mains, as witnessed and approved by the City's authorized representative.

e. Acceptable results of samples taken for bacteriological examination by an Oregon Environmental Laboratory Accreditation Program (ORLAP) accredited drinking water laboratory.

501.11.02 Locate Wire Testing

Prior to paving, the contractor shall notify the City's authorized representative that the water system locate wire is ready for testing. City personnel shall connect to the locate wire and attempt to locate water main line, services, and connections to water system appurtenances. All points of the water system shall be located from at least two connection points to be considered to have adequate coverage. The contractor will be required to locate and repair any gaps in the locate wire coverage. Failed sections shall be retested until adequate coverage is obtained.

501.11.03 Water Line Acceptance

The City of Wilsonville will accept new water installations or systems built to the "Public Works Standards," provided that the following conditions are met.

a. Dedication of any required easements or rights-of-way have been recorded with the County Recorder and the Engineering Department receives a reproducible copy of the recorded documents.

b. After completion of construction of the total project, and after all testing has been satisfactorily completed, project closeout shall proceed as outlined in Section 101.8.17, "Project Closeout."

c. The Contractor or Applicant shall be responsible for providing Maintenance Assurance for Public Improvements as outlined in Section 101.8.18, "Maintenance and Warranty." Public water improvements shall be warranted for a minimum of two years.

d. At any time during the warranty period, the City's authorized representative has reason to believe the public water improvements have defects that were the result of faulty workmanship or flaws in construction material, the responsible party shall be required, at that party's own cost, to repair any faults to the public water improvements deemed necessary by the City's authorized representative.

e. Before the end of the Construction Maintenance period, the City's authorized representative shall inspect the project for any remaining deficiencies. If the deficiencies that remain are determined to be the responsibility of the contractor or the applicant, the contractor or applicant shall then make such repairs.

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SECTION 6

TRENCH EXCAVATION AND BACKFILL

601.1.00 DEFINITIONS

a. **Trench Excavation:** Trench excavation is the removal of all material encountered in a trench to the depths shown on the plans or as directed by the City's authorized representative. Trench excavation shall be classified as either common or rock excavation.

   1. "Common excavation" is defined as the removal of all material that is not classified as rock excavation. The term "rock excavation" shall be understood to indicate a method of removal and not a geological formation.

   2. "Rock excavation" is defined as the removal of material that cannot, in the City Engineer's judgment, be reasonably excavated with equipment comparable in machine weight and rated horsepower to a hydraulic hoe excavator with a minimum weight of 45,000 pounds and a net horsepower rating of 130 to 140. Rock excavation is also the removal of material by drilling and blasting (see Section 601.3.01.i, "Explosives" for blasting restrictions) or power-operated rock-breaking equipment. Boulders or concrete pieces larger than ½ cubic yard encountered in the trench excavation shall be classified as rock excavation if removing them requires any of the above excavation methods, in the opinion of the City's authorized representative.

b. **Trench Foundation:** The bottom of the trench where the pipe bedding will lie. The trench foundation supports the pipe bedding.

c. **Pipe Bedding:** The furnishing and placing of specified materials on the trench foundation to uniformly support the barrel of the pipe, from the trench foundation to the spring line of the pipe.

d. **Pipe Zone:** The full width of the trench, from 12 inches above the top outside surface of the barrel of the pipe to the spring line of the pipe.

e. **Spring Line:** Halfway up the sides of the pipe (horizontal centerline) when the pipe is laid on the pipe bedding.

f. **Haunch:** That portion of the pipe below the spring line.

g. **Trench Backfill:** The furnishing, placing, and compacting of material in the trench between the top of the pipe zone material and the bottom of the pavement base rock, ground surface, or surface materials.

h. **Native Material:** Earth, gravel, rock, or other common material free of humus, organic matter, vegetative matter, frozen material, clods, sticks, and debris, isolated points or areas, or larger stones that would fracture or dent the structure or subject it to undue stress.

601.2.00 MATERIALS

601.2.01 Trench Foundation

Trench foundation (as defined in Section 601.1.00.b, "Trench Foundation") shall be native material in all areas except where groundwater or other conditions exist and, in the opinion of the City's authorized representative, the native material cannot support the bedding and pipe. Under those conditions, geotextile fabrics approved by the City's authorized representative shall be installed, or the unsuitable material shall be removed, as determined by the City's authorized representative, and the trench foundation backfilled with Class B backfill in accordance with Section 601.2.03, "Trench Backfill".

601.2.02 Pipe Area

a. **Pipe Bedding:** Pipe bedding material shall be Class B backfill in accordance with Section 601.2.03, "Trench Backfill", or as approved by the City's authorized representative.

b. **Pipe Zone:** The pipe zone material shall consist of Class B backfill in accordance with Section 601.2.03, "Trench Backfill."

601.2.03 Trench Backfill

Above the pipe zone, trench backfill will be divided into the following classifications:

a. **Class A Backfill:** Class A backfill shall be native or common material, which in the opinion of the City's authorized representative meets the characteristics required for the specific surface loading. Selected trench backfill material shall contain no frozen soil, gravel, or cobbles larger than 6 inches in diameter, and shall be free of organic or other deleterious material.

b. **Class B Backfill:** Class B backfill shall be ¾"-0" granular grade crushed aggregate material, unless otherwise approved by the City's authorized representative. The aggregate shall conform to the following.

1. The aggregate shall consist of uniform-quality, clean, tough, durable fragments of rock or gravel and shall be free of flat, elongated, soft, or disintegrated pieces, or other objectionable matter occurring either free or as a coating on the stone.

2. The aggregate shall meet the requirements for fractured faces and durability as specified in ODOT SSC Section 02630.10 "Dense-Graded Aggregate."

3. Gradation and plasticity index requirements of the crushed aggregate shall be as shown for ¾"-0" rock in **Table 2.15**, "Gradation Requirements of Granular Fill." Sieve analysis shall be determined according to AASHTO T-27.

4. Class B backfill material shall be approved by the City's authorized representative prior to placement.

c. **Class E Backfill**: Class E backfill shall be commercially mixed Controlled Low-Strength Material (CLSM) made up of a mixture of fly ash, cement, fine aggregate, water and admixtures, if necessary. Fine aggregate shall consist of commercial quality concrete sand. CLSM shall attain a 28-day compressive strength of 100 psi – 200 psi.

601.3.00 CONSTRUCTION

601.3.01 Excavation

a. **Clearing and Grubbing:** When clearing the right-of-way is necessary, clearing shall be completed before the start of trenching. Clearing and grubbing shall follow the procedures outlined in Section 201.5.02, "Clearing and Grubbing." Under no condition shall excavated materials be permitted to cover brush before the brush is cleared and disposed of. Excavated material shall be stockpiled where and so it does not create a hazard to pedestrian or vehicular traffic; nor shall it interfere with the function of existing drainage facilities.

b. **Erosion Control:** The contractor shall be responsible for erosion prevention and sediment control on the jobsite and shall use appropriate prevention measures as outlined in Section 101.9.04, "Erosion Prevention and Sediment Control." The contractor shall maintain the erosion-prevention and sediment-control facilities as specified in Section 101.9.05, "Maintenance."

c. **Interferences and Obstructions:** Various obstructions may be encountered during the course of the work. The contractor shall follow the guidelines established in Section 101.8.05, "Interferences, Obstructions, Abandoned Utilities."

d. **Contaminated Soils:** If during construction soils contaminated with hazardous materials or chemicals are encountered, the Contractor shall follow the procedures specified in Section 101.9.02, "Contaminated Soils or Hazardous Materials."

e. **Open Trench Limit**

1. Construction shall proceed in a systematic manner that will result in minimum inconvenience to the public. Construction staking for the work being performed shall be completed before the start of excavation.

2. The contractor shall limit their operations to a small work area per crew. The length of the excavated trench shall always be kept to a minimum. At no time shall the trenching equipment be farther than 100 feet ahead of the pipe-laying

crews, unless advance written permission is given by the City's authorized representative.

3. Trenches shall be backfilled so that no section of trench is left open at the end of each work day, unless the trench is covered with Steel Plates. Use of Steel Plates shall conform to Section 101.8.02.b.7, "Progress of Construction."

4. Trenches with unstable trench walls shall be backfilled immediately upon verification by the City's authorized representative.

5. Trenches located outside of an active right-of-way (e.g. roadways closed to all modes of access, subdivision construction), may be left open at the request of the City's authorized representative of a sufficient length of time to perform necessary inspections. Open trenches shall be protected with the use of an adequate number of cones, construction tape, and/or construction fencing.

f. **Trench Width**

1. The trench width at the surface of the ground shall be kept to the minimum necessary to safely install the pipe. All aspects of excavation, trenching, and shoring shall meet current OSHA standards and regulations. In all cases, trenches must be wide enough to allow for shoring and to permit proper joining of the pipe and backfilling and compaction of material along the sides of the pipe.

2. The trench width in the pipe zone must include a clear working space outside the maximum outside diameter of the pipe as follows.

   (a) For pipe less than and including a 12-inch interior diameter, the clear working space shall be 6 inches.

   (b) For pipe greater than a 12-inch interior diameter, the clear working space shall be ½ the inside pipe diameter up to a maximum of 24 inches.

   (c) For manholes and other structures, the clear working space shall be wide enough to provide 12 inches between the face of the structure and the sides of the excavation or shoring.

   See Table A in **Detail No. S-2145** for the required clear working space for each size of pipe.

3. Maximum width of the trench at the top of the pipe shall be 12 to 24 inches plus the width of the pipe bell. When required by the project design, the maximum trench width shall be shown on the plans.

4. If the contractor exceeds the maximum trench width without written authorization, the contractor shall be required to contact the design engineer or the geotechnical engineer and obtain written approval allowing installation of the pipe as specified, or contractor shall provide, at their cost, pipe of a higher strength

designation, a higher class of bedding, or both, as recommended by the design engineer or the geotechnical engineer, and approved by the City's authorized representative.

5. Where circumstances require extending the trench width at ground surface beyond the right-of-way or easement boundary, the applicant shall obtain written agreements with the affected property owner(s), and provide them to the City's authorized representative before commencing excavation.

g. **Grading**

1. The bottom of the trench shall be graded to the line and grade to which the pipe is to be laid, with proper allowance for pipe thickness and bedding material, or for greater base when specified or indicated. Before laying each section of the pipe, check the aggregate grade and correct any irregularities.

2. The trench bottom shall form a continuous and uniform bearing surface and support the pipe on solid and undisturbed ground at every point between bell holes, except that the grade may be disturbed for removing lifting tackle.

h. **Rock Excavation**

1. Where the bottom of the trench encounters ledge rock, boulders, or large stones that meet the definition of "rock excavation," rock excavation shall be performed to create six inches of clearance on each side and below all pipe and accessories.

2. Excavations below subgrade in rock shall be backfilled to subgrade with Class B backfill material, in accordance with Section 601.2.03, "Trench Backfill" and compacted to not less than 90% of its maximum dry density as determined by AASHTO T-180.

i. **Explosives**

Explosives shall not be used in the City of Wilsonville without prior written approval from the City Engineer.

601.3.02 Installation

a. **Shoring**

1. The contractor shall provide all materials, labor, and equipment necessary to adequately shore trenches to protect the work, existing property, utilities, pavement, etc., and to provide safe working conditions in the trench.

2. Cribbing or sheeting that extends below the spring line of rigid pipe or below the crown elevation of flexible pipe shall be left in place, unless a satisfactory means can be demonstrated for reconsolidating bedding or side support that would be disturbed by removing the cribbing or sheeting.

3. If a movable box is used instead of cribbing or sheeting and the bottom cannot be kept above the spring line of the crown elevation of the flexible pipe, the bedding or side support shall be carefully reconsolidated behind the movable box before backfill is placed.

4. The use of horizontal strutting below the barrel of pipe, or the use of pipe as support for trench bracing, will not be permitted.

b. **Dewatering**

1. The contractor shall provide and maintain ample means and devices for promptly removing and disposing of all water entering the trench excavation while the trench is prepared for pipe laying, during the laying of the pipe, and until the backfill is placed and compaction is complete.

2. Groundwater shall be controlled to keep it from softening the bottom of the excavation. Dewatering systems shall be designed and operated to prevent removal of the natural soils and to keep the groundwater level outside the excavation from being reduced to an extent that would damage or endanger adjacent structures or property.

3. Dewatering systems shall be discharged to a storm water detention/retention facility unless otherwise approved by the City's authorized representative.

4. Sediments shall be settled and filtered before discharge. All settling systems shall be engineered and adequately sized for site conditions. In general, settling and filtering options, which shall be approved by the City's authorized representative, include but are not limited to:

   (a) Containment in a pond structure until water is clear. Place the pump in a gravel bed at the bottom of the pond.

   (b) Pumping to a Baker tank or other settling tank with sampling ports.

   (c) Filtering through a sieve or other filter media.

   (d) Manufactured bags or other systems. These systems do not always work on fine clay soils and will be allowed for use only where approved.

   (e) Application of a polymer/flocculant where its use has been approved.

5. Filtering devices need to be inspected frequently to make sure they are functioning properly.

6. Filtering devices shall be filled in or otherwise removed when they are no longer necessary.

c. **Grade**

The contractor shall excavate the trench a minimum of 6 inches plus the pipe wall thickness below the specified pipe grade, or as established by the geotechnical engineer. The subgrade on which the bedding is to be placed shall be firm, undisturbed, and true to grade.

d. **Trench Foundation**

1. When in the judgment of the geotechnical engineer or the City's authorized representative, the existing material in the bottom of the trench is unsuitable to support the pipe, the contractor shall excavate below the pipe, as directed.

2. The contractor shall backfill the trench to the subgrade of the pipe bedding with Class B backfill in accordance with Section 601.2.03, "Trench Backfill", over the full width of the trench, and shall compact in layers not exceeding 6 inches deep.

3. Fill material shall be compacted to not less than 90% of its maximum dry density, as determined by AASHTO T-180.

e. **Pipe Bedding**

1. Class B backfill in accordance with Section 601.2.03, "Trench Backfill", shall be placed under all pipes.

2. Pipe bedding consists of leveling the bottom of the trench on the top of the foundation material and placing bedding material to the horizontal centerline of the pipe, unless otherwise specified.

3. Granular base shall be placed in the trench to a depth of 6 inches, loose, for the full width of the trench. The contractor shall spread the bedding smoothly to the proper grade so the pipe is uniformly supported along the barrel.

4. The contractor shall excavate bell holes at each joint to permit proper assembly and inspection of the entire joint. Bedding under the pipe shall provide firm, unyielding support along the entire pipe length.

5. Contractor shall be aware of the importance in proper placement and compaction of backfill material placed below the spring line of the pipe (haunch area). Proper backfilling ensures that adequate stability and support is provided to the pipe during final backfilling of the pipe zone. Backfill material shall be worked under the haunches by hand to ensure intimate contact between the backfill material and the pipe.

f. **Backfill in Pipe Zone**

1. After the pipe is in place and ready for backfilling, place Class B backfill, in accordance with Section 601.2.03, "Trench Backfill", to a minimum depth of 12 inches over the top of the pipe. The material shall be placed at approximately the

same rate on each side of the pipe, so that the elevation of the aggregate on each side of the pipe is always equal.

2. Particular attention shall be given to the backfilling and tamping procedure to assure that there are no unfilled or uncompacted areas around the pipe.

g. **Trench Backfill**

1. Backfill shall be placed in the trench in such a way as to **not** permit material to freefall until the top of the pipe is covered by at least 2 feet of material. Under no circumstances shall the contractor allow sharp, heavy objects to drop directly onto the pipe or pipe zone material around the pipe.

2. If the required compaction density cannot be obtained, the contractor shall remove the backfill from the trench and recompact. The process shall be repeated until the contractor establishes a procedure that will provide the required density. The contractor will then be permitted to proceed with backfilling and compaction of the rest of the pipeline under the approved compaction procedure.

3. Within the public right-of-way, trench backfill shall consist of Class B backfill.

4. The City‘s authorized representative may approve the use of Class E backfill, CLSM, material for trench backfill above the pipe zone.

h. **Native or Select (Class A) Backfill**

1. Backfill the entire depth of the trench above the pipe zone with excavated trench materials placed in 12-inch layers. Remove all cobbles and stones 2 inches in diameter and larger from material used for backfill in the upper 12 inches of the trench.

2. Compact each layer using mechanical tampers or vibratory compactors to 85% of its maximum dry density, as determined by AASHTO T-180. Bring the fill to the required surface grade, and compactde so that no settlement will occur.

i. **Granular (Class B) Backfill**

1. Granular backfill material shall meet the requirements of Section 201.3.01, “Granular Fill.” Granular backfill shall be tested at a minimum of every 200 feet of trench length and at depths specified by the City’s authorized representative.

2. Compact the trench backfill material within 2 feet of road base rock grade to not less than 95% of its maximum dry density, as determined by AASHTO T-180. Compact trench backfill material placed more than 2 feet from road base rock grade to not less than 90% of its maximum dry density.

j. **Controlled Low-Strength Material (Class E) Backfill**

1. Controlled Low-Strength Material (CLSM) shall meet the requirements of Section 601.2.03.c, "Class E Backfill."

2. Backfill the trench above the pipe zone with CLSM to the bottom of the proposed surfacing. No compaction of the CLSM is allowed.

3. Use steel plates to protect the CLSM from traffic a minimum of 24 hours. After 24 hours, the CLSM may be paved. Use of Steel Plates shall conform to Section 101.8.02.b.7, "Progress of Construction."

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CITY OF WILSONVILLE

PUBLIC WORKS STANDARDS ~~– 2006~~ – 2014

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CITY OF WILSONVILLE

PUBLIC WORKS

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SECTION 1

GENERAL CONSTRUCTION REQUIREMENTS & ADMINISTRATIVE PROVISIONS

101.1.00 AVAILABILITY

Copies of these "Public Works Standards ~~– 2006~~" for the City of Wilsonville, Oregon, or any subsection of the standards are available from the Wilsonville Community Development Department, given reasonable notice and payment of current reproduction costs, or are available to download from the City of Wilsonville, Engineering website.

Due to its size, Chapter 3 "Stormwater & Surface Water Design and Construction Standards" is provided under separate cover, but is still considered a part of these Public Works Standards.

The "Public Works Standards" are subject to change (see ~~Section 103.00.c);~~Section 101.3.00.c, "Scope"); check the City of Wilsonville Engineering website or with the City of Wilsonville Engineering Division for revisions or updates.

101.1.01 Reference to Standards

The design engineer may, at his or her sole discretion, use the standards by direct reference in the contract documents prepared for the construction of public ~~street,~~streets, storm drainage, water, and sanitary sewer facilities in the City of Wilsonville. If the design engineer incorporates the City's standards in that way, the contract documents shall contain the following statements:

a. Material and workmanship shall be in strict accordance with the standard specifications of the City of Wilsonville. No changes from the approved project plans and specifications shall be made without approval of the City's authorized representative.

b. The standards are in outline form only, and shall not operate to relieve the design engineer of his or her professional responsibilities during project design and construction.

c. These standards represent the minimum requirements for construction in a public right-of-way or public easement to protect the public health, safety and welfare. Any deviation from the standards must be approved, in writing, by the City's authorized representative.

101.2.00 INTENT

101.2.01 Intent of Public Works Standards

These standards for constructing public facilities in the City of Wilsonville are intended to protect the public health, safety, and welfare by:

a. ~~a.~~ Setting forth uniform material and workmanship standards.

b. Supplementing and completing the public health and safety requirements of Chapter 4 of the Wilsonville Code.

c. Streamlining the administration and construction of public facilities in the City and minimizing repairs to these public facilities.

~~Nothing in these standards shall relieve any person or organization from the obligation to comply with the applicable laws, rules, and regulations of any federal, state, and local authority.~~

~~101.2.02~~ 101.2.02 Interpretation

Where situations arise that are not clearly covered by these Standards, the City's authorized representative will review the issue on a case by case basis to determine the design and/or construction methodology acceptable to the City.

101.2.03 Order of Precedence

All federal, state, county (Clackamas or Washington) or local laws and ordinances are to be adhered to. If there is any conflict between the Standard Specifications and pertinent laws and ordinances, the laws and ordinances shall prevail.

If there is a conflict between approval documents, the document highest in precedence shall control. The order of precedence shall be:

First: Permits from other agencies or jurisdictions, as may be required by law.

Second: Land use decision-making authority's Conditions of Approval.

Third: City of Wilsonville master plans (latest editions): Parks and Recreation Master Plan, Transportation Systems Plan, Storm Water Master Plan, Wastewater Collection System Master Plan, Water System Master Plan.

Note: Permits, Land Use Conditions of Approval, and Master Plans are intended to provide the authority for what public facilities are to be constructed; the below public works detail drawings and standards and the various standards that follow describe how public facilities are to be constructed through ~~he~~the use of the approval component materials equipment, and methods set forth.

Fourth: City of Wilsonville *Standard Detail Drawings*.

Fifth: City of Wilsonville *Public Works Standards ~~– 2006~~*.

Sixth: City of Wilsonville *Planning and Land Development Ordinance.*

Seventh: ~~Clean Water Services (CWS) *Design*~~ City of Wilsonville Bicycle and ~~*Construction Standards*~~Pedestrian Master Plan, latest edition.

Eighth: *Oregon Standard Specifications for Construction* (current edition) (ODOT, Oregon APWA) and any reference specifications and standard practices adopted by nationally recognized professional societies such as ASCE, AWWA, APWA, ACI, ~~and ASTM~~ ASTM, and AASHTO, and any reference specifications or guidelines as presented in the latest edition of the MUTCD.

Ninth: *ODOT Pavement Design Guide.*

Tenth: *Uniform Building Code* and City-issued building, mechanical, electrical, and plumbing permits.

Eleventh: Americans with Disabilities Act ~~of 1990~~latest approved standards or guidelines as referenced in the Standard Details of these standards. .

Twelfth: ~~-~~ Plans and details prepared by the design engineer.

Supplemental written agreements, franchise agreements, and approved revision to plans and specifications by the appropriate jurisdictions and conforming to local, state, and federal law will take precedence over documents listed above. Detailed plans shall have precedence over general plans. In any event, the determination of the City Engineer shall be final.

101.3.00 SCOPE

These standards for construction of public facilities in the City of Wilsonville:

a. Cover all public streets, storm drainage, water, sanitary sewer, and appurtenant facilities inside the corporate limits of the City that are to be turned over to the City for maintenance and operation.

b. Relate only to public facilities constructed in the City and should not be confused with building codes, zoning ordinances, and other regulations for which the City has established separate procedures and standards.

c. May be amended or updated periodically by ordinance of the City Council on the recommendation of the City Engineer to protect the public health, safety, and welfare.

d. ~~Not withstanding~~Notwithstanding the foregoing, the City Engineer shall have the authority to modify the Standard Detail Drawings~~, as provided in Appendix G~~ of these standards, as needed to maintain conformance to the periodic changes to national and state design requirements, guidelines, and specifications and industry standards.

101.4.00 DEFINITIONS

The following definitions apply throughout these standards:

AASHTO:	American Association of State Highway and Transportation Officials
AC:	Asphaltic concrete
ACI:	American Concrete Institute
ACPA:	American Concrete Pavement Association
ADA:	Americans with Disabilities Act
ADAAG:	American with Disabilities Act Accessibility Guidelines and Standards
ADT:	Average daily traffic
ANSI:	American National Standards Institute
APWA:	American Public Works Association
ASTM:	American Society for Testing and Materials
AWWA:	American Water Works Association
Act of God:	Earthquake, flood, cyclone, or other cataclysmic natural phenomenon
Addendum:	Written or graphic modification or interpretation of contract documents
Agreement:	Written agreement covering performance of work and furnishing of labor and materials in construction of work
Alley:	Street or road primarily intended to provide secondary access to road or side of lots or buildings and not intended for normal through vehicular traffic

Applicant:	Person, organization, or duly authorized representative identified as such in specifications and in agreement, and referred to throughout contract documents as if singular in number and masculine in gender; means owner or authorized representatives, including parties acting as designated authority for aspects of work
Approve:	"Approved," "approve," "approval," or similar words shall mean to give, in writing, limited, conditional, or qualified permission to use material, equipment, or methods, such conditions being in strict compliance with City's standards; approval will be by the City's authorized representative
ARCPACS:	A federation of certifying boards in agriculture, biology, earth, and environmental sciences. Provides professional certification for soil scientists whose education, experience and career path are in some aspect of the soil science profession and can meet the standards of the ARCPAC program
As-Built Plans/Record Drawing:	Plans signed and dated by the Project Engineer indicating that the plans have been reviewed and revised to accurately depict all known as-constructed details of a particular public works project
As-Constructed Plans/Record Drawing:	See As-Built Plans/Record Drawing
Authorized representative:	Party or parties authorized or employed by applicant to observe, test, or review quality and sufficiency of work performed, materials used, and determine compliance with plans and specification; for the City of Wilsonville, designated authority shall be the City Engineer or one of the City's authorized representatives
Bid bond:	Form of security furnished by contractor, guaranteeing that he/she will enter into a contract in accordance with contract documents if the proposal is accepted
Bidder:	Any individual, firm, or corporation formally submitting a proposal for work contemplated, or any part of it, acting directly or through an authorized representative

Bioengineering:	A construction methodology used to stabilize and conserve soils through the use of live plants alone or in combination with biodegradable material to produce living, functioning systems that can prevent erosion, control sediment, and provide habitat
BPMP:	City of Wilsonville's ~~1993~~ Bicycle and Pedestrian Master Plan, ~~or~~ latest edition
Building Drain:	The building drain is that part of the lowest piping of the sewer system which receives the discharge from waste and other drainage pipes inside the walls of the building and conveys it to the building sewer ,which begins five feet (5') outside the building wall (building foundation)
Building Foundation:	That part of the horizontal piping of the sewer system which extends from the end of the building drain and which receives the discharge of the building drain and conveys it to a public sewer, or privately managed sewage collection system, or other point of disposal
CD:	Construction documents
CDF:	Control density fill
CEC:	Cation exchange capacity
CLSM:	Controlled Low-Strength Material
CN:	Curve number
Certificate of Insurance:	Evidence of insurance coverage of the contractor, furnished to the City
Change order:	Written order to contractor by City Engineer or the City's representative authorizing addition, deletion, or revision of work within general scope of contract, or adjustment in price or time
City:	City of Wilsonville

City Boards and Commissions:

City Council:	Five-member governing body responsible for identifying community problems and needs, and establishing policies and goals to address those needs

Development Review Board:	Empowered to review and take action on land-use applications; decisions are usually binding, but may be appealed to City Council
Planning Commission:	Makes recommendations to City Council regarding City's comprehensive plan, facilities plans, capital improvements program, and planning and zoning ordinances and provide input on traffic-related concerns
Parks & Recreation Advisory Board:	Aids in planning and developing present and future parks and recreation in City and advises City Council on policy matters regarding parks and recreation services
City Engineer:	Professional Engineer registered in the State of Oregon, designated by the City Manager to carry through with planning, designing, and project supervision of public facilities that will be accepted and owned by the City
Contract:	Binding agreement between contractor and applicant covering performance of work and furnishing of labor and materials for construction of public facilities
Contractor:	The person or entity that has entered into contract with the applicant; "contractor," though here used to describe an individual, shall mean contractor, agents, employees, officials, subcontractors, or anyone connected with work set forth on behalf of contractor
Contract documents:	Agreement, addenda, instructions to bidders, contractor's proposal, bonds, notice of award, notice to proceed, general provisions, technical provisions, plans, change orders, field orders, and all other modifications of such documents entered into in accordance with contract
Contract price:	Total amount payable to contractor for work, including all sales, use, and other consumer taxes related to work.
Contract time:	Number of calendar days allowed contractor to complete work
Construction maintenance assurance:	A one-year bond for 10% of the cost to construct public improvements

County road:	Public road incorporated into county roadway system by formal action of Board of County Commissioners; these roads are assigned numbers and county assumes maintenance responsibility
Cut Sheets:	Sheets of tabulated data, indicating stationings, structures, fittings, angle points, beginning of curve, points on curve, end of curves, sewer slope, staking offset, various elevations, offset cuts, and sewer depths
Definition of Words:	Wherever, in these PS & FM Standards, the works directed, required, permitted, ordered, designated, or words of like meaning are used, they shall be understood to mean the direction, requirement, permission, order or designation of the City Engineer. Similarly, the words approved, acceptable, satisfactory, shall mean approved by, acceptable, or satisfactory to the City Engineer
DBH	Diameter at Breast Height: Standard method of determining the size of a tree
DEQ:	Oregon Department of Environmental Quality
Design engineer:	Professional Engineer registered in the State of Oregon responsible for planning, designing, and producing record drawings of public facilities that will be accepted and owned by the City
Detail Drawings:	Construction drawings produced by the City of Wilsonville providing details of acceptable construction standards for public facilities. Drawings may be periodically updated or changed, as needed, by approval of the City Engineer
Development:	Development includes new development, redevelopment, and/or partial redevelopment
Directed, required, etc.:	In these standards, “directed,” “required,” “permitted,” “ordered,” “designated,” or similar words shall mean at the direction, requirement, permission, order, or designation of applicant or City Engineer
Domestic Sewage:	The liquid and water borne waste derived from the ordinary living process, 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

Drainage Waste:	Storm water, ground water, surface drainage, subsurface drainage, spring water, well overflow, roof drainage, or other like drainage other than sewage or industrial waste
Dwelling Unit:	A facility designed for permanent or semi-permanent occupancy and provided with minimum kitchen, sleeping, and sanitary facilities for one family
Easement:	An interest in land owned by another that entitles the easement holder to a specific limited use of the land; however, ownership of the land does not change
Easement, Public Pipeline:	The space identified within the easement document that is in, upon, above, along, across, over or under the publicly owned and maintained storm, sanitary, or water facility
Easement, Public Utility:	The space in, upon, above, along, across, over or under the easement as identified within the easement document. By way of general description, public utility easements are typically created along the border(s) of a tax lot or frontage along public right-of-way and are intended for the use of utility companies and other authorized users to operate, place, relocate and maintain facilities in accordance with city requirements and standards
EPSC Plan:	Erosion Prevention and Sediment Control Plan following recommendations outlined in the Erosion Prevention and Sediment Control Planning and Design Manual, ~~2000 or~~ latest edition
EPSC Planning and Design Manual:	Erosion Prevention and Sediment Control Planning and Design Manual developed in partnership between CleanWater Services of Washington County, Water Environment Services of Clackamas County, City of West Linn, ODOT, and Harza Engineering, ~~2000 or~~ latest edition
FEMA:	Federal Emergency Management Agency
FHWA:	Federal Highway Administration
Field order:	Written order to contractor, approved by applicant, changing work but not affecting contract price or time

Final completion:	Date when project correction list is completed; a 10% maintenance bond is submitted in accordance with contract documents, as modified by change orders agreed to by parties, or as specified in ~~Section 101.8.17~~Section 101.8.17, "Project Closeout;" and the City's authorized representative receives confirmation that all easements and legal documents have been recorded with the County Recorder
First party:	Applicant or duly authorized representative
Flow:	The liquid and water borne waste derived from domestic sewage, industrial wastes, and in some cases drainage waste
Grout:	Thin, fast-setting, high-strength, non-shrink mortar used to fill cracks and joints in masonry
HMAC:	Hot mixed asphalt concrete
ICEA:	Insulated Cable Engineers Association
Inclement weather:	Weather conditions so extraordinary that previous climatic conditions in locality of work give no reasonable warning of them; shall be determined by City Engineer
Indicated, shown, etc.:	"Indicated," "noted," "shown," "called for," or similar words shall mean indicated, noted, shown, or called for in the contract documents for the work referred to
Industrial Waste:	A water borne waste and wastewater from other than domestic users
Intersection:	Area jointed by two or more roads intersecting; for design purposes, intersection is not formed by naming two approaches of continuous street at curve or other point with different street names
Landscape maintenance assurance:	A ~~two-year~~ bond for 100% of the cost to install all required landscaping in water quality/quantity facilities and vegetated corridors, plus 100% of the cost to maintain the landscaping in these areas for ~~two years~~the duration of the bond
Large-diameter pipe:	Pipe with diameter larger than 24 inches

Lateral Sewer (Service Lateral):	Any sewer line to which a private building sewer connects or may connect. The lateral sewers are located within public right-of-way or easement, and generally connect to the main sewer and extend to the right-of-way or easement
Letter of commitment:	A letter issued by another jurisdictional agency to the City as performance assurance or maintenance assurance and warranty for public improvements
Main Sewer (Public Sewer):	A public sewer that has been or is being constructed to accommodate more than one lateral sewer or to which a building sewer connects or may connect. (Normally not less than eight inches in diameter)
Maintenance Assurance Bond:	Maintenance assurances required by the City for work performed to ensure post-construction quality and landscape survivability. May consists of both construction maintenance assurance and landscape maintenance assurance
Manager:	The City Manager of the City of Wilsonville or his/her authorized representative
Manufacturer's Name:	Any manufacturer's name, specification, catalog number, or type used herein is specified to make and order to establish the standard requirements of the City. Other equivalent makes will be considered for approval, providing they are comparable with this established standard
Mortar:	Plastic building material of cement or lime, sand, and water that hardens in place and is used in masonry or plastering
MUTCD:	*Manual on Uniform Traffic Control Devices*, ~~2000 or~~ latest edition
NAVD 88:	North American Vertical Datum of 1988: the vertical control datum established in 1991 by the National Geodetic Survey
Neighborhood Erosion Control Plan:	An approved erosion-prevention and sediment-control plan for multiple lots
NEMA:	National Electrical Manufacturers Association
NGVD 29:	National Geodetic Vertical Datum of 1929: vertical control datum established for vertical control in the United States by the general adjustment of 1929 (formerly called the "Sea Level Datum of 1929")

NPSH:	Net Positive Suction Head, in association with sanitary sewer pumping units
NRCS:	National Resource Conservation Service
Notice to proceed:	Written notice given by designated authority to contractor fixing date when contractor shall begin to perform the obligations under contract documents
O&M plan:	Operation and maintenance plan for mechanical systems to be operated by the City, or plan designed for stormwater facilities and prepared by the responsible party in the Stormwater Maintenance Covenant and Access Easement
ODFW:	Oregon Department of Fish and Wildlife
ODOT:	Oregon Department of Transportation
ODOT QPL:	Qualified Products List; published twice each year by ODOT's Construction Section
ODOT SSC:	2015 Oregon Department of Transportation Standard Specifications for Construction~~, 2002 (in association with the Oregon Chapter of the APWA), or latest edition~~
OSHA:	Occupational Safety and Health Administration
Or equal:	"Or equal," "or approved equal," or similar words shall mean to possess same performance qualities and characteristics and fulfill utilitarian function without any decrease in quality, durability, or longevity and shall meet with approval of designated authority (no inference is intended that items must be identical in all respects if above conditions are satisfied)
Owner:	Any individual partnership, firm or corporation by whom the Project Engineer has been retained or who, as a property owner, is making arrangements with the City
PCA:	Portland Cement Association
PCC:	Portland ~~cement concrete~~Cement Concrete
Payment bond:	Form of security furnished by contractor and their surety guaranteeing payment of all labor, material, equipment, and all other obligations arising from work

Performance bond:	Security furnished by applicant, or such other party acceptable to the City, and their surety guaranteeing complete and faithful performance of all obligations and conditions placed on contractor by contract
Person:	Individual, firm, corporation, association, agency, or other entity
Plans:	Plans, profiles, and detailed drawings showing locations, character, dimensions, and details of work to be done
Plumbing System:	All plumbing fixtures and traps, or soil, waste, special waste, and vent pipes within a building and to a point five fee outside the building foundation thereof
PRMP:	City of Wilsonville's ~~1994~~ Parks and Recreation Master Plan, ~~or~~ latest edition
Predevelopment:	Considered as the natural, unimproved and unaltered state of the land.
Product data:	Complete catalog data for manufactured items of equipment and all component parts, including specific performance data, material description and source, rating, capacity, working pressure, material gauge thickness, brand name, catalog numbers, and other necessary information
Project correction list:	Final project inspection to repair checklist, or punch list, compiled after construction of total project is complete, and after all testing is satisfactorily finished
Project Engineer:	The engineer, licensed by the State of Oregon as a Civil Engineer, under whose direction plans, profiles, and details for the work are prepared and submitted to the City for review and approval
Proposal:	Offer for work made out and submitted on prescribed proposal form and properly signed and guaranteed by bidder
PUE:	Public Utility Easement
Public road:	Road dedicated for use by public; ~~for most part~~ maintained by the City and funded by the road maintenance fee

Public works facility:	Any facility constructed in public right-of-way or public easement that is either immediately or eventually to be taken over by City for maintenance and operation; includes but is not limited to streets, sidewalks, curbs, parking lots, driveways, storm drainage facilities, water system works, and sanitary sewer systems
Public Sewer:	Any sewer in public right-of-way or public easement operated and maintained by the City
Punch list:	Final project inspection to repair checklist, or project correction list, compiled after construction of total project is complete, and after all testing is satisfactorily finished
Representative:	City Engineer or authorized representative
Reserve strip:	A 1-foot ~~long~~ wide- section adjacent to or at terminus of right-of-way ~~at stub streets~~, to be ~~provided to~~recorded as a plat restriction with access controlled by the City Engineer.
Residential User:	The owner, lessee, or occupant of a single-family dwelling unit in one structure
Right-of-way:	~~Part of ground provided to or required by City for use in constructing and maintaining public facilities~~The space in, upon, above, along, across, over or under the public streets, roads, highways, lanes, courts, ways, alleys, boulevards, sidewalks, bicycle lanes, and places used or intended to be used by the general public for travel as the same now or may hereafter exist, that the City has the right to allow User to use. Right-of-Way shall not include the airspace above the Right-of-Way used for cellular mobile radio service or broadcast television service
Road:	Part of right-of-way used for vehicular traffic, including appurtenances, storm drain system, traffic control devices, etc.
Roadway:	All of the right-of-way dedicated, granted, used or to be used, for vehicle movement
SBUH:	Santa Barbara Unit Hydrograph
SCS:	Soil Conservation Service, U.S. Department of Agriculture

Sensitive areas:	Areas sensitive to environmental degradation, such as existing or created wetlands; rivers, streams, and springs with year round or intermittent flow; and impoundments (natural lakes and ponds). Sensitive areas also include any resource protected within the SROZ
Service Lateral:	See Lateral Sewer
Sewage:	The wastewater derived from human habitation and use of buildings for residential, institutional, or commercial purposes, excluding storm waters and industrial waste
Shop drawings:	Diagrams, drawings, illustrations, brochures, schedules, and all other data submittals required by contractor and furnished by contractor illustrating fabrication, installation, dimensions, and other aspects of work
Specifications:	Directions, requirements, explanations, terms, and provisions in these standards, supplemented by such special conditions as may be necessary pertaining to various features of work to be done, manner and method of performance, and manner and method of measurement and payment; specifications include directions, requirements, and explanations that appear in plans
SROZ:	Significant Resource Overlay Zone: the delineated outer boundary of an identified significant natural resource as defined by Wilsonville's Development Code
Standard specifications:	Codes, rules, and regulations set forth in City of Wilsonville "Public Works Standards" as adopted by City Council and considered to be the latest issue, with all amendments as of date of these standards
Standards:	Specifications in the "Public Works Standards" adopted for use in City of Wilsonville.
Steel plate:	A-36 steel meeting AASHTO H-20 loading specifications
Stock pile:	Temporary staging of construction and/or excavated materials
Streets or Roads:	Any public highway, road, street, avenue, alley, way, easement, or right-of-way used or to be used for vehicle movement

Structures:	Those structures designated on the Standard Drawings as manholes, cleanouts, weirs, etc. Detailed drawings of structures or devices commonly used in City work and mentioned in these PS & FM Standards are included in Section IV, Standard Drawings
Subcontractor:	Any individual, firm, or corporation having contract with contractor or with any other subcontractor for performance of part of work
Substantial completion:	In the opinion of the City's authorized representative, construction is to the point of completion where all facilities are usable for their intended purpose: utilities (storm, sanitary, and water) are tested, approved and connected to public lines, all weather access is completed; roadway striping is completed; street lighting is approved and activated; all fire, life, and safety issues meet code
Substantial progress:	In the opinion of the City's authorized representative, construction work is proceeding at a rate close to that of the submitted construction timetable
Traffic coefficient:	Number used in determining structural section of street
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
TSP:	City of Wilsonville's ~~2003~~ Transportation Systems Plan, ~~or~~ latest edition
TVF&R:	Tualatin Valley Fire and Rescue
Uniform Plumbing Code:	The Uniform Plumbing Code adopted by the International Association of Plumbing and Mechanical Officials, current edition
USCGS:	United States Coast and Geodetic Survey
Wet-season:	For the purpose of monitoring ground water elevations, the "wet-season" is defined as November 1 through April 30
WQV:	Water Quality Volume
WPWS:	Wilsonville ~~"~~Public Works Standards~~ 2006"~~, current edition

Work:	Furnishing of all labor, materials, equipment, and other incidentals necessary or convenient to successfully complete project or part of project, and carrying out of all duties and obligations imposed by contract
Working Day:	Calendar day, any and every day shown on the calendar, excluding Saturdays, Sundays, and legal holidays.
Written notice:	Written communication delivered in person to individual or to member of firm or to officer of corporation for whom it is intended. If delivered or sent by mail to last business address known to one who gave notice, it shall be duty of each party to advise other parties to contract of any change in business address until contract is complete

101.5.00 CONTROL OF PUBLIC WORKS CIP PROJECTS

a. All public system improvements and public works facilities, or improvements or facilities to become public, shall be designed by or under the direction of the Project Engineer, a Professional Engineer registered in the State of Oregon. All public system improvements and public works facilities shall be designed and constructed in accordance with all applicable rules and regulations of the City and any City interpretations of those rules and regulations, including applicable technical guidance manuals, and in accordance with all applicable federal, state, and local statutes and rules.

b. Project Engineer Responsibilities.

1. The Project Engineer shall, at a minimum, be available for the following:

(a) Project Orientation

(b) Preliminary Design

(c) Final Design: Includes 50%, 90% and 100% bid design.

(d) Pre-Bid Conference

(e) Construction Management: Includes preconstruction conference, weekly (at a minimum) construction meetings, and completion.

2. The Project Engineer shall prepare agendas and meeting minutes for all project-related meetings unless otherwise directed by the City's authorized representative.

Meetings shall be scheduled at least 10 business days in advance. The Project Engineer shall distribute agendas and supporting information through the City's authorized representative to all invited attendees at least 2 business days in advance of any meeting. The Project Engineer shall distribute meeting minutes to all meeting attendees and other interested parties within 5 business days of the meeting date.

3. The Project Engineer shall develop and submit to the City's authorized representative a detailed schedule for the entire project (design, property acquisition, permits and construction) showing major tasks and supporting activities for completion of the project. The schedule shall account for periods of City review and comment submission where required.

~~b.~~c. Approval of the plans and schedule must be made by the City's authorized representative before construction is permitted. An authorized representative of the City will be available for construction observation during construction of the project.

~~c.~~d. At the completion of construction, the design engineer shall submit a completion certificate to the City stating that all permitted work has been completed in accordance with the approved project plans and specifications, or approved modifications to the plans.

~~d.~~e. All surveys for public works facilities shall be performed under the direction of a Professional Land Surveyor registered in the State of Oregon. ~~All elevations shall be referenced to a U.S. Coast and Geodetic Survey (USCGS) datum.~~ A list of acceptable benchmarks is available at the City. It is the surveyor's responsibility to verify the accuracy of these benchmarks. Surveys shall be in compliance with Section 101.7.07, "Surveying and Land Monuments."

~~e.~~f. Materials and workmanship shall meet or exceed the adopted standards and at all times shall be subject to the approval of the City's authorized representative.

~~f.~~g. On completion of projects to become public works, the applicant or their ~~design engineer~~Project Engineer shall submit one complete set of reproducible "record drawings" (see ~~Section 101.8.17.a, "Project Closeout~~Section 101.8.17.a, "Record Drawings") to the City's authorized representative for future reference. The drawings shall show any deviations from the original construction drawings and shall include sufficient information to accurately locate water, sanitary sewer, and storm sewer service extensions. No bond will be released until the City's authorized representative receives an acceptable set of reproducible record drawings from the design engineer, with his or her stamp of certification.

~~g.~~h. Before the City accepts a public works project for operation and maintenance, a ~~one-year~~ guarantee on all materials and workmanship incorporated in the project shall be provided to the City on one of the acceptable forms described in ~~Section 101.8.17.b~~Section 101.8.18, "Maintenance ~~Assurance~~and Warranty."

101.6.00 PRIVATE DEVELOPMENT PROCESS REQUIREMENTS

101.6.01 Pre-Application Conference

The City of Wilsonville will hold a pre-application conference with the applicant (owner/developer), unless otherwise waived by the Planning Director, before formal application for public works permits and review of site design and construction plans. The pre-application process allows the applicant and the City to discuss the proposed project and the standards and regulations that will apply while the project is still in a preliminary stage. Any specific development standards, regulations, or problem areas can thus be discussed before the applicant makes a substantial investment in the project or proceeds with a formal application unaware of the issues.

101.6.02 Plan Check and Permits

a. Permit required: No work shall be performed, nor materials stored, nor encroachment made on or within a Right-of-Way, Public Easement, or Public Utility Easement without first acquiring a permit from the City's Engineering Division, except as provided by City Ordinance.

~~a.~~b. Plan checks and/or permits are required and issued on all construction projects within public rights-of-way, or easements, which will eventually be maintained and operated by the City of Wilsonville. Any permits required by federal, state, and local governments shall be obtained by the person proposing the improvements.

~~b.~~c. Public Works Permit: Projects requiring ~~permits~~Public Works Permits shall include, but not necessarily be limited to, improvements or upgrades to publicly owned and maintained streets, sidewalks, curbs, driveway approaches, water systems, sanitary sewer systems, and storm drainage systems. Projects that also require plan checks and permits include all private storm drainage, sanitary sewer, and water systems that will be connected to or that will discharge into a system under the jurisdictional control of the City of Wilsonville.

~~c.~~d. Utility Construction Permit: The construction, repair, maintenance, or replacement of all other utilities located within a public right-of-way or public easement, including, but not exclusively, power, telephone, gas, and cable television, shall be required to submit for plan check and obtain a Utility Construction Permit.

e. Right of Way Permit: For all other work done within the Right-of-Way that blocks, partially blocks, hinders or impedes the flow of traffic, cyclists, or pedestrians, a Right of Way Permit shall be required.

101.6.03 Plan Check Requirements

At the pre-application conference, the applicant will be given a copy of the Community Development Department Plan Review Checklist**,** which is to be used as a guide during the review of all proposed new, or improvements to, public works facilities.

Along with the items in the plan review checklist, the following requirements shall be met before the City's authorized representative completes a plan check:

a. ~~a.~~ Satisfy all requirements of Chapter 4 of the Wilsonville Code and other ordinances and regulations pertaining to construction in the City of Wilsonville.

b. ~~b.~~ Submit ~~minimum of four copies of stamped and signed~~ detailed plans printed to PDF and combined into a single electronic file and specifications ~~produced~~ printed to PDF and combine into a single electronic file, with each being stamped and digitally signed by a Professional Engineer registered in the State of Oregon, along with three printed copies. Incorporated within the construction plans and specifications shall be applicable franchise utility installation plans, stamped and signed and prepared by the proper authority.

c. For projects which include street construction, re-construction or expansion, submit two sets of the Street Design Report and a single electronic file in PDF format, stamped and signed by a Professional Engineer registered in the State of Oregon~~.~~ in conformance with Section 201.2.00, "Street Design Standards."

d. ~~c.~~ Submit two sets ~~each~~ of storm water design report and a single electronic file in PDF format, stamped and signed by a Professional Engineer registered in the State of Oregon in conformance with Section 301.3.00, "Submittal Requirements".

e. Submit two sets of design calculations for the water system design~~,~~ or wastewater system design~~, or storm drainage system design~~ and a single electronic file in PDF format, stamped and signed by a Professional Engineer registered in the State of Oregon, where applicable or as required.

~~d. Submit two sets of other applicable utility installation plans, stamped and signed and prepared by the proper authority. The plans shall also be incorporated in the construction plans and specifications.~~

~~e. Submit two sets of stamped and signed soil-bearing tests, as required by the City for pavement design, to verify street section designs and alternatives. Soil testing to ascertain the strength of the soil is required for all roads to analyze and design the road structural section. Soil tests are needed on samples of the subgrade material that is expected to be within 3 feet of the planned subgrade elevation. Samples are needed for each 1,000 feet of roadway and for each visually observed soil type. Soil tests are required for a minimum of two locations.~~

f. ~~f.~~ A plan check fee must be paid before a plan review will be ~~completed~~started. The amount of the fee will be established by resolution of the City Council.

g. ~~g.~~ Plans deemed incomplete by the City's authorized representative may be returned without a full plan review being completed. An explanation will be provided by the City indicating sections of the plans deemed incomplete. Once all items are addressed, plans may be resubmitted for review.

h. Plans shall include all necessary current City details and City Construction Note Sheet.

101.6.04 Plan Review

a. If all conditions of the plan check requirements as specified in ~~Section 101.6.03~~Section 101.6.03, "Plan Check Requirements," are met, and no additional information is requested by the City's authorized representative, ~~a~~the plan review will be ~~completed~~commenced. The City's authorized representative will prepare a plan review redline comments list, to be sent to the appropriate permit applicant or responsible party. The list will indicate any deficiencies in the construction plans and specifications. The proper party shall then make the corrections and resubmit the plans and specifications for review.

b. The plan check fee submitted as per ~~Section 101.6.03.f~~Section 101.6.03.f, "Plan Check Requirements," covers the City's first and second plan reviews. An additional plan review fee shall be required for the third, fifth, and every other plan review performed by the City. A partial plan review or plans deemed incomplete as per ~~Section 101.6.03.g~~Section 101.6.03.g, "Plan Check Requirements," will be considered as a full plan review ~~is~~in respect to the plan check fee. The amount of the additional fee will be established by resolution of the City Council.

c. Once the plans and specifications are approved for construction, the City's authorized representative shall issue a written notice of plan approval. The written notice of plan approval shall remain in effect for 90 calendar days from the date of approval. If the applicant cannot proceed with the project within the 90-day limit, a 180-calendar-day extension can be applied for. If no substantial progress has been made within the allotted time, no further ~~permit~~plan approval extension will be granted, the ~~permit~~plan review fee shall be forfeited to the City, and the plan approval will expire. Plans may be resubmitted, subject to payment of new plan review fees.

101.6.05 Record Drawings, Maps, and Plans Not Guaranteed

Record drawings, maps and plans ~~are~~stamped and signed by the Project Engineer, a Professional Engineer registered in the State of Oregon, shall be provided to the City by the Owner/Developer upon completion of development and/or improvement projects within the City. The City does not guarantee the accuracy of measurements, elevations, locations, or other information on such maps and plans. All information should be independently verified by ~~a registered engineer~~the Project Engineer, as part of their due diligence, via survey, potholing, or other appropriate means prior to conducting any improvement or development.

101.6.06 Permit and Assurances

a. Before any public construction begins, a letter of commitment, letter of credit, ~~performance~~assignment of deposit, bond, or cash deposit in form and substance satisfactory to the ~~City's authorized representative~~City and meeting the requirements

in Section 101.6.08, "Qualifications of Insurance and Bonding Companies" shall be submitted by the applicant as a performance assurance for such construction. The amount of the performance assurance for private development projects shall be 150% of the design engineer's estimate or bid total on public improvements and shall be conditional on the performance of all terms and conditions of the permit and these standards. The guarantee shall include, but not be limited to, restoration of settled fills, trenches, pavement, and surfaces. The amount of the performance assurance for public projects financed by the City shall be 100% of the ~~successful bid amount.~~full contract price in accordance with ORS 279C.380. Additionally, a payment bond in the amount of 100% of the full contract price shall be submitted in accordance with ORS 279C.380 unless exempted by the Local Contract Review Board in accordance with ORS 279C.390..

b. When all requirements stipulated here are met and the construction plans are stamped and signed by the City's authorized representative, a Public Works Permit can be issued on payment of the Public Works Permit fee. The amount of the fee will be established by resolution of the City Council.

c. The Public Works Permit shall be valid for one year from the date of issuance. If time elapses on the permit, the applicant can request, in writing, a permit extension from the City Engineer or the City's authorized representative. If the request is approved, the permit holder then has 180 calendar days to begin construction on permitted projects and shall show substantial progress during this permit extension, as determined by the City. If no substantial progress is made within the allotted time, no further permit extension will be granted, the permit will expire, and the permit fees will be forfeited to the City. Plans may be resubmitted, subject to payment of new fees. Resubmitted plans shall be reviewed to determine compliance with the Public Works Standards, including any newly approved codes and/or regulations.

101.6.07 Insurance Requirements

The City requires additional assurances from the applicant/contractor including, but not limited to, Certificates of Insurance from insurance companies or entities acceptable to the City ~~and authorized to issue insurance in the State.~~meeting the requirements of Section 101.6.08, "Qualifications of Insurance and Bonding Companies." The Certificate shall specify all of the parties who are Additional Insureds. The contractor shall be responsible for paying all deductibles, self-insured retentions and/or self-insurance included under these provisions. For City financed projects, a Certificate of Insurance shall be executed by the successful bidder and their insurance company prior to the execution of the contract by the applicant ~~(see Appendix G for acceptable form).~~.

101.6.08 Qualifications of Insurance and Bonding Companies

a. **Minimum requirement:** All bonding and insurance companies providing insurance or bonds required by the City must meet certain minimum financial security requirements. These requirements conform to the rating published by A.M. Best &

Co. and a current Bests Key Rating Guide Property Casualty. All companies providing bonds or insurance must meet the following requirements.

1. Have a current Bests Rating not less than A.

2. Have a current Bests Financial Size Category not less than Class IX.

3. Be authorized to conduct and transact insurance and surety contracts in the State of Oregon.

4. Be a U.S. Treasury Circular 570 listed company, if providing payment or performance bonds.

b. **Failure to meet minimum requirements**: If the issuing company does not meet these minimal requirements, or for any other reason is unsatisfactory to the City, written notification will be made by the City to the Applicant, who must promptly obtain and submit to the City a new policy or bond issued by an insurer/surety acceptable to the City.

101.6.09 Indemnification

The applicant/contractor shall indemnify and hold harmless the City~~,~~ of Wilsonville and its officers, agents, and employees~~,~~; Wilsonville City Council; City of Wilsonville Urban Renewal Agency and its officers, agents, and employees; and Wilsonville Urban Renewal Board from and against all claims, demands, penalties, damages, losses, expenses, including attorney's fees, and causes of action of any kind or character, including the cost of defense thereof, arising or alleged to have risen in favor of any person on account of personal injury, death, or damage to property arising out of or resulting from, or alleged to have risen out of or resulted from, in whole or in part, any act or omission of the applicant, the applicant's design engineer, the applicant's contractor, or anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable.

101.7.00 CONSTRUCTION PROCEDURAL REQUIREMENTS

101.7.01 General Procedure and Requirements

a. ~~a.~~ During the construction period, the City will maintain two sets of approved plans and specifications. The permit holder or contractor shall retain one set of approved, stamped, and signed plans and specifications at the construction site at all times. Any modification to the approved plans shall be first approved, stamped, and signed by the City's authorized representative prior to construction of the modification.

b. A pre-construction conference with the City's authorized representative and the applicant, contractor, design engineer, and other parties requested to attend or having an interest in the project will meet to discuss the project before any construction begins. The pre-construction conference will discuss the role of the City's inspection team and the team's relation to the contractor and applicant.

c. The permit holder or contractor shall submit material cut sheets to the City's authorized representative for review against City standard and project specific specifications. All material submittals must be approved by the City's authorized representative prior to the material's use or installation within the project.

~~c.~~d. An inspection criteria checklist ~~may~~shall be provided to the contractor outlining the necessary inspections~~, if requested.~~. The customary inspections are generally as follows:

1. ~~1.~~ All underground utilities, including water, sanitary sewers, and storm sewers.

2. ~~2.~~ All subgrade preparation, fill placement, base rock, and leveling rock.

3. All concrete pours, such as driveways, sidewalks, curbs, catch basins, manholes, and cleanouts.

4. Asphaltic or Portland cement concrete pavement.

~~d.~~e. The City's authorized representative shall at all times have access to the project and will make routine inspections. Should any inspection reveal that the construction of the improvements is not proceeding according to the approved plans and the specifications in this document, the City Engineer may order all work stopped, all defective work removed, or both.

~~e.~~f. The contractor shall give the City's authorized representative a minimum of 24 hours' (one working day) advance notice before a required inspection. It is the responsibility of the permit holder or contractor to obtain inspections and approvals for all work installed.

~~f.~~g. Failure to give advance notice to the City's authorized representative for inspections, receive adequate inspections, or violation of other regulations, ordinances, resolutions, rules, and City codes as outlined in these standards can result in one or more of the following, as determined by the City:

1. Stoppage of work until problem is resolved.

2. Suspension of future inspections.

3. Withholding certification of projects as complete, which ~~is required to begin~~will delay the start of the warranty period and ~~eventual~~ City acceptance for maintenance and operation.

4. Citation for violation of the Wilsonville Code and its penalties and provisions.

5. Uncovering or removal of work not inspected.

101.7.02 Testing of Construction

a. The applicant shall be responsible for providing the name of a compaction-testing firm that will be paid by the permit applicant and that will supply the City's authorized representative with the compaction tests needed to certify that the soils, aggregate, and surface materials meet the minimum requirements of these standards. The testing firm hired by the permit applicant shall be required to be under the direct supervision of a Professional Engineer registered in the State of Oregon whose area of expertise is geotechnical engineering.

b. The applicant shall also be responsible for providing the name of a materials-testing firm that will be paid by the permit applicant and that will supply the City's authorized representative with the concrete-strength tests and other materials tests required to certify that the materials meet the minimum requirements of these standards. The testing firm hired by the permit applicant shall be required to be under the direct supervision of a Professional Engineer registered in the State of Oregon.

c. City reserves the right to direct testing agency on frequency of testing.

101.7.03 Right of Entry to Work

Representatives of the City and any federal, state, or local agencies having jurisdiction over the work shall have right of entry to any and all parts of the work at reasonable times. The contractor shall cooperate in all respects with such agencies and shall provide proper facilities for access and inspection.

101.7.04 Suspension of Work

The City Engineer may suspend the work and give written notice to the applicant/contractor of such suspension when the contractor is using material that does not conform to the requirements of the contract documents or when the contractor is improperly performing the work, and neglects or refuses to replace or reconstruct such work. The suspension shall remain in effect until appropriate corrections are made. Review of the City Engineer's decision shall be made, on request, by the City Manager within 48 hours of the initial suspension. Regardless of the decision, the City shall not incur pecuniary liability for an incorrect suspension of work, unless such suspension was a willfully malicious act of the City.

101.7.05 Protection of Existing Facilities

a. The approximate location of underground City water, sewer, and storm drainage facilities are available at the City Engineer's office. The approximate locations of underground power, gas, telephone, and cable facilities are available from the serving utility companies. The location of existing facilities shall be shown on the construction drawings for public works projects.

b. Appropriate and timely notice shall be given to all public and private utility companies in advance of construction, for the purpose of protecting or relocating

existing facilities. The exact location of underground facilities shall be verified in advance of public works construction, in cooperation with the public or private utilities involved.

c. When the contractor is physically locating underground utilities in roadways, the Portland cement concrete (PCC) or asphalt concrete (AC) roadway surfaces shall be cored and not square-cut. PCC roadway cores shall be repaired in accordance with Section 201.7.04.b, "Coring." Asphalt roadway cores shall be repaired in accordance with Section 201.7.02.d, "Asphalt Concrete Replacement."

d. All existing underground and surface facilities shall be protected from damage or degradation during construction of public works facilities.

e. Any existing facilities not specifically designated for alteration or removal that are damaged or degraded during construction shall be restored or replaced to an "in kind" or better condition at the contractor's expense.

f. Turf damaged during utility construction shall be replaced with sod in a timely manner acceptable to the City's authorized representative.

101.7.06 Protection of Property

The contractor shall protect stored materials, cultivated trees and crops, and other items next to proposed construction. Property owners likely to be affected by the construction activities, as determined by the City's authorized representative shall be notified at least 48 hours in advance of the time construction begins. During construction, no person shall be without access to their place of residence or business for a period exceeding 8 hours, unless the contractor has made special arrangements in writing with the affected person(s).

101.7.07 Surveying and Land Monuments

~~1.~~a. **NAVD 88 Datum**: All elevations on design plans and record drawings shall be based on NAVD 88 Datum. Each page of the plans and drawings shall state the benchmark datum information. Note that City of Wilsonville control points are based on NGVD 29 datum and that necessary adjustments will need to be made by the applicant's surveyor to meet NAVD 88 requirements.

~~2.~~b. **Permanent Survey Markers:** Before beginning any construction activity, the applicant's engineer/surveyor shall adequately reference all permanent survey monuments, property corners, stakes, or benchmarks on the subject site, or markers that may be subject to disturbance in the construction area or during the construction of any off-site improvements. It shall be the responsibility of the contractor to protect survey monuments throughout the construction process. The contractor shall not disturb permanent survey monuments without written consent from the City's authorized representative.

3.c. **Disturbed, Destroyed, or Lost Monuments:** If any survey monument is disturbed, moved, relocated, or destroyed as a result of construction activity, the contractor shall, at contractor's cost, retain the services of a Professional Land Surveyor registered in the State of Oregon to restore the monument to its original condition and shall file all documentation required by Oregon law. A copy of the recorded documentation shall be submitted to the City Engineer.

101.7.08 Railroad Crossings

a. Crossings of railroad rights-of-way shall be done in a manner that conforms to the requirements of ODOT Rail Division and the railroad having jurisdiction. If any bonds or certificates of insurance protection are required, they shall be furnished by the contractor or applicant to the railroad company concerned, with the City as an additionally named insured. Costs for railroad flagging shall be the responsibility of the applicant, unless specifically stated otherwise in the City's Contract Documents.

b. Permits or easements for such crossings shall be obtained by the applicant, unless specifically stated otherwise in the City's Contract Documents. All the terms of such permits or easement shall be met by the applicant and contractor. In some locations, the railroad may require casing pipe.

101.7.09 Criteria for Stream-Road Crossings

a. Stream crossings shall be avoided whenever possible, whether by roads, utilities, or other development. If streams must be crossed, impacts shall be minimized by preferring bridges or arch spans to culverts, and by designing bridges and culverts to pass at least the 100-year flood and meet the Oregon Department of Fish and Wildlife (ODFW) *Fish Passage Criteria*, or latest edition.

b. Before any work may be performed in any stream, the method of operation and the schedule of such work shall be approved in writing by the City's authorized representative. The timing of in-water work shall comply with the guidelines established by the ODFW. Mechanized equipment shall enter streams only when necessary and only within the immediate work area.

c. The contractor shall comply with the regulatory requirements of the Oregon Department of State Lands, ODFW, U.S. Fish and Wildlife Department, U.S. Army Corps of Engineers, National Marine Fisheries Service, and any other state and federal agencies having jurisdiction.

101.8.00 CONSTRUCTION

101.8.01 Construction Commencement

a. The contractor shall not undertake nor instruct the subcontractor(s) to undertake any portion of the work without notifying the City's authorized representative 24 hours in advance of beginning work. At the time of this notice to the City, unless otherwise specifically waived, in writing, by the City, the applicant shall have submitted to the

City, as applicable, a performance ~~assurance,~~, payment, and/or completion assurances (in the form of cash deposit, a letter of credit, or bonds approved as to form, content and issuer by the City), construction ~~permit~~contract, development agreement, and/or public works permit, appropriate plan check and permit fee, certificate of insurance, and any necessary off-site easements.

b. Contractor shall conduct construction activities only during the hours of work ~~guidelines~~ established by the City.

101.8.02 Scheduling

a. **Sequence of Operations:** The contractor shall plan construction work and execute operations with a minimum of interference to the operation of existing City facilities and the traveling public. It may be necessary to do certain parts of the construction work outside normal working hours to avoid undesirable conditions, and it shall be the obligation of the contractor to make this change to the work schedule. Such scheduling, however, is subject to approval of the City's authorized representative, and does not relieve the contractor from making their work available for inspection.

b. **Progress of Construction**

1. Construction shall proceed in a systematic manner that will result in minimum inconvenience to the public.

2. Contractor shall pothole and verify existing utilities and facilities prior to commencing proposed work.

3. Tree protection fencing shall be installed and inspected prior to erosion control measure installation.

~~3.~~4. Erosion control measures shall be installed and inspected, as per Section 101.9.06~~.a~~, "~~Inspections~~Inspection," prior to commencing work.

~~4.~~5. Construction staking for the work being performed shall be completed before the start of excavation. The contractor shall limit their operations to a small work area per crew. ~~At no time shall the trenching equipment be farther than 100 feet ahead of the pipe-laying crews, unless advance written permission is given by the City's authorized representative.~~

~~5.~~6. The trench shall be backfilled in conformance to ~~Section 6~~Section 6, "Trench Excavation and Backfill~~," so that no section~~." The length of open trench ~~is left open longer than 24 hours. Before the contractor stops construction for the day, trenches located in the right-of-way~~ shall be ~~completely backfilled, unless the trench is covered and with secured Steel Plates.~~limited to the requirements of Section 601.3.01.e, "Open Trench Limit."

~~6.~~7. Where Steel Plates are used as a temporary road surface they shall comply with the following:

(a) Steel Plates shall be minimum ¾" thick, A-36 steel meeting AASHTO ~~H~~HS-20 traffic loading specifications.

(b) Steel ~~Plates~~plates shall be centered over the cut and adequately secured to prevent any movement for the AASHTO HS-20 traffic loading specifications. No more than ½ of the plate shall span a trench that has been completely backfilled, or no more that ⅓ of the plate shall span a trench that has not been completely backfilled.

(c) At locations where an excavation will remain open for more than 24 hours, steel plates shall be installed with transition ramps manufactured specifically for the intended use per **Detail No. S-2146** of these standards.

(d) At locations where an excavation will remain open for less than 24 hours, steel plates shall be installed as follows:

~~(c)~~i. Uneven pavement surfaces must first be leveled with cold mix before laying steel plates over trench.

~~(d)~~ii. ~~Plates~~Steel plates shall be secured to the roadway with a minimum of two ½-inch or larger steel pins driven a minimum of 6 inches below the surface and at least 18 inches from the edge of the roadcut.

~~(e)~~iii. Cold patch shall be used to ramp up to the ~~Steel Plate~~steel plate edges; minimum 6-inch ramp per ½-inch difference in grade change between road surface and Steel Plate.

~~(f)~~(e) Contractor is responsible for maintaining transition ramps and cold mix around Steel Plates.

~~(g)~~(f) Use of plates in travel lanes shall require contractor to place a 30-inch by 30-inch "BUMP" warning sign for each affected travel direction.

~~(h)~~(g) Plates shall not be left in the travel lane for longer than 5 working days unless approved in writing by the City's ~~Authorized Representative~~authorized representative.

c. **Connections:** ~~Connections between~~Any connections to existing ~~work and new work~~public utilities or newly constructed facilities proposed to be public utilities shall be made only with approval of the City's authorized representative. ~~Connections~~Public utilities shall be ~~made~~placed into service only after all testing is completed on the new work and it is found to conform in all respects to the requirements of the plans and specifications, unless otherwise approved by the City's authorized representative. Prior to making connection(s) to existing facilities, contractor shall have all necessary pipe and fittings available and on-site.

d. **Cleanup:** Cleanup of all construction debris, excess excavation, and excess materials and complete restoration of all fences, mailboxes, ditches, culverts, signposts, and

similar items shall be completed according to Section 101.8.16, "Preservation, Restoration, and Cleanup."

101.8.03 City Inspection

a. The City's authorized representative shall inspect the project as necessary and shall check materials, equipment, and the construction of the project to determine whether the work is proceeding in accordance with the City's standards. The contractor shall notify the City's authorized representative at least 24 hours (one working day) to request City inspection. No such inspection, however, shall relieve the contractor of their duties under these standards.

b. The City's authorized representative shall have the authority to direct replacement of defective material and uncovering work not inspected as required. Material rejected by the City's authorized representative shall be removed from the job site by the contractor immediately after its rejection and shall not be used on the project.

c. Instructions given by the City's authorized representative shall be respected and executed by the contractor. The City's authorized representative, however, shall not have the power to waive the obligations of the contractor to furnish high-quality equipment, supplies, and materials, or to perform good work.

d. Should a contractor encounter a condition different than that indicated by the construction documents, the contractor shall notify the City's authorized representative in writing of the changed condition and shall not precede with any work associated with the changed condition until a written response is received from the City. The City's authorized agent shall review the change with the contractor and the Project Engineer and issue a written directive to the contractor Any work commenced prior to the issuance of a written directive from the City will be at the contractor's risk.

101.8.04 Change in Plans or Standards

The City's authorized representative shall have the right to make changes in the plans or in these standards to protect the public interest or the normal operations of the City. Such changes shall be made at the sole discretion of the City's authorized representative and may include, but are not limited to, the allowance of new or different materials for products that are equivalent to, or better than, the products specified in the plans or standards.

101.8.05 Interferences ~~and~~, Obstructions, Abandoned Utilities

a. **Utility Notification:** The contractor shall comply with the rules and regulations of the Oregon Utility Notification Center: OAR 952-001-0010 through 952-001-0090 and ORS 757.993. At least 48 hours' notice shall be given to all utility offices that may be affected by the construction operation.

b. **General:** Various obstructions may be encountered during the course of the work. Maps and information regarding underground utilities shall be obtained from the utility owning and operating such utilities, but the location of such utilities is not guaranteed. If the services of any utility are interrupted because of the construction operation, the contractor shall notify the utility owner and the City's authorized representative immediately.

c. **Protection:** The contractor shall exercise all due care in protecting existing underground and surface facilities and property along the route of the improvement in compliance with City of Wilsonville Code Chapter 4 and Ordinance 464. This protection shall include, but not be limited to, trees, yards, fences, drainage lines, mailboxes, driveways, shrubs, and lawns. Any existing facilities not specifically designated for alteration or removal that are damaged during construction shall be restored or replaced to an "in kind" or better condition, at the expense of the contractor.

d. **Access:** The contractor shall maintain access to all mail boxes; access to all property entrances shall be in conformance with Section 101.7.06, "Protection of Property."

e. **Abandoned Utilities:** All abandoned utilities shall be properly removed, grouted, or plugged at the discretion of the City's authorized representative. Sewer facilities shall be abandoned in accordance with Section 401.5.05, "Abandon Sewer Facilities." Water systems shall be abandoned in accordance with Section 501.5.05, "Abandon Water Facilities." Storm facilities shall be abandoned in accordance with Section 301.10.05, "Abandon Storm Facilities."

101.8.06 Contaminated Soil

If during construction contaminated soil ~~or with,~~ hazardous materials or chemicals are encountered, the Contractor shall follow the procedures specified in Section 101.9.02, "Contaminated Soils or Hazardous Materials."

101.8.07 Guarantee

a. The applicant/contractor shall furnish high-quality equipment, supplies, and materials and perform the work in accordance with these specifications. Any failure or omission by the City's authorized representative to condemn any defective equipment, supplies, materials, or work shall not be construed as an acceptance thereof nor release the contractor from their obligations.

b. On notification of any deficiency by the City's authorized representative, the contractor shall properly reconstruct or replace any defective equipment, supplies, materials, or work at their own cost any time on discovery of the defect during the period of construction and for the full guarantee period after acceptance of the work, and shall indemnify the City from any claims resulting from the defect.

c. The applicant/contractor shall guarantee all materials and equipment furnished and work performed ~~for a minimum period of one year from the date of formal written acceptance by the City's authorized representative~~ in conformance with ~~Section 101.8.17.b~~Section 101.8.18, "Maintenance ~~Assurance~~and Warranty."

d. The applicant/contractor shall further warrant and guarantee ~~for a minimum period of one year from the date of formal written acceptance of the system~~ that the completed system is free from all defects due to faulty materials or workmanship~~.~~ in conformance with Section 101.8.18, "Maintenance and Warranty." The applicant/contractor shall promptly make such corrections as may be necessary by reason of such defects, including the repair of any damage to other parts of the system resulting from such defects.

e. If the applicant/contractor, after notice, fails within 10 days to proceed to comply with the terms of this guarantee, the City may have the defects corrected, and the applicant and the applicant's surety shall be liable for all expense incurred. However, in case of an emergency where, in the opinion of the City Engineer, delay would cause serious loss or damage, repairs may be made without notice being given to the applicant/contractor and the applicant/contractor shall pay the cost thereof.

101.8.08 Substitution of Materials

Whenever any material, article, device, product, fixture, form, type of construction, or process is indicated or specified by patent or proprietary name, by name of manufacturer, or by catalog number, such specifications shall be for the purpose of establishing a standard of quality and facilitating the description of the material or process desired. Such specification is not to be construed as eliminating from competition other products of equal or better quality made by other manufacturers and that are fully suitable in design, and shall be deemed to be followed by the words "or as approved" or "approved equal." The contractor may, in such cases, submit complete data to the City Engineer for consideration of another material, type, or process that shall be substantially equal in every respect to the one indicated or specified. Substitute materials shall not be used unless approved in writing by the City's authorized representative.

101.8.09 Safety Requirements

a. The contractor shall at all times conduct work in such a manner as to comply with all Occupational Safety and Health Administration (OSHA) requirements, shall minimize the possibility of accident or injury of any workers or the general public, and shall conduct the work, maintain operations, and provide all reasonable safeguards so as to protect public and private property as well as to protect persons from injury.

b. If in the opinion of the City's authorized representative the contractor is in violation of the above safety practices, the City's authorized representative may issue and post a stop-work order if the contractor, after being informed of such violation, refuses to

comply immediately. The City's authorized representative will also notify the ~~State of Oregon Workers' Compensation Division~~OSHA of such action.

c. ~~The City's authorized representative's role is not one of supervision or safety management, but of observation only, as specified in Section 101.8.10.g., "Traffic Maintenance and Safety."~~The City's authorized representative's role is not one of supervision or safety management, but of observation only. Nothing contained in this section or elsewhere in this document shall be interpreted to obligate the City to act in any situation, nor shift the applicant's responsibility for safety compliance to the City. No responsibility for the safety of the work or for construction means, methods, techniques, sequences, or procedures shall attach to the City by virtue of its action or inaction.\

101.8.10 Traffic Maintenance and Safety

a. The contractor shall comply with all rules and regulations of City, county, or state authorities and applicable fire protection and law enforcement agencies regarding the closure of public streets or highways to public traffic. No public road shall be closed to the public except by express permission of the public agency responsible for the road.

b. The contractor shall conduct their operations so as to assure the least possible obstruction to traffic, including vehicular, bike, and pedestrian and normal commercial pursuits. Traffic control in work zones shall conform to the *Manual on Uniform Traffic Control Devices* (MUTCD ~~2000, or~~, latest edition), published by the Federal Highway Administration, U.S. Department of Transportation.

c. The contractor shall be required to submit a traffic control plan to the appropriate jurisdiction for review and approval before beginning construction.

d. The contractor shall provide and be responsible at all times for flaggers, signs, and other devices not otherwise specified to be furnished by the applicant. The contractor shall erect and maintain all barricades, guards, lights, variable message boards, standard construction signs, warning signs, and detour signs as are necessary to warn and protect the public at all times from injury or damage as a result of work operations on highways, roads, streets, bike lanes, sidewalks, multi-use paths, or recreational trails affected by such operations.

e. If the applicant or contractor fails to immediately provide the necessary flaggers or to provide, erect, maintain, and remove barricades, guards, lights, variable message boards, standard construction signs, warning signs, and detour signs when so ordered, the ~~City Engineer~~City's authorized representative shall be at liberty, without further notice to the contractor or applicant, to do so and to deduct all costs from the applicant's/contractor's performance assurance.

f. When traffic will pass over backfilled trenches before they are paved, the top of the trench shall be maintained with cold patch or hot patch, to be removed later, and shall

allow normal vehicular movement to continue. Access driveways shall be provided where needed. Cleanup operations shall follow immediately behind backfilling. The work site shall be kept orderly at all times.

~~g. The City's authorized representative's role is not one of supervision or safety management, but of observation only. Nothing contained in this section or elsewhere in this document shall be interpreted to obligate the City to act in any situation, nor shift the applicant's responsibility for safety compliance to the City. No responsibility for the safety of the work or for construction means, methods, techniques, sequences, or procedures shall attach to the City by virtue of its action or inaction under this section.~~

101.8.11 Access for Police, Fire, and Postal Service

a. No closure of a part of a street shall be made without first requesting and receiving approval from the City's authorized representative. Closure of public streets shall be in conformance with ~~Section 101.8.10.a~~Section 101.8.10.a, "Traffic Maintenance and Safety." The contractor shall conduct operations so as to cause the least interference with emergency vehicle access.

b. The contractor shall comply with all requirements of the U.S. Postal Service with regard to the location of mailboxes that must be disturbed during construction. Mailboxes may be moved to temporary locations designated by the Postal Service. At the completion of work in each area, the contractor shall replace the mailboxes in their original location and in a condition satisfactory to the Postal Service.

101.8.12 Compliance with Applicable Laws

a. The contractor shall keep fully informed of all local ordinances, including those of Tualatin Valley Fire and Rescue (TVF&R) and state and federal laws and regulations that in any manner affect the work specified ~~here~~herein.

b. The contractor shall at all times comply with said ordinances, laws and regulations, and shall protect and indemnify the applicant and his/her officers and agents against any claim or liability arising from or based on the violation of any such laws, ordinances, or regulations.

c. All permits, licenses, and inspection fees necessary for prosecution and completion of the work shall be secured by the applicant/contractor.

101.8.13 Work in Public Rights-of-Way

a. Closure of public streets shall be in conformance with ~~Sections 101.8.10.a ,~~Section 101.8.10.a, "Traffic Maintenance and Safety," and ~~101.8.11.a~~Section 101.8.11.a, "Access for Police, Fire, and Postal Service." Construction operations and traffic control shall be in conformance with ~~Section 101.8.10.b~~Section 101.8.10.b, "Traffic Maintenance and Safety."

b. The contractor shall use every reasonable precaution to safeguard the persons and property of the traveling public. It shall be the sole responsibility of the contractor to furnish, place, and maintain barricades, barriers, lights, flares, danger signals, signs, and security guards as necessary to protect the persons and property of the traveling public. All barricades and obstructions shall be protected at night by signal lights that shall be suitably distributed and kept burning from sunset to sunrise.

c. When working in the public right-of-way, the contractor shall maintain the construction area in the interest of public health, safety and welfare, including, without limitation, maintenance of proper steel plates, trench backfill, patching, signage, and lighting. It is the City's right, but not its obligation, to monitor contractor's compliance with this subsection. Upon discovery of non-compliance, or upon notice by the City's authorized representative, the contactor shall take immediate corrective action. If the contractor is not on site, and if, in the sole judgment of the City, conditions impose an immediate or eminent threat to public health, safety and welfare, the City has the right to perform emergency repairs or cause the repairs to be made, without notice and with all costs of such work being the responsibility of the contractor. Within sixty days of receipt of a detailed invoice for payment from the City, the contractor shall reimburse the City for costs incurred.

~~c.~~d. In the event of interruption to domestic water, sewer, storm drain, or other utility services as a result of accidental breakage, or as the result of being exposed or unsupported, the contractor shall promptly notify the proper authority, cooperate with said authority in restoring the service as promptly as possible, and bear all costs of providing temporary service measures and repairs. In no case shall interruption of any water or utility services be allowed to exist outside working hours, unless prior approval by the City's authorized representative is received.

e. ~~d.~~ Work site cleanup shall conform to Section 101.8.16, "Preservation, Restoration, and Cleanup."

101.8.14 Easements

~~a. The minimum~~ Public utility ~~and drainage~~ easements ~~for residential subdivisions~~ shall be ~~as follows:~~

~~1.~~a. ~~A 6-foot public utility easement~~ provided along all ~~front~~ lot lines~~, as shown on approved plans.~~ fronting a public street according to **Table 1.1**.

~~**A 20-foot wide easement with an all-weather surface for maintenance access, as shown on approved plans. Lateral access shall**~~

Table 1.1 PUBLIC UTILITY EASEMENT WIDTH REQUIREMENT

Street Classification	Easement Width
Local	6-foot

Collector	8-foot
Arterial	10-foot

2. ~~When it is~~ not ~~be greater than 800 feet.~~

b. ~~Public~~ possible or practical to install the public sanitary, storm sewer, ~~and~~or water ~~lines on private property shall be centered~~line in a ~~permanent easement~~ dedicated public street, a minimum 15-foot wide permanent, public pipeline shall be granted to the City~~, with a minimum width~~ for utilities that meet all of ~~15 feet along its entire length. Such easements, when directed by the City, shall be accompanied by temporary easements granted to~~ the ~~City of adequate width to allow construction of water, storm, and sanitary sewers. The surveyor shall provide the City with the documents necessary to grant easements. The width of combination easements will be evaluated at the site development permit stage, but in no case shall they be less than 20 feet wide.~~following criteria:

1. Single utility.

2. Utility pipe less than 24" in diameter.

3. Utility pipe less than 10 feet in depth.

4. Utility located on a cross slope less than 10%.

Where the utility(s) do not meet the criteria above, the easement width shall be determined by the Engineer of Record and reviewed for approval by the City's authorized representative. The easement width determination shall consider the number, depth, and size of utilities, the ground cross slope, soil stability, required vertical and horizontal separation between utilities, work zone width, and all other relevant information.

c. All easements shall be shown on the approved construction plans.

d. No permanent structures shall be allowed within an easement area.

e. Certain types of wooden fences, chain link fences, or other similar structure acceptable to the City's authorized representative may be allowed to be installed across and/or within easements.

101.8.15 Sanitation

Contractors shall provide and maintain adequate sanitary/sanitation facilities for employees.

101.8.16 Preservation, Restoration, and Cleanup

a. ~~a.~~ **Site Restoration and Cleanup**

1. The contractor shall keep the premises clean and orderly at all times during the construction period and leave the project free of rubbish or excess materials of any kind on completing the work. The contractor shall immediately replace mailboxes and signposts disturbed by construction activities.

2. During construction, the contractor shall stockpile the excavated trench materials so as to do the least damage to adjacent lawns, grassed areas, gardens, shrubbery, trees, or fences, regardless of the ownership of these areas. These surfaces shall be left in a condition equivalent to their original condition or better and free from all rocks, gravel, boulders, or other foreign material.

3. If damaged or altered during construction, existing trenches, drainage ditches, and culverts shall be ~~regraded~~re-graded, and original drainage tiles and sewer laterals shall be repaired expeditiously. Within 500 feet of pipe-laying and backfilling operations in any trench section, the contractor shall rake and drag all disturbed areas and leave them free of rocks, gravel, clay, or any other foreign material and ready, in all respects, for seeding. The finished surface shall conform to the original surface, and shall be free-draining and free from holes, rough spots, or other surface features detrimental to a seeded area.

4. After backfilling the trenches, the contractor shall restore all public and private irrigation and/or utility systems that were destroyed, damaged, or otherwise modified during construction to their original condition or better.

5. All areas disturbed by the contractor's operations inside dedicated rights-of-way or easements shall be returned to their original condition or better. Areas outside the easements or rights-of-way that are disturbed by the contractor's operations shall be returned to their original condition or better.

6. ~~b.~~ All site restoration and cleanup work as described above shall be performed by the contractor within 5 working days of substantial completion of the work associated with the disturbance.

b. **Street Cleanup**

1. The contractor shall clean spilled soil, mud, rock, gravel, or other foreign material caused by construction operations from all sidewalks, gutters, streets, and roads at the conclusion of each day's operation.

~~2. Within five days of substantial completion of the project, including all paving, gravel shoulder resurfacing, and/or utility work, the contractor shall thoroughly remove all soil, mud, rock, gravel, and other foreign material from sidewalks, gutters, and paved surfaces.~~

~~3.~~2. Cleaning shall be by grader and front-end loader, power brushing, vacuuming, and hand labor, unless otherwise approved by the City's authorized representative. At no time shall any such material be washed or flushed into any part of the stormwater and surface water system. If the contractor does not follow these standards, the City may exercise its option to have the street(s) cleaned and bill the contractor for such service.

~~4.~~3. ~~Within five days of final completion of~~When directed by the ~~project~~City's authorized representative, the contractor shall, within 5 working days of notice, remove all erosion-control materials and thoroughly remove all dirt, mud, rock, gravel, and other foreign material from sidewalks, gutters, catch basins, curb inlets, area drains, manholes, and paved surfaces.

c. ~~c.~~ **Preservation of Irrigation and Drainage Ditches**

1. The contractor shall arrange schedules so that construction will not interfere with the irrigation of cultivated lands or pasturelands. Construction may proceed during the irrigation season provided the contractor constructs, at their own expense, temporary irrigation ditches, turnouts, and miscellaneous structures acceptable to the owner of the land in question that shall permit the land to be irrigated by others during construction.

2. After backfilling the trenches, the contractor shall restore all irrigation and storm drain ditches destroyed, damaged, or otherwise modified during construction to a condition equivalent, in the opinion of the City's authorized representative, to the condition of the ditches before construction. Ditches shall be built in their original locations, unless specified otherwise on the construction plans.

101.8.17 Project Closeout

~~a.~~ **~~Project Completion:~~** At the conclusion of the project, the applicant shall notify the City's authorized representative in writing that the project is ready for final inspection. On receipt of this notice, the City's authorized representative will request the following:

1. **Record Drawings:** At the completion of construction, the design engineerinstallation of any required public improvements, and before final inspection, in accordance with Section 101.8.17.b, "Final Inspection," is scheduled, the Project Engineer shall perform a record survey. ThatThe record survey shall be the basis for the preparation of record drawings that will serve as the physical record of changes made to the approved plans and/or specifications during construction. Using the record survey as a guide, the appropriate changes shall be made to the construction plans and/or specifications and a complete revised set, the record drawings, shall be submitted. The initial set of record drawings shall be submitted on approved Mylarä material (minimum 3 mil thickness) using a photo printing method; Xerox printed drawings are not acceptable. Recordto the City for review and approval and consist of a set of paper drawings must be received before the City's authorized representative issues a project correction list (punch list). Record drawings shall include all work done within the public right-of-way or public easements.

2.a. **AutoCAD Drawing:** Anand an electronic copy of thein PDF format. Once the record drawings are approved, a final set of record drawings in AutoCAD format (check with City for acceptable versions)on approved 3 mil Mylarä material , an electronic copy in the City's current edition of AutoCAD, and a digitally signed PDF shall be submitted to the City's authorized representative on a 3½-inch floppy diskette or compact diskette. ElectronicCity. The initial set of record drawings must be received before the City's authorized representative issues a project correction list (punch list) in accordance with Section 101.8.17.c, "Project Correction List." Record drawings shall include all work done within the public right-of-way or public easements.

3.b. **Final Inspection:** Once the City's authorized representative receives the Mylarinitial set of paper and electronic PDF format record drawings, a final inspection of the project will be conducted with representatives fromby the City, the design engineering firm, and the contractorCity's authorized representative.

4.c. **Project Correction List:** After this inspection, a project correction/repair list (punch-list) will be issued by the City's authorized representative to the applicant and contractor. The project correction/repair list will include any items either damaged or improperly placed during construction, and any item(s) that, in the opinion of the City's authorized representative, need repair.

5.d. **CompletionProject Corrections:** Contractor shall perform correction/repair work as required on the project correction/repair list. WhenThe City encourages the contractor to complete all items ofcorrection/repair work as expeditiously as possible, the City will retain the performance assurance until the project correction list havehas been completed, and inspected and approved by the City's authorized representative, and the contractor submits all maintenance and landscape maintenance assurances (see Section 101.8.17.b, "Project Closeout"), the City's authorized representative will consider the project complete and shall so state in writing. At this time, the one-year

~~warranty period will go into effect, on written notice from the Engineering Division~~to the City.

e. **Completion:** The City's authorized representative will consider the project complete and shall so state in writing when all of the following items are complete.

1. All items of the project correction list are completed, inspected and approved by the City's authorized representative.

2. Final set of Mylar, AutoCAD, and digitally signed PDF record drawings are submitted to the City and approved by the City's authorized representative.

3. Confirmation that all easements and legal documents have been recorded with the County Recorder.

4. Contractor submits approved maintenance assurances and warranty as specified in Section101.8.18, "Maintenance and Warranty."

At this time, the warranty period will go into effect on written notice from the Engineering Division.

101.8.18 Maintenance and Warranty

~~b.~~a. **Maintenance Assurance~~: Maintenance assurances~~ Required:** Contractor shall fully warrant all work from defect, for a period of time as determined by the type of work. The warranty shall be required for work to ensure post-construction quality and landscape survivability. If defective or negligent work is discovered and repaired, this warranty will automatically be extended from the date the repair is made and accepted by the City. This warranty by the Contractor is in addition to and not in lieu of any other warranties provided by various suppliers or manufacturers. Such warranty shall be guaranteed in the form of maintenance assurance.. Assurances shall be in the form of a letter of commitment, letter of credit, assignment of deposit, bond, or cash deposit, in form and substance satisfactory to the City~~.~~ and meeting the requirements of Section 101.6.08, "Qualifications of Insurance and Bonding Companies." Assurances shall remain in place until a written release is issued from the City. This provision of the Maintenance Assurance is to help secure the Contractor's performance of any corrective work that may need to be performed within the warranty period of the Project, but in no way limits the Contractor's liability therefore.

~~1. **Construction maintenance assurance:** a one-year bond for 10% of the cost to construct public improvements. Released one year after acceptance of construction and after correction of all defects identified during the maintenance assurance period.~~

b. **Construction Maintenance Assurance:** Maintenance assurance shall be required for all public improvements constructed by the Contractor. The construction maintenance assurance shall be for 10% of the cost to construct the public

improvements and be in place for a period of not less than 2 years from the date of Final Acceptance. Prior to the end of the two-year assurance, the City will provide contractor with a maintenance project corrections list; the City reserves the option to video inspect the sanitary and/or storm sewer lines, if any were constructed, repaired or installed as part of the contract. Contractor shall make all necessary repairs and replacements to remedy any and all defects, breaks, or failures of the public improvements as identified by the City and having occurred within two years following the date of Final Acceptance due to faulty or inadequate materials or workmanship, in a manner satisfactory to the City's authorized representative and at no cost to the City. Contractor shall repair damage or disturbances to other improvements under, within, or adjacent to the public improvements, whether or not caused by settling, washing, or slipping, when such damage or disturbance is caused, in whole or in part, from activities of the Contractor in performing his/her duties and obligations when such defects or damage occur within the warranty period. Construction maintenance assurance shall be released two years after acceptance of any corrective work performed during the maintenance assurance period.

~~2.~~c. **Landscape maintenance assurance:** ~~a two-year bond~~Landscape maintenance assurance shall be for 100% of the cost to install all required landscaping in water quality/quantity facilities and vegetated corridors, *plus* 100% of the cost to maintain the landscaping in these areas ~~for two years.~~and be in place for a period of not less than 2 years from the date of Final Acceptance. The assurance shall be released two years after acceptance of construction, providing the landscaping meets the 90% survival level (see ~~Section 301.13.02,~~Section 301.15.02, "Landscape Inspection for Warranty").

~~c. **Final Completion:** A project shall meet final completion when the City's authorized representative receives confirmation that all easements and legal documents have been recorded with the County Recorder.~~

d. **Prompt Compliance**: If Contractor, after written notice, fails within 10 days to proceed to comply with the terms of this section, Owner may have the defects corrected, and Contractor and Contractor's Surety shall be liable for all expenses incurred. If the assurance is in the forms of cash or letter of credit, the City may immediately draw upon such amount. In case of an emergency where, in the opinion of the Engineer, delay would cause serious loss or damage, repairs may be made without notice being given to Contractor and Contractor or Surety shall pay the cost of repairs. Failure of the Engineer to act in case of an emergency shall not relieve Contractor or Surety from liability and payment of all such costs.

e. **Water Lines**: In addition to provisions a and b above, City of Wilsonville water line facilities installed by the contractor under the Public Works Permit contract that require repair or replacement during the maintenance period shall be repaired by the City or under direct supervision of the City and the Contractor and Contractors surety will be liable for prompt reimbursement of all labor costs and expenses incurred by the City in making the repair.

101.9.00 ENVIRONMENTAL PROTECTION, EROSION PREVENTION, AND SEDIMENT CONTROL

101.9.01 Introduction

This section identifies requirements for erosion prevention and sediment control. The provisions are intended to prevent or reduce adverse impacts to the City's drainage system and water quality. In combination with other federal, state, and local laws and ordinances, the requirements are intended to protect the beneficial uses of state waters.

101.9.02 Contaminated Soils or Hazardous Materials

If construction reveals soils contaminated with hazardous materials or chemicals, or if soil is suspected to be contaminated, the contractor shall cease earthwork activity immediately, ensure that no contaminated material is hauled from the site, remove their workforce from the immediate vicinity of the contaminated area (leaving all machinery and equipment), and secure the area from access by the public until an OSHA certified HAZMAT response team has relieved them of that responsibility. The contractor shall immediately notify the City's authorized representative, the design engineer, and the Oregon Department of Environmental Quality (DEQ) of the situation.

101.9.03 General Policy

a. **Erosion Prevention Techniques and Measures**

1. The use of erosion prevention techniques shall be emphasized, rather than measures to control sediment. This shall be especially important on construction sites immediately before and during the rainy season. Erosion prevention techniques are designed to protect soil particles from the force of rain and wind so they shall not erode. When land is disturbed at a construction site, the erosion rate accelerates dramatically.

2. Erosion prevention techniques include, but are not limited to, construction scheduling, ground cover, and matting. Sediment control measures are designed to capture soil particles after they are dislodged and to retain the soil particles on site.

3. Erosion prevention measures include, but are not limited to, silt fences, sediment barriers, and settling basins. Both erosion prevention techniques and sediment control measures have appropriate uses. Studies have shown, however, that sediment control measures are less effective than erosion prevention techniques in preventing soil movement.

4. Permanent vegetation or seeding shall be established only between March 1 through May 15 and September 1 through October 15. If an irrigation system is installed, vegetation or seeding may be established from March 1 through November 15. If an area falls under definition of a wetland, permanent vegetation or seeding shall be established only between March 1 through April 30 and

September 1 through October 15 and in a manner satisfying applicable local, state and federal ~~reuirements~~requirements.

5. Permanent vegetation or seeding shall meet the 90% survival level as detailed in ~~Sections 301.13.02.c~~Sections 301.15.02.c and ~~301.13.02.~~d, "Landscape Inspection for Warranty".

b. **Existing Vegetation**

1. Existing vegetation shall be protected and left in place whenever practicable. Work areas shall be carefully located and marked to reduce potential damage to trees and existing vegetation. Trees shall not be used as anchors for stabilizing working equipment. Where required, trees and existing vegetation shall be protected with a non-movable, chain link fence (see **Detail No. ~~R-1155~~RD-1230** of these standards).

2. Where existing vegetation has been removed, or the original land contours have been disturbed, the site shall be ~~revegetated~~re-vegetated, and the vegetation established, as soon as practicable.

c. **Enforcement**

Failure to comply with any provision of this section or with any term of an erosion-prevention and sediment-control permit shall be deemed a violation and subject to enforcement action pursuant to applicable City ordinance and resolutions, and orders, including all implementing rules and regulations.

101.9.04 Erosion Prevention and Sediment Control

a. **Application and Purpose**

1. It is a City ~~requirement~~goal to ~~reduce~~eliminate or minimize to the ~~amount of~~extent feasible all sediment and other pollutants reaching the public storm and surface water system resulting from development, construction, grading, excavating, clearing, and any other activity that accelerates erosion, to the limits prescribed in these standards.

2. It is the policy of the City to require temporary and permanent measures for all construction projects to lessen the adverse effects of construction on the environment. All projects shall include properly installed, operated, and maintained temporary and permanent erosion-control measures as provided in these standards or in an approved plan, designed to protect the environment during the term of the project. Compliance with the measures prescribed here or in an approved plan ~~do~~does not lessen the necessity to provide effective and comprehensive erosion prevention and sediment control.

3. Nothing in this section shall relieve any person of the obligation to comply with the regulations or permits of any federal, state, or local authority.

b. **Erosion Prohibited**

1. Visible or measurable erosion that enters, or is likely to enter, the public or private stormwater and surface water system or other properties is hereby prohibited, and is a violation of these standards. An offsite sedimentation control facility may be utilized if it has been identified and approved in writing by the City's authorized representative, written approval is obtained from the respective property owner, and a written agreement for rehabilitation of the facility by the applicant or contractor is submitted to the City. The owner of the property or the applicant under a Public Works Permit, together with any person or persons, including but not limited to the contractor or the design engineer causing such erosion, shall be held responsible for violation of the City's standards.

2. No person shall create physical erosion by dragging, dropping, tracking, or otherwise placing or depositing, or permitting to be deposited, mud, dirt, rock, or other such debris on a public street, or into any part of the public stormwater and surface water system, or into any part of a private stormwater and surface water system that drains or connects to the public stormwater and surface water system. Any such deposited material shall be immediately removed by hand labor or mechanical means. No material shall be washed or flushed into any part of the stormwater and surface water system until all mechanical means to remove the debris are exhausted and preventive sediment filtration is in place.

3. The owner of the property or the applicant under a Public Works Permit, together with any person or persons, including but not limited to the contractor or the design engineer who causes such erosion, shall be held responsible for violation of these Standards.

c. **Erosion-Prevention Techniques and Methods**

The techniques and methods described in the latest edition ~~the~~of the Clackamas County Water Environment Services "Erosion Prevention and Sediment Control Planning and Design Manual" ~~may~~(www.clackamas.us/wes/designmanual.html) shall be used to control and prevent erosion in addition to the following procedures:

1. **Gravel Construction Entrance and Wheel Wash**

(a) A gravel construction entrance is required as per **Detail No. S-2240** of these standards. If there is more than one vehicle access point, a gravel construction entrance shall be required at each entrance.

(b) For project sites 5 acres or greater in size, a wheel wash as per **Detail No. S-2235** of these standards will be required to be constructed. For sites less than 5 acres in size, a wheel wash may be required if, in the opinion of the City's authorized representative, excess tracking of soil occurs.

~~(b)~~(c) The responsibility for design and performance of the driveway remains with the applicant. Vehicles or equipment shall not enter a property next to a stream, watercourse, stormwater or surface water facility, or wetlands unless adequate measures are installed to prevent physical erosion into the water or wetland.

2. **Erosion Control**

(a) During periods of wet weather, disturbed areas of the site and/or stockpiled soil shall be covered by tarps or straw at the end of each day's operations; all disturbed, unworked areas of the site shall be protected from erosion.

(b) Temporarily seed disturbed soils and slopes that are not at finished grade and which will be exposed for two months or longer before being disturbed again.

(c) Where seeding is used for erosion control, Regreen® or equivalent, or sterile wheat shall be used to stabilize slopes until permanent vegetation is established.

(d) Temporary seeding shall establish a minimum of ~~70~~90% coverage of the ground surface with uniform healthy plants. If this coverage is not achieved, or if the City determines that it is not effective in stabilizing the soil from erosion, the contractor, at their expense, shall stabilize the area with other temporary stabilization methods as approved by the City's authorized representative.

(e) Biodegradable fabrics (Coir/Jute Matting), reinforced turf mats, or straw mulch can be used to stabilize slopes and channels. The fabrics can also be used to hold plugs in place and discourage floating upon inundation.

Consult the *Erosion Prevention and Sediment Control (EPSC) Planning and Design Manual* for additional information.

(f) Permanent vegetation shall be established as outlined in ~~Section 101.9.03.a.4~~Section 101.9.03.a.4, "Erosion Prevention Techniques and Measures."

3. **Bioengineering Techniques**

(a) Any person performing work in a watercourse or in an environmentally sensitive area (e.g., essential salmonid habitat, wetlands, steep slopes) shall employ bioengineering techniques whenever feasible.

(b) Bioengineering techniques include, but are not limited to, contour wattling, brush layering or matting, live cuttings, fascines, and stakes.

4. **Sediment filters/barriers**

(a) Using straw bales as a sediment filter or barrier is not allowed.

(b) A filter system may not be used on catch basins in public streets as part of erosion-prevention and sediment-control plans for single-family dwellings.

5. **Plastic Sheeting:** Plastic sheeting shall generally not be used as an erosion-control measure for single-family house construction. Plastic sheeting may be used to protect small, highly erodible areas or temporary stockpiles of material. If plastic sheeting is used, the path of concentrated flow from the plastic must be protected.

6. **Protection Measure Removal:** The erosion-prevention and sediment-control measures shall remain in place and be maintained in good condition until all disturbed soil areas are permanently stabilized by installation and establishment of landscaping, grass, or mulching, or are otherwise covered and protected from erosion.

7. **Wet Weather Measures:** On sites where vegetation and ground cover have been removed, vegetative ground cover shall be planted on or before September 1, with the ground cover established by October 15. As an alternative if ground cover is not established by October 15, the open areas shall be protected through the winter with mulch, erosion blankets, or other method(s) approved by the City's authorized representative.

8. **Exceptions to Sediment Barrier Requirements:** Sediment barriers are not required on a site in the following circumstances:

(a) ~~Where a Neighborhood Erosion Control Plan~~Where a Neighborhood Erosion Control Plan is in effect, for a maximum of four lots.

(b) Where there are no concentrated flows and the slope being protected has a grade of less than 2%.

(c) Where flows are collected by using temporary or permanent grading or other means, such that the flows are routed to an approved settling pond, filtering system, or sediment barrier.

(d) Where there are no concentrated flows, where slopes are less than 10%, and where the runoff passes through a grassed area that is either owned by the applicant or where such use is allowed, by written agreement, by the owner of the grassed area. The grass area shall be at least equal in dimension to the project area.

(e) Where the surface is protected by ground cover or matting approved by the City's authorized representative.

d. **Dust Prevention**

During all phases of the work, the contractor shall take precautions to abate any dust nuisance. Dust-prevention measures shall be continuous until final inspection by the City's authorized representative. Dust shall be minimized to the extent practicable, using all measures necessary to accomplish results satisfactory to the City's authorized representative, including, but not limited to:

1. Sprinkling haul and access roads and other exposed dust-producing areas with water.

2. Applying City-approved dust palliatives on access and haul roads.

3. Establishing temporary vegetative cover.

4. Placing wood chips or other effective mulches on vehicle- and pedestrian-use areas.

5. Maintaining proper moisture conditions on all fill surfaces.

6. Prewetting cut and borrow area surfaces.

7. Using covered haul equipment.

e. **Neighborhood Erosion Control Plan**

1. Any individual or group may submit an erosion-prevention and sediment-control plan for multiple lots. Plans shall be submitted to City of Wilsonville for review and approval. This shall be referred to as a "Neighborhood Erosion Control Plan." In such case, the group of lots will be evaluated as if they were one lot.

2. If an individual lot in a Neighborhood Erosion Control Plan is sold to new owners, the new owners may either join the neighborhood plan (with the approval of the other neighborhood owners), or will need to submit their own erosion control plan if erosion potential still exists on the parcel. If a lot is sold and the new owner does not join the Neighborhood Erosion Control Plan, then the plan must be revised and the new owner must submit an individual plan.

101.9.05 Maintenance

a. The applicant shall maintain the facilities and techniques contained in the approved erosion-prevention and sediment-control plan so they will continue to be effective during the construction phase, post construction phase, establishment of permanent vegetation, or any other permitted activity.

b. If the facilities and techniques approved in an erosion-prevention and sediment-control plan are not effective or sufficient as determined by the City site inspection, the applicant shall submit a revised plan within three working days of written notification by the City's authorized representative. On approval of the revised plan by the City's authorized representative, the applicant shall immediately implement the additional facilities and techniques included in the revised plan.

c. In cases where erosion is likely to occur, the City's authorized representative may require the applicant to install interim control measures before submitting a revised erosion-prevention and sediment-control plan.

101.9.06 Inspection

a. **City Initial Inspection:** On a site development or any other type of project, the erosion-prevention and sediment-control measures shall be installed before the start of any permitted activity. The applicant shall ~~call~~schedule an inspection by using the City's ~~authorized representative~~24-hour Inspection Request Line at (503) 682-4159, or submit a request online or by e-mail, for ~~a pre-construction conference~~an initial inspection before beginning any site clearing or grading. If necessary, tree protection shall be installed and inspected by the Planning Division before any erosion-prevention and sediment-control measures are installed.

b. **Applicant Inspections**: The applicant shall be required to inspect erosion-prevention and sediment-control measures as outlined in the approved Grading and Erosion Control Plan (as required by City's current erosion control ordinance) and to provide information to the City's authorized representative. Inspections shall be completed as required by the latest edition of the Clackamas County Water Environment Services "Erosion Prevention and Sediment Control Planning and Design Manual" and the ~~Minimum Erosion Prevention~~minimum erosion prevention and ~~Sediment Control Plan Monitoring Requirements (see Appendix G).~~sediment control plan monitoring requirements. Inspection information is to be maintained on-site and available to City's authorized representative on request.

c. **Final Inspection:** A final erosion control inspection shall be required before the sale or conveyance to new property owner(s) or before the removal of erosion-prevention and sediment-control measurements.

SECTION 2

~~STREET IMPROVEMENT~~TRANSPORTATION DESIGN & CONSTRUCTION STANDARDS

201.1.00 ENGINEERING

201.1.01 Introduction

This section outlines design and construction requirements for all public ~~street~~transportation construction. The provisions and technical specifications herein set forth the requirements of the City of Wilsonville for ~~roadway construction and~~constructing transportation facility improvements. Interpretations of such provisions and their application in specific circumstances shall be made by the City's authorized representative~~.~~, unless specifically stated otherwise. Refer to Section 1 of the "Public Works Standards" for general provisions and requirements.

201.1.02 Extension of Public Transportation Systems

a. The extension, addition, or widening of public transportation facilities to serve any adjacent parcel or tract of land, shall be done by the property owner or permit applicant and may be subject to applicable System Development Charge (SDC) credits, as determined by the City's authorized representative.

b. The City reserves the right to perform the work or cause it to be performed and bill the owner for the cost of the work or to pursue special assessment proceedings.

c. The public transportation system shall extend to the most distant parcel boundary, to facilitate future extension, unless otherwise approved by the City's authorized representative.

d. Where public infrastructure improvements paid for by the property owner or permit applicant directly benefit adjacent properties, the property owner or permit applicant may pursue establishment of a reimbursement district per Section 3.116 of the City Code.

201.1.03 Alternative Design and Construction Standards

a. If approved by the Development Review Board and City Engineer, alternative roadway design standards may be substituted for the standards specified herein. ~~Metro's "2000 Regional Transportation Plan" (RTP) provides street~~

~~design policies and concepts (such as *Green Streets, Livable Streets, and Skinny Streets)* that address federal, state, and regional transportation mandates with respect to local implementation of Metro's "2040 Growth Concept." While this section provides for the consideration of alternative standards that may conflict with the City's adopted Fire Prevention Code, it is understood that alternative standards will be considered and applied on a case-by-case basis, with due regard to the Fire Prevention Code.~~ Any requests for substitution must be in writing, stamped by a Professional Engineer registered in the State of Oregon at the time of submittal, and submitted as part of the Land Use process. The City Engineer may request submission of any additional information deemed necessary to properly evaluate an alternative roadway design standard.

b. If approved by the ~~City Engineer~~City's authorized representative, alternative construction standards may be substituted for the standards specified herein. Any requests for substitution must be in writing, stamped by a Professional Engineer registered in the State of Oregon ~~at the time of submittal~~, and submitted at least three weeks prior to the ~~Engineering Plan Review submittal process.~~start of any work associated with the construction standard. The City's authorized representative may request submission of any additional information deemed necessary to properly evaluate an alternative construction standard.

201.1.~~03~~04 General Requirements

a. **Functional Classification:** The functional classification of existing and proposed roads is established by the City of Wilsonville's Transportation Systems Plan (TSP). Where the functional classification of a road is not defined by the TSP, the existing land use and existing operational characteristics shall be used by the City's authorized representative to determine the functional classification of the road in question.

b. **Access:** Access to city, county, and public roads shall conform to the City of Wilsonville TSP~~.~~ and Section 201.2.23, "Driveways."

c. **Width:** The width of the streets shall be in compliance with the City of Wilsonville TSP.

d. **Number of Lanes:** The number of lanes for each class of road is defined by the City of Wilsonville TSP.

e. **On-Street Parking:** Streets shall be provided with on-street parking strips as specified in the City of Wilsonville TSP and Section 201.2.26, "On-Street Parking."

~~e.~~f. **Sidewalks and Planter Strips:** Streets shall be provided with sidewalks and planter strips as specified in the City of Wilsonville TSP~~.~~ and Section 201.2.25, "Sidewalks."

g. **Design Speed:** ~~The posted vehicle~~Design speed is the maximum safe speed that can be ~~85%~~maintained over a specified section of roadway when traffic, weather, and other conditions are so favorable that the design ~~speed, unless the road improvement will increase the 85% speed. If road improvement is likely to increase~~features of the ~~85% speed, the~~ roadway govern.

1. The target design speed ~~will~~shall be ~~based~~as follows:

   (a) Arterials 45 miles per hour

   (b) Commerical/Industrial 35 miles per hour

   (c) Collectors 35 miles per hour

   (d) Local 25 miles per hour

2. The City Engineer may approve a lower alternative design speed where it can be shown that the 85th percentile speed of traffic of traffic will be lower than the design speed standard during all hours. The design speed is the minimum speed that shall be used in design of safe road geometry. The design speed shall not prohibit the use of traffic calming features or signing where approved to encourage lower traffic speed.

3. The City Engineer may approve a design speed of 20 miles per hour in accordance with Oregon Revised Statute (ORS) 810.180 (10) as follows:

   (a) The section of roadway is located within a residential district.

   (b) The section of roadway has an average volume of fewer than 2,000 motor vehicles per day.

   (c) The section of roadway has more than 85 percent of motor vehicles traveling less than 30 miles per hour.

   (d) The section of roadway includes traffic control devices that indicate the presence of pedestrians or bicyclists.

   ~~f.~~(e) The section of roadway is posted with speed zone signs giving notice of the designated speed at each end of the portion of roadway where the designated speed is imposed and at such other locations on the ~~City Engineer's recommendation.~~roadway as may be necessary to inform the public.

4. The roadway design speed is not the same as the posted speed. The posted speed shall be determined in accordance with the most current Oregon Department of Transportation Speed Zone Manual.

201.1.~~04~~05 Street Plans

a. It is the design engineer's responsibility to ensure that engineering plans are sufficiently clear and concise to construct the project in proper sequence, using specified methods and materials, with sufficient dimensions to fulfill the intent of the design guidelines in these standards.

b. All ~~elevation~~elevations on design plans and record drawings shall be based on the ~~applicable~~ NAVD ~~datum~~88 Datum, as specified in ~~Section 101.7.07.a, "Surveying~~Section 101.7.07.a, "NAVD 88 Datum."

~~b.~~c. Existing conditions and facilities on design plans and ~~Land Monuments."~~record drawings shall be shown in light, gray print. Proposed conditions and facilities on design plans and record drawings shall be shown in bold, black print.

~~c.~~d. All engineering street plans shall be stamped by a Professional Engineer registered in the State of Oregon. At a minimum the street plan shall contain the following:

1. At least one sheet showing a plan view of the entire project site. If the project site is sufficiently large that detailed street plans on any given sheet do not encompass the entire project site, then a sheet showing the plan view of the entire site must serve as an index to subsequent detailed plans sheets.

2. A topographic map showing existing conditions for the site, including:

   (a) Existing topography for the site. Plan views showing existing features may be required for a distance of up to 100 feet (or further if warranted) beyond the proposed improvement in order to prevent future grade conflicts and will be determined on a case-by-case basis by the City's authorized representative.

   (b) Adjacent streets, trails, multi-use paths, and rail lines, including ~~street~~the respective names.

   (c) Existing utilities, including franchised utilities located above or below ground and drainage facilities that transport surface water onto, across, or from the project site. Existing drainage pipes, culverts, and channels shall include the invert or ~~flowline~~flow line elevations.

   (d) ~~Existing~~Existing vegetation, including denoting the type, DBH, and canopy size of trees within the construction limits.

   ~~(d)~~(e) Existing environmentally sensitive areas (e.g., ravines, swales, steep slopes, wells, springs, wetlands, creeks, lakes). For natural

drainage features, show direction of flow, drainage hazard areas, and 100-year floodplain boundary (if applicable).

(f) Adjacent existing features that are within 25 feet outside of the site boundary, including but not limited to construction activities that will potentially compromise the structural stability or condition of off-site features, such as cultivated vegetation, landscaping and trees, buildings, fences, decks, walls, slabs, and pavements. Denote the type, DBH, and canopy size of all trees.

3. Plans for proposed street improvements shall include the following:

(a) Grading and erosion control plan.

(b) Finished grades, showing the extent of cut and fill by existing and proposed contours, profiles, or other designations. Plan views showing existing features may be required for a distance of up to 100 feet (or further if warranted) beyond the proposed improvement in order to prevent future grade conflicts and will be determined on a case-by-case basis by the City's authorized representative.

(c) Horizontal stationing along centerline, showing points of tangency and curvature, including centerline stationing of all intersecting streets. Curve data shall show tangent length, radius distance, centerline curve length, and delta angle.

(d) Curb alignment and elevation data, including table showing curve and segment station and offset, curb length, tangent length, radius distance, curve length, delta angle, and elevations. Curb elevations at all horizontal alignment break points, quarter-deltas, and low points.

(e) ADA ramp and driveway elevation data for all corners of the ramp and wings; also for connecting sidewalks up to a maximum distance of 15 feet out from ramp or driveway wing when running slopes exceed the general grade established for the adjacent street.

~~(c)~~(f) Proposed structures, including roads and road improvements, parking surfaces, building footprints, walkways, landscaped areas, street lighting, public and private utilities, etc.

~~(d)~~(g) Signing and striping plan.

(h) Lighting and illumination plan.

~~(e)~~(i) Applicable detail drawings.

~~(f)~~(j) Existing and proposed property lines, right-of-way lines, survey monuments, and easements.

~~(g)~~(k) Setbacks from environmentally sensitive areas or resource areas protected within the Significant Resource Overlay Zone (SROZ).

~~(h)~~(l) Any proposed phasing of construction. (Note: water quality and quantity facilities must be constructed before completion of any phased construction)

(m) Any additional information that the City's authorized representative deems necessary.

4. Profiles for construction plans will be provided at the same horizontal scale as the plan sheets and a 1" = 5' vertical scale. Profile drawings shall be drawn below the plan view or immediately following the associated plan view sheet. Profile views showing existing features may be required for a distance of up to 100 feet (or further if warranted) beyond the proposed improvement in order to prevent future grade conflicts and will be determined on a case-by-case basis by the City's authorized representative. The profiles shall include the following:

   (a) Existing ground along centerline and the edges of the right-of-way, if grade differences are significant.

   (b) Existing street centerline and gutter flow lines, including intersecting streets.

   (c) Proposed street centerline and gutter flow lines showing stationing, elevations, and slopes for beginning and end of vertical curves, point of vertical intersection, high and low points, and grade breaks. Vertical curves shall be labeled with vertical curve length, algebraic grade difference, and K values.

   (d) Proposed vertical alignment for stub streets that may be extended in the future, a minimum 300 feet beyond the construction limits. The City's authorized representative may request additional design information deemed necessary to properly evaluate the vertical alignment design of future street extensions.

   (e) Any additional information that the City's authorized representative deems necessary.

~~4.~~5. Detailed grading and landscape plans will be provided. The plans shall include the following:

   (a) Existing ground contours (shaded) and proposed ground contours at a minimum of a ~~1~~ 2 foot contour interval. Slopes steeper than 6H: 1V shall be identified.

(b) Location of all drainage structures as well as any other piped utilities in vicinity (i.e., at 0.1-foot detail).

(c) Landscape planting plan. Show all sewer laterals, water services, fire hydrants, and street lighting as per **Detail No.** ~~R-1157~~**RD-1240** of these standards.

(d) Irrigation plan to achieve the required plant survival rate.

(e) Maintenance access, as applicable.

~~5.~~6. Cross-sections shall be provided for at least the following:

(a) All street sections or amended soil sections, as applicable.

(b) Proposed ditches and swales, including vegetated swales.

201.1.~~05~~06 Surveying

~~1.~~a. The design engineer shall be responsible for establishing the location of the street by means of reference stakes offset along the centerline. No construction shall be allowed to begin before construction staking. All staking shall be performed by or under the direction of a Professional Land Surveyor registered in the State of Oregon.

~~2.~~b. Reference stakes shall be set at 25-foot station intervals along the centerline. Stakes shall, at a minimum, reference the following:

~~-~~1. Point of Curvature (PC), ~~midpoint~~ quarter-deltas, Point of Tangency (PT) for horizontal curves.

~~-~~2. Begin Vertical Curve (BVC) point, low/high point, End Vertical Curve (EVC) point for vertical curves.

~~-~~3. Beginning and ending point of super-elevation.

~~-~~4. Beginning and ending of full super-elevation.

~~-~~5. Centerline of intersecting street.

~~-~~6. PC, ~~midpoint~~quarter-deltas, and PT for curb returns.

~~-~~7. ~~Centerline~~All corners of ~~access (wheelchair) ramp~~ADA ramps.

~~-~~8. Centerline of driveways.

~~-~~9. Curb scoring for match into concrete street joints.

c. The design engineer shall also be responsible for identifying and staking easements during construction.

201.2.00 STREET DESIGN STANDARDS

Street design shall be documented in a Street Design Report prepared, stamped and signed by a Professional Engineer registered in the State of Oregon. The Street Design Report shall include pavement designs, including geotechnical investigations and testing, prepared by an Oregon registered Professional Engineer experienced in pavement design. The report shall include sufficient design documentation regarding site conditions, design assumptions and design parameters to allow for independent peer review of the design recommendations. Two copies of the stamped and signed Street Design Report shall be provided to the City.

201.2.01 Subgrade Evaluation

a. Subgrade evaluation and recommendations shall be prepared, stamped and signed by a Professional Engineer registered in the State of Oregon whose area of expertise is geotechnical engineering and shall be ~~summarized~~included in ~~a Geotechnical~~the Street Design Report.

b. Soil testing to obtain the strength of the soil is required for all roads to analyze and design the road structural section. Soil tests are needed on samples of subgrade materials that are expected to be within 3 feet of the planned subgrade elevation. ~~Samples are~~At least one sample is needed for each ~~1,000~~500 feet of roadway and for each visually observed soil type. Soil tests are required for at least ~~two~~three locations.

c. The selected design structural strength of the soil must be consistent with subgrade compaction requirements. That is, the strength and compaction moisture content at optimum to slightly over optimum must be specified. The ~~Geotechnical~~Street Design Report shall address subgrade drainage and groundwater considerations for year-round conditions. Recommendations for both dry-weather and wet-weather construction shall be included.

d. Test the subgrade and determine the modulus of subgrade reaction, k, or the resilient modulus (M_R) to design the street structure. The procedure for determining M_R is given in AASHTO T-292. Alternately, these soil strength criteria can be based on either the California Bearing Ratio (CBR) or H-veem resistance testing (R-value). The CBR will be determined in accordance with AASHTO T-193, based on the modified proctor (AASHTO T-180). R-values shall be determined at 300-psi exudation pressure in accordance to AASHTO T-190.

1. ~~1.~~ A correlation of M_R to CBR is given by the following relationship (Heukelom and Klomp, 1962):

M_R (psi) = 1,500 x CBR

2. ~~2.~~ A correlation of M_R to R-value is given by the following relationship (Asphalt Institute, 1982):

M_R (psi) = A + B x (R-value)

Where: A = 772 to 1,155, B = 369 to 555

3. ~~3.~~ A correlation of M_R to R-value for fine-grained soils (R-value ≤ 20) is given by the following correlation (AASHTO, 1993):

M_R = 1,000 + 555 x (R-value)

~~4.~~ A correlation of CBR to k may be made using ~~**Table 2.1.**~~

4. ~~**Table 2. 1**~~**Table 2.1**.

Table 2.1. RELATIONSHIP BETWEEN k AND CBR

CBR Value	Modulus of Subgrade Reaction (k) (psi/in.)
3	100
5.5	150
10	200
20	250
50	500
80	710

SOURCE: Portland Cement Association (PCA).

201.2.02 Subsurface Drainage

Subsurface street drainage must be considered in the design of each street:

a. Subsurface drains shall be designed and constructed according to the recommendations of the ~~Geotechnical~~Street Design Report. ~~In the event that no~~Generally, subsurface drainage ~~is required based on~~at the low point of each sag vertical curve shall be managed through the ~~Geotechnical Report~~use of weep holes installed in adjacent catch basins. For pervious street sections, a transverse perforated drainpipe with a minimum diameter of 4 inches shall be installed below the base rock at the point of each sag vertical curve.

b. The subsurface drains are for the purpose of collecting and conveying subsurface water only, not surface runoff. They are not to be considered part of the storm drainage system for purposes of sizing storm drain pipe.

c. Subsurface drains shall connect and drain into the storm drainage system at catch basins, ~~gutter~~curb inlets, manholes, or roadside ditches. Surcharge from the storm drainage system shall not be allowed to back up into the subsurface drains.

d. Alternative subsurface drainage measures may be used if approved by the City's authorized representative.

201.2.03 Structural Section

a. ~~—~~Arterial or Collector Streets may be constructed of:

~~-~~1. ~~Full depth AC, or~~ AC with crushed aggregate base and/or treated bases, or

~~-~~2. PCC with ~~cushion course of~~ crushed aggregate base.

b. Residential Streets may be constructed of:

1. AC with crushed aggregate base and/or treated bases, or

2. Standard or permeable segmental concrete unit pavers, or

3. A combination of the two methods above, with the concrete pavers separated from the AC by a flush curb.

4. Arterial or Collector Roundabouts may be constructed of PCC with crushed aggregate base only.

201.2.04 Crushed Aggregate Design

a. When crushed aggregate is included in the pavement design section, it shall consists of 2-inch thick leveling course of ¾" – 0 crushed aggregate placed over 1 ½" – 0 crushed aggregate.

b. Crushed aggregate shall meet the requirements of Section 201.3.01 "Granular Fill" of these standards.

c. Crushed aggregate shall be separated from native subgrade soils using a geotextile fabric to prevent fine material from migrating up into the base rock.

201.2.05 Asphalt Pavement Design

a. AC pavement shall be designed using nationally recognized procedures: the AASHTO method or the Asphalt Institute method.

b. The wearing surface of AC pavement shall conform to the Oregon Department of Transportation Standard Specifications for Construction (ODOT SSC) Section 00745, "~~Hot Mixed Asphalt Concrete," for either Level 2 or Level 3 HMAC, as determined by the City's authorized representative. Minimum total thickness of AC shall be 4 inches placed in at least two lifts. If the thickness is more than 6 inches, place the asphalt in three lifts. The base courses for AC pavement shall conform to ODOT SSC Section 00745, "Hot Mixed Asphalt Concrete," for either Level 2 or Level 3 HMAC, as determined~~Asphalt Concrete Pavement (ACP)," for ½" Hot Mix Asphalt Concrete, unless otherwise specified by the design engineer and approved by the City's authorized representative.

c. The base courses for AC pavement shall conform to ODOT SSC Section 00745, "Asphalt Concrete Pavement (ACP)," for ¾" Hot Mix Asphalt Concrete, unless otherwise specified by the design engineer and approved by the City's authorized representative.

d. Generally, Level 2 ACP mix design shall be used on local and collector streets. Level 3 ACP mix design shall be used on arterial streets. The City's authorized representative shall make the final determination on mix design level on a case-by-case basis.

e. Warm Mix Asphalt Concrete (WMAC) may be used as a substitute for Hot Mix Asphalt Concrete (HMAC) on all paving with approval by the City's authorized representative. WMAC shall conform to all requirements for HMAC in Section 2, "Transportation Design & Construction Standards" of these standards and ODOT SSC Section 00745, "Asphalt Concrete Pavement (ACP)", as modified in Section 201.3.02, "Asphalt Concrete" and Section 201.6.02, "Asphalt Pavement."

f. Asphalt thickness shall be determined by the approved Street Design Report. The minimum total thickness of AC shall be the following:

1. Local Streets: 4 inches (4.5 inches winter construction)

2. Collector Streets: 5 inches

3. Arterial Streets: 6 inches

g. The minimum total thickness of asphalt concrete constructed between October 15th and March 15th (winter construction) shall be 4.5 inches.

h. The asphalt lift thickness shall be a minimum of 2-inch and a maximum of 3-inch.

~~c.~~i. Pavement thickness design criteria shall be accomplished in accordance with the AASHTO method or the Asphalt Institute method, using soil strength

criteria based on either the CBR or R-value (see Section 201.2.01, "Subgrade Evaluation~~," City of Wilsonville "Public Works Standards").~~.")

~~d. AC pavement shall be compacted to a minimum of 92% relative density, based on the theoretical maximum density determined in accordance with American Society for Testing and Materials (ASTM) D-2041 (Rice Gravity).~~

~~e.~~j. Use a minimum 20-year design period. Design using an initial ride index of 4.2 and a terminal serviceability index of 2.5.

201.2.~~05~~06 Portland Cement Concrete Design

a. At the direction of the City's authorized representative, certain streets may be required to be designed and constructed using PCC.

b. PCC pavement shall be designed using nationally recognized procedures: the PCA method or the AASHTO method.

c. Use a minimum ~~20~~40-year design period.

d. Minimum thickness of PCC shall be 7 inches.

e. Minimum thickness of crushed rock base shall be 6 inches.

~~f. PCC for pavement construction shall conform to ODOT Class 4350 – 1½, Structural Concrete or Structural Concrete Option A.~~

~~g.~~f. Design of concrete joints shall follow the guidelines and requirements outlined in the American Concrete Pavement Association (ACPA) publication, "Design and Construction of Joints for Concrete Streets," except for the following:

~~i.~~1. Maximum joint spacing shall be 12 feet.

~~ii.~~2. Joints shall be designed to be skewed 6:1 when meeting the edge of pavement.

~~iii.~~3. For doweled contraction joints, do not lubricate the dowels.

~~iv.~~4. Isolation joints shall be used around manhole covers. Isolation joints shall be circular with ~~a~~ 2-foot spacing from the manhole cover.

~~h.~~g. All castings for manholes in concrete streets shall be standard type.

h. PCC for pavement, impact slab and concrete crosswalks construction shall conform to ODOT Class 4000 – 1½, Paving Concrete.

i. PCC for curbs, sidewalks, driveways and miscellaneous construction shall conform to ODOT Class ~~3000~~3300 – ¾, Commercial Grade Concrete.

201.2.~~06~~07 Segmental Concrete Paver Design

a. Concrete Unit Pavers

1. Provide the City with paver manufacturer's/installation subcontractor's drawings and details: indicate perimeter conditions, junction with other materials, expansion and control joints, paver layout, patterns, color arrangement, installation and setting details. Indicate layout, pattern and relationship of paving joints to fixtures, and project formed details.

2. Furnish and install pavers meeting the ASTM C936 with an average compressive strength of 8,000 PSI with no less than 7,300 PSI when tested to ASTM C140 standards. The pavers shall be 3-1/8" (80mm), minimum thickness.

3. A submittal shall be provided to the City which includes:

   (a) Paver manufacturer's catalog sheets with product specifications.

   (b) Four representative full-size samples of each paver type, thickness, color, and finish. Submit samples indicating the range of color expected in the finished installation.

   (c) Laboratory test reports certifying compliance of the concrete pavers with ASTM C 936.

   (d) Minimum 3 lb. samples of subbase, base and bedding aggregate materials.

   (e) Sieve analysis of aggregates for subbase, base and bedding materials per ASTM C 136.

   (f) Project specific or producer/manufacturer source test results for void ratio and bulk density of the base and subbase aggregates.

4. Prior to beginning construction, the contractor shall provide to the City's authorized representative proof of representative tests confirming compliance to the minimum requirements. If the tests reflect failure to meet the requirements then the whole lot will be rejected.

5. The city reserves the right to determine the suitability of some concrete pavers for use on exposed faces, edges or corners.

6. Concrete containment edge restraints shall be required with all concrete paver street installations in compliance with **Detail No. RD-1290** of these standards.

7. Segmental Concrete Pavers shall be designed with a minimum 1" layer of bedding sand, over a minimum 8" layer base of ¾"-0 fractured rock; a greater thickness may be required based on the soils conditions as provided in the Street Design Report. Crushed aggregate shall be separated from native subgrade soils using a geotextile fabric to prevent fine material from migrating up into the base rock

8. Sand for the leveling (bedding) course shall be sound, sharp, washed, natural sand or crushed stone complying with gradation requirements shown in **Table 2.2**; sand for joint filler material shall comply with the gradation requirements shown in **Table 2.3**.

Table 2.2. ASTM NO. 8 BEDDING & JOINT OPENING FILLER GRADING REQUIREMENTS

Sieve Size	ASTM No. 8 Percent Passing
1/2 in.	100
3/8 in.	85 – 100
U.S. No. 4 sieve	10 – 30
U.S. No. 8 sieve	0 – 10
U.S. No. 16 sieve	0 – 5

Table 2.3. ASTM No. 89 and No. 9 JOINT OPENING SAND GRADING REQUIREMENTS

Sieve Size	ASTM No. 89 Percent Passing	ASTM No. 9 Percent Passing
1/2 in.	100	--
3/8 in.	90 - 100	100
U.S. No. 4 sieve	20 - 55	85 - 100
U.S. No. 8 sieve	5 - 30	10 - 40
U.S. No. 16 sieve	0 - 10	0 - 10
U.S. No. 50 sieve	0 - 5	0 - 5

9. On large projects, a 10' x 10' mock up area may be used to review quality control. Upon acceptance of the mock up area, all future work will be compared to this mock up for acceptance on the project.

10. The contractor shall supply the City with a minimum of 100 s.f. of additional material of each type, color and/or thickness of pavers for use

by the city for maintenance and repairs. The additional pavers shall be delivered on a pallet and be wrapped in plastic.

b. Permeable Concrete Unit Pavers

1. For Permeable Concrete Pavers the submittals shall be as outlined above.

2. Compliance shall generally follow the Concrete Unit Paver specification listed above with revisions as listed below.

3. Permeable Concrete Pavers shall be designed with a minimum 2" layer of bedding sand, over a minimum 4" base layer of ASTM No. 57 stone, over ASTM No. 2 stone sub-base of sufficient thickness to hold the design storm and as provided in the Street Design Report. The No. 2 Stone shall be separated from native subgrade soils using a geotextile fabric to prevent fine material from migrating up into the rock.

4. The crushed stone shall have 90% fractured faces, LA Abrasion < 40 per ASTM C 131, with a minimum CBR of 80% per ASTM D1883.

5. Round river rock will not be allowed on applications subject to vehicular traffic.

6. All stone material shall be washed with less than 1% passing the No. 200 sieve.

7. Sand for the leveling/bedding course and for the joint/opening filler, shall conforming to ASTM No. 8 gradation as shown in **Table 2.2**,

8. Gradation requirements for the ASTM No. 57 stone and ASTM No. 2 stone shall be in conformance with **Table 2.4**, and **Table 2.5**, respectively:

Table 2.4. ASTM NO. 57 BASE AGGREGATE GRADING REQUIREMENTS

Sieve Size	ASTM No. 57 Percent Passing
1 1/2 in.	100
1 in.	95 – 100
1/2 in.	25 - 60
U.S. No. 4 sieve	0 – 10
U.S. No. 8 sieve	0 – 5

Table 2.5. ASTM NO. 2 SUB-BASE AGGREGATE GRADING REQUIREMENTS

Sieve Size	ASTM No. 2 Percent Passing
3 in.	100
2 1/2 in.	90 – 100
2 in.	35 - 70
1 1/2 in.	0 – 15
3/4 in.	0 – 5

9. Gradation criteria for the bedding and base:

(a) D_{15} base stone / D_{15} bedding stone <5

(b) D_{50} base stone / D_{50} bedding stone > 2

201.2.08 Subgrade Geotextile

Separate the base rock from native subgrade soils using a geotextile fabric to prevent fine material from migrating up into the base rock. Subgrade geotextile shall conform to Oregon Department of Transportation Standard Specifications for Construction (ODOT SSC) Section 00331.

201.2.09 Pavement Transition – Portland Cement Concrete to Asphalt

Where ~~PCC paving abuts~~ AC paving abuts PCC paving, concrete crosswalks, flush curbs or lateral concrete bands used as edge restraints for segmental concrete pavers, there shall be a lateral transition zone extending ~~4~~3 feet, with a cross-section designed according to **Detail No.** ~~R-1090~~**RD-1175** of these standards.

201.2.~~07~~10 Pavement Overlay Design

Pavement overlays shall be designed using nationally recognized procedures: the Asphalt Institute method, PCA method, or AASHTO method.

201.2.~~08~~11 Horizontal Alignment

Alignments shall meet the following requirements:

a. Centerline alignment of improvements should be parallel to the centerline of the right-of-way. The centerline of a proposed street extension shall be aligned with the existing street centerline. Intersections shall align in accordance with Section 201.2.15, "Intersections."

b. Horizontal curves in alignments shall meet the minimum radius requirements shown in ~~**Table 2.2**, except as noted in c. below~~**Table 2.6**, unless otherwise directed by the City's authorized representative.

c. ~~Minimum centerline radius street curves in residential neighborhoods shall be as follows:~~

1. ~~(a). Residential collectors: 100 feet.~~

2. ~~(b). Residential streets: 75 feet.~~

c. Cross-slope of the street section shall be no less than 2% and no greater than 4%, unless otherwise approved by the City's authorized representative.

d. The use of superelevation is subject to approval by the City's authorized representative. Where superelevation is used, street curves should be designed for a maximum superelevation rate of 4 percent. If terrain dictates sharp curvature, a maximum superelevation of 6 percent is justified if the curve is long enough to provide an adequate super elevation transition.

e. Off right-of-way runoff shall be controlled to prevent concentrated cross flow in superelevated sections.

Table ~~2.~~2.6. DESIGN SPEED / CENTERLINE RADIUS—MINIMUMS

~~**Major Collector / Arterial Streets / All Rural Roads**~~

~~Design Speed (mph)~~	~~Friction Factor (F)~~	~~Slope/R min.~~					
		~~(e*) - 4%~~	~~(e) - 2.5%~~	~~(e) 0%~~	~~(e) + 2.5%~~	~~(e) + 4%~~	~~(e) + 6%~~
~~25~~	~~0.165~~	~~335'~~	~~300'~~	~~255'~~	~~220'~~	~~205'~~	~~185'~~
~~30~~	~~0.160~~	~~500'~~	~~445'~~	~~375'~~	~~325'~~	~~300'~~	~~275'~~
~~35~~	~~0.155~~	~~710'~~	~~630'~~	~~530'~~	~~455'~~	~~420'~~	~~380'~~
~~40~~	~~0.150~~	~~970'~~	~~855'~~	~~710'~~	~~610'~~	~~560'~~	~~510'~~
~~45~~	~~0.145~~	~~1285'~~	~~1125'~~	~~930'~~	~~795'~~	~~730'~~	~~660'~~
~~50~~	~~0.140~~	~~1665'~~	~~1450'~~	~~1190'~~	~~1010'~~	~~925'~~	~~835'~~
~~55~~	~~0.130~~	~~2240'~~	~~1920'~~	~~1550'~~	~~1300'~~	~~1190'~~	~~1060'~~
~~60~~	~~0.120~~	~~3000'~~	~~2525'~~	~~2000'~~	~~1655'~~	~~1500'~~	~~1335'~~

~~**Minor Collector**~~

Design Speed (mph)	**Friction Factor (F)**	**Slope/R min.**					
		(e*) - 4%	**(e) - 2.5%**	**(e) 0%**	**(e) + 2.5%**	**(e) + 4%**	**(e) + 6%**
15	.330	55’	50’	45’	45’	40’	40’
20	.300	105’	100’	90’	85’	80’	75’
25	0.252	195'	185'	165'	150'	145'	135'

30	0.221	330'	305'	270'	245'	230'	215'
35	0.197	520'	475'	415'	370'	345'	320'
40	0.178	775’	700’	600’	525’	490’	450’
45	0.163	870’	980’	830’	720’	665’	605’

NOTE: ~~*~~ *e = rate of superelevation (tan~~-~~B)

~~(1) Off right-of-way runoff shall be controlled to prevent concentrated cross-flow in superelevated sections.~~

~~(2) Where superelevation is used, street curves shall be designed for a maximum superelevation rate of 0.04.~~

~~(3) If terrain dictates sharp curvature, a maximum superelevation of 0.06 is justified if the curve is long enough to provide an adequate superelevation transition.~~

~~**201.2.09**~~

f. On local streets, requests for design speeds less than 25 miles per hour shall be based on topography, right-of-way, or geographic conditions and in accordance with Section 201.1.04.g.3, “Design Speed.” Requests must show that a reduction in centerline radius will not compromise safety.

201.2.12 Vertical Alignment

Alignments shall meet the following requirements:

a. Minimum tangent street gradients shall be 1% along the crown and curb.

b. Maximum street centerline gradients shall be 8% for collector and local streets, and 6% percent for arterial streets. Grades in excess of 8% but not more than 12% may be permitted for short distances and must be approved by the City’s authorized representative on an individual basis.

c. At street intersections, the crown of the major (higher classification) street shall continue through the intersection. The roadway section of the minor street will flatten to match the longitudinal grade of the major street at the projected curb line.

~~c.~~d. Local streets intersecting with a ~~minor~~ collector or greater functional classification street or streets intended to be posted with a stop sign shall provide a landing that averages 5% gradient or less. Landings are that portion of the street within 20 feet of the edge of the intersecting street at full improvement or from the extended curb line.

~~d.~~e. Grade changes of more than 1% shall be accomplished with vertical curves.

~~e.~~f. Street grades, intersections, and superelevation transitions shall be designed not to allow concentrations of storm water to flow over the pavement.

~~f.~~g. Offset crowns may be allowed and must be approved by the City's authorized representative on an individual basis .

~~g.~~h. Streets intersected by streets not constructed to full urban standards shall be designed to match both present and future vertical alignments of the intersecting street. The requirements of these standards shall be met for both present and future conditions.

~~h.~~i. Vertical curves shall conform to the values listed in ~~**Tables 2.3 and 2.4.**~~**Table 2.7** and **Table 2.8**.

~~i.~~j. Slope easements shall be dedicated or obtained for the purposes of grading outside the right-of-way.

Table 2.~~3~~7. DESIGN CONTROLS FOR MINIMUM CREST VERTICAL CURVES ~~-~~BASED ON STOPPING SIGHT DISTANCE

Design Speed	K
15	3
~~25~~20	~~20 – 30~~7
25	12
30	~~30 – 40~~19
35	~~40 – 50~~29
40	~~60 – 80~~44
45	~~80 – 120~~61
50	~~110 – 160~~84
55	~~150 – 220~~114

Where: K = L / A = feet / percent.

L = length of vertical curve (feet).

A = algebraic difference in grades (percent).

Table 2.~~4~~8. DESIGN CONTROLS FOR MINIMUM SAG VERTICAL CURVES BASED ON STOPPING SIGHT DISTANCE

Design Speed	~~K~~Without Street Lighting - K	With Street Lighting - K
15	10	5
20	20	10
25	30~~—40~~	15
30	40~~—50~~	20
35	50~~—60~~	30
40	60~~—70~~	35
45	70~~—90~~	45
50	90~~—110~~	55
55	100~~—130~~	65

Where: K = L / A = feet / percent.

L = length of vertical curve (feet).

A = algebraic difference in grades (percent).

~~**Note:** Values may be reduced if street lighting is present for sag vertical curves. AASHTO publication, "An Informational Guide for Roadway Lighting" (1984), shall serve as a guide.~~

201.2.~~10~~13 Transitions

The following specify the minimum requirements for street transitions:

a. Street width transitions from a narrower width to a wider width shall be designed with a 5:1 taper. Delineators, as approved by the City's authorized representative, shall be installed to define the configuration.

b. For street width transitions from wider to narrower, the length of the transition taper shall be determined as follows:

$$L = S \times W, \text{ for } S \geq 45 \text{ mph}$$

$$L = \frac{W \times S^2}{60}, \text{ for S less than 45 mph}$$

Where L = minimum length of taper (feet).

S- = design speed (mph).

W = edge of pavement offset (feet).

c. Delineators, as approved by the City's authorized representative, shall be installed to define the configuration. Maximum spacing of delineators shall be the numerical value of the design speed, in feet (i.e~~., a.~~ 35-foot spacing for a 35 mph speed).

d. In situations where tapered transitions occur on both sides of the roadway, both transitions will taper at the same rate in accordance with subsection b above, unless otherwise approved by the City Engineer.

~~d.~~e. In situations where a tapered transition cannot be provided, a Type III barricade shall be installed at the end of the wider section of the street and a taper shall be appointed and delineated as approved by the City's authorized representative. The barricade shall conform to **Detail No.** ~~R-1145~~**RD-1220** of these standards; diagonal striping shall slope down in the direction of the taper. If the wider section does not provide an additional travel lane, only a barricade is required without the transition.

201.2.~~11~~14 Superelevation Cross-Sections

~~1.~~a. Design elements for superelevation shall be based on AASHTO design guidelines.

~~2.~~b. Offset crown cross-sections are not acceptable as superelevation sections.

201.2.~~12~~15 Intersections

The following specifies the minimum requirements for intersections:

~~1.~~a. The interior angle at intersecting streets shall be kept as near 90 degrees as possible, unless existing development or topography make it impracticable. Where intersecting streets cannot be kept at right angles, the interior angle shall in no case be less than 75 degrees~~, unless approved by the City's authorized representative after consultation with TVF&R.~~. A tangent section shall be carried a minimum of 25 feet each side of intersecting right-of-way lines.

~~2. Opposing intersections shall be designed so that no offset dangerous to the traveling public is created.~~

b. ~~Intersections on major arterial streets shall be separated by at least~~ Intersection spacing shall conform to the values in **Table 2.9**. The distance between streets is measured from the centerline of the subject street to the centerline of the adjacent street.

c. At intersections, including alleyways, opposing street centerlines shall be in the same alignment. If in the opinion of the City Engineer, opposing street centerlines cannot align due to topography, existing features, or geographic conditions, the opposing street centerlines shall be in alignment as close as possible. Offset intersections that create danger to the traveling public, such as over-lapping left turn movements, will not be allowed under any circumstances.

~~(a)~~ The minimum curb ~~1000 feet.~~

~~(b) Intersections on minor arterial streets shall be separated by at least 600 feet.~~

~~(c) Intersections on collector, residential, and rural streets shall be separated by at least 100 feet.~~

~~c.~~d. ~~Curb~~ radii at intersections shall be as shown in ~~**Table 2.5**~~**Table 2.10** for the various function classifications with exceptions subject to approval by the City's authorized representative. The right-of-way radii at intersections shall be sufficient to maintain at least the same right-of-way-to-curb spacing as the lower classified street.

~~4. Where Minor Collector and/or Rural Streets carry transit traffic, the radii indicated for Residential Streets shall take precedence.~~

~~5. Sidewalk access (wheelchair) ramps conforming to the Americans with Disabilities Act (ADA) Standards for Accessible Design shall be provided at all corners of all intersections, regardless of curb type, and shall conform to Section 201.2.22, "Sidewalks," and to Detail No. R-1075 of these standards.~~

e. ~~**Table 2.5**~~The City Engineer may require turning radii larger than shown in **Table 2.10** in locations where larger design vehicles need to be accommodated.

Table 2.9. STREET INTERSECTION SPACING

~~**. MINIMUM TURNING RADII FROM EDGE OF PAVEMENT OR CURB (feet)**~~

Street **onal Classification**	~~**Major/ Minor Arterial Street**~~**Distance Between Intersections Along The**	~~**Major Collector Street**~~	~~**Minor Collector Street**~~	~~**Residential Street**~~**Distance Between Intersections Along the Street Shall Not Exceed**		~~**Rural Street**~~
Major ~~**/Minor Arterial Street**~~	1000 feet~~55~~			~~40~~N/A	~~30~~	~~25~~
~~**Major Street**~~Minor Arterial	600 feet~~40~~			~~40~~1000 feet	~~30~~	~~25~~

~~r~~ Collector ~~Street~~	~~30~~300 feet	~~30~~600 feet	~~30~~	~~25~~
~~Residential Street~~Local	~~25~~100 feet	~~25~~600 feet	~~25~~	~~25~~
~~reet~~Bike & Pedestrian Facilities	~~25~~100 feet	~~25~~300 feet	~~25~~	~~25~~

f. The minimum turning curb radii shown in **Table 2.10** may be reduced by the distance between the edge of the travelled way and the adjacent curb face, up to 10 feet. The curb radii reduction is limited to the road width with the least distance between the edge of the travelled way and the adjacent curb face.

Table 2.10. MINIMUM TURNING RADII FROM EDGE OF PAVEMENT OR CURB (feet)

~~201.2.13~~

Street Classification	Arterial Street	Commercial Industrial	Collector Street	Residential* Street	Rural Street
Arterial Street	55’	40’	30’	28’	28’
Commercial Industrial	40’	40’	30’	28’	28’
Collector Street	30’	30’	30’	28’	28’
Residential* Street	28’	28’	28’	28’	28’
Rural Street	28’	28’	28’	28’	28’

* The Residential Streets classification includes collector streets that are located in residential neighborhoods

g. Curbs shall be designed to minimize the length of pedestrian crossings. Streets with on-street parking shall have intersections designed with curb extensions to reduce pedestrian crossing lengths, where the design turning radius allows. The City Engineer may require/approve the use of compound curves and other methods to minimize intersection width.

h. Sidewalk access (wheelchair) ramps shall be in conformance with Section 201.2.25, “Sidewalks,” and to **Detail No. RD-1110 – Detail No. RD-1140** of these standards.

201.2.16 Cul-de-Sacs, Eyebrows, Turnarounds

The design engineer's plans must be approved by TVF&R and the City's authorized representative. The following specifies the minimum requirements for cul-de-sacs, eyebrows, and turnaround areas. Other turnaround geometrics for alternative design vehicles, such as a single-unit truck, garbage truck, street sweeper, etc., may be used when conditions warrant and when the City's authorized representative approves the design and application of its use.

a. Cul-de-sacs and other turnaround areas shall be allowed only on residential streets and commercial/industrial streets. Cul-de-sacs shall not be more than 200 feet long, unless approved by the Development Review Board. The length of cul-de-sacs shall be measured along the centerline of the cul-de-sac roadway from the nearside right-of-way of the nearest through-traffic intersecting street to the farthest point of the cul-de-sac right-of-way.

b. The minimum curb radius for cul-de-sac bulbs shall be ~~45~~48 feet, and the right-of-way radius shall be sufficient to maintain at least the same right-of-way-to-curb spacing as in the adjacent part of the road.

c. Cul-de-sacs and other turnaround areas shall have a 6-foot public utility easement extending outside the right-of-way around the cul-de-sac continuously. The minimum curb radius for transitions into cul-de-sac bulbs shall be ~~25~~28 feet. The right-of-way radius shall be sufficient to maintain the same right-of-way-to-curb spacing as in the adjacent part of the road.

d. An eyebrow corner may be used on a local street where expected average daily traffic (ADT) counts will not exceed 500 vehicles. Eyebrow geometry shall be evaluated on the basis of turning requirements for Fire Department vehicles.

201.2.~~14~~17 Stub Streets

Stub streets allow for future ~~extensions.~~extension of the roadway. A ~~reserve strip~~note shall be added to the plat restricting access at the terminus of the right-of-way ~~shall be provided.~~. The ~~reserve strip~~access restriction shall ~~be at least one foot long and~~ extend the full width of the right-of-way~~, and~~; access control shall be ~~provided to~~governed by the City. ~~-~~A Type III Street Barricade conforming to **Detail No.** ~~R-1145~~**RD-1220** of these standards shall be erected at the edge of pavement of the stub street and "No Parking" signs installed on the barricade; a Type III Sidewalk Barricade conforming to **Detail No. RD-1220** of these standards shall be erected at the end of any sidewalks on the stub street. Additionally, a sign shall be installed stating the street will be extended in the future ~~and to contact the City of Wilsonville Engineering Department (503-682-4960) for further information.~~, per **Detail No. RD-1225** of these standards. Streets 50 feet in length or greater shall provide a garbage/recycling vehicle turn around approved by the City's authorized representative.

~~201.2.15~~ **201.2.18 Half-Streets**

To allow for reasonable development, half-street improvements may be approved by the Planning Commission and the Development Review Board. Whenever a half-street improvement is approved, it shall conform to the following:

a. Street section design and construction shall be in conformance with these standards

b. Minimum pavement width shall be 24 feet for arterial and collector streets, and 20 feet for residential and rural streets as measured from face of curb.

c. Intersectional improvements shall be adequate to provide turn lanes.

   1. Arterials and collectors: 40 feet paved for 250 feet as measured from centerlines of intersecting streets.

   2. Residential and rural: 36 feet paved for 150 feet as measured from centerlines of intersecting streets.

d. A ~~reserve strip~~note shall be added to the plat restricting access at the limits of the right-of-way~~ shall be provided to the City.~~. The ~~reserve strip~~access restriction shall ~~be at least one foot wide and~~ extend the full ~~length~~width of the ~~half street improvement~~right-of-way; access control shall be governed by the City.

201.2.~~16~~19 Private ~~Streets~~Access Drives

~~Approval for private streets shall come from~~ With prior approval of the Development Review Board ~~and~~a private access drive may be allowed for ingress and egress to two to four residential units and where there is no possibility of future extensions of the drive.

a. Private access drives shall meet the requirements of the City of Wilsonville Planning Division and TVF&R.~~ Private streets~~

b. Private access drives shall not be used for ingress and egress into mixed use developments.

c. Private access drives shall be designed with the same structural section as the adjacent residential street, or designed in conformance with these Standards.

d. Private access drives shall be constructed and inspected in conformance with these Standards.

e. Private access drives shall be signed with a blue street name sign in conformance with Section 201.8.01.b, “Street Name Signs” and **Detail No.**

RD-1255 of these standards; in addition all private access drives shall be signed with a blue sign stating, "Not maintained by the City of Wilsonville."

201.2.~~17~~20 Raised Medians and Traffic Separators

The following specify the minimum requirements for raised medians:

a. Raised center medians and landscape medians are allowed and encouraged where feasible on certain arterial and collector streets as defined in the City of Wilsonville TSP.

b. Where raised medians are allowed, the following criteria must be met:

~~(a)~~1. Street lighting shall be sufficient to provide illumination of the raised median.

~~(b)~~2. Objects, such as trees, shrubs, signs, light poles, etc., shall not physically or visually interfere with vehicle or pedestrian traffic in the travel way.

3. Raised medians shall incorporate pedestrian refuge areas at locations of pedestrian street crossings in order to reduce pedestrian crossing lengths.

4. The style and design of the raised median shall be site specific. The raised median shall be safe for the design speed. Raised medians shall be designed in conformance with AASHTO guidelines.

~~3.~~5. Design shall be in conformance to Section 201.2.24.b, "Curb and Gutter Style" and consider the use of ~~rolled curbs and~~ appropriate surface loading for emergency vehicle left-turn access. Raised median designs shall be subject to City approval.

c. Concrete traffic separators shall be designed where they are needed as determined by the City's authorized representative; concrete traffic separators shall conform to **Detail No. RD-1070** of these standards.

201.2.~~18~~21 Transit Turnout Design

The need for transit turnouts shall be determined by South Metro Area Regional Transit (SMART) in coordination with the City Engineering Division. Transit turnouts shall be provided where required by the City ~~of Wilsonville.~~ Engineering Division

a. Transit turnouts shall conform to **Detail No.** ~~R-1195~~**RD-1160** of these standards.

b. Transit pad sections shall be a minimum thickness of 9 inches of PCC over 6 inches of compacted base rock.

c. Transit pad shall be reinforced with No. 4 reinforcement steel bar, placed 1-foot on center each way, 2 inches above base rock.

d. Transit pad shall be doweled into adjacent PCC gutter; dowels spaced 3-feet on center and centered on face of gutter. If adjacent street is PCC, transit pad shall be doweled into the street as shown in **Detail No.** ~~R-1095~~**RD-1180** of these standards.

~~e. Minimum concrete specifications shall be 4,000-psi compressive strength and design modulus of rupture (M_R) shall be 525 psi in 28 days. A higher value of M_R shall be allowed if adequately supported by test data.~~

e. PCC for transit pad construction shall conform to ODOT Class 4000 – 1 ½, Paving Concrete.

f. Base rock shall conform to Section 201.3.01, "Granular Fill."

g. Design of concrete joints shall follow the guidelines and requirements outlined in the ACPA publication, "Design and Construction of Joints for Concrete Streets," except for the following:

~~i.~~1. Maximum joint spacing shall be 12 feet.

~~ii.~~2. Joints shall be designed to be skewed 6:1 when meeting the edge of pavement.

~~iii.~~3. For transit pads adjoining PCC streets, joints shall match street jointing.

~~iv.~~4. For doweled contraction joints, do not lubricate the dowels.

~~v.~~5. Isolation joints shall be used around manhole covers. Isolation joints shall be circular with ~~a~~ 2-foot spacing from the manhole cover.

201.2.~~19~~22 Sight Distance

A clear vision area shall be maintained on each corner of property at the intersection of any two streets, a street and a railroad, or a driveway and a street. Clear vision area shall be in conformance with Section 4.177 of the City Code and this standard. The following specifies the minimum requirements for sight distance for roads that intersect each other, and for driveways that intersect roads:

a. The minimum intersectional sight distances shall be based on the ~~posted~~higher of the following: the design speed, the posted speed, or the measured 85% percentile speed of the road. The intersectional sight distance shall be

~~-~~1. Based on an eye height of 3.5 feet and an object height of ~~2.0~~3.5 feet above the road surface.

~~.~~2. Measured ~~from~~at the center of the drive lane ~~10~~15 feet from the ~~extended curb line or~~nearest edge of ~~pavement~~the nearest travel lane of the ~~crossroads~~intersecting street.

b. No structures, plantings, or other obstructions shall be allowed that would impede visibility between the height of 30 inches and 10 feet, as measured from the top of curb, or in absence of a curb, from the established street centerline elevation.

c. Trees placed in sidewalk planting areas must be located at least 30 feet from the nearest intersection and 10 feet from driveways per **Detail No. RD-1240** of these standards.

d. Minimum intersectional sight distance for railroad and street intersections shall be in conformance with AASHTO design guidelines.

e. Minimum intersectional sight distance shall be equal to 10 times the posted speed of the road for grades of 3% or less, as shown in ~~**Table 2.6.**~~**Table 2.11.** For grades in excess of 3%, sight distances must be adjusted and shall be in conformance with AASHTO design guidelines. For significant road improvement projects, the following intersectional standards shall be met in addition to the AASHTO remaining sight distance standards.

Table 2.~~6~~11. INTERSECTIONAL SIGHT DISTANCE

Design Speed (mph)	Distance Along Crossroads (feet)
25	250
30	300
35	350
40	400
45	450
50	500

201.2.~~20~~23 Driveways

~~———~~Access to private property shall be permitted with the use of driveway curb cuts. The following specifies the minimum requirements for driveways:

a. Driveways shall conform to **Detail No.** ~~R-1115~~**RD-1090, Detail No. RD-1095,** or ~~R-1120~~**Detail No. RD-1100** of these standards; or to **Detail No. RD-1085** of these standards on non-curbed streets.

b. Driveways shall be designed to meet all applicable rules and regulations of Title III of the Americans with Disabilities Act of 1990 (ADA).

~~b.~~c. Driveways shall not be permitted on streets with existing ~~or proposed~~ non-access reserve strips, or where plat restrictions limit access to the right-of-way, or as set forth in the TSP and Planning Code.

~~c.~~d. For commercial or industrial developments, driveway access shall be a minimum of 100 feet from the nearest intersection (as measured from ~~centerline~~near edge of driveway drop to near face of curb at intersection), unless otherwise approved in writing by the City's authorized representative.

~~d.~~e. For residential developments, driveway access from the nearest intersection shall be ~~established~~a minimum of 50 feet (as measured from near edge of driveway drop to near face of curb at intersection) unless otherwise approved in writing by the ~~City of Wilsonville Building and Planning Departments, in coordination with the~~ City's authorized representative.

f. Driveways on arterial and collector streets shall be minimized, where practicable, and shall be placed first on a lower classification street.

g. Access spacing, including driveways alleys, & streets, shall be in conformance with **Table 2.12.**

1. Spacing between driveways is measured between the nearest edges of driveway drops.

2. The desired access spacing shall be adhered to unless otherwise approved by the City's authorized representative. Deviating from the desired access spacing may be allowed by the City's authorized representative when aligning with existing driveways, topography constraints, property limitations and safety related issues.

Table 2.12. ACCESS SPACING STANDARDS

Roadway Functional Classification	Access Spacing Desired	Access Spacing Minimum
Major Arterial	1320 feet	1000 feet
Minor Arterial	1000 feet	600 feet
Collector	300 feet	100 feet
Local Street	Access to Each Lot	

3. To modify the minimum access spacing, the City Engineer may require an access study prepared and certified by a professional Traffic Engineer registered in the State of Oregon. The access study shall include, at a minimum, the following:

   (a) Review of site driveway spacing and design.

   (b) Evaluation of traffic impacts adjacent to the site within a distance specified by the City Engineer.

   (c) Review of all modes of transportation to the site.

   (d) Mitigation measures where access spacing standards are not met, including but not limited to medians, turning restrictions, driveway consolidation, and shared driveways.

h. Driveways and alleys shall be constructed to align with existing or planned streets, if the driveway intersects with a street controlled with an existing or planned traffic signal, intersects with an existing or planned arterial or collector street, or would be an extension of an existing or planned street or major driveway. If in the opinion of the City's authorized representative, the driveway and opposing street cannot align due to topography, existing

features, or geographic conditions, the driveway and opposing street shall be in alignment as close as possible. Offset alignment that creates danger to the traveling public, such as over-lapping left turn movements, will not be allowed under any circumstances.

i. The City's authorized representative may limit the number or location of connections to a street, impose access restrictions where the roadway authority requires mitigation to alleviate safety or traffic operations concerns.

j. Driveways shall not be wider than necessary to safely accommodate projected peak hour trips and turning movements, and shall be designed to minimize crossing distances for pedestrians in accordance with **Detail No. RD-1080**, **Detail No. RD-1085**, **Detail No. RD-1090**, **Detail No. RD-1095**, and **Detail No. RD-1100** of these standards. The City's authorized representative shall make the final determination of maximum driveway width on a case-by-case basis.

k. The City's authorized representative may require a driveway to extend to one or more edges of a parcel and be designed to allow for future extension and inter-parcel circulation to allow access to adjacent parcels as part of future development. The owner(s) of the subject site may be required to record an access easement for future joint use of the approach and driveway.

~~e.~~l. Access driveways shall have a minimum width of 12 feet for one-~~-~~way traffic and 20 feet for two way traffic. Driveway widths shall meet requirements of TVF&R.

m. Parking lot drive aisles shall align with the approved access driveway. A clear drive aisle, containing no parking spaces or intersecting drive aisles, shall be provided at all parking lot access driveways in accordance with **Detail No. RD-1105** of these standards and as follows:

1. Within 50 feet of the back of sidewalk or right-of-way boundary, whichever is greater, for access driveways with less than 100 Average Daily Trips (ADT).

2. Within 100 feet of the back of sidewalk or right-of-way boundary, whichever is greater, for access driveways with 100 or more Average Daily Trips (ADT).

3. The clear drive aisle shall not have a width greater than the approved access driveway.

4. The City Engineer may reduce the clear drive aisle length to not less than 20 feet from the back of sidewalk or right-of-way boundary, whichever is greater. The City Engineer may require submission of additional information, including but not limited to a traffic study prepared and certified by a registered professional Traffic Engineer in the State of

Oregon. Any reduction in the required clear drive aisle length shall be based on the following:

(a) Queuing areas are designed such that vehicles do not obstruct a driveway, fire access lane, walkway, or public right-of-way.

(b) On-site circulation is designed in such a way as to not create a safety hazard by reducing the clear drive aisle length.

n. Detectable warning surfaces shall be provided at the junction between the pedestrian route and the vehicular route where driveways have yield or stop control or incorporate curb ramps or blended transitions into the driveway design.

o. Grading on driveway approaches shall not exceed 5H:1V within the PUE.

~~f.~~p. Concentrated surface runoff shall not be allowed to flow ~~over~~from private commercial ~~driveways or sidewalks~~/industrial property, private access drives, or private alley accessways across public sidewalk and into the public right-of-way.

~~g.~~q. Driveways intersecting with roads shall meet the minimum sight distance requirements as specified in Section 201.2.~~19~~22, "Sight Distance."

r. Where the addition or modification of a driveway access requires the removal of center landscape median, a new center landscape median shall be constructed at a different location within the City of Wilsonville. The new center landscape median shall be equal in length to the removed center landscape median. The City's authorized representative shall determine the appropriate location for construction of the new center landscape median.

s. Where driveway requirements and standards cannot be met due to the location or configuration of an existing building, structure, topography or geographic feature, the existing driveway shall be brought into conformance to the greatest extent feasible as determined by the City's authorized representative.

201.2.~~21~~24 Curbs and Grading

The following specifies the requirements for curbs and cross-slope grading for streets:

a. **Location and Design:** ~~urban arterial and major~~ Arterial collector ~~roads~~ and residential streets shall include ~~curbs~~curb and gutters on both sides, except in some situations of interim width improvements. Interim designs shall ~~have shoulders and ditches. Nonmountable curbs~~be reviewed and approved on a case by case basis by the City's authorized representative. Non-mountable curb and gutters shall be required on ~~urban~~ arterial ~~and major,~~ collector ~~roads.~~and residential streets.

b. **Curb and Gutter Style:** On edges of streets or where designed to carry water, curb and gutter shall be designed in conformance to **Detail No. RD-1055** of these standards for AC streets or **Detail No. RD-1060** of these standards for PCC streets; at street medians or where designed to spill water, curb shall be provided for AC streets and curb and gutter shall be provided for PCC streets in conformance with **Detail No. RD-1065** of these standards. In all cases the gutter shall be a minimum depth of 6 inches or shall match the design depth of the AC or PCC street section.

~~b.~~c. **Shoulders:** ~~rural~~ Rural streets or interim width urban streets shall have minimum 6-foot-wide shoulders next to the street, at 2% cross-slope, and roadside ditches ~~on each side of~~next to the ~~shoulder~~shoulders, with a maximum ~~sideslope~~side slope of 2H: 1V. ~~-~~The 6-foot shoulder area ~~may~~shall consist of a ~~section~~minimum of 4 feet of pavement and ~~a section~~2 feet of crushed aggregate. ~~The pavement section shall be a minimum of 2 feet wide and a maximum of 6 feet wide.~~

~~c.~~d. ~~**Curb**~~**Gutter Stamping:** ~~newly~~ Newly constructed ~~curbs~~public or private curb and gutters or replaced ~~curbs~~curb and gutters shall be stamped on the outer face of the gutter pan with the capitol letters "SS" at the location of each sanitary lateral crossing, the ~~capitol~~ capital letters "SD" at the location of each storm drain lateral crossing, the ~~capitol~~capital letter "W" at the location of

each water line crossing, ~~and~~ the ~~capitol~~capital letter "C" at the location of each conduit crossing~~.~~, and the capital letter "F" at the location of each City fiber crossing. Letters shall be 3 inches in height and embossed a minimum of ⅛-inch deep.

~~d.~~e. **Root Barriers:** ~~where~~ Where trees are located within 8 feet of public curbs, the curb shall be protected from root intrusion with a root control barrier system designed by a Professional Landscape Architect registered in the State of Oregon; root control barrier shall be approved by the City's authorized representative before installation. Generally, the root control system should be installed a minimum of 24 inches deep, with a minimum 20-foot length centered on the root source. Installation of such systems shall be done so as to not disturb the ~~curb~~existing finish materials or base rock previously installed. Provide landscaping plan showing location of root control barrier system.

~~e.~~f. **Grading, Collector and Arterial Streets:** ~~grading~~ Grading outside the improved areas shall be as follows: Minor collector or higher functional classification shall have a 2% upward grading to the right-of-way line, a 5H:1V upward or downward grading within the public utility easement, and no steeper than 1½H:1V up or 2H:1V down outside the right-of-way. Retaining walls shall be used if slopes are greater than the 1½H~~:~~: 1V to a height where the slope is no more than 1½H: 1V.

~~f.~~g. **Grading, Residential and Rural Streets:** ~~residential~~Residential streets and rural roads beyond the swale shall have a 2% upward grading to the right-of-way line, a 5H:1V upward or downward grading within the public utility easement, and no steeper than 1½H:1V up or 2H:1V down, outside the public utility easement. Retaining walls shall be used if slopes are greater than the 1½H~~:~~: 1V to a height where the slope is no more than 1½H: 1V.

~~g.~~h. **Cross- slope:** ~~cross~~Cross-slope of the street section shall be ~~no less than 2% and no greater than 5%.~~in conformance with Section 201.2.11.c, "Horizontal Alignment."

201.2.~~22~~25 Sidewalks

The following specifies the requirements for sidewalks:

a. **Location and Design:** The location of sidewalks shall be based on the City of Wilsonville TSP, the City's Bicycle and Pedestrian Master Plan, and as required by the Planning Department, in accordance to subsection 4.~~178, "Sidewalk and Pathway~~177, "Street Improvement Standards," of the Wilsonville Code.

1. A pedestrian access route shall be provided within sidewalks, pedestrian street crossings, curb ramps and other pedestrian circulation paths located in the public right-of-way. The pedestrian access route shall connect to all

accessible elements, spaces, and facilities that connect building and facility entrances to public streets and sidewalks.

2. The pedestrian access route shall be designed and constructed in accordance with the rules and regulations of Title III of the Americans with Disabilities Act of 1990 (ADA).

3. Sidewalks shall be designed with a minimum width of 5 feet and clear width of 4 feet or as designated in the TSP, whichever is greater, exclusive of curb and obstructions. Sidewalk width may be required to be wider than 5 feet in Commercial Zones. Actual designed sidewalk width shall be determined by the City Engineer.

4. Sidewalk thickness, slope, finish work, and location of expansion and contraction joints shall be as specified in **Detail No.** ~~R-1080~~**RD-1075** of these standards.

5. Final facility location and design are subject to the approval of the City's authorized representative~~.~~, unless otherwise stated.

6. Sidewalks shall have a light broom finish transverse to the line of travel.

   (a) Sidewalk joints in new construction shall be finished with a 3-inch wide shine~~, or if construction is fill~~ for sidewalks less than and including 6 feet in ~~work, finish~~width.

   (b) Sidewalk joints in areas of infill and replacement shall be finished to match existing ~~pattern.~~adjacent sidewalk.

b. **Separation:** Sidewalks shall be separated from the roadway through the use of landscape strips in accordance with the City of Wilsonville TSP. Sidewalk separation from the street shall be provided in accordance with **Table 2.13**.

1. The combined planter strip and sidewalk width shall not be less than the minimum provided in the Require Planter Strip + Sidewalk Width column of **Table 2.13**.

2. In cases of extreme topography, protection of existing trees, and existing structures, the City Engineer may reduce the combined planter strip and sidewalk width to no less than the Minimum Sidewalk Width column of **Table 2.13** or require that the sidewalk to swing curb tight or outside of the right-of-way in a public easement. The length and reduction of the combined width and change in alignment shall be the minimum necessary to bypass the conflicting topography, tree, and/or structure,

Table 2.13. SIDEWALK SEPARATION FROM ROADWAY

Street Classification	Required* Planter Strip + Sidewalk Width	Minimum Sidewalk Width	Minimum** Planter Strip Width	Combine to Full Sidewalk Width with Tree Wells
Major Arterial	13.5' – 16.5'	5'	6'	Yes
Minor Arterial	13.5' – 15.5'	5'	6'	Yes
Collector	11.5' – 13.5'	5'	5'	Yes
Local	10.5' – 12'	5'	5'	No
LID Local	10.5' - 12'	5'	5'	No

* Width includes the width of the curb.

** The minimum planter width that incorporates a water quality swale is 6.5'.

~~b.~~c. **Easements:** All public-owned pedestrian facilities shall be constructed within a public right-of-way or an easement. All new development or redevelopment shall consider access to adjacent properties in their development plans, especially schools, retail, and commercial areas. Easements shall be provided as necessary for compliance with the ADA Standards for Accessible Design.

~~c.~~d. **Access Ramps:** Access ramps shall be included in the design of sidewalks at all ~~intersections. Access ramp design shall meet the criteria established in the ADA Standards for Accessible Design. On streets classified as collector or above and at intersections that have a major street classification, double access ramps shall be installed. Ramps shall have a smooth transition at the gutterline.~~corners of all intersections, regardless of curb type or terrain.

1. A curb ramp shall connect the pedestrian access route to each pedestrian street crossing. For example, a street intersection with pedestrian street crossings in each direction shall have two separate curb ramps, one for each pedestrian street crossing.

2. The curb ramp, excluding flared sides, shall be contained wholly within the width of the pedestrian street crossing served.

3. In alterations where existing physical constraints prevent compliance with this requirement, the City's authorized representative may approve use of a single diagonal curb ramp to serve both pedestrian street crossings.

4. Ramps shall conform to **Detail No. RD-1110 – Detail No. RD-1140** of these standards and shall have a smooth transition at the gutter line.

e. **Pedestrian Street Crossings:** Pedestrian street crossings shall be included in the design of sidewalks and street intersections, regardless of terrain.

1. The location of a pedestrian street crossings shall be determined by the City's authorized representative.

2. Where pedestrian street crossings at intersections are prohibited, "No Pedestrian Crossing" signs shall be provided along with detectable features. Signage is not required where location of urban design features and/or landscaping clearly indicates a street crossing is not allowed.

3. The pedestrian street crossing distance shall be minimized whenever possible through the installation of curb extensions, center median refuge, island refuge, and other devices as approved or required by the City's authorized representative.

~~d.~~f. **Thickened Design:** At all intersections~~,~~ adjacent to the curb radius, curb-tight sidewalks and sidewalk ramps shall be constructed with a similar section as shown for a residential driveway (see **Detail No.** ~~R-1115~~**RD-1090** of these standards).

~~e.~~g. **Root Barriers:** Where trees are located within 8 feet of public sidewalks, the sidewalk shall be protected from root intrusion with a root control barrier system ~~designed by a Professional Landscape Architect registered in the state of Oregon; root control barrier shall be approved by the City's authorized representative before installation. Generally, the root control system should be installed a minimum of 24 inches deep, with a minimum 20-foot length centered on the root source. Installation of such systems shall be done so as to not disturb the sidewalk, curb or base rock previously installed. Provide landscaping plan showing location of root control barrier system.~~in accordance with Section 201.2.24.e "Root Barriers".

h. **Urban Design Features:** Urban design features including, but not limited to street trees, furniture, kiosks, trash receptacles, directional signage, and bicycle amenities, shall be provided when required by the City Engineer. Urban design features will be provided, located, and installed in accordance with the rules and regulations of Title III of the Americans with Disabilities Act of 1990 (ADA).

201.2.~~23~~ 26 On-Street Parking~~Bike Lanes~~

The ~~need~~ following specifies the requirements for ~~bike lanes shall be~~ on-street parking:

a. The location of on-street parking shall be based on the City of Wilsonville TSP and where directed by the City's authorized representative.

b. On-street parking shall not be permitted on arterial roadways.

c. On-street parking is permitted on one or both sides of collector roadways. The minimum width of an on-street parking strip on a collector road is 7 feet.

d. On-street parking is required on local streets, on one or both sides, as determined by the City Engineer. The minimum street width (curb to curb) for a local street is 32 feet for parking on both sides and 28 feet for parking on one side.

e. On-street parking is permitted on Low Impact Development (LID) local streets, on one or both sides, as determined by the City Engineer. The minimum street width (curb to curb) for a LID local street is 28 feet for parking on both sides, 24 feet for parking on one side, and 20 feet for no on-street parking.

f. On-street parking shall be located outside the curb return radii of intersections and pedestrian street crossings, whichever is furthest from the intersection.

g. 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 2.14**.

Table ~~, based on the TSP.~~ 2.14. ACCESSIBLE ON-STREET PARKING SPACES

Total Number Marked or Metered On-Street Parking Spaces	Minimum Required Number of Accessible On-Street 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% of total

201.2.27 Bicycle and Shared-Use Path Facilities

The following specifies the requirements for bicycle and shared-use path facilities:

a. **Types:** Bicycle routes throughout the City shall consist of the following types of facilities.

1. Bike lanes, adjacent to motor vehicle travel lanes and local street bikeways that share the travel lane with motor vehicle traffic.

2. Alternative bicycle facilities consist of buffered bike lanes, cycle tracks, and other bike facilities that provide buffers between bike and motor vehicle travel lanes typically on roadways with high traffic volumes.

3. Shared-use paths, including regional trails, consist of facilities for multiple non-motorized users, typically within a separate right-of-way, with minimal conflicts with automobile traffic.

b. **Location:** The location of bicycle and shared-use path facilities shall be based on the City of Wilsonville TSP, the City's Bicycle and Pedestrian Master Plan, and as required by the Planning Department, in accordance to subsection 4.177, "Street Improvement Standards," of the Wilsonville Code.

Alternative bicycle facilities, such as buffered bike lane and cycle tracks, shall be considered for incorporation into design of Arterial streets in place of typical bike lanes. The City Engineer shall determine locations where alternative bicycle facilities will be utilized in consultation with the National Association of City Transportation Officials (NACTO) Urban Bikeway Design Guide.

c. **Design Standards:** Bicycle and shared-use path facilities shall be designed in accordance with 2011 ODOT Bicycle and Pedestrian Design Guide, 2012 AASHTO Guide for the Development of Bicycle Facilities, NACTO Urban Bikeway Design Guide, and the City of Wilsonville Bicycle and Pedestrian Master Plan.

Bicycle and shared-use path facilities shall be designed and constructed in accordance with the rules and regulations of Title III of the Americans with Disabilities Act of 1990 (ADA). The City authorized representative may allow nature trails to be designed to Accessibility Guidelines for Outdoor Developed Areas when applicable.

d. **Drainage Grates:** The following specify the minimum design requirements for drainage grates on bike facilities and shared use paths.

1. Curb inlets shall be utilized to the extent possible on streets designated for bicycle facilities.

2. Where grated inlets are necessary, the grates shall be installed flush with the adjacent street surface and drainage grates shall be bicycle safe and hydraulically efficient.

3. Grate inlets shall be identified with a pavement marking in accordance with Section 201.2.27.g, "Signage and Pavement Markings".

e. **Railroad Crossings:** The following specify the minimum design requirements for bike facilities and shared use paths crossing railroad tracks.

1. Bicycle facilities and shared-use paths should be designed to cross railroad tracks at right angles.

2. Where the crossing angle is less than 45 degrees, bicycle facilities and shared-use paths shall be designed with additional width to allow bicyclists to cross the tracks close to a 90 degree angle. The additional width can be provided within the bike lane or by providing access onto an adjacent wide sidewalk to make the crossing.

3. Where additional lane width to provide a crossing close to a 90 degree angle cannot be provided, commercially available compressible flange fillers shall be installed.

f. **Root Barriers**: Where trees are located within 8 feet of bicycle facilities and shared-use paths, the surface material shall be protected from root intrusion with a root control barrier system in accordance with Section 201.2.24.e "Root Barriers".

g. **Signage and Pavement Markings:** The following specify the minimum signage and pavement marking requirements for bike facilities and shared use paths.

1. Signage and pavement markings for bicycle facilities and shared-use paths shall be provided in accordance with the most current edition of the MUTCD, Part 9.

2. Shared-use paths shall be striped in accordance with **Detail No. RD-1165** of these standards.

3. Striping and pavement markings shall be skid resistant.

h. **Bicycle Facility Design:** The following specify the minimum design requirements for bicycle facilities.

1. Bike Lanes

(a) Bike lanes shall be one-way facilities and carry bicycle traffic in the same direction as adjacent motor vehicle traffic.

(b) Bike lanes shall be 6 feet in width. In alterations of existing streets, the City's authorized representative may reduce the required bike

lane width to 5 feet when the existing street is physically constrained or when a bike buffer line is added.

(c) A minimum clear riding zone width of 4-feet shall be maintained between the longitudinal joint of the asphalt pavement and concrete gutter. In alterations of existing streets, the City's authorized representative may reduce the required clear riding zone width to 3 feet when the existing street is physically constrained or when a bike buffer line is added.

2. Local Street Bikeways

(a) Local street bikeways shall incorporate design elements recommended in the design standards referenced in Section 201.2.27.c, "Design Standards."

(b) The City's authorized representative shall determine the required design elements that include, but are not limited to, sharrows, traffic calming devices, and wayfinding signage.

3. Roadway Speed Reduction

On residential streets with designated pedestrian and/or bike facilities, the design and posted speed may be reduced to 20 miles per hour in accordance with Section 201.1.04.g.3, "Design Speed."

i. **Shared-Use Path Design:** The following specify the minimum design requirements for shared use path facilities.

1. Dimensions

(a) Shared-use paths located in exclusive right-of-way shall have a right-of-way or public easement a minimum width of 18 feet. In locations that are physically constrained, the City's authorized representative may reduce the right-of-way / easement width to a minimum 14 feet.

(b) Shared-use paths adjacent to roadways shall be separated by a minimum 5-foot wide landscaped buffer. The City Engineer may allow vertical separation between the shared-use path and adjacent roadway in lieu of the landscape buffer at locations that are physically constrained.

(c) Shared-use paths shall be constructed of asphalt concrete or portland cement concrete surface, as determined by the City's authorized representative.

(d) Shared-use paths shall be 12 feet wide with a clear distance width of 3 feet on each side of the path. In locations that are physically

constrained, the City's authorized representative may reduce the shared-use path width to a minimum 10 feet and the clear distance width to 2 feet.

(e) Natural trails shall be constructed of materials that are firm and stable, including asphalt concrete, portland cement concrete, compacted gravel and soil, and wood boardwalk.

(f) Nature trails shall have a right-of-way or public easement width between 12 feet and 15 feet.

(g) The surface of nature trails shall have a width between 3 feet and 12 feet, to be determined by the City Engineer based on the type and volume of expected uses.

(h) The minimum overhead clearance, excluding trees and vegetation, along shared-use paths is 10 feet. Provide landscaping clearances in accordance with Section 201.2.27.i.5.(c).ii, "Landscaping."

(i) Regional trails shall be constructed to the dimensions identified in the associated Master Plan for each individual trail.

2. Grade

(a) The running grade of a shared-use path adjacent to a street shall not exceed the general grade established for the street.

(b) The running grade of a shared-use path within an exclusive right-of-way or easement shall not exceed 5%. Compliance to the extent practicable is required when compliance with the maximum allowed grade is not practicable due to:

i. Existing terrain or infrastructure

ii. Right-of-way availability

iii. Notable natural feature

iv. Precluded by federal, state, or local laws the purpose of which is to preserve threatened or endangered species, environment, and archaeological, cultural, historical, or significant natural features, compliance is required to the extent practicable.

(c) In areas of steep terrain, the shared-use path shall meander along the path alignment to attain reasonable grades for steep slope ascent. In no case shall the downhill approach grade of a shared-use path exceed 5% for a distance of 50 feet before an intersection.

(d) The cross slope of a shared-use path shall not exceed 2%.

(e) The gradient of the side clear areas shall not exceed 6H:1V.

3. Materials

(a) The City Engineer may require subgrade to be sterilized with a suitable non-environmentally hazardous herbicide that is approved by the City of Wilsonville Public Works Department, in cooperation with the Natural Resources Program.

(b) The wearing surface of AC pavement shall conform to the Oregon Department of Transportation Standard Specifications for Construction (ODOT SSC) Section 00745, "Asphalt Concrete Pavement(ACP)," for Level 2 - ½" Hot Mix Asphalt Concrete (HMAC). The pavement design shall be a minimum 3 inches of HMAC over a 4-inch thick base consisting of ¾"-0 crushed aggregate backfill, meeting the requirements of Section 201.3.01, "Granular Fill". Where shared-use paths provide occasional vehicular access, the City's authorized representative shall require minimum 4-inches of HMAC or thicker pavement design where anticipated loading conditions warrant.

(c) The wearing surface of PCC pavement shall conform to the ODOT Class 3300 – ¾, Commercial Grade Concrete. The pavement design shall be a minimum 6 inches of PCC over a 6-inch base consisting of ¾"-0 crushed aggregate backfill, meeting the requirements of Section 201.3.01, "Granular Fill". At locations where shared-use paths provide occasional vehicular access, the City's authorized representative shall require a thicker pavement design based on anticipated loading conditions

(d) Shared-use path finish work and location of expansion and contraction joints shall be as specified in **Detail No. RD-1165** of these standards.

(e) Where trees are located within 8 feet of a shared-use path, the shared use path shall be protected from root intrusion with a root control barrier system in accordance with Section 201.2.24.e, "Root Barriers".

4. Handrails

~~a.~~ Shared-use paths constructed adjacent to slopes greater than 3H:1V and a change of elevation greater than 18 inches shall be protected with an approved system to be reviewed and approved by the City's authorized representative.

~~b.~~5. Landscaping

(a) Landscaping shall be provided along ~~and~~ multi-use paths and recreational trails. Selection of trees, shrubs, and ground cover should include low-maintenance varieties that are drought tolerant and require little pruning. Shrubs should be low growing (under 3 feet at mature height). Location and placement of plant materials should not result in growth over or onto the path surface.

(b) All proposed plant materials shall be approved by the City of Wilsonville. All landscaping, signs, and other potential obstructions shall be set back a minimum of 1 foot from the edge of the pathway surface. No exposed rock shall be permitted within 2 feet of the pathway surface. All exposed earth within 2 feet of the pathway surface shall be planted with grass, sod, or covered with 2" of bark dust.

~~1.~~(c) A number of important design considerations should be reviewed when selecting materials and planning planting schemes. Trees are of primary concern regarding location and variety. Specifically, placement and selection of trees should evaluate the following:

~~(a)~~i. Tree rooting characteristics - to avoid potential path surface upheaval.

~~(b)~~ii. Tree size - trees shall be of satisfactory caliper to permit a minimum vertical clearance of 8 feet to the lowest branch. The clearance shall be a minimum of 10 feet where vehicular traffic is expected.

~~(c)~~iii. Tree placement - to avoid creating hiding areas or permitting foliage to block path lighting, trees shall be located a minimum of 10 feet from path lighting fixtures.

6. Urban Design Features

Urban design features including, but not limited to street trees, furniture, kiosks, trash receptacles, directional signage, and bicycle amenities, shall be provided when required by the City Engineer. Urban design features will be provided, located, and installed in accordance with the rules and regulations of Title III of the Americans with Disabilities Act of 1990 (ADA).

7. Lighting

Lighting shall be provided on shared-use paths, excluding locations as determined by the City Engineer. The City Engineer shall determine when nature trails shall have lighting based on the type and volume of expected

uses. Lighting shall meet the requirements of ~~the City of Wilsonville "Public Works Standards," as described in Appendix A, "Bicycle and Pedestrian Facilities~~Section 201.9.02, "Shared-Use Path Lighting."

201.2.~~24~~28 Street Trees

The following specify the minimum requirements for the location and placement of street trees:

a. Street trees shall be provided in accordance with Section 4.176.06(D) of the Wilsonville Code.

b. Street trees shall be located in accordance with **Detail No. RD-1240** of these standards.

201.2.29 Guardrails

The following specify the minimum requirements for the location and type of guardrails:

a. The decision whether to install a guardrail shall be based on information in the AASHTO ~~publication, "Guide for Selecting, Locating, and Designing Traffic Barriers," or most recent edition~~Roadside Design Guide.

b. Guardrails shall be designed in conformance with AASHTO design guidelines and constructed according to ODOT SSC Section 00810, "Metal Guardrail."

201.2.~~25~~30 Roadside ditches

Roadside ditches shall be designed in conformance with ~~Section 301.7.03, "Channel Construction for New Roadside Ditches~~Section 301.6.02.i, "Channel Design."

201.2.~~26~~31 Utilities

The following specifies the minimum requirements for utilities:

a. Franchised utilities shall be located underground, preferably in a public utility easement, outside the paved road and sidewalk if possible, to avoid future cuts in paved roads.

b. A ~~6 foot wide~~ Public Utility Easement (PUE) shall be required adjacent to right-of-ways on all frontages to public roadways~~. PUE's shall be graded as per Section 201.2.21~~; PUE widths shall be as provided in Section 101.8.14, "Easements," and the detail drawings. PUE's may cross or run parallel to City pipeline easements, but shall not coincide with a City pipeline easement. PUE's shall be graded as per Section 201.2.24, "Curbs and Grading," from back of curb or sidewalk unless otherwise approved by the City's authorized

representative. Earthen berms or any other encroachments are not allowed within a PUE.

c. On all phased (interim) road improvements, the necessary utilities shall be stubbed across the interim improvement to assure that cuts are not necessary when the road is expanded to its full width. A 5-year moratorium will prohibit street cuts on all projects. The moratorium begins when a project is complete and the warranty begins. Check with the City Engineering Division for a current list of streets on the 5-year moratorium.

d. Except for sanitary sewers, storm drainage and water mains, underground utilities intended to provide direct service to adjacent properties with future connections shall not be located in the full-width paved section of a street to be constructed. If all service connections are installed and extended beyond the full-width section before the street is paved, franchised utilities can be located in the paved section, if approved by the City's authorized representative.

e. Underground utilities being constructed along existing paved streets shall not be located under the existing pavement, unless approved by the City's authorized representative. Underground utilities that must cross an existing paved street shall not be installed by any method that cuts the pavement, unless approved by the City's authorized representative.

f. Underground utilities shall be buried a minimum depth of 36 inches, measured from finished grade to top of utility.

g. Streetlights shall be located as required to provide proper illumination but shall not physically or visually interfere with vehicle or pedestrian traffic. All installation of streetlights shall be done in accordance with ~~the "Statement of Streetlight Installation Responsibilities," Option B, by PGE, revised March 1, 2001, or latest edition.~~Section 201.9.00, "Lighting."

201.2.32 Traffic Signals

Traffic signals shall be designed in accordance with Section 260.2 of the most current Clackamas County Roadway Standards. In addition to these standards, the Project Engineer shall design traffic signal infrastructure to accommodate installation of the City's fiber/communications network.

201.3.00 MATERIAL SPECIFICATIONS

201.3.01 Granular Fill

a. Crushed aggregate for base rock, leveling course, and surface replacement shall consist of an aggregate base as specified by the design engineer, with approval of the City's authorized representative, and shall be in conformance with ODOT

SSC Section 02630, “Base Aggregate,” for gradation, fractured faces, and durability.

~~a.~~b. The leveling course shall consist of ¾”-0” grade crushed aggregate material, and be a minimum thickness of 2 inches when compacted.

~~b.~~c. The aggregate shall consist of uniform-quality, clean, tough, durable fragments of rock or gravel, free from flat, elongated, soft, or disintegrated pieces, and other objectionable matter occurring either free or as a coating on the stone.

~~c.~~d. Gradation requirements of the crushed aggregate shall be in conformance with ODOT SSC Section 02630, “Dense-Graded Aggregate,” as indicated in ~~**Table 2.7**~~ **Table 2.15**. Sieve analysis shall be determined according to AASHTO T-27.

201.3.02 Asphalt Concrete

a. Courses of asphalt concrete pavement shall consist of the following unless otherwise specified by the design engineer and approved by the City Engineer.

1. The wearing surface of AC pavement shall consist of ½” Hot Mixed Asphalt Concrete (HMAC), conforming to ODOT SSC Section 00745; “Asphalt Concrete Pavement (ACP)”.

2. The base courses for AC pavement shall consist of ¾” Hot Mixed Asphalt Concrete (HMAC) conforming to ODOT SSC Section 00745, “Asphalt Concrete Pavement (ACP)”.

~~a.~~3. The AC pavement shall be either Level 2 or Level 3 ACP, as determined by Section 201.2.05, “Asphalt Pavement Design”.

b. Asphalt cement shall be 85-100 penetration paving asphalt conforming to ASTM D-946.

c. Liquid asphalt for use as a prime coat under AC shall be RC-70 rapid-curing liquid asphalt conforming to AASHTO M-81, or MC-70 medium-curing liquid asphalt conforming to AASHTO M-82.

d. ~~**Table 2.7**~~Warm Mix Asphalt Concrete (WMAC) shall incorporate the additives or processes listed in **Table 2.16**.

Table 2.15. GRADATION REQUIREMENTS FOR GRANULAR FILL

~~Sieve Size~~	~~2 ½" - 0~~	~~2" - 0~~	~~1 ½" - 0~~	~~1" - 0~~	~~¾" - 0~~
Sieve Size	2 ½" - 0	2" - 0	1 ½" - 0	1" - 0	¾" - 0
	Percent Passing				
~~2 ½"~~	~~95 – 100~~	~~100~~			
2 ½"	95 – 100	100			
2"	--	95 – 100	100		
1 ½"	--	--	95 – 100	100	
1 ¼"	55 – 75	--	--	--	
1"	--	55 – 75	--	90 – 100	100
¾"	--	--	55 – 75	--	90 – 100
½"	--	--	--	55 – 75	--
~~3/8"~~	~~–~~	~~–~~	~~–~~	~~–~~	~~55 – 75~~
3/8"	--	--	--	--	55 – 75
¼"	30 – 45	30 – 45	35 – 50	40 – 55	40 – 60
U.S. No. 10 sieve	12 – 27	12 – 27	14 – 30	16 – 33	16 – 36
U.S. No. 40 sieve	0 – 16	0 – 16	3 – 18	8 – 24	8 – 24
U.S. No. 200 sieve (wet sieving)	0 – 9	0 – 9	0 – 8	0 – 8	0 – 10

Note: All percentages are by weight. Material passing the U.S. No. ~~100~~200 sieve shall have a maximum plasticity index of 6 when tested according to AASHTO T-90.

~~201.3.02 Asphalt Concrete~~

~~a.~~1. ~~The wearing surface of AC pavement shall conform to ODOT SSC Section 00745, "Hot Mixed Asphalt Concrete" for either Level 2 or Level 3 HMAC, as determined by the City's authorized representative. The base courses for AC pavement shall conform to ODOT SSC Section 00745, "Hot Mixed Asphalt Concrete," for either Level 2 or Level 3 HMAC, as determined by the City's authorized representative.~~

e. ~~Asphalt cement shall be 85-100 penetration paving asphalt conforming to ASTM D-946.~~

f. ~~Liquid asphalt for use as a prime coat under AC shall be RC-70 rapid-curing liquid asphalt conforming to AASHTO M-81, or MC-70 medium-curing liquid asphalt conforming to AASHTO M-82.~~

g. ~~The temperature of the AC during mixing, placement, or while in storage shall not exceed 350°F and shall not be less than 240°F as per ODOT SSC Section 00745.43, "Drying and Heating Aggregates for HMAC." Asphalt storage shall meet requirements of ODOT SSC Section 00745.45, "HMAC Storage."~~

Table 2.16. WMAC ADDITIVES AND PROCESSES

WMAC Technology	Process Type	Supplier
Advera (Synthetic Zeolite)	Foaming Process	PQ Corporation
Aspha-min (Synthetic Zeolite)	Foaming Process	Aspha-Min
Evotherm	Chemical Additive	Mead Westvaco Asphalt Innovations
Redi-Set WMX	Chemical Additive	Akzo Nobel Surfactants, Inc.
Sasobit	Organic Additive	Sasol Wax Americas, Inc.
Plant Foaming Equipment	Foaming Process	Various Suppliers

201.3.03 Portland Cement Concrete

a. PCC for concrete pavement shall conform to ~~Section 201.2.05.f.~~Section 201.2.06.h, "Portland Cement Concrete Design."

b. PCC for curbs, sidewalks, driveways and miscellaneous construction shall conform to ~~Section 201.2.05.i.~~Section 201.2.06.i, "Portland Cement Concrete Design."

c. All forms for curbs and sidewalks shall be 2-inch dimensioned lumber, plywood, or metal forms. Forms for curb and sidewalk radii shall consist of bender board as approved by the City's authorized representative. Forms on the face of the curb shall have no horizontal form joints within 7 inches of the top of the curb. All forms shall be approved by the City's authorized representative.

d. Reinforcement steel shall conform to ASTM A-615, Grade 40, deformed bars.

201.3.04 Segmental Concrete Pavers

Materials for segmental concrete paver streets shall be in conformance with Section 201.2.07, "Segmental Concrete Paver Design."

201.4.00 CONSTRUCTION SPECIFICATIONS

201.4.01 General Provisions

The specifications in this chapter and any other applicable requirements of the City shall govern the character and quality of material, equipment, installation, and construction procedures for roadway construction or improvements.

201.4.02 Scheduling

The contractor shall plan their construction work in conformance with Section 101.8.02, "Scheduling."

201.4.03 Environmental Protection, Erosion Prevention, and Sediment Control

The contractor shall take all appropriate measures and precautions to minimize their impact on the environment and control erosion, as outlined in Section 101.9.00, "Environmental Protection, Erosion Prevention, and Sediment Control."

201.4.04 Interferences and Obstructions

Various obstructions may be encountered during the course of the work. The contractor shall follow the guidelines established in ~~Section 101.8.05~~Section 101.8.05, "Interferences ~~and~~, Obstructions, Abandoned Utilities."

201.4.05 Contaminated Soil or Hazardous Material

If during construction contaminated soil ~~or with~~, hazardous materials or chemicals are encountered, the Contractor shall follow the procedures specified in Section 101.9.02, "Contaminated Soils or Hazardous Materials."

201.4.06 Trench Excavation, Preparation, and Backfill

Trench excavation, preparation, and backfill shall conform to the requirements of Section 6, "Trench Excavation and Backfill."

~~201.4.07~~ 201.4.07 Steel Plates

Where excavated trenches located in the right-of-way are not backfilled at the end of the construction day, the trench shall be covered with Steel Plates~~.~~, in accordance with **Detail No. S-2146** of these standards. Use of Steel Plates shall conform to ~~Section 101.8.02.b.5~~Section 101.8.02.b.7, "Progress of Construction."

201.4.08 Preservation, Restoration, and Cleanup

Cleanup of all construction debris, excess excavation, and excess materials and complete restoration of all fences, mailboxes, ditches, culverts, signposts, and similar items shall be completed according to Section 101.8.16, "Preservation, Restoration, and Cleanup."

201.5.00 WORKMANSHIP

201.5.01 Demolition

Debris from the demolition of pavement, sidewalks, curbs, or gutters shall be ground and recycled or hauled off site and disposed of in a manner approved by the City's authorized representative.

201.5.02 Clearing and Grubbing

a. Brush shall be cut as near to the ground surface as practicable and removed to a disposal site approved by the City's authorized representative. Under no condition shall excavated materials be permitted to cover brush before the brush is cleared and disposed of. Ground surface shall be stripped of all organic soil and unsuitable material as recommended in the ~~Geotechnical~~Street Design Report. Stripping operations shall be approved by the City's authorized representative prior to proceeding with any construction activity.

b. Erosion-prevention and sediment-control measures shall be installed before the start of clearing and grubbing (see ~~Section 101.9.00~~Section 101.9.00, "Environmental Protection, Erosion Prevention, and Sediment Control"). The applicant shall call the City's authorized representative for inspection and approval of all erosion-prevention and sediment-control measures before beginning any site clearing, grubbing, or grading.

201.5.03 Subgrade

Subgrade shall be prepared according to the recommendations in the ~~Geotechnical~~Street Design Report and must be approved by the City's authorized representative.

a. The subgrade shall be ~~compacted to 95%~~firm and free of ~~the maximum dry density, as determined by AASHTO T-180. In periods of dry weather,~~ aroots and deleterious materials.

b. A proof-roll of the subgrade using a 10 cubic yard dump truck, fully loaded with rock, or equivalent loaded vehicle shall be observed by the City's authorized representative~~.~~ and the geotechnical engineer of record. Soft areas shall be repaired or replaced~~.~~ and re-proof rolled until the subgrade is deemed satisfactory by the City's authorized representative and approved by the geotechnical engineer of record. During periods of wet weather, the proof-roll shall occur after placement of the base course material in accordance with Section 201.5.04, "Base and Leveling Course."

201.5.04 Base and Leveling Course

Base and leveling course shall consist of crushed aggregate as specified in Section 201.2.04, "Crushed Aggregate Design" and Section 201.3.01, "Granular Fill."

a. Base and leveling aggregate material shall be placed and compacted to the required depth of finished pavement and for proper matching with the adjacent existing pavement.

b. Material shall be compacted to 95% of the maximum dry density, as determined by AASHTO T-180~~.~~ and acceptable testing reports provided to the City.

c. A proof-roll of the base and leveling ~~course~~courses using a 10 cubic yard dump truck, fully loaded with rock, or equivalent loaded vehicle shall be observed by the City's authorized representative. Soft areas shall be repaired or replaced and re-proof rolled until the base and leveling courses are deemed satisfactory by the City's authorized representative.

201.6.00 CONSTRUCTION PROCEDURE

a. The geotechnical engineer reserves the right to vary the classes of backfill and the type of resurfacing as best serves the interest of the City, with the approval of the City's authorized representative. Subgrade shall be approved in conformance to Section 201.5.03, "Subgrade". Base rock shall be approved by the City's authorized representative prior to placement of asphalt concrete, Portland cement concrete or Segmental Concrete Pavers.

b. A state approved mix design for asphalt concrete or Portland cement concrete shall be submitted to the City's authorized representative for approval a minimum of seven calendar (7) days prior to placement taking place.

c. PCC for concrete pavement shall conform to Section 201.2.06.h, "Portland Cement Concrete Design."

d. PCC for curbs, sidewalks, driveways and miscellaneous construction shall conform to Section 201.2.06.i, "Portland Cement Concrete Design."

e. Testing shall be in conformance with Section 201.6.07, "Testing."

f. Portland cement concrete whose batch time exceeds 90 minutes and has not yet been placed may be refused by the City's authorized representative.

g. Segmental concrete pavers, bedding sand, joint sand, base aggregate and sub-base aggregate shall conform to Section 201.2.07, "Segmental Concrete Paver Design."

201.6.01 Curb and Gutter

a. Curb and gutter shall be installed as per **Detail No. RD-1055** of these standards with asphalt pavement, or **Detail No. RD-1060** of these standards with PCC pavement.

b. When medians are specified, curb and gutter shall be installed as per **Detail No. RD-1065** of these standards.

c. At no time shall construction equipment or traffic be allowed on new curb and gutter until laboratory tests indicate that at least 90% specified design strength (Section 201.2.06.i, "Portland Cement Concrete Design") has been attained; this includes installation of adjacent asphalt pavement.

d. Curb and gutter jointing shall match adjacent PCC street pavement jointing. Joint locations shall be installed per **Detail No. RD-1060** of these standards and staked per Section 201.1.06, "Surveying."

201.6.02 Asphalt Pavement

a. ~~a.~~ **Prime Coat**: After the leveling course is compacted, an asphalt prime coat, as specified ~~above,~~in Section 201.3.02, "Asphalt Concrete," shall ~~-~~ be applied to the edges of the existing pavement~~.~~ and curb and gutter. Also, cast iron manhole frames and cleanout frames shall be tack-coated below grade.

~~b. Asphalt Concrete~~

b. **Temperature:** The temperature of the HMAC during mixing, placement, or while in storage shall not exceed 350°F and shall not be less than 240°F as per ODOT SSC Section 00745.43, "Drying and Heating Aggregates."

For Warm Mix Asphalt Concrete (WMAC), complete breakdown and intermediate compaction before the WMAC temperature drops below the threshold recommended by the additive supplier or equipment manufacturer. The temperature of the WMAC shall not be less than 215°F as per ODOT SSC Section 00745.43, "Drying and Heating Aggregates."

c. **Storage:** Asphalt storage shall meet requirements of ODOT SSC Section 00745.44, "Asphalt Concrete Pavement Storage."

~~1.~~d. **Thickness:** Minimum total thickness of AC shall be 4 inches placed in ~~at least~~ two 2-inch lifts. Place AC after the prime coat has set. If the thickness is greater than 6 inches, place the asphalt in three lifts. Maximum lift thickness shall be 3 inches. Spread and level the AC with use of a self-propelled machine or hand tools, depending on the size of the area to be paved. Bring the AC to the proper grade and compact by rolling, or use hand tampers where rolling is not possible. ~~Temperature of the AC material shall be in conformance with Section 201.3.02.d.~~

e. ~~**Placement:**~~ **Placement:** Asphalt concrete shall be placed according to the following minimum requirements.

1. Prior to placing asphalt concrete, all cold edges of existing asphalt concrete shall be sawcut to provide a clean joint to pave against.

2. Lay the AC mixture in strips of such width as to hold to a practical minimum the number of longitudinal joints required. ~~-~~Joints shall not be located in wheel paths.

~~2.~~3. The longitudinal joints in any layer of pavement shall be offset from those joints in layers below by not less than ~~6 inches. Joints shall not be located in wheel paths~~1-foot.

4. The lateral joints in any layer of pavement shall be offset from those joints in layers below by not less than 3 feet. Where new AC ties into existing asphalt concrete, the existing AC shall be ground the thickness of the new AC lift along the lateral joint a minimum of 3 feet in width for each lift of new AC installed.

f. **Compaction:** Compact asphalt concrete in accordance with the following minimum requirements.

1. Roll asphalt concrete with power rollers capable of providing compression of 350 pounds per linear inch.

2. Begin rolling from the outside edge of the replacement and progress toward the existing surfacing, lapping the existing surface at least half the width of the roller. If the existing surfacing bounds both edges of the replacement, begin rolling at the edges of the replacement, lapping the existing surface at least half the width of the roller and progressing toward the center of the replacement area. Overlap each proceeding track by at least half the width of the roller and make sufficient passes over the entire area to produce the desired result.

~~e.~~3. AC pavement shall be compacted to a minimum of 92% relative density, based on the theoretical maximum density determined in accordance with ASTM D-2041, "Rice Gravity."

~~4.~~g. **Finished surface:** The finished surface of the new compacted paving shall be flush with the existing surface and shall conform to the grade and crown of the adjacent pavement.

201.6.~~0~~203 Portland Cement Concrete Pavement

a. Construction of PCC pavement shall be in conformance with the guidelines in ODOT SSC Section 00756, "Plain Concrete Pavement."

b. Construction of concrete joints shall follow the guidelines and requirements outlined in the ACPA publication, "Design and Construction of Joints for Concrete Streets," except for the following:

1. Maximum joint spacing shall be 12 feet.

2. Transverse joints shall be designed to be skewed 6:1 when meeting the edge of pavement, at the ~~gutterline~~gutter line.

3. For doweled contraction joints, do not lubricate the dowels.

4. Staking of curb joints shall be required and performed by or under the direction of a Professional Land Surveyor registered in the State of Oregon.

5. Isolation joints shall be used around manhole covers. Isolation joints shall be circular with ~~a~~ 2-foot spacing from the manhole cover.

c. All joints shall be hot air lanced and moisture evaporated prior to sealing of joints.

~~c.~~d. All joints shall be sealed in conformance with the ACPA publication, "Design and Construction of Joints for Concrete Streets."

~~d.~~e. The surface finishing and smoothness of PCC surfaces shall follow the guidelines outlined in ODOT SSC Section 00756.49, "Surface Finishing" and ODOT SSC Section 00756.55, "Surface Tolerance, Testing, and Correction."

~~e.~~f. At no time shall construction equipment or traffic be allowed on the new pavement until laboratory tests indicate that at least 90% ~~design strength~~specified design strength (Section 201.2.06.h, "Portland Cement Concrete Design") has been attained and the City's authorized representative and the design engineer agree that the street is ready for traffic and construction loads.

~~**201.6.03 Sidewalks**~~

201.6.04 Segmental Concrete Pavers Installation

a. The installer shall have a minimum of two years of experience with similar installations and provide to the City job references from projects of a similar size and complexity. Provide Owner/Client/General Contractor names, postal address, phone, and email address and location of previous jobs. The contractor shall present this list of similar installations to the City for approval a minimum of seven days before starting work.

b. The installer shall provide a written Method Statement and Quality Control Plan that describe material staging and flow, paving direction and installation procedures, including representative reporting forms that ensure conformance to the project specifications.

c. The maximum allowable chipping on the paver edges and corners shall be ¼". The cumulative length of chips on the exposed face of a single unit shall not

exceed 1 percent of the perimeter of the exposed face of the paver, and no single chip shall exceed ½- inch in length.

d. Other than chips, the paver shall be free of cracks, color and other imperfections detracting from the appearance of a designated sample when viewed from a distance of 5 feet away.

e. Installation shall include preparing the base by removing unstable or unsuitable material a minimum of 6", compacting and grading the soil, draining or stabilizing weak or saturated soils and taking measures to prevent water penetration and mitigation of bedding sand. The sub base shall be compacted to a minimum of 95% of the T-99 density value.

f. Preparation of the subgrade shall be as described for the Unit Pavers section above.

g. Install the concrete perimeter edge restraints.

h. Install the sub base in 4-6" lifts to the specified thickness. Moisten, spread and compact the base layer in 4" lifts. For segmental concrete pavers test compaction of the base lift in conformance to Section 201.5.04, "Base and Leveling Course".

i. For permeable concrete pavers, install the sub-base and base rock per the manufacture's recommendation.

j. Check grade of base rock with a 10' straight edge. The tolerance shall be within 1" over 10'.

k. Install the bedding layer and compact making at least two passes, or per manufacturer's recommendation. Recheck grade and adjust as necessary. The tolerance shall be within 3/8 "over 10'. Place the pavers and begin infilling the gaps with the joint material. Sweep excess joint material away and compact with a plate compactor, making at least two passes, or per manufacturer's recommendation. Apply additional material in the low areas as needed and compact.

l. After sweeping the surface, check the grade. The final surface shall be within 1/8" of the adjacent drainage inlets, concrete collars or channels. Bond lines for pavers are +/- ½ inch. over a 50' string line

201.6.05 Driveways

a. Construct ~~sidewalks~~residential driveways in accordance to ~~Section 201.2.05.i~~Section 201.2.06.i, "Portland Cement Concrete ~~-~~Design" and **Detail No.** ~~R-1080~~**RD-1090** of these standards.

b. Construct commercial driveways in accordance to Section 201.2.06.i, "Portland Cement Concrete Design" and **Detail No. RD-1095** or **Detail No. RD-1100** of these standards.

c. At no time shall construction equipment or traffic be allowed on the new concrete driveway until laboratory tests indicate that at least 90% specified design strength (Section 201.2.06.i, "Portland Cement Concrete Design") has been attained; this includes installation of adjacent asphalt pavement.

201.6.~~04~~06 Sidewalks

a. Construct new sidewalks in conformance with Section 201.2.06.i, "Portland Cement Concrete Design" and **Detail No. RD-1075** of these standards.

b. Sidewalk repairs, replacement or reconstruction shall be in conformance with Section 201.2.06.i, "Portland Cement Concrete Design" and **Detail No. RD-1075** of these standards. Sidewalk shall be finished in accordance with Section 201.2.25.a.6, "Sidewalks."

c. ADA ramp repairs, replacement or reconstruction shall be in conformance with Section 201.2.25, "Sidewalks" and to **Detail No. RD-1110 – Detail No. RD-1140** of these standards.

d. At all intersections adjacent to the curb radius, curb-tight sidewalks and sidewalk ramps shall be constructed with a similar section as shown for a residential driveway (see **Detail No. RD-1090** of these standards.)

e. Root Barriers shall be installed in conformance with Section 201.2.24.e, "Root Barriers."

201.6.07 Testing

a. **Asphalt pavement:** Asphalt pavement shall have minimum density testing performed every 100 ft. of each lift and panel width installed. The pavement shall be compacted to a minimum of 92% relative density, based on the theoretical maximum density determined in accordance with ASTM D-2041, "Rice Gravity."

b. **PCC pavement:** Portland cement concrete shall be tested at a minimum of once per every 4 hours of work or 100 cubic yards of concrete installed. Testing shall include temperature, slump, air content, and minimum of 4 test cylinders. If water or other additives are added to the concrete load after the testing samples have been taken, an additional 4 test cylinders of the modified concrete mix shall be taken and tested. The 28-day compressive strength shall exceed 4,000 psi; a minimum compressive strength of 3,600 psi is required to allow traffic on the pavement.

c. **Curb, gutter, and driveways:** Portland cement concrete shall be tested a minimum of once per 4 hours of work. Testing shall include temperature, slump,

air content, and minimum of 4 test cylinders. If water or other additives are added to the concrete load after the testing samples have been taken, an additional 4 test cylinders of the modified concrete mix shall be taken and tested. The 28-day compressive strength shall exceed 3,300 psi. A minimum compressive strength of 2,970 psi is required to allow traffic.

d. **Testing Frequency:** City reserves the right to direct testing agency on frequency of testing.

201.6.08 Weather Conditions

a. AC pavement shall not be placed during periods of rainfall, sand or dust storms, or any imminent storms that might adversely affect the finished pavement quality. AC material shall not be applied over frozen surfaces or standing water. AC shall be placed at temperatures not colder that the minimum atmospheric temperatures specified in ~~**Table 2.8.**~~**Table 2.17.** Temperature of the AC material shall be in conformance with ~~Section 201.3.02.d.~~Section 201.6.02.b, "Temperature."

Table 2.~~8.~~ 17. ATMOSPHERIC TEMPERATURE REQUIREMENTS

Individual Lift Thickness	Atmospheric Temperature
~~Less than 1½"~~	~~60° F~~
~~1½" –~~ 2" to 2 ½"	50° F
2~~½" –~~ ½"+ to 3"	40° F

b. PCC pavement shall not be placed during periods of rain or on frozen bases. ~~Placement~~PCC placement shall not occur when descending air temperature falls below 40°F, nor shall it resume until ascending air temperature reaches 35°F. The contractor shall protect PCC ~~pavement~~ from weather damage. The contractor shall protect unhardened PCC from precipitation with protective material. If PCC is being placed during cold weather, and the air temperature is forecast to drop below 35°F, the contractor shall prevent the PCC from freezing for at least 7 days.

c. The base aggregate shall be thoroughly watered to the satisfaction of the City's authorized representative immediately prior to the placement of PCC when the measured or forecasted ascending air temperature is 80°F or greater.

201.6.~~05~~09 Protection of Structures

a. Provide whatever protective coverings may be necessary to keep oil or asphalt from splashing on the exposed parts of bridges, culverts, curbs, gutters, posts, guardrails, road signs, and any other structures during paving operations.

Remove any oil, asphalt, dirt, or any other undesirable matter from these structures that resulted from the paving operations.

b. Where water valve boxes, manholes, catch basins, or other underground utility appurtenances are situated in the area to be surfaced, the resurfacing shall be level with the top of the existing finished elevation of the appurtenances. If it is evident that an appurtenance does not match the proposed finished grade, notify the proper authority to have the item altered before proceeding with the resurfacing around the obstruction, unless otherwise approved by the City's authorized representative. Protect all covers during asphalt application.

201.6.~~06~~10 Excess Materials and Trench Settlement Repair

Contractor shall dispose of excess materials. Contractor shall be responsible for repairing all settlement of pavement over trenches for a 1-year period.

201.6.~~07~~11 Rock Surfacing

Where gravel shoulders have been disturbed, place ¾"–0" crushed aggregate backfill (see Section 201.3.01, "Granular Fill") as surfacing material for the full width of all streets, driveways, parking areas, street shoulders, and other areas disturbed by the construction. Spread the material by "tailgating" and supplement by hand labor when necessary. Level and grade the aggregate to conform to existing grades and surfaces.

201.7.00 SURFACE RESTORATION

201.7.01 Scope

This section covers the work necessary for all required replacement of pavement, curbs, sidewalks, rock surfacing, and drainage facilities that were removed during construction. Replacement pavement and base course thickness design shall conform to current City standards.

201.7.02 Asphalt Concrete Replacement

~~1.~~a. Base, subbase, or subgrade material that has been removed shall be replaced with ¾"–0" crushed aggregate backfill (see Section 201.3.01, "Granular Fill") or control density fill (CDF, minimum 28 day compressive strength shall be 200 psi). Bring the trench or excavation to a smooth, even grade at the correct distance below the top of the existing pavement surface so as to provide adequate space for AC pavement. Crushed aggregate trench backfill placed within 3 feet of finished grade shall be compacted to 95% of the maximum dry density, as determined by AASHTO T-180. Crushed aggregate backfill placed below 3 feet of finished grade shall be compacted to 90% of the maximum dry density. Place the leveling course for the full width of the trench where pavement was disturbed, including bituminous surface shoulders.

~~2.~~b. Compact the base rock and leveling course material to 95% of the maximum dry density, as determined by AASHTO T-180. At the conclusion of each day's operation, the contractor shall patch or place steel plates in accordance with Section 101.8.02.b.7, "Progress of Construction" over all trench or excavation areas. Cold-patch asphalt mix may be used as a temporary patch.

~~3.~~c. The contractor shall grind edges and make a minimum 1-foot T-cut in the existing pavement surrounding a trench or excavation as shown on **Detail No. S-2145** of these standards. Trim existing pavement to a straight line to remove any pavement that has been damaged or that is broken and unsound to create a smooth, sound edge for joining the new pavement.

~~4.~~d. Within 5 working days, weather permitting, after completion of all paving or utility work, the contractor shall repair all trench or excavation areas with ~~hot-patch asphalt mix and tack and sand all joints and sawcuts~~asphalt concrete. AC pavement thickness shall be a minimum of 4 inches or match existing pavement depth, whichever is greater. AC pavement shall be compacted to a minimum of 92% relative density, based on the theoretical maximum density determined in accordance with ASTM D-2041, "Rice Gravity."

1. When the pavement surface has been cored, the area shall be repaired as follows: At the conclusion of each day's operation, the contractor shall patch all cored areas. Cold-patch asphalt mix may be used as a temporary patch.

2. Within 5 working days after completion of all paving or utility work, the contractor shall repair all cored areas with hot-patch asphalt mix.

e. All joints and sawcuts shall be sand sealed within 24 hours of trench and excavation areas repaired with asphalt concrete. Seal material shall consist of hot-applied emulsified asphalt slurry seal, supplied and installed in accordance with ODOT SSC Section 00706, "Emulsified Asphalt Slurry Seal Surfacing."

201.7.03 Asphalt Restoration for Streets Listed on 5-Year Moratorium

When emergencies or special circumstances require access to underground utilities, the City may allow street cuts in streets listed on the 5-year moratorium (see ~~Section 201.2.26.c~~Section 201.2.31.c, "Utilities"). In addition to the repair work outlined in Section 201.7.02, "Asphalt Concrete Replacement," an additional minimum 1-foot wide, 2-inch grind out around the T-cut perimeter shall be required per **Detail No. S-2145** of these standards.

201.7.04 Portland Cement Concrete Replacement

a. ~~a.~~ **Trenching or Excavation in Pavement and Driveways**: The City Engineer encourages directional boring under existing concrete streets and discourages trenching or excavation work in streets or driveways. When this is unavoidable, the contractor shall remove and replace all panels that have

been cut or damaged~~.~~ within 5 working days, weather permitting, after completion of all paving or utility work. New panels shall be connected ~~with No. 4 reinforcement tie-bars~~ into the adjacent existing panels per **Detail No. RD-1180** of these standards. Tie-bars shall be epoxied in place using an epoxy bonding agent as provided in the ODOT QPL. Bring the trench to a smooth, even grade at the correct distance below the top of the existing pavement surface so as to provide adequate space for the base, leveling course, and PCC pavement.

b. ~~b.~~ **Coring:** When the pavement surface has been cored, the area shall be repaired as follows:

1. Base, subbase, or subgrade material that has been removed shall be replaced with ¾"–0" crushed aggregate backfill (see Section 201.3.01, "Granular Fill") or ~~CDF.~~CLSM (see Section 601.2.03.c, "Class E Backfill." Bring to a smooth, even grade at the correct distance below the top of the existing pavement surface so as to provide adequate space for PCC pavement.

2. At the conclusion of each day's operation, the contractor shall patch all cored areas within roadways with concrete having a minimum 4,000-psi compressive strength at 28 days (concrete with a minimum 3,~~000~~300-psi compressive strength may be used in driveways).

c. **Surface Smoothness:** The surface smoothness of the replaced pavement shall be such that when a straightedge is laid across the patched area between the edges of the old surfaces and the surface of the new pavement, the new pavement shall not deviate from the straightedge by more than ¼ inch.

d. ~~d. **Sidewalks and Curbs:** Replace concrete sidewalks and curbs~~**Curbs and Gutters:** Remove existing damaged curbs and gutters to the nearest joint, unless otherwise directed by the City's authorized representative. Replace concrete curbs and gutters to the same section, width, depth, line, and grade as that removed or damaged. Cut the ends of existing curb to a vertical plane. Before replacing the sections, properly backfill and compact the trench to prevent subsequent settlement. Where the section of curb and/or gutter replacement is less than 10 feet in length, connect new curbs and gutters to existing curbs and gutters with No. 4 reinforcement tie-bars. A minimum of 2 tie bars shall be used for curbs and a minimum of 2 tie bars used for gutters. Tie bars shall be epoxied in place to a minimum depth of 1 foot using an epoxy bonding agent as provided in the ODOT QPL.

e. ~~e.~~ **Catch Basins:** Reinstall catch basins as a curb inlet in their original locations and reconnect them to the drainage system in a manner equal to the original. If the existing catch basins are damaged beyond repair by operations, construct new basins ~~of similar size, cross-section, and design as the original~~in accordance with these specifications. The new basin shall have

a volume equal to or greater than the damaged catch basin, unless otherwise approved by the City's authorized representative.

201.7.05 Sidewalk Replacement

a. Construct sidewalks in accordance to Section 201.2.06.i, "Portland Cement Concrete Design" and **Detail No. RD-1075** of these standards

b. Match finish work to existing panels; re-compact base rock if disturbed. Replace base rock if insufficient depth or contaminated with soil.

c. Replacement ADA ramps shall meet current standards as per **Detail No. RD-1110 – Detail No. RD-1140** of these standards.

201.8.00 STREET NAMES AND TRAFFIC CONTROL SIGNAGE AND STRIPING

201.8.01 Street Name Signs and Posts

All newly platted streets shall be signed with the name as shown on the approved or proposed county plat; proposed county plats shall show street names as approved by the Design Review Board (DRB~~) and the county.~~). Signs are to conform to **Detail No.** ~~R-1165~~**RD-1250** and ~~R-1170~~**Detail RD-1255** and to these ~~City~~ standards, as follows.

a. ~~a.~~ **Posts**

1. ~~1.~~ Materials

(a) A minimum of 2 x 2-inch x 10-foot, 14-gauge galvanized "quick-punch" or 12-gauge perforated posts, or approved equal, shall be used.

(b) A 2 x 2-inch x 12-foot, 14-gauge galvanized "quick-punch" or 12-gauge perforated posts, or approved equal, shall be used when a combination of signs is more than 36 inches high.

(c) Signposts are made of 2-inch square tubing and must be embedded 18 inches into the base.

2. ~~2.~~ Base~~:~~

The breakaway post base shall consist of a 2.25 x 2.25 inch (I.D.) x 36-inch galvanized base with a 2.5 x 2.5 inch (I.D.) x 18-inch sleeve placed flush with the base. All sleeves and bases shall be 14-gauge "quick punch" or 12-gauge perforated material, or approved equivalent.

3. ~~3.~~ Fastening~~:~~

Drive rivets shall be used to fasten signs onto metal signposts, except for street name signs, which shall be attached by hex nuts. Washers shall be used behind all drive rivets used to affix signs to posts. Two drive rivets at right angles shall be used to fasten the post to the base.

b. ~~b.~~ **Street Name** ~~Signs~~**Sign**

1. In business districts and on principal arterials, street name signs shall be placed in diagonally opposite corners so that they will be on the ~~righthand~~right hand side of the intersection for traffic on the major street.

2. To optimize visibility at signaled intersections, street name signs shall be mounted overhead. In residential districts, at least one street name sign shall be mounted at each intersection.

3. On T-intersections, the street name signs shall be designated at two locations. One street name sign shall be placed at the end of a T-intersection, and the second placed at the ~~righthand~~right-hand corner of the intersecting street~~. Signs naming both streets shall be installed at each street sign location~~.

4. Signs naming both streets shall be installed at each street sign location.

~~1. **Materials:** On streets with a speed limit of 35 mph or greater, a street name sign shall consist of 8-inch high, flat, 0.080-inch thick aluminum. On streets with speed limits of less than 35 mph, a street name sign shall consist of 6-inch high, flat, 0.080-inch thick aluminum. The minimum length is 24 inches. The maximum length is 36 inches.~~

~~2. **Sheeting:** Both sides of street signs shall be green 3M Scotchlite brand high-intensity reflective sheeting.~~

~~3. **Lettering:** Street name signs consist of 3M Scotchlite brand high-intensity white letters on green background. All letters shall be uppercase.~~

201.8.02 Traffic Control Signage and Striping

Traffic control signing and striping shall be in conformance with **Detail No.**~~'s R-1175, R-1180~~ **RD-1265, Detail No. RD-1270, Detail No. RD-1275, Detail No. RD-1280**, and ~~R-1185~~**Detail No. RD-1285** of these standards and the MUTCD. A "Signage and Striping Plan" shall be included with plan submittals for new street construction and street improvements.

201.9.00 LIGHTING

~~All installation of streetlights~~**201.9.01 Roadway and Intersection Lighting**

a. Street lighting shall be ~~done~~designed in accordance with ~~"Statement of Streetlight~~ the most current American National Standard Practice for Roadway Lighting (RP-8-00) prepared by the Illuminating Engineering Society (IES).

b. Installation ~~Responsibilities," Option B, by PGE, revised March 1, 2001,~~of streetlights shall be in accordance with the City's most current policies/agreements regarding the installation and maintenance of street lights.

c. In addition to these requirements the air gap between the top of pedestal and bottom of light pole shall be grouted with a high-strength, non-shrinking grout meeting ODOT SSC Section 02440.50(b), "Non-Shrink Grout," such as Alcrete Twenty Minute Fast Setting Grout®, or ~~latest edition.~~ approved equal.

d. Selection and installation of street lighting luminaires shall be in conformance with the City's most current "Dark Sky" policies.

e. The warranty for public works projects shall include streetlights.

201.9.02 Shared-Use Path Lighting

a. Lighting of shared-use paths, including pedestrian tunnels shall be designed to provide at least 0.4 average foot candles, depending on the location, with a minimum average lighting uniformity of 3.0.

b. The City Engineer may reduce the lighting standards or not require lighting of shared-use paths in designated natural resource and wildlife areas.

c. Lighting provided along shared-use paths shall be pedestrian scale with a mounting height no greater and no less than 10 feet. A clearance of 10 feet shall be provided from the path surface for street lighting overhanging a shared-use path. Pedestrian level lighting, such as bollards, shall not be permitted.

d. Installation of shared-use path streetlights shall be in accordance with the City's most current policies/agreements regarding the installation and maintenance of street lights.

f. In addition to these requirements the air gap between the top of pedestal and bottom of light pole shall be grouted with a high-strength, non-shrinking grout meeting ODOT SSC Section 02440.50(b), "Non-Shrink Grout," such as Alcrete Twenty Minute Fast Setting Grout®, or approved equal.

g. Selection and installation of street lighting luminaires shall be in conformance with the City's most current "Dark Sky" policies.

h. The warranty for public works projects shall include streetlights.

201.10.00 STREET ACCEPTANCE POLICY

The City of Wilsonville will accept new public street installations or systems built to the "Public Works Standards," providing that the following conditions are met.

201.10.01 Legal Recordings

All plats are recorded with the County Surveyor, all easements and dedications are recorded with the County Recorder and the Engineering Department receives a reproducible copy of the recorded documents.

201.10.02 Project Completion

After completion of construction of the total project, and after all testing has been satisfactorily completed, project closeout shall proceed as outlined in ~~Section 101.8.17.a, "Project Completion~~Section 101.8.17, "Project Closeout."

201.10.03 Maintenance Period

a. The Contractor or Applicant shall be responsible for providing Maintenance Assurance for Public Improvements as outlined in ~~Section 101.8.17.b, "Maintenance Assurance." Public street improvements shall be warranted for a minimum of one year; public landscape improvements shall be warranted for a minimum of two years.~~Section 101.8.18, "Maintenance and Warranty."

b. At any time during the warranty period, the City's authorized representative has reason to believe the public street improvements have defects that were the result of faulty workmanship or flaws in construction material, the responsible party shall be required, at that party's own cost, to repair any faults to the public street improvements deemed necessary by the City's authorized representative.

c. Before the end of the Construction Maintenance period, the City's authorized representative shall inspect the project for any remaining deficiencies. If the deficiencies that remain are determined to be the responsibility of the contractor or the applicant, the contractor or applicant shall then make such repairs.

~~d. The Landscape Maintencance assurance shall be released two years after acceptance of construction, providing the landscaping meets the 90% survival level (see Section 301.13.02, "Landscape Inspection for Warranty").~~

SECTION 3

STORMWATER & SURFACE WATER DESIGN & CONSTRUCTION STANDARDS

The Storm Drainage Design & Construction Standards are bound in a separate document.

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SECTION 4

SANITARY SEWER DESIGN ~~AND~~ & CONSTRUCTION STANDARDS

401.1.00 ENGINEERING

401.1.01 Introduction

This ~~chapter~~section outlines design and construction requirements for all public sanitary sewers. The provisions and technical specifications herein set forth the requirements of the City of Wilsonville for constructing sanitary sewer improvements. Interpretations of such provisions and their application in specific circumstances shall be made by the City's authorized representative~~.~~, unless specifically stated otherwise. Refer to Section 1 of the "Public Works Standards" for general provisions and requirements.

~~A map may be required that shows the drainage basin in which the project is located. The map shall show the major basin that is consistent with the City's current Wastewater Collection System Master Plan, and any applicable amendments and updates to it.~~

401.1.02 ~~**General Provisions**~~

~~**Along with the provisions established in Section 101.5.00, "Control**~~**Extension of Public ~~Works Projects," all sanitary sewers shall be designed and constructed so as to conform to the requirements of the Oregon state plumbing laws and rules of the Oregon DEQ. Except as otherwise provided, the~~ Sewer Systems**

a. The extension or upsizing of the public sewerage facilities in excess of 8 inches in diameter or as shown in the Wilsonville Wastewater System Master Plans to serve ~~any parcel or tract of land~~the ultimate development density of the contributing area shall be done by~~, and at the expense of,~~ the property owner~~, although the~~ or permit applicant and may be subject to applicable System Development Charge (SDC) credits.

b. The City reserves the right to perform the work or cause it to be performed and bill the owner for the cost of the work or to pursue special assessment proceedings. ~~Public~~

c. The public sanitary sewer ~~extensions~~system shall extend to the most distant parcel boundary~~,~~ and be designed at a size and grade to facilitate future extension~~, unless otherwise approved~~ to serve development of the entire contributing area.

d. Where public infrastructure improvements paid for by the ~~City's authorized representative~~property owner or permit applicant directly benefit adjacent properties, the property owner or permit applicant may pursue establishment of a reimbursement district per Section 3.116 of the City Code.

401.1.03 ~~**Extension of Public Sanitary Sewer Systems**~~

~~Except as otherwise provided, the extension or upsizing of the public sanitary systems to serve any parcel or tract of land shall be done by, and at the expense of, the property owner or permit applicant. The City's authorized representative may require a sewer pipeline that serves or may serve more than one property to be a public system.~~

~~401.1.04~~ Sanitary Plans

a. It is the design engineer's responsibility to ensure that engineering plans are sufficiently clear and concise to construct the project in proper sequence, using specified methods and materials, with sufficient dimensions to fulfill the intent of ~~the~~these design ~~guidelines contained in these~~ standards.

b. All elevation on design plans and record drawings shall be based on the ~~-~~applicable NAVD ~~datum~~88 Datum specified in ~~Section 101.7.07.a, "Surveying~~ Section 101.7.07.a, "NAVD 88 Datum."

~~b.~~c. Existing conditions and facilities on design plans and ~~Land Monuments."~~record drawings shall be shown in light, gray print. Proposed conditions and facilities on design plans and record drawings shall be shown in bold, black print.

~~c.~~d. All engineering sanitary plans shall be stamped by a Professional Engineer registered in the State of Oregon. ~~The~~ At a minimum, the sanitary ~~plan~~plans shall contain the following:

1. ~~1.~~ At least one sheet shall show a plan view of the entire project site. If the project site is sufficiently large that detailed sanitary plans on any given sheet do not encompass the entire project site, then a sheet showing the plan view of the entire site must serve as an index to subsequent detailed plan sheets.

2. ~~2.~~ A topographic map showing existing conditions for the site, including the following:

~~(a) Existing topography for the site.~~

(a) Existing topography for the site. Plan views showing existing features may be required for a distance of up to 100 feet (or further if warranted) beyond the proposed improvement in order to prevent future grade conflicts and will be determined on a case-by-case basis by the City's authorized representative.

(b) Adjacent streets, trails, multi-use paths, and rail lines, including ~~street~~the respective names.

(c) Existing utilities, including franchised utilities located above or below ground~~.~~, and drainage facilities that transport surface water onto, across, or from the project site. Existing drainage pipes, culverts, and channels shall include the invert or ~~flowline~~flow line elevations.

(d) Existing vegetation, including denoting the type, DBH, and canopy size of trees within the construction limits.

~~(d)~~(e) Existing environmentally sensitive areas (e.g., ravines, swales, steep slopes, wells, springs, wetlands, creeks, lakes). For natural drainage features, show direction of flow, drainage hazard areas, and 100-year floodplain boundary (if applicable).

(f) Adjacent existing features that are within 25 feet outside of the site boundary, including but not limited to construction activities that will potentially compromise the structural stability or condition of off-site features, such as cultivated vegetation, landscaping and trees, buildings, fences, decks, walls, slabs, and pavements. Denote the type, DBH, and canopy size of all trees.

3. Plans for proposed sanitary improvements shall include the following:

(a) Grading and erosion control plan.

~~(a)~~ Finished grades, showing the extent of cut and fill by existing and proposed contours, profiles, or other designations.~~Finished grades, showing the extent of cut and fill by existing and proposed contours, profiles, or other designations.~~

(b) Plan views showing existing features may be required for a distance of up to 100 feet (or further if warranted) beyond the proposed improvement in order to prevent future grade conflicts and will be determined on a case-by-case basis by the City's authorized representative.

(c) Horizontal stationing along centerline, showing points of tangency and curvature, including centerline stationing of all intersecting streets.

~~(b)~~(d) Proposed structures, including roads and road improvements, parking surfaces, building footprints, walkways, landscape areas, etc.

~~(c)~~(e) Sanitary facilities, including pipe sizes, pipe types and materials, lengths, and all sanitary system structures and appurtenances, including but not limited to manholes, clean outs, and service laterals. Notes shall be included for referencing details, cross-sections, profiles, etc.

~~(d)~~(f) ~~Proposed~~Existing and proposed utilities, showing exact line and grade of all ~~proposed~~ utilities ~~at crossings with~~crossing the proposed sanitary system.

~~(e)~~(g) Applicable detail drawings.

~~(f)~~(h) Existing and proposed property lines, right-of-way lines, survey monuments, and easements.

~~(g)~~(i) Setbacks from environmentally sensitive areas ~~r~~or resource areas protected within the Significant Resource Overlay Zone (SROZ~~.~~).

~~(h) Proposed sanitary structures.~~

~~(i)~~(j) Maintenance access, as applicable (see Section 401.2.03, "Access").

~~(j)~~(k) ~~Plan and profile of sanitary systems, including the following information: pipe sizes, pipe types and materials, lengths, slopes, type of structure, location of structures, invert elevations in/out of structures, and top elevations of structures. Notes shall be included for referencing details, cross-sections, profiles, etc.~~

~~(k)~~(l) Any proposed phasing of construction.

(m) Any additional information that the City's authorized representative deems necessary.

4. Profiles for proposed sanitary improvements will be provided at the same horizontal scale as the plan sheets and a 1" = 5' vertical scale. Profile drawings shall be drawn below the plan view or immediately following the associated plan view sheets. Profile views showing existing features may be required for a distance of up to 100 feet (or further if warranted) beyond the proposed improvement in order to prevent future grade conflicts and will be determined on a case-by-case basis by the City's authorized representative. The profiles shall include the following:

   (a) Existing and proposed ground along the proposed sanitary main alignment.

   (b) Sanitary facilities, including pipe sizes, pipe types and materials, lengths, backfill material, and all sanitary system structures and appurtenances, including but not limited to manholes, fittings, and clean outs. Notes shall be included for referencing details, cross-sections, etc.

   (c) Existing and proposed utilities, showing exact line and grade of all utilities crossing the proposed sanitary system, specifically water lines. The vertical separation from existing and proposed utilities shall be labeled for all proposed utility crossings.

   (d) Any additional information that the City's authorized representative deems necessary.

5. Design Submittals

   (a) A manhole detail may be required to be submitted for each new manhole and each existing manhole being worked on. The manhole details shall include rim elevation, number and size of grade rings, manhole frame type, cone or flat slab top with dimensions, each manhole section with dimensions, manhole base type with dimensions, step location, ledge elevation, and invert elevation(s), pipe size(s), pipe direction(s) with angle(s) noted for each pipe connection.

(b) Where a manhole pipe connection is larger than 24 inches or where more than four mainline connections are approved, the manufacturer or design engineer shall submit supporting calculations, stamped by a Professional Engineer registered in the State of Oregon, documenting the structural integrity of the manhole. The supporting documents shall be submitted with the manhole detail submittal.

401.1.~~05~~04 Surveying

~~1.~~a. The design engineer shall be responsible for establishing the location of the sewer line by means of reference stakes offset along the centerline of the sewer line. No construction shall be allowed to begin before construction staking. All staking shall be performed by or under the direction of a Professional Land Surveyor registered in the State of Oregon.

~~2.~~b. Stakes shall locate all public tees, cleanouts, manholes, water line crossings, and pump stations. Maximum spacing for reference stakes is 50 feet. Stakes shall reference cuts or fills to all invert elevations and rim grades. The design engineer shall also be responsible for identifying and staking easements during construction.

401.1.~~06 Population Density~~05 Sewage Flow Determination

a. A map is required that shows the drainage basin in which the project is located. The map shall show the major basin that is consistent with the City's current Wastewater Collection System Master Plan and any applicable amendments and updates to it

b. Population density figures shall be obtained from the most recent information available for use by the ~~zoning or planning department~~Planning Division of the City of Wilsonville. If those figures vary from those of the applicable master plan estimates, the difference must be noted in the design calculation.

~~401.1.07 Sewage Flow Determination~~

~~a.~~c. When required by the City's authorized representative, the design engineer shall prove to the City that all necessary methods of determining present and future capacity of the sanitary sewer have been considered. For flow ~~variations~~parameters and peaking factor, accepted flow design practice must be employed. ~~A factor must be used,~~The flow parameters and ~~the method used to obtain the~~peaking factor must coincide with the method used in the City's Sanitary Sewer Master Plan unless directed by the City's authorized representative to use more current information particular to the basin in which the project is located is available. Infiltration and inflow must be represented in flow calculations in the design of the sanitary system. Infiltration and inflow figures shall be obtained from the City's Sanitary Sewer Master Plan or more current data as approved by the City's authorized representative.

~~b.~~d. Sewage flows must reflect any reasonably anticipated increase due to the development of the drainage basin upstream of the project being considered. Design engineers are cautioned not to specify sewers of sizes that are obviously larger than

necessary to achieve satisfactory carrying capacity, but which are specified to meet grade requirements.

401.1.~~08 Interceptor Required~~

~~Grease, oil, and sand interceptors shall be required when, in the opinion of the City's authorized representative or Building Official, they are necessary for the proper handling of wastewater containing fats, wax, grease, sand, or oils, whether emulsified or not, and containing any products or substances that may solidify or become viscous at temperatures of between 32° and 150°F (0° to 65°C). Any discharger of such wastewater shall be required to install, use, maintain, and keep in good working condition an interceptor – a device designed and installed so as to adjust, separate, and retain deleterious, hazardous, or undesirable matter from sewage, and to permit normal sewage or liquid wastes to discharge into the disposal terminal.~~

~~401.1.09~~06 Interference with City Sewer System Prohibited

No person shall block, obstruct, or interfere with any portion of the City sanitary sewer system without a diversion plan being submitted and approved by the City's authorized representative. This prohibition includes, but is not limited to, the obstruction of the flow of sewage from, and to any point within, the City sewer system.

401.2.00 SANITARY ~~MANHOLE AND PIPE~~SEWER DESIGN STANDARDS

The following design standards are intended only as a guide for the design of sanitary sewer improvements. All designs shall conform to the most current requirements of the Oregon state plumbing laws and rules of the Oregon DEQ, except where the City's standards exceed those of the state.

401.2.01 Manhole Design

a. Manholes shall be provided at least every 400 feet, unless otherwise approved by the City's authorized representative. Manholes shall be located at every grade change, change in pipe size, ~~and~~ change in alignment~~.~~, and at the end of main lines not to be extended in the future. Manhole lids shall be ~~centered in the roadway~~located as indicated in the street detail drawings of these standards unless an exception is approved by the City's authorized representative.

b. ~~When a manhole is 5 feet or less deep, a flat-top or~~A shallow manhole with precast grooves shall be ~~used,~~provided for manholes 4 feet deep from crown of pipe and less. The shallow manhole top shall consist of a short eccentric cone as shown in **Detail No. S-2025** of these standards. Where the short eccentric cone top is not feasible as determined by the City's authorized representative, a flat slab top may be permitted as shown in **Detail No. S-2030** of these standards.

~~b.~~c. Flat-top manholes shall be designed to be installed at an elevation to permit construction of the full street section, allowing for the design gradients.

~~c. All manholes shall be a minimum of 48 inches in diameter.~~

d. Manholes shall be designed such that the manhole cover is flush with the surrounding grade in paved areas, set 1-foot above grade in landscape areas unless otherwise directed by the City's authorized representative, and set at an elevation of at least 2 feet greater than the 100-year storm event in designated floodplain areas.

e. Manhole grade rings shall be concrete, key-lock joint designed to withstand AASHTO H-20 loadings. Grade rings shall not exceed 12 inches in height.

f. The minimum manhole size shall be as follows:

1. 48-inch diameter manhole for pipe equal to or less than 24 inch diameter

2. 60-inch diameter manhole for pipe between 27-inch and 36-inch diameter

3. 72-inch diameter manhole for pipe equal to or greater than 42-inch diameter.

~~d.~~g. Suburban style manholes frames shall not be used in PCC streets.

h. ~~Detail(s)~~There shall be ~~submitted with the plans where~~a maximum of 4 pipes ~~into or out of~~ entering/exiting a manhole ~~are~~unless otherwise approved by City's authorized representative.

i. Sewer lateral connections to manholes are prohibited except where required under Section 401.2.02.a.3, "Pipe Size" or where constrained by manhole placement as determined by the City's authorized representative.

~~e.~~j. The manufacturer or design engineer shall provide supporting structural calculations for manholes with pipe connections larger than 24 inches or where more than four mainline connections are ~~made. The manufacturer or design engineer shall provide the City's authorized representative~~approved, in accordance with ~~supporting calculations, stamped by a Professional Engineer registered in the State of Oregon, documenting the structural integrity of the manhole.~~Section 401.1.03.d.5, "Design Submittals."

~~f. Connections to an existing manhole, elevation of the existing ledge, location of steps, and elevations of existing inlets and outlets shall be submitted with the plans.~~

~~g.~~k. All precast manhole bases and sections shall ~~have~~be manufactured with smooth, clean openings at the design ~~inlets~~inlet and outlet points~~.~~ for the size of pipe specified. Manholes shall be core drilled to field adjust the design connection points. Openings shall not be sawcut or broken out.

~~h.~~l. A ~~All manhole bases shall be properly channelized. No more than three side laterals are allowed to be connected to a manhole, unless an exception is approved by the City's authorized representative. There shall be a~~ minimum of 8 inches ~~separating~~shall separate connections, measured from the outside diameter of the core holes.

m. All manhole bases shall be properly channelized.

~~i.~~n. All manholes shall have inlets at a minimum 90-degree angle in relation to the outlet, as measured from the center of the manhole base.

o. The crowns of all incoming pipes shall be at least as high as the crown of the outgoing pipe.

~~j.~~p. Manholes shall have a minimum ~~freefall~~free drop of 0.20 feet ~~and~~ . Any drop greater than 0.20 feet shall only be allowed when existing utilities or physical obstructions prevent a connection from being made within this specification as determined by the City's authorized representative. Where allowed, the maximum ~~freefall of~~ free-drop shall be 1.5 feet.

q. ~~Drop~~ Where services lateral connections to manholes~~: The maximum inside drop in~~ are allowed in accordance with 401.2.01(i), "Manhole Design", service laterals 6" and less in diameter shall have an invert elevation a ~~manhole shall be 18 inches.~~ minimum 0.50 feet above the main line outlet invert elevation.

~~k.~~r. When more than 18 inches of drop ~~exists~~is allowed, an ~~outside~~inside drop manhole shall be ~~used. Outside drops shall be constructed of ductile iron pipe (see~~provided in accordance with **Detail No. S-**~~2040~~**2042** of these standards~~).~~. Outside drop manholes are not allowed.

~~l. The contractor shall supply the City with manhole cover inserts, such as Southwestern Packing & Seals Rainstopper®, or approved equal, for all public manholes. For public manholes located in natural or landscaped areas or in residential streets, the contractor shall supply manhole cover inserts made of durable plastic. For public manholes located in arterial and collector streets, the contractor shall supply manhole cover inserts made of stainless steel.~~

s. All manholes shall be provided manhole cover inserts in accordance with **Detail No. S-2005** of these standards.

401.2.02 Sanitary Pipe Design

a. **Pipe size:** ~~No public~~

1. Pipe size shall be determined by the design depth of flow (d) over the pipe inside diameter (D) is 0.67.

$$D = d / 0.67$$

2. Public sanitary ~~sewer~~sewers shall be ~~less than~~ 8 inches in diameter or larger, unless otherwise specified by the City's authorized representative. ~~Side sewers shall be either 6-inch or~~Sewer laterals for residential service shall be 4-inch inside diameter. All other sewer laterals shall be sized to accommodate the anticipated flow, but no less than a 4-inch inside diameter.

3. Sewer laterals tapped into existing sanitary lines shall be no larger than 50% of the diameter of the main line, unless otherwise approved by the City's authorized representative. Sewer laterals larger than 50% of the diameter of the main line

shall be connected through the installation of a manhole in accordance with Section 401.4.01.c.2, "Pipe Connections."

b. **Materials:**~~, as required by the City. All side~~

1. Generally, sanitary sewer ~~pipes~~mains and laterals shall be ~~polyvinyl chloride~~Polyvinyl Chloride Pipe (PVC) pipe, ASTM D-3034, SDR 35 or lower, unless otherwise recommended by the Engineer of Record and directed by the City's authorized representative.

~~a.~~2. Pipe materials shall conform to ~~ASTM D-3034~~the specifications in Section 401.4.02.b "Materials" unless otherwise approved by the City's authorized representative.

3. Pipe and fittings shall consist of one type of material throughout and no interchanging of pipe and fitting material is allowed.

~~b.~~c. **Location:** Sanitary sewers~~, wherever possible, shall~~ will normally be ~~installed near~~placed on the ~~centerline~~north and west side of the ~~public right-of-way~~street, outside the bike lane and vehicle wheel path, as indicated in the street detail drawings of these standards. Sanitary pipe shall be located not closer than 5 feet to face of curb, unless an exception is approved by the City's authorized representative. In any event, all sewer locations shall be approved by the City's authorized representative.

~~c.~~d. **Easements:** Piped sewer systems shall generally be located in the right-of-way. When it is not possible or practical to install ~~the~~Public sewer ~~line~~facilities in a dedicated public street, ~~a minimum 15-foot public pipeline easement shall be provided. Sewer lines~~the facilities shall be located ~~in the center of~~within a sanitary sewer easement granted to the ~~easement, unless an exception is approved by the City's authorized representative. The centerline of the pipe shall~~City. Sanitary sewer easements typically be ~~at least 7½ feet from an easement side line.~~exclusive and conform to Section 101.8.14, "Easements."

~~d.~~e. **Alignment:** Public sanitary pipe shall be laid on a straight alignment and at uniform grade~~, unless an exception is approved by the City's authorized representative~~.

~~e.~~f. **Connections:** Lateral connections on new construction work shall be done using manufactured tees installed at surveyed locations. Lateral connections to existing sanitary lines may be done using either saddle tees as per ~~Section 401.4.02.b.5(a), or by using Inserta Tee® as per Section 401.4.02.b.5(c). Laterals shall be of same material as main.~~Section 401.4.02.b.5(a), "PVC Tee Saddle" or by using Inserta Tee® as per Section 401.4.02.b.5(c), "Inserta Tee." Lateral connections to manholes are prohibited in accordance with Section 401.2.01(i), "Manhole Design."

~~f.~~g. **Laterals:** Sanitary laterals shall be provided ~~with a cleanout installed at the public right-of-way or easement~~ as shown in **Detail No. S-2175** of these standards. ~~Cleanouts shall not be installed in the driveway or sidewalk, unless approved by the City's authorized representative.~~

~~g.~~h. **Curb Marking:** Newly constructed curbs or replaced curbs shall be stamped with the capitol letter "SS" at the location of each sanitary lateral crossing. Letters shall be 3 inches in height and embossed a minimum of ⅛-inch deep.

~~h.~~i. **Locating Wire and Tape:** Sanitary mains and laterals shall have tracer wire ~~(12-gauge with green THNN insulation)~~ installed beside the pipe and plastic caution tape installed 1-foot above the pipe crown as shown in **Detail No. S-2175** of these standards. Main line tracer wire shall be connected to service lateral tracer wire using solderless connection kit suitable for direct burial that joins wires mechanically and electrically and seals out moisture, GelCap or approved equal. Tracer wire shall be 12-gauge stranded or solid copper insulated High Molecular Weight Polyethylene (HMW-PE) with a green insulated cover a minimum 45 mil in thickness and the wire UL rated for 140°F. Surface locating wire at ~~right-of-way~~ cleanouts; tape shall be tied off to the 2 x 4 marker.

j. **Grade:** Sanitary sewers shall be laid on a grade that maximizes the serviceable area to facilitate future extension of the sanitary sewer system as determined by the City's authorized representative. The maximum serviceable area shall be based on the future development within the contributing area as identified by the Wilsonville Wastewater System Master Plans. The use of drop manholes in the design of new sanitary sewers shall be restricted as necessary to maximize the serviceable area.

~~i. Grade:~~ All sanitary sewers shall be laid on a grade that will produce a mean velocity of at least 2 feet per second when flowing full or half-full. The minimum grades for various sizes of pipe are listed in ~~**Table 4.1**~~ **Table 4.1**.

Table 4.1. MINIMUM GRADIENT FOR SANITARY SEWERS

Inside Pipe Diameter (inches)	Grade (%) (feet per 100 feet)
Sanitary Laterals	
4	~~1~~2.00
6	~~0.60~~2.00
Sanitary Mains	
8	0.40
10	0.28
12	0.22
15	0.15
18	0.12
21	0.10
24	0.08
27	0.07
30	0.06

The minimum slope of sanitary sewer laterals may be reduced to 1.00% in unusual conditions upon review and approval of a sewer lateral report by the City's authorized representative. The report shall be prepared by the Engineer of Record and shall include documentation of the unusual conditions causing the need for slope reduction and analysis documenting the reduced slope will not impact the function of the sewer lateral for the intended use.

k. **Steep Slopes:** Sewers pipes on slopes in excess of 20% gradient shall be secured with approved concrete anchor walls as shown in **Detail No. S-2195** of these standards~~. Spacing for anchors shall be as shown in **Table 4.2**~~. or other approved anchor systems as approved by the City's authorized representative. Where construction access is limited as determined by the City's authorized representative, steel anchor systems as shown in **Detail No. S-2196** may be used. Spacing for concrete anchors shall be as shown in **Table 4.2**.

~~j.~~

Table 4.2. SECURING SEWERS ON SLOPES

Minimum Anchor Spacing Sewer Gradient >20%

Grade (%)	Center to Center (feet)
<35	35
35-50	25
>50	15 (or concrete encasement)

~~**Pipe Cover:** All sanitary sewers shall have a minimum of 5 feet of cover over the top of the sewer pipe to finish grade. When such minimum cover~~

~~k.~~l. **Pipe Cover:** All sanitary sewer pipes shall be laid at a depth sufficient to drain building sewers, including basements where practical. Typically, sanitary sewers shall be placed with mains at 8 feet of cover and service laterals at property lines at 6 feet of cover. The City's authorized representative may approve shallow sanitary sewers upon verification that the typical depths cannot be met. Where shallow sewers are approved and a cover of 5 feet is not possible, ductile iron pipe, AWWA C-900, or concrete encasement or other material approved by the City's authorized representative shall be used.

~~l.~~m. **Sewer in Vicinity of Water Supplies:** No existing or proposed pressured sanitary sewer shall be permitted within 100 feet of any well, spring, or other source of domestic water supply. No existing or proposed gravity sewer line shall be permitted within 50 feet of any well, spring, or other source of domestic water supply.

~~m.~~n. **Water and Sewer Lines**

1. Sanitary sewers and domestic water lines shall not be laid in the same trench~~. Parallel water and sewer lines shall be at least 10 feet apart horizontally (see Detail No S-2150 of these standards).~~ and shall comply with OAR 333-061-0050(9).

2. Parallel water and sewer lines shall have a minimum horizontal clearance of at least 5 feet when the bottom of the water pipe is higher in elevation than the top of the parallel sewer pipe. Parallel water and sewer lines shall have a minimum horizontal clearance of at least 10 feet horizontally when the bottom of the water pipe is lower in elevation than the top of the parallel sewer pipe. See Zone 1 of **Detail No. S-2150** of these standards.

~~2.~~3. When there is ~~less~~more than 18 inches of vertical clearance between water and sewer, ~~and when physical conditions render that spacing impossible or impractical~~but less than 5 feet of horizontal clearance, then pressure pipe with watertight joints, such as class 50 ductile iron pipe~~ with watertight joints,~~ , C-900 PVC pipe, reinforced concrete encasement, or other pipe approved by the City's authorized representative shall be required. See Zone 2 of **Detail No. S-2150** of these standards.

~~3.~~4. Wherever it is necessary for sewer and water lines to cross each other, the crossing shall be at an angle of approximately 90 degrees. The sewer line shall ~~be located~~ have a minimum vertical clearance of 18 inches ~~or more~~ below the water

line ~~or~~ and one full length of water pipe shall be ~~constructed of pipe material approved by the City's authorized representative for a distance of 10 feet~~centered on ~~both sides of~~ the ~~water line~~crossing.

5. Where a sewer line has less than 18 inches of vertical clearance below a crossing water line, the water line shall be replaced with one full length of water pipe centered on the crossing. Also, the sewer line shall be encased in a reinforced concrete jacket 10 feet on each side of the crossing. In lieu of a concrete jacket, the sewer line may be replaced with one full length of sewer pipe centered on the crossing. The sewer pipe shall be pressure pipe, such as class 50 ductile iron pipe, C-900 PVC pipe, or other pipe approved by the City's authorized representative.

401.2.03 Access

Access roads are for maintenance and inspection purposes. All-weather access shall be provided to every manhole. Access roads shall be constructed as per ~~Section 301.4.04,~~Section 301.11.05, "Access Road Design."

401.3.00 WASTEWATER PUMP STATION DESIGN STANDARDS~~—~~

401.3.01 General Provisions

a. **Applicability**

These standards are applicable to ~~the~~ construction, installation, or modification of any wastewater pump station system requiring a City of Wilsonville Public Works Permit.

b. **Scope**

Pursuant to ~~the~~ City of Wilsonville Development Code Section (~~February 2004~~July 2013) 4.262.04 Sanitary Sewers:

In order to accomplish the orderly and desirable development of land within the corporate limits of the City and to limit the costs associated with the operation and maintenance of wastewater pump stations borne by the City, the City Engineer deems it reasonable and necessary to restrict the installation of the wastewater pump stations. Therefore, wastewater pump stations will not be allowed in areas: where gravity sewer service is programmed for construction in an applicable capital improvement plan, where improvements are recommended in the City of Wilsonville Wastewater Collection System Master Plan, or where sewers are available within three thousand (3,000) feet.

Temporary pump stations will be allowed in areas where future development will require extension of gravity sewers and the City's authorized representative determines that the temporary station is economically justified. Design life must be less than ten (10) years, as determined in the preliminary ~~engineering~~design report, and have a capacity requirement of less than four hundred (400) gallons per minute (gpm).

Permanent pump stations will be allowed in areas where future development does not require extending gravity sewers, as determined in the ~~preliminary engineering~~design report and the applicable~~, if any,~~ master plan for the area.

c. **Reviewing Authority**

The Oregon Department of Environmental Quality is the final reviewing authority. All plans and specifications for a wastewater pump station shall be reviewed and approved by the Oregon Department of Environmental Quality (DEQ). The basis for review by DEQ review engineers is Oregon Administrative Rule 340 Division 52 (OAR 340-52), Review of Plans and Specifications. To that extent, all plans and specifications shall follow the guidelines and criteria set forth in *the Oregon Standards for Design and Construction of Wastewater Pump Stations*, Oregon Department of Environmental Quality, May 2001 (DEQ Standards). (The DEQ Standards may be found at: http://www.deq.state.or.us/wq/rules/div052/guidelines/designwwps.pdf)

The standards in this Wastewater Pump Station Design Standards chapter (City Standards) of the Public Works Standards are developed as supplemental standards to address local needs, preferences, and existing equipment. Conflicts between the City Standards and the DEQ Standards shall be resolved by first following that standard which is more stringent and/or specific; second, by the determination by the City's authorized representative as to which standard or guideline is advantageous to or in the best interests of the City.

d. **Variance**

When engineering justification satisfactory to the City's authorized representative is provided that substantially ~~demonstrating~~demonstrates that variation from the ~~design standards~~DEQ Standards or ~~siting criteria~~City Standards will result in either: at least equivalent effectiveness while significantly reducing costs, or improved effectiveness, such a variation from ~~design standards~~the DEQ Standards or ~~siting criteria~~City Standards may be accepted as determined by the City's authorized representative.

e. ~~**Reviewing Authority**~~

~~The Oregon Department of Environmental Quality is the final reviewing authority. All plans and specifications for a wastewater pump station shall be reviewed and approved by the Oregon Department of Environmental Quality (DEQ.) The basis for review by DEQ review engineers is Oregon Administrative Rule 340 Division 52 (OAR340-52), Review of Plans and Specifications. To that extent, all plans and specifications shall follow the guidelines and criteria set forth in the Oregon Standards for Design and Construction of Wastewater Pump Stations, May 2001. The standards in this Wastewater Pump Station Design Standards chapter of the Public Works Standards are developed as supplemental standards to address local needs, preferences, and existing equipment. Conflicts between the City's established standards and DEQ guidelines shall be resolved by first following that standard or guideline which is more stringent and/or specific; second, by determination of the~~

~~City's authorized representative as to which standard or guideline is advantageous to or in the best interests of the City.~~

401.3.02 General Requirements

a. **Administration**

The design engineer in charge must be a Professional Engineer registered in the State of Oregon and have had previous experience designing similar facilities, including ~~mechanical~~but not limited to; mechanical piping and appurtenances, pumps, buildings, site improvements, odor control, plumbing, HVAC, electrical, telemetry, and control systems. The engineer's qualifications shall be submitted prior to initiation of ~~study~~the preliminary design report and shall be acceptable to the City's authorized representative. An authorized representative of the City ~~will~~may be available for construction observation during construction of the project. The design engineer's responsibilities for construction management, inspections, testing, start-up and project closeout are outlined in the DEQ Standards. The availability of the City's on-site representative does not relieve the design engineer of ~~the pump station shall provide startup services. Provisions for maintenance of temporary pump stations may be~~any responsibilities as required~~.~~ in the DEQ standards.

b. **Flood Protection**

The ~~station's~~ pump station building finish floor elevation and electrical and mechanical equipment~~, which would be permanently damaged by flooding,~~ shall be located at an elevation that is ~~not subject to a~~at least two feet above the FEMA one~~-~~ hundred (100) year flood ~~or~~ elevation and shall ~~otherwise~~ be ~~adequately protected against damage from~~located above the ~~one~~ FEMA five-hundred (~~100~~500) year flood elevation. In addition, the rim elevation of the wet well and any vault or structure that drains back to the wet well shall also meet the requirements listed above. The station shall be designed to remain operational and accessible during the ~~twenty-five (25~~one-hundred (100) year flood. In the absence of official ~~records~~FEMA maps to establish the one~~-~~hundred (100) year and ~~twenty-~~five ~~(25~~-hundred (500) year flood elevations, the best available local information ~~shall~~should be used.

c. **Siting**

Pump stations shall be located as far as practical from present or proposed built-up residential areas and off the traffic way of streets and alleys. Noise control, odor control, station architectural design and other aesthetic items shall be taken into consideration and reviewed by the Design Review Board. Sites for stations shall be of sufficient size for future expansion or addition, if applicable.

d. **Safety**

It is the design engineer's responsibility to ensure that the Occupational Safety and Health Administration (OSHA), the National ~~Electrical~~Electric Code~~;~~ (NEC), and all other applicable building and construction codes and requirements are met during construction. Adequate provision shall be made to protect construction and,

subsequently, maintenance and operation personnel from ~~hazards~~hazard. Equipment and training for confined space entry in accordance with OSHA and regulatory agency requirements shall be provided for all wastewater pumping stations.

401.3.03 Preliminary ~~Engineering~~Design Report

A preliminary ~~engineering~~design report prepared and stamped by the design engineer as a basis for design for ~~all~~the wastewater pumping ~~stations~~station shall be submitted to the City's authorized representative and DEQ for review and approval. The ~~preliminary engineering~~ report shall ~~include, but is not limited to, the following information~~follow the design report guidelines listed in section IV of the DEQ Standards. Additional requirements are listed below:

~~a. **Service Area Study**~~

a. **Site Selection**

1. The City of Wilsonville's comprehensive plan designation shall be considered during pump station site selection, in addition to guidelines in the DEQ and City Standards.

2. If the selected location is not currently owned by the City, the City's acquisition process must be started as soon as the parcel is selected and approved by City. In the case of a pump station being planned/designed as a condition of a private development, it shall be the developer's obligation to see that the appropriate site needs are acquired and conveyed to the City. If the pump station is a City-led project, the City will pursue all necessary property acquisition.

b. **Preliminary Design Report Contents**

1. Population: Present and future population and/or industrial/commercial usage projections~~. Present~~ for present, design and ultimate ~~flows~~buildout of all areas that could be served by the pump station.

~~2. Land Use: Type of land use, zoning and comprehensive plan designations.~~

~~b. **Design Characteristics**~~

~~3.~~2. Average and, peak flow, daily and peak instantaneous calculations, unit for present, design and ultimate flows. Average residential per capita flows and, peaking factors and infiltration/inflow allowances for present and future design conditions~~.~~ shall follow the recommendations of the City's current Wastewater Collection System Master Plan and/or subsequent sewer basin studies.

~~4.~~3. Wet well configuration and size.

~~5.~~4. Number, type, capacity, motor horsepower and Net Positive Suction Head (NPSH) ~~requirements~~requirement of proposed pumping units. ~~Motor shall be protected from over-current, over-temperature and voltage imbalance. Pumping units shall be duplex.~~

~~6.~~ System head curve and head computations for design conditions of pumping system. ~~(Future pumping capacity requirements shall be considered in sizing pumping equipment.)~~

~~7.~~5. System head calculations shall include the size and length of force main, static head, and all dynamic losses ~~and~~. System curves shall be developed using the Hazen-Williams equation, and for assumed "c" ~~(friction) factor. Force main shall be a minimum of four (4) inch diameter~~factors of 100, 120, and 150.

~~8. Calculations showing flotation potential and ballasting, if necessary.~~

~~9.~~6. Description of primary and back-up power sources. ~~All wastewater pump stations shall be supplied with a back-up or alternate power source.~~

~~10.~~7. Other hydraulic computations ~~shall~~to include, but not be limited to, pump cycling time, wet well capacity, flushing velocity, force main detention time and surge analysis.

8. Downstream collection system analysis as described herein.

c. **Preliminary Plans**

Shall be in conformance with Section 401.1.~~04~~03, "Sanitary Plans~~,""~~", and, in addition, shall show the following:

1. A contour map of the proposed site, service area, and force main~~.~~ with elevations referenced in accordance with Section 101.7.07.a, "NAVD 88 Datum."

2. Proposed pump station, including structure, site layout and piping, landscaping, street connection, and provisions for future pumps, if necessary.

3. ~~Existing~~Demolition or modifications to existing pump station, if applicable.

4. The 100-year and 500-year flood plain elevation at the site.

~~5. Maximum~~Location and elevation of ~~wastewater~~sewage overflow point in the collection system and ~~wet well in~~ the ~~event~~location of ~~a power failure for~~ the ~~estimated duration of the power outage.~~

~~6.~~5.~~Worst case overflow drainage pattern and~~ receiving stream for sewage overflow.

~~7.~~6. Process and Instrumentation diagrams for electrical and control systems. Electrical site plan and one line diagrams.

~~8.~~7. Force main ~~with~~in both plan and profile views to the connection at the receiving location.

d. **Final Design Report**

Final design report and final construction plans shall be prepared and stamped by the design engineer, reviewed and approved by the City prior to submittal to DEQ for review and approval. Final design shall be in conformance with preliminary design report as approved by the City and DEQ, and shall conform to applicable land use decisions.

401.3.04 Construction Plans

Construction drawings shall be in conformance with Section 401.1.03, "Sanitary Plans," and include, but not be limited to, the following as applicable by the design engineer unless otherwise directed by the City's authorized representative:

a. General sheets - Cover sheet, Symbols & Legend, Location and Vicinity Map, General Notes and Abbreviations.

b. Civil Sheets - Demolition plan, Site Layout, Grading, Drainage, Paving, Site Piping Plans and Profiles, and Details.

c. Landscaping Sheets - Landscaping, Planting, and Irrigation.

d. Architectural Sheets - Architectural Plans, Roof Plans, Door and Window Schedules, Elevations, Sections and Details.

e. Structural Sheets – Structural Plans, Foundation Plans, Sections, and Details.

f. Mechanical Sheets – Mechanical Pump and Piping Plans, Pump Station Design Data, Temporary Pumping Plan, Piping Schematics, HVAC and Plumbing, Sections, and Details.

g. Electrical Sheets – Electrical Symbols and Legend, Electrical Site Plan and Power Plan, One-Line Diagrams, Lighting Plans, Motor Control Center Elevations, Miscellaneous Devices/Panels One-Line Diagrams, Panel Schedules and Layout, Circuit Schedule.

h. Instrumentation Sheets - Instrumentation Symbols and Legend, Instrumentation Plan, Process and Instrumentation Diagram.

i. Other construction drawings as may be required.

401.3.05 Pump Station Design Criteria

The design criteria shall follow the guidelines in Section III of the DEQ Standards, except as additionally required or modified below:

a. **General**

1. All sewage pump stations shall be designed as submersible pump style pump stations with an above grade control building to house electrical equipment, instrumentation and control equipment, odor control equipment, backup power equipment, and other applicable equipment, unless otherwise approved by the City.

2. The electrical and mechanical equipment systems, including but not limited to pumps, motors, valves, electrical and instrumentation equipment shall be designed and specified for a minimum 25-year design life. Structures and piping shall be designed for a minimum 75-year service life.

~~1.~~ The pump station shall be designed ~~to maintain the liquid level of a wet well by automatically starting and stopping pumping operation as required by wet well conditions.~~

~~2.~~3.~~The pump station shall have~~with a firm capacity to continuously pump the peak ~~hourly and peak~~ instantaneous ~~flows~~flow associated with the ~~5~~10-year, 24-hour storm intensity (see ~~**Table 3.2.** Rainfall Distribution)~~**Table 3.2.** Rainfall Distribution) of its service area, without ~~overflows~~overflow from the station or ~~its~~the contributing collection system. Firm capacity is defined as the ability to continuously discharge the design flow with the largest pump unit out of service. The design flows shall be based on projected development of the service area associated with the 25-year design life of the pumping equipment.

4. Future pumping capacity requirements and potential changes to the force main configuration required for ultimate buildout of the pump station service area shall be considered in sizing the wet well and pumping equipment. The pump station facility shall be capable of accommodating future components that may be needed for projected growth in the service area beyond the identified design period. The wet well shall be sized for ultimate buildout, with space available for installation of additional pumps or larger pumps as needed to meet ultimate buildout flows.

~~3.~~5. Design shall be consistent with EPA Class I reliability standards for mechanical and electrical components and alarms.

~~4. Pumping systems shall be duplex with pump sequencing and each pump sized in excess of the expected maximum flow.~~

~~5. Aboveground pump stations shall be required unless otherwise approved.~~

6. ~~The wet well shall have sufficient volume to provide a holding period of 10 minutes between pump operating cycles at maximum design pump station flow. The floor shall be sloped for proper installation and function of the pumps inlets. Influent flow shall enter the wet well above the pump operating level.~~

7. ~~All weather~~A paved access road for maintenance vehicles shall be provided. The access road shall be at least 12 feet wide. Access roads longer than 50 feet shall be provided with an additional paved area for turning around maintenance vehicles. The maximum access road grade shall be 12 percent and the maximum turning area grade shall be 2 percent. Pavement section shall be approved by City's authorized representative.

~~7.~~8. The site shall be fenced ~~and the fence shall be~~with a minimum six (6) ~~feet~~foot high~~. Landscaping shall be provided that adequately obscure the site from view~~ chain link fence. A minimum of one locking access gate shall be provided, consisting of rolling gates 16 feet in width or as required by site constraints and approved by the City's authorized representative. Fence shall be galvanized steel fabric with bonded vinyl coating. Vinyl coating shall be a color designed to blend with the surrounding area (green, brown, or black), as approved by the City. All fence posts, cross bars and gates shall be painted or coated same color as the fence. The access gate shall be provided with an intrusion alarm that is tied into the City's SCADA notification system.

9. ~~A remote telemetry unit shall be installed and integrated with the city's programmable logic controller/SCADA system.~~ Landscaping shall be provided around the pump station building and associated site improvements and shall be compatible with the character of the surrounding properties. The landscaping shall be designed by a registered landscape architect and include low maintenance and low irrigation type trees and shrubs. Permanent automatic irrigation shall be provided to all planted areas, unless otherwise approved by the City. Landscaping shall meet all applicable City Codes and Standards.

10. The existing downstream sanitary sewer collection system shall be evaluated by the design engineer to determine the impact of the increase in flow (i.e. peak pumping capacity) from the proposed pump station. Evaluation shall be performed under the design flow condition for all pumped and gravity connections to the receiving system. Sanitary sewer system shall be evaluated downstream to a point where no surcharging (caused by the increase in flow from the pump station) above the top of the pipe occurs. Hydraulic profile and downstream collection system analysis shall be provided in the design report. The City reserves the right to require upgrades to the downstream receiving system to mitigate the impact of the increased flow.

~~8. Local control shall be provided in case of telemetry failure. All appropriate alarms shall be wired and tested for accuracy before they are accepted.~~

~~9. The pump station shall be provided with potable water for wet well washdown. Water shall be metered, at or above finish grade and provided with a reduced~~

~~principle (rp) backflow device (If outside, a heated enclosure for the rp shall be supplied.)~~

~~10. Sufficient back up power to operate the station in case of power outage shall be supplied.~~

~~11. Exterior and interior lighting and convenience outlets shall be provided.~~

~~12.~~11. Adequate piping, valves, and appurtenances for isolation and removal of equipment shall be provided. ~~Capability for bypass pumping shall be provided~~A bypass pumping port on the force main shall be provided to allow for temporary bypass pumping operations. The bypass connection shall be located downstream of the common force main isolation valve, and be provided with an independent isolation valve.

~~13. Pumps shall be sized to pass a minimum of a three (3) inch sphere. Pump suction, discharge, and force mains shall be at least four (4) inches diameter.~~

12. ~~Suitable shutoff and check valves shall be placed on the discharge line of each pump.~~Capability for pig launching and retrieval shall be included at all pump stations for cleaning of the force main. The system shall utilize the station's sewage pumps to propel the pig, unless otherwise approved by the City.

~~14.~~13. Federal and State OSHA regulations and guidelines, and any other relevant state, federal and local safety regulations and guidelines shall be followed and adhered to.

14. An emergency overflow path shall be provided as necessary to prevent property damage and sewer backups, or as required by the City and DEQ. The overflow point shall be reviewed and approved by the City and DEQ. A dedicated overflow alarm shall be provided in the wet well or collection system and tied to the City's SCADA notification system.

15. All wastewater pump stations shall be supplied with a back-up standby generator or alternate power source.

b. **Submersible Pumps and Wet Well**

1. Submersible pumps and motors shall be designed specifically for raw wastewater use, including totally submerged operation during a portion of the pump cycle.

2. Pumps shall be sized to pump the required flow when the force main is in a degraded condition, with a Hazen-Williams 'C' value of 120 for force mains with no sags in its profile, or 110 for force mains with a sag in the profile. The pumps shall be selected so as to operate within the manufacturer's recommended operating range under the full range of normal operating conditions anticipated during the service life of the pump.

3. Submersible pumps shall be readily removed and replaced on two stainless steel guide rails without de-watering the wet well or disconnecting any piping in the

wet well. Guide rails shall be secured to the wet well lid. Guide rail supports shall be as recommended by pump manufacturer and shall not interfere with pump removal or re-installation.

4. Each pump assembly shall be provided with a stainless steel lifting chain and stainless steel lifting knuckles of adequate strength to support 150% of the entire assembly weight. Chain links shall be minimum 5/16-inch inside diameter and lifting knuckles shall be provided every 3 feet.

5. Wet well and vault access shall be provided through a minimum double door with 3-foot square opening. The door shall be aluminum, diamond plated, H20 rated, and spring assisted. The door shall be provided with a recessed padlock hasp for locking with a standard padlock.

6. An on-site hoist and crane shall be provided for pump assembly and removal. The crane shall be load rated for 150% of the maximum weight of the pump assembly.

~~15.~~7. Check valves and isolation valves for submersible pumps shall be located in a separate valve vault chamber. The check valve shall be located between the pump and the shutoff valve. Check valves shall be suitable for the material being handled, and shall be placed on the discharge line in a horizontal position. ~~All shutoff and check valves shall be operable and accessible from floor level.~~ Swing check valves shall have outside levers.

~~16.~~8. ~~Federal and State OSHA regulations and guidelines, and any other relevant state, federal and local safety regulations and guidelines shall be followed and adhered to.~~

~~b. **Above Ground Pump Station**~~

~~1. The above ground pumping station shall be an enclosure housing a duplex, skid mounted, auto-start station utilizing two electric motor driven, self-priming centrifugal pumps, motor control panel, system piping, two level control systems and a natural gas standby engine (in addition to back-up electric power.). The pump station shall be a Gorman-Rupp base mounted package pump station.~~

~~2. A load-test-certified electric hoist and trolley, or approved equal, shall be provided in the pump room. Overhead crane hoist and other installed equipment shall have adequate horizontal and vertical clearance~~Vaults shall be no deeper than five feet from the rim to the vault floor, unless otherwise approved by the City's authorized representative. Vaults shall be large enough to allow for ~~lifting and moving motors and pump equipment to the station doors using the monorail.~~

~~3. The level control system shall consist of a duplex pump air bubbler wastewater level sensing system with a backup submersible pressure transducer or ultrasonic level sensor. Provision shall be made to automatically/manually alternate the bubbler air pumps. The level control system shall be capable of sensing and activating controls at four (4) wet well levels.~~

4. The pump station enclosure shall be supplied with adequate ventilation and a thermostatically controlled electric heater. The heater shall be sufficient to prevent the freezing of the pumps and piping within the pump station enclosure at an outside temperature of minus twenty (20) degrees F.

5. The pump equipment compartment shall be above grade or offset and effectively isolated from the wet well to prevent humid and corrosive wastewater gases from entering the equipment compartment.

6. Wet well access shall not be through the equipment compartment.

7. Valving shall not be located in the wet well.

c. **Submersible Pumps**

1. Submersible pumps and motors shall designed specifically for wastewater use, including totally submerged operation during a portion of the pump cycle.

2. Submersible pumps shall be readily removable and replaceable without de-watering the wet well or disconnecting any piping in the wet well.

3.9. Valves for submersible pumps shall be located in a separate valve chamber.a worker to enter and perform routine maintenance. Accumulated water shall drain to the wet well. with a minimum 2-inch diameter drain line and shall be primed and trapped as required plumbing codes. Wastewater and gases from the wet well shall be prevented from entering the valve chambervault.

10. Valves shall not be located in the wet well.

17.11. The wet well shall have sufficient operating volume to maintain individual pump cycle times that comply with NEMA and pump manufacturer requirements for motor starts per hour. In addition, additional wet well space shall be provided for future pumps, as applicable. The floor shall be sloped for proper installation and function of the pumps inlets. Influent flow shall enter the wet well above the pump operating level.

12. Wet well shall be provided with a corrosion resistant cementitious coating, Strong Seal or approved equal. Corrosion resistant coating shall be reviewed and approved by the City's authorized representative.

13. Motors shall be protected from over-current, over-temperature and voltage imbalance. Minimum number of pumps shall be two, unless otherwise approved by the City.

c. **Control Building Features**

1. The control building shall consist of a control room that houses all electrical and control equipment, and the generator. As applicable, an additional space may be required for odor control chemical feed or air compressor equipment.

2. Building shall be a low-maintenance above-grade structure that is architecturally compatible with the surrounding area and constructed using materials meeting City Code and approved by the City's authorized representative. The building shall be of adequate size with equipment clearances provided that meet applicable code requirements and for operation and maintenance of all systems. Building structure and site layout shall be designed in accordance with the current International Building Code (IBC) and applicable energy codes and noise codes.

3. Pump station building shall generally consist of reinforced-concrete floor slab and foundation and be constructed of durable materials that accommodate the intended uses of the building. Doors shall be metal and any glazing shall be safety glass. The structure shall be secure and provided with intrusion alarms on all doors and shall otherwise be resistant to vandalism. All exterior building materials and colors shall be approved by the City's authorized representative.

4. Doors shall be sized, as applicable based on equipment sizes, for removal of all equipment located within the control building. Where required, overhead doors shall be of heavy-duty construction, roll-up style, with insulated panels, and shall provide a minimum of 9-feet of vertical clearance. Adequate clearances, sufficient anchorage, and hoists must be provided to remove, replace and maintain all major and minor equipment.

5. Pump station noise sources that may create noise problems include, but are not limited to, electrical equipment, engine-generator sets, fans and air compressors. Design engineer shall provide at minimum acoustic style louvers and sound dampeners at all wall and/or roof penetrations. Noise suppression mufflers shall be provided for the generator. The design engineer shall incorporate all applicable and reasonable control measures to and comply with all applicable noise regulations.

d. **Electrical and Instrumentation**

1. Permanent back-up standby power shall be provided for each pump station and shall be approved by the City's authorized representative. Alternatively a secondary power source may be acceptable, as approved by the City's authorized representative. Generator systems shall be as required by the DEQ Standards.

   For pump stations located in residentially zoned areas the generator shall be housed inside the pump station control building, unless otherwise approved by the City's authorized representative. In commercial or industrial zoned areas, the generator may be allowed outside based on City Code requirements and approval by the City's authorized representative.

   Where required by the City, the generator shall be located in a separate room from the control and electrical equipment. The generator room shall be provided with a louver sized for removal of the generator from the building. The room shall be sized adequately for maintenance access to the generator.

~~4.~~2. Electrical supply, power, control, alarm circuits, and lines shall be designed to provide strain relief and to allow for disconnection and de-energizing outside the wet well. Terminals and connectors shall be protected from corrosion by location outside the wet well. All penetrations of the wet well shall be watertight. ~~All conduits~~Provisions shall be ~~sealed~~made to prevent wet well gases from entering ~~outside~~ cabinets and equipment located in the control building. The design shall provide a method to allow for disconnection of the pump from the ~~wet well~~motor control center without destroying conduit seals.

3. A remote telemetry unit shall be installed and integrated with the City's programmable logic controller/SCADA system. The telemetry panel shall be designed and programmed by the City's systems integrator, unless otherwise approved by the City, and furnished and installed by the pump station electrical contractor. Local control shall be provided in case of telemetry failure.

~~18.~~ At a minimum, the following alarm signals shall be made available from the pump station control panel to the telemetry/SCADA system: pump #1 on, pump #2 on, pump #1 fail, pump #2 fail, motor #1 high temperature, motor #2 high temperature, phase fail, low water alarm, high water/pumps call (float), overflow alarm, intrusion and smoke detection. For stations with more than two pumps, alarm signals shall be expanded to include all pumps. All appropriate alarms shall be wired and tested for accuracy before they are accepted.

~~5. The motor control center shall be located outside of the wet well and protected by conduit seals to prevent gases from the wet well from entering the control cabinet.~~

~~6. A stainless steel rail and mounted hoist shall be provided for access to and servicing of the pumps and backup generator or motor.~~

4. Pump station level sensing and control shall be provided by an integrated controller and level sensor in addition to back-up control system. All pump station control systems must be listed as intrinsically safe by a nationally recognized testing laboratory.

(a) Primary controls shall include a pulse radar level sensor to measure wet well levels. The radar level sensor shall be a Vegapuls 65, unless otherwise approved by City's authorized representative. Sensor shall be rated for explosive environments and an accuracy of +/- 8mm.

(b) Controller for primary controls shall be designed to operate integrally with the level sensor. Controller shall have a minimum of 5 relay contacts assignable as alarms and pump controls. Controller shall be provided with an LCD display.

(c) Backup level control shall be provided with floats for high level wet well and low level wet well for use in the event of primary level control system failure. High level float shall signal high water alarm and a call for both pumps; low level float shall signal low water alarm and turn both pumps off.

Alternatively, a timed relay can be provided in lieu of the low level float. Intrinsically safe relays shall be supplied in a separate enclosure.

5. Pump stations shall be provided with a red alarm lamp mounted to and visible from the nearest public roadway. Red alarm lamp shall be energized in conjunction with any pump station alarm. No local audible alarms shall be installed. A red light test switch shall also be installed.

6. Control panel construction, electrical wiring, and equipment shall be in strict conformance with the National Electric Code, State and Local Codes, and in conformance with applicable specifications of NEMA, ANSI, UL, and ICEA. Inside panels shall be NEMA 12; outside panels shall be NEMA 4X.

7. All electrical equipment shall be mounted inside an electrical panel that is placed at safe operating levels and shall not be subject to flooding. Panels shall be located so they are out of the way of maintenance operations for equipment. Control panel shall include the following monitoring devices: phase monitor (with switch to allow for checking all three phases); elapsed time meter; pump start counter; voltmeter and ammeter. Uninterruptible Power Supply (UPS) – Install a UPS in the control panel to prevent control system failure in the event of a voltage dip (up to 35%) at generator startup. The UPS must be compatible with the generator operations.

401.3.~~05~~06 Operation and Maintenance Manual

~~Three copies of an operation and maintenance manual shall be provided and shall contain the following information:~~

a. ~~Component~~ The design engineer shall prepare an Operations and Maintenance (O&M) Manual for the completed project. All required information shall be provided in both hard-copy and electronic format. Three copies of the O&M is required to provided, reviewed and accepted by the City's authorized representative and DEQ prior to initial station startup. The City project number and the name/address of the pump station shall be noted on each manual. Binding of each hard-copy shall be by locking three-ring binder. System operation and equipment literature shall be in separate volumes. A table of contents shall be included.

b. The design engineer shall shall include, but not be limited to, the following information that is to be provided in the O&M:

~~a.~~1. Sequence of operations including description~~,~~ of the operation and interaction of systems and subsystems during startup, operation in automatic mode, operation in manual mode, and operation with backup power. This includes, but is not limited to, equipment, pumps, pipng, valves, HVAC, generator, electrical, controls, and instrumentation. Provide both simplified and detailed system schematics, as required.

2. ~~Operation information,~~List of contacts including ~~startup, normal,~~, but not be limited to, design engineer, contractors and ~~emergency~~subcontractors, utility companies, pump equipment supplier, instrumentation equipment supplier.

~~b.~~ Station operation and ~~instructions on common problems.~~

3. ~~Maintenance~~ controls, including updated information~~, including records, lubrication, and scheduling requirements and~~ on the actual pumps installed.

4. On-site utilities.

~~c.~~5. A consolidated summary of required routine maintenance and scheduled preventative and predictive maintenance for all station equipment along with references to the location within the manual where detailed information ~~on local representatives~~may be found.

~~d.~~6. Safety procedures.

~~e. Manufacturers' manuals.~~

7. Emergency plans and procedures.

8. Design engineer's certification of construction.

c. The Contractor shall be required by the project specifications to include, at a minimum, the following information in the equipment literature section of the O&M:

1. Disassembly and reassembly instructions.

2. Parts list including part numbers.

3. Name, location, and telephone number of nearest supplier and spare parts warehouse.

4. Manufacturer's certifications, including calibration data sheets and specified calibration procedures and/or methods for installed equipment.

5. Warranty forms and information for all installed equipment as provided by the contractor.

6. Test results of all equipment installed and tested.

401.4.00 MATERIAL AND TECHNICAL SPECIFICATIONS

401.4.01 Manholes and Structures

a. ~~a.~~ General

Manholes shall be constructed at locations shown on the plans~~,~~ and in compliance with the design requirements of Section 401.2.01, "Manhole Design", or as required by the City's authorized representative. ~~The maximum distance between manholes~~

~~shall be 400 feet, unless otherwise approved by the City's authorized representative. All manholes shall be a minimum of 48 inches in diameter. When a manhole is less than 5 feet deep, a shallow or flat-top manhole shall be used, as shown in Detail No. S-2025 or Detail No. S-2030 of these standards. Flat-top manholes shall be installed at an elevation to permit for construction of the full street section, allowing for the design gradients.~~

b. ~~b.~~ Materials

1. ~~1.~~ **Aggregate and Cement:** Aggregate shall meet the standards set forth in ODOT SSC Section 02690, "PCC Aggregates"; Portland cement shall meet the standards set forth in ODOT SSC Section 02010, "Portland Cement."

2. ~~2.~~ **Concrete:** PCC for poured in place manholes and structures shall conform to ODOT Class 3000 – 1½, Commercial Grade Concrete. Slump shall be between 2 and 4 inches.

3. ~~3.~~ **Manhole Frames and Covers:**

(a) Casting shall be of new material, tough, close-grained gray iron conforming to ASTM A-48, Class ~~30, and~~30B and AASHTO M 105, Class 30B. Where the ASTM and AASHTO specifications differ, the more stringent shall apply. Casting shall be smooth and clean, free of blisters, blowholes, and all defects. Bearing surfaces shall be planed or ground to ensure flat, true surfaces. Covers shall be true and set within rings at all points.

(b) Rings shall be grouted in place and made watertight with a high-strength, non-shrink grout meeting ODOT SSC Section 02440.50(b), "Non-Shrink Grout," such as Alcrete Twenty Minute Fast Setting Grout®, or approved equal. Unused grout shall be discarded after 20 minutes and shall not be used. Rings shall not be brought to grade with lumber.

(c) Frames and covers shall be standard or suburban, depending on the manhole location and as approved by the City's authorized representative. Suburban style manhole frames shall not be installed in PCC streets or arterial roadways.

(d) Manholes installed outside of paved street or sidewalk areas shall be installed with a tamperproof frame and cover as shown in **Detail No. S-2060** of these standards.

4. ~~4.~~ **Manhole Types:** Manholes shall be ~~one of~~preformed rubber O-ring gasket design only and conform to the following ~~types or equal.~~:

(a) **Precast 48-Inch-Diameter Manholes:** Materials shall conform to the requirements of ASTM C-478. Minimum wall thickness shall be 5 inches.

(b) **Precast Large-Diameter (60-inch or larger) Manholes:** Materials shall conform to the requirements of ASTM C-478.~~Cones shall be eccentric.~~

Manhole structural dimensions shall be reviewed and approved on a case by case basis in accordance with Section 401.1.03.d.5, "Design Submittals."

(c) **Precast Manhole Tops:** Standard eccentric cone, short eccentric cone, and flat slab tops shall be provided in accordance with Section 401.2.01.b, "Manhole Design" Eccentric cones shall conform to all requirements of ASTM C-478, with the exception of the steel reinforcement requirement. Precast manhole tops shall be designed to withstand AASHTO H-20 loadings.

~~(a)~~(d) **Permeability Testing:** Before precast manhole sections of any size are delivered to the job site, the sections shall meet the permeability test requirements of ASTM C-14 and ASTM C-497.

~~(b) **Precast Large Diameter (60-inch or larger) Manholes:** Materials shall conform to the requirements of ASTM C-478.~~

~~(c) **Cast-in-Place Large Diameter Manholes:** Aggregate shall meet the standards set forth in ODOT SSC Section 02690, "PCC Aggregates"; Portland cement shall meet the standards set forth in ODOT SSC Section 02010, "Portland Cement."~~

(e) **Precast Bases:** Precast ~~base sections or~~ manhole bases shall be used, except when placing a manhole over existing pipe~~, where poured-in-place~~. Precast bases shall ~~be used (see Section 401.4.01.c.5). Precast~~conform to the requirements of ASTM C-478. The base riser section shall be integral with the base slab.

~~(d)~~(f) **Poured-in-place Bases**: Poured-in-place manhole bases ~~shall be inspected and approved by the City's authorized representative prior to installation. Where prescast bases are not channelized, the contractor shall construct smooth channels to connect the flow from inlet~~may only be used when placing a manhole over an existing pipe~~(s) to outlet pipe.~~.

5. ~~**Pipe Stubouts for Future Sewer Connections:** Pipe stubouts~~**Manhole Pipe Connectors**: Connections to manholes shall be made with an approved flexible connector specifically manufactured for the intended use, conforming to ASTM C923, and in accordance with **Detail No. S-2010** of these standards. Field fabricated waterstops or improvised adapters, such as gaskets stretched over the pipe, will not be allowed.

Connections to existing manholes may be made with a sand collar fabricated of the same material as the connecting pipe by an approved manufacturer in accordance with **Detail No. S-2010**. Sand collars shall be constructed with a gasketed joint located within 12" or half the pipe diameter, whichever is greater, from the manhole wall. Sand collars shall not be fabricated in the field.

~~5.~~6. **Pipe Stub outs for Future Sewer Connections:** Pipe stub outs shall be the same type as approved for use in the lateral, main, or trunk sewer construction.

Strength classifications shall be the same class as in adjacent trenches. Where two or more different classes of pipe exist at a manhole, the ~~higher-strength pipe~~City's authorized representative shall ~~govern~~determine the strength classification. Connect ~~stubouts~~stub outs to manholes as specified in ~~Section 401.4.01.d.1,~~Section 401.4.01.e.1, "Connection to Existing Manholes." Rubber-gasketed, watertight plugs shall be furnished with each ~~stubout~~stub out and shall be adequately braced against air test pressures.

~~6.~~7. **Gaskets:** Manhole sections shall be installed with ~~either~~ preformed rubber O-ring gaskets ~~or plastic gaskets.~~only. Rubber gaskets shall conform to AASHTO M 315 and ASTM C-443~~. Plastic gaskets shall be Kent-seal No. 2 or Ram Neck, or approved equal, and shall meet all requirements of ASTM C-990~~.

~~7.~~8. **Manhole Steps:** Steps shall be required and shall be constructed as specified and shown in **Detail No. S-2080** of these standards, unless otherwise approved by the City's authorized representative. When pipe is 24 inches in diameter or smaller, steps shall be located as indicated in **Detail No. S-2065** of these standards. For pipe larger than 24 inches in diameter, steps shall be located over a bench as coordinated with the City's authorized representative. ~~Maximum drop from rim to first step shall be 27 inches.~~

c. Workmanship

1. **Foundation Stabilization:** If, in the opinion of the geotechnical engineer or the City's authorized representative, unstable subgrade material exists that will not support the manhole or other structure, the contractor shall excavate below grade and backfill with foundation-stabilization material ~~approved by the City's authorized representative.~~in accordance with the standards of Section 601.3.02.d, "Trench Foundation."

2. **Pipe Connections:** All rigid pipes, such as concrete, entering or leaving the manhole shall be provided with flexible joints within 1 foot or half the pipe diameter, whichever is greater, of the manhole structure and shall be placed on firmly compacted bedding. All flexible pipe, such as PVC, shall connect to manholes using connectors as specified in Section 401.4.01.b.5, "Manhole Pipe Connectors." Special care shall be taken to see that the openings through which pipes enter the structure are completely watertight. ~~All flexible pipe shall be connected to manholes according to the manufacturers' recommendations.~~

3. **Flexible Joints:** ~~Where the last~~At rigid pipe connections, such as concrete, where a flexible joint cannot be provided within the greater of ~~the line laid up to the manhole is more than~~ 1 foot or half the pipe diameter from the manhole ~~base~~, a 6-inch concrete encasement shall be constructed around the entire pipe, from the manhole base to within 1 foot of the pipe joint, at the discretion of the City's authorized representative. The pipe encasement shall be constructed integrally with the manhole base. Pipes laid out of the manhole shall be shortened to ensure that the first flexible joint is no more than 1 foot from the manhole base.

4. **Manhole Connections:** The contractor shall connect sewer pipe to manholes as specified in ~~Section 401.4.01.d~~Section 401.4.01.e, "Types of Connections."

5. **Concrete Bases (Poured-in-Place):** Poured-in-place bases shall be used over existing pipelines~~.~~ in accordance with **Detail No. S-2015** of these standards for 48" diameter manholes. For manholes greater than 48" in diameter, poured-in-place bases shall be provided in accordance with **Detail No. S-2040** of these standards. The contractor shall remove water from the excavated area, ~~provide a minimum 8-inch-thick layer of~~ place the compacted ~~¾"-0" crushed~~, aggregate ~~for a~~ base, ~~and~~ construct the concrete base ~~so that~~, and set the first precast manhole section ~~has~~before the concrete has set. The first precast manhole section shall be properly located and plumb and have a uniform bearing throughout the full circumference. ~~There shall be a minimum of 8 inches of concrete between the compacted gravel and the lowest invert of the manhole.~~ The contractor shall deposit sufficient concrete on the base to assure a watertight seal between base and manhole wall. Twenty-four hours shall be allowed to elapse before the remaining manhole sections are placed on the base, unless otherwise approved by the City's authorized representative. Where poured-in-place concrete bases are used to construct manholes over existing sewers, comply with Section 401.4.01.e.2, "Manholes Over Existing Sewers."

6. **Drop Manholes**

   (a) The maximum ~~inside~~free drop in a manhole shall be 18 inches. See ~~Section 401.4.01.d.3~~Section 401.4.01.e.3, "Shallow Inside Drop Manhole," for construction of this connection.

   (b) ~~-~~When more than 18 inches of drop exists, ~~an outside~~a drop manhole shall be ~~used. Outside drop manholes shall use ductile iron pipe (see Detail No. S-2040 of these standards).~~provided in accordance with Section 401.2.01.r, "Manhole Design."

7. **Placing Manhole Section:** The contractor shall clean the end of each sections of foreign material. Manholes shall be installed with ~~either~~ watertight rubber ~~o-rings or preformed plastic~~O-ring gaskets ~~in conformance with the manufacturers' recommendations. If plastic gaskets are used, the~~only. The inside seams shall be grouted with a high-strength, non-shrink grout meeting ODOT SSC Section 02440.50(b), "Non-Shrink Grout," such as Alcrete Twenty Minute Fast Setting Grout®, or approved equal. Unused grout shall be discarded after 20 minutes and shall not be used. All grouted joints and pick holes shall be troweled smooth. Manholes will be visually inspected for water leakage by the City's authorized representative. Any leakage observed shall be repaired at the contractor's expense, and the manhole re-inspected.

8. **Manhole Inverts:** The contractor shall construct manhole inverts in conformance with **Detail No. S-2005** or **Detail No. S-~~2010~~2015** of these standards. Inverts shall have smooth transitions to ensure an unobstructed flow through the manhole. The contractor shall remove all sharp edges or rough sections that tend to obstruct flow.

9. **Manhole ~~Stubouts~~Stub outs:** The contractor shall install ~~stubouts~~stub outs from manholes for sewer extensions, as shown in these standards or as required by the City's authorized representative. A watertight flexible connection shall be ~~used for pipe sizes 6 inches through 18 inches~~provided in all new manholes. The contractor shall construct invert channels in accordance with **Detail No. S-2005** or **Detail No. S-~~2010~~2015** of these standards. The minimum length of ~~stubouts~~stub outs in existing manholes shall be 12 inches outside the manhole wall. Pipes shall be grouted in precast walls or the manhole base to create a watertight seal around the pipes. The contractor shall install compacted base rock, as specified in these standards, ~~to~~over undisturbed earth under all ~~stubouts~~stub outs.

~~10.~~d. Manhole Extensions, Rings, and Covers: The contractor shall install rings and covers on top of manholes to positively prevent all infiltration of surface water or groundwater into manholes. Rings shall be set in a bed of high-strength, non-shrink grout meeting ODOT SSC Section 02440.50(b), "Non-Shrink Grout," such as Alcrete Twenty Minute Fast Setting Grout®, or approved equal, with the grout carried over the flange of the ring, and shall be set so that tops of covers are flush with the surface of the adjoining pavement, or 1 foot above the natural ground, unless otherwise directed by the City's authorized representative. Unused grout shall be discarded after 20 minutes and shall not be used. Grouted surfaces shall be troweled smooth. Total thickness of grade rings shall not exceed 12 inches; rings shall be grouted watertight. Drop from rim to first manhole step shall not exceed 27 inches. ~~In designated floodplain areas, all manholes shall be at an elevation of at least 2 feet greater than the 100-year storm event.~~

~~d.~~e. Types of Connections

1. **Connection to Existing Manholes:** The contractor shall connect sewers to existing manholes at the locations shown on the plans. Contractor shall submit a plan for diversion control and receive written approval from the City's authorized representative before proceeding with construction. The contractor shall provide all diversion facilities, and shall perform all work necessary to maintain sewage flow in existing sewers while connections are being made to the manholes. Connections to existing manholes shall be core-drilled, and the bases shall be grouted as necessary to allow a smooth flow into and through the existing manholes.

2. **Manholes Over Existing Sewers:**

(a) The contractor shall construct manholes over existing operating sewer lines at the locations shown on the plans.

(b) Manholes constructed over existing sanitary sewers shall have all portions of the pipe to be in contact with the manhole cleaned and:

i. Concrete Pipe Connections: An approved commercial concrete bonding agent shall be applied to the pipe prior to placement of concrete.

ii. PVC Pipe Connections: A dense coating of clean mortar sand shall be applied to the pipe using PVC solvent cement. After the cement has cured, an approved commercial concrete bonding agent shall be applied to the sand prior to placement of concrete. Water as a substitute for commercial bonding agent will not be allowed.

(c) The contractor shall construct a poured-in-place base under the existing sewer and the precast sections as specified.

(d) The contractor shall not cut into any existing lines until the new manhole(s) are grouted and pressure tested, the new lines are balled, ~~flushed~~cleaned, deflection tested, and pressure tested, and all portions of the sewer have been approved and accepted by the City's authorized representative.

~~2.~~(e) After acceptance, the contractor shall ~~sawcut~~saw cut into the existing line; cut edges of concrete pipe shall be covered with grout and troweled smooth; with ductile iron or plastic pipe, grout shall be applied up to cutout and troweled smooth.

3. **Shallow Inside Drop Manhole:** Where the invert of the connecting pipe is above the manhole shelf and less that 18 inches above the outlet, an inside drop shall be constructed utilizing Portland cement concrete ~~as shown in Detail No. S-2040 of these standards.~~. The sewage entering the manhole shall follow a smooth concrete channel transitioning evenly from the invert of the inlet pipe into the main channel. Sewage shall not be allowed to fall freely to the manhole base.

401.4.02 Gravity Sewer Pipe

a. General

1. It is not intended that the materials listed herein are to be considered equal or to be generally interchangeable for all applications. The material suitable for project conditions shall be determined by the Engineer of Record and approved by the City's authorized representative.

2. Sanitary sewer pipe shall have flexible gasket joints. Joints on all fittings shall be the same as the joints used on the pipe. Caps or plugs shall be furnished with each fitting, outlet, or stub, as required, and shall have the same type of gasket or joint as the pipe.

3. Each piece of pipe and fitting shall be clearly identified as to strength, class, and date of manufacture.

b. Materials

Materials shall be the following types or approved equal:

1. Reinforced Concrete Pipe ~~(NRCP/RCP)~~

~~(a) Non-reinforced~~Reinforced concrete ~~pipe shall conform to requirements of ASTM C-14. Unless otherwise specified, pipe shall conform to Class 3 design requirements.~~

~~(b)~~(a) ~~Reinforced concrete, nonpressure~~, non-pressure pipe shall conform to the requirements of ASTM C-76 ~~or C-655~~ and shall be of the class specified. Unless otherwise specified, pipe shall meet the design requirements of Wall B. ~~Reinforced concrete low-head pressure pipe shall conform to the requirements of ASTM C-361.~~

~~(c)~~(b) Gaskets shall conform to the requirements of ASTM C-443.

~~(d)~~(c) All steam-cured concrete ~~pipe~~pipes must be at least seven days old before it can be used. If the pipe has not been steam-cured, it must not be used before it has cured for 28 days.

~~(e)~~(d) Fittings shall be manufactured integrally and be of a class at least equal to that of the adjacent pipe. Field taps shall be machine-drilled.

~~(f)~~(e) Mortar used shall be standard nonshrink premixed mortar conforming to ASTM C-387 or in a proportion of one part Type II Portland cement to two parts clean, well-graded sand that will pass a ⅛-inch screen. Mortar mixed for longer than 30 minutes shall not be used.

~~i.~~2. Ductile Iron Pipe (D.I.)

(a) Ductile iron pipe shall ~~conform~~be cement mortar lined with push-on joints conforming to the requirements of AWWA C-151/ ANSI A21.51~~, cement lined push-on joint~~ and AWWA C-104/ANSI A21.4. The minimum thickness class shall be Class 50 (up through 12-inch diameter pipe) and Class 51 (for 14-inch diameter and larger pipe). .

(b) Fittings shall be mechanical or push-on~~.~~ and be of a class at least equal to that of the adjacent pipe. Mechanical joint ductile iron fittings shall conform to AWWA C-110/ANSI A21.10. Push-on joint fittings shall be gray iron, with body thickness and radii of curvature conforming to ANSI A-21.10. Rubber gasket joints shall conform to AWWA C-111/ ANSI A-21.11.

~~2.~~3. Polyvinyl Chloride Pipe (PVC)

~~(a)~~ Polyvinyl Chloride Pipe (PVC) pipe ~~shall conform to the applicable portions of the following specifications: ASTM D-3034, ASTM D-2729, ASTM D-1784, ASTM D-1785, ASTM F-679, ASTM F-794, AWWA C-900, and AWWA C-905.~~

~~(b)~~ ~~PVC~~ and fittings shall conform to ~~the applicable portions of the following specifications: ASTM D-3034, ASTM D-2729, ASTM D-1785, ASTM D-2466,~~ASTM D-3034 (SDR 35 or lower) and ASTM ~~D-2467.~~

~~Fitting joints shall be the same as the~~F-679. Where added pipe ~~joints. Threaded connections shall conform to the requirements of ASTM D-2464 for schedule 80~~ strength is required, PVC pipe~~.~~ shall conform to AWWA C-900 and AWWA C-905.

4. Fittings

   (a) General

   ~~(1)~~i. ~~-~~Manufactured tee fittings shall be provided in the sewer main for side sewers. Fittings shall be of sufficient strength to withstand all handling and load stresses encountered.

   ~~(2)~~ii. Fittings shall be of the same materials as the pipe. Material joining the fittings shall be of the same material as the pipe.

   ~~(3)~~iii. Material joining the fittings to the pipe shall be free from cracks and shall adhere tightly to each joining surface.

   ~~(4)~~iv. All fittings shall be capped or plugged, and shall be gasketed with the same gasket material as the pipe joint, fitted with an approved mechanical stopper, or have an integrally cast knockout lug. The plug shall be able to withstand all test pressures without leaking. When later removed, the plug shall permit continuation of piping with jointing similar to joints in the installed line.

   (b) Mechanical Couplings: Mechanical couplings shall be wrought steel. Installation procedures must meet the manufacturers' recommendations.

5. Line Tap Saddle

   (a) PVC Tee Saddle: manufactured in accordance with ASTM D-3034 (SDR 35 or lower) with minimum cell classification of 12454B-C or 12364-C as defined in ASTM D-1784. Elastomeric seals shall meet ASTM F-477 specifications; locate seals at both the lead and skirt ends of the saddle. Saddles shall be banded to pipe with #316 Stainless Steel bands, 9/16-inch wide. This saddle is allowed on PVC, clay, IPS, concrete, asbestos cement, and PE pipe.

   (b) Romac Style "CB" Saddle shall be made of casting of ductile iron, which meets ASTM A-536, grade 65-45-12. Rubber gaskets shall conform to AWWA C-111/ANSI A21.11. The band shall be stainless steel with Teflon coated nuts and bolts. This saddle is not allowed on plastic pipe except C-900.

   (c) Inserta Tee®, or approved equal: hub adaptor shall be manufactured in accordance with ASTM D-3034; elastomeric seals shall meet ASTM F-477 specifications. This connection is allowed only on thick wall pipe material, e.g., concrete, ductile iron, rib type plastic. Connection point shall be core

drilled~~;~~. The hole diameter shall be cut to manufacturer's specifications. Hub adaptor shall be connected to rubber sleeve with #316 Stainless Steel band (9/16-inch wide), screw, and housing. Inserta Tee® connection shall have a gasketed bell for use with sanitary sewers.

c. Proof Tests

The intent of this requirement is to prequalify a joint system, components of which meet the joint requirements, ~~as to the watertightness~~for water tightness capability of the joint system. The proof test shall be understood to apply to sanitary sewers that are to be tested for ~~watertightness~~water tightness before acceptance. Material and test equipment for proof-testing shall be provided by the manufacturer. When approved, internal hydrostatic pressure may be applied by a suitable joint tester. Each pipe material and joint assembly ~~shall~~may be subject to the following three proof tests, at the discretion of the City's authorized representative:

1. ~~1.~~ **Pipe in Straight Alignment:** No less than three or more than five pipes selected from stock by the City's authorized representative shall be assembled according to the manufacturers' installation instructions, with the ends suitably plugged and restrained against internal pressure. The pipe shall be subjected to 10-psi hydrostatic pressure for 10 minutes. Free movement of water through the pipe joint wall shall be grounds for rejecting the pipe.

2. ~~2.~~ **Pipe in Maximum Deflected Position:** A test section is described below for each pipe material. The pipe shall be subjected to 10-psi hydrostatic pressure for 10 minutes. Free movement of water through the pipe joint or pipe wall shall be grounds for rejecting the pipe.

3. ~~3.~~ **Joints Under Differential Load:** The test section shall be supported on blocks or otherwise, as described below for each pipe material. There shall be no visible leakage when the stressed joint is subjected to 10-psi internal hydrostatic pressure for 10 minutes.

   (a) ~~(a)~~ **Concrete Pipe:** For a deflected position, a position ½ inch wider than the fully compressed position shall be created on one side of the outside perimeter. For a differential load, one pipe shall be supported so that it is suspended freely between the adjacent pipe, bearing only on the joints. In addition to the weight of the suspended pipe, a test load shall be added, as shown in ~~**Table 4-3.**~~**Table 4.3.**

Table 4.3. TEST LOADS FOR CONCRETE PIPES UNDER DIFFERENTIAL LOAD

Pipe Size (inches)	Load per Foot, Laying Length Up to 4 Feet (pounds)	Total Load, Pipe 4 Feet and Over (pounds)
Sanitary Laterals		
4	650	2,600
6	1,000	4,000
Sanitary Mains		
8	1,300	5,200
10	1,400	5,600
12	1,500	6,000
15	1,850	7,400
18	2,200	8,000
21	2,500	10,000
24 and over	2,750	11,000

~~(b)~~

(b) **Ductile Iron Pipe:** For the deflected position, a position ½ inch wider than the fully compressed section shall be created on one side of the outside perimeter. For a differential load, one of the pipes shall be supported so that it is suspended freely between the adjacent pipe, and bearing only on the joints. A force shall be applied along a longitudinal distance of 12 inches beside one of the joints, as specified in ~~Table 4-4.~~**Table 4.4**.

~~**Table 4.4. TEST LOADS FOR DUCTILE IRON PIPES UNDER DIFFERENTIAL LOAD**~~

~~Pipe Size (inches)~~	~~Load (pounds)~~	~~Pipe Size (inches)~~	~~Load (pounds)~~
~~4~~	~~600~~	~~15~~	~~3,700~~
~~6~~	~~900~~	~~18~~	~~4,400~~
~~8~~	~~1,200~~	~~21~~	~~5,000~~
~~10~~	~~1,500~~	~~24 and over~~	~~5,500~~
~~12~~	~~1,800~~	~~--~~	~~--~~

(c) ~~(c)~~ **PVC Pipe:** For the deflected position, two 12½-foot lengths shall be joined, then deflected along an arc of 720-foot radius (0.11 feet offset at the end of each length from a tangent at the joint). For a differential load, two lengths shall be joined and uniformly supported for at least 2 feet on both sides of the joint and the adjacent pipe to 95 percent of its vertical diameter.

Table 4.4. TEST LOADS FOR DUCTILE IRON PIPES UNDER DIFFERENTIAL LOAD

Pipe Size (inches)	Load (pounds)	Pipe Size (inches)	Load (pounds)
4	600	15	3,700
6	900	18	4,400
8	1,200	21	5,000
10	1,500	24 and over	5,500
12	1,800	--	--

d. Workmanship

1. **Line and Grade**

(a) Survey control hubs for both line and grade shall be provided by the design engineer in ~~a manner consistent with accepted practices. The contractor shall establish line and grade for pipe by the use of lasers or by transferring the cut from the offset stakes to the trench at a maximum of 50-foot intervals, to maintain the line and grade.~~accordance with Section 401.1.04, "Surveying."

(b) Variance from the established line and grade shall not be greater than ¼ inch for grade and ½ inch for line, provided that such variation does not result in a level or reverse-sloping invert.

(c) The contractor shall check line and grade as necessary. If the limits prescribed in these standards are not met, the work shall be immediately stopped~~,~~; the City's authorized representative notified, and the cause remedied before proceeding with the work.

(d) Variation in the invert elevation between adjoining ends of pipe, due to ~~nonconcentricity~~non-concentricity of joining surface and pipe interior surfaces, shall not exceed 1/64 per inch of pipe diameter, or ½ inch maximum.

~~(e) Tee stations shall be staked as specified in Section 401.1.05, "Surveying," to enable the contractor to install services at the correct property location.~~

2. **Pipe Handling**

(a) The contractor shall unload pipe only by approved means. Pipe shall not be unloaded by dropping it to the ground and shall not be dropped or dumped into trenches.

(b) Pipe shall not be unloaded or stored within the public right-of-way unless approved by the City's authorized representative.

~~(b)~~(c) The contractor shall inspect all pipe and fittings before lowering them into trenches to ensure that no cracked, broken, or otherwise defective materials are used.

~~(c)~~(d) The contractor shall clean the ends of pipe thoroughly, remove foreign matter and dirt from inside the pipe, and keep it clean during laying and joining.

~~(d)~~(e) The contractor shall lower the pipe into the trench in such a manner as to avoid any physical damage to the pipe.

~~(e)~~(f) The contractor shall remove all damaged pipe from the job site.

3. **Tying In**

(a) ~~The~~Where poured-in-place manhole bases are installed, the contractor shall not break into an existing sewer line until just before the project is finalized and the manhole has been tested and approved by the City's authorized representative.

(b) When a contractor ties into a "live" line, the contractor shall keep the new line plugged at the downstream end of the construction to prevent groundwater from entering the City's sewage system.

4. **Foreign Material**

(a) The contractor shall take all necessary precautions to prevent excavated or other foreign material from entering the pipe during the laying operation.

(b) At all times, when laying operations are not in progress, the contractor shall use a mechanical plug at the open end of the last laid section of pipe, to prevent entry of foreign material or creep of the gasketed joints.

5. **Pipe Laying**

(a) Trench excavation shall be in accordance with Section 6, "Trench Excavation and Backfill."

~~(a)~~(b) Pipe laying shall proceed upgrade, with the spigot ends pointing in the direction of flow.

~~(b)~~(c) After a section of pipe is lowered into the prepared trench, the contractor shall clean the end of the pipe to be joined, the inside of the joint, and the rubber ring (if required) immediately before joining the pipe.

~~(c)~~(d) At the location of each joint, dig bell (joint) holes of ample dimensions in the bottom of the trench and at the sides, where necessary, to permit the joint to be made properly.

(e) The joint shall be assembled according to the recommendations of the manufacturer. The contractor shall provide all special tools and appliances required for the jointing assembly. The contractor shall take care to properly align the pipe before forced entirely home.

(f) Upon completion of pipe laying, all pipe joints shall be in the "home" position, which is defined as the position where the least gap (if any) exists when the pipe components that comprise the joint are fitted together as tightly as the approved joint design will permit. Gaps at pipe joints shall not exceed that allowed by the manufacturer's recommendations.

(g) Joints that exceed the manufacturers allowed gap shall be repaired as required by the City's authorized representative at no cost to the City. Where 3 or more joint gaps between two structures exceed that

recommended by the manufacturer, then all pipe from the first gap to the structure shall be properly re-laid at the Contractor's sole expense.

~~(d)~~(h) After the joint is made, the pipe shall be checked for alignment and grade.

~~(e)~~(i) The trench bottom shall form a continuous and uniform bearing and support for the pipe at every point between joints.

(j) After installation, the contractor shall backfill the trench to the extent necessary to prevent pipe movement from any cause, including uplift or floating. Upon inspection and approval by the City's authorized representative, the contractor shall complete backfill of the trench.

~~(f)~~(k) Do not lay pipe in water or when, in the opinion of the City's authorized representative, trench conditions are unsuitable.

6. **Movable Shield:** When pipe is laid in a movable trench shield, the contractor shall take all necessary precautions to prevent the pipe joints from pulling apart when the shield is moved ahead. The bottom of the shield shall not extend below the ~~springline~~spring line of the pipe without recompacting the pipe zone.

7. **Cutting Pipe:** When cutting or machining the pipe is necessary, the contractor shall use only the tools and methods recommended by the pipe manufacturer and approved by the City's authorized representative. The contractor shall cut ductile iron pipe using a method approved by the City's authorized representative; all burrs or rough edges shall be removed before joining pipe. The contractor shall not flame-cut the pipe.

8. **Transition Fittings:** When joining different types of pipes, the contractor shall use approved ridged fittings. ~~Flexible~~Where ridged fittings are not available, flexible fittings with No. 305 stainless steel bands, such as Fernco, Caulder, or approved equal, may be considered upon approval of the City's authorized representative; flexible fittings may require additional support under the coupling. Bell type couplings are considered flexible.

   (a) Shear ring/ridge transition couplings meeting the ASTM C-564 or equal shall be used.

   (b) PVC couplers or adapters shall meet the specifications for ASTM D-3034, SDR 35 pipe fittings.

   (c) Ductile iron transition couplings shall be manufactured from ductile iron conforming to ASTM A-536, grade 65-45-12, for center and end rings. Rubber gaskets, bolts, and nuts shall conform to AWWA C-111/ANSI A21.11.

9. **Concrete Closure Collars**

   (a) The contractor shall pour closure collars against undisturbed earth, remove all water from the excavation, and construct suitable forms to create shapes

that will provide full bearing surfaces against undisturbed earth, as indicated in **Detail No. S-2190** of these standards.

(b) Closure collars shall be used only when approved by the City's authorized representative, and then only to make connections between dissimilar pipe ~~or~~and where standard rubber-gasketed joints are impractical.

(c) Before the closure collars are installed, the contractor shall wash the pipe to remove all loose material and soil from the surface where they will be placed.

10. ~~**Pipe Zone Material**~~**Trench Backfill:** The contractor shall ~~install pipe zone material uniformly on both sides of the pipe, up to the springline of the pipe. Material~~place trench backfill in accordance with Section 6, "Trench Excavation and Backfill."

11. **Sanitary Sewer Laterals and Tees**

(a) Lateral sewers shall be ~~placed in lifts not exceeding 6 inches Material~~connected to new sanitary sewer mains with manufactured tee fittings per Section 401.4.02.b.4, "Fittings", except where sewer laterals are larger than 50% of the diameter of the main line. Such sewer laterals shall be ~~well worked with hand tools~~connected to ~~ensure proper support~~the main line through the installation of a manhole. Line taps in ~~the haunching area~~new mains are not permitted.

(b) Install sanitary sewer laterals and tee fittings in accordance with **Detail No. S-2175** of these standards.

~~10.~~(c) Lateral pipe and fittings shall consist of one type of material throughout and no interchanging of pipe and fitting material is allowed.

~~11.~~12. **Line Taps**

(a) Line taps are allowed on existing sanitary lines only and shall be core drilled unless approved otherwise by the City's authorized representative. Core drilled holes shall be done using a cylinder-style hole saw for only plastic pipe material or a diamond core bit for concrete and D.I. pipes.

(b) Line tap connections to sanitary lines shall be located a minimum 12" from the sanitary mainline pipe bell.

~~(b)~~(c) Line tap connections to existing sanitary lines may be done using either saddle tees as per ~~Section 401.4.02.b.5(a),~~Section 401.4.02.b.5.(a), "PVC Tee Saddle" or by using Inserta Tee® as per ~~Section 401.4.02.b.5(c).~~Section 401.4.02.b.5(c), "Inserta Tee®".

~~(c) Line taps shall be centered on the spring line of the pipe being tapped.~~

(d) PVC tee saddles shall be installed in accordance with **Detail No. S-2155** of these standards. Inserta Tee® shall be installed in accordance with **Detail No. S-2160** of these standards.

~~(d)~~(e) The area around the ~~saddle~~line tap installation site shall be cleaned and free of all rough edges before installing ~~the saddle~~fittings.

~~(e)~~(f) While installing the ~~saddle~~connection, no rock, dirt, or debris shall be allowed to enter the main sewer line from the core hole.

~~(f)~~(g) The contractor shall install ¾”-0” crushed aggregate in the pipe zone around the line tap, from 6 inches below the pipe to 12 inches above the pipe.

~~(g)~~(h) Laterals shall have tracer wire ~~(12-gauge with green THNN insulation)~~ installed beside the pipe and plastic caution tape installed 1-foot above the pipe crown as shown in **Detail No. S-2175** of these standards.

401.4.03 Pressure Mains

a. General Provisions

These specifications, together with all other applicable requirements of federal, state, and local law, shall govern the character and quality of material, equipment, installation, and construction procedures for pressurized sanitary sewer work.

b. Materials

1. **Ductile Iron Pipe:** Ductile iron pipe shall be lined with cement mortar and seal-coated and shall conform to applicable portions of the following specifications: ASTM A-536, AWWA C-104/ANSI A21.4, AWWA C-111/ANSI A21.11, and AWWA C-151/ANSI A21.51.

2. **PVC Pipe**: PVC pipe with diameters of 4 inches through 12 inches shall conform to the requirements of AWWA C-900. Joints shall be elastomeric gasketed and shall conform to the requirements of ASTM D-3139.

3. **High Density Polyethylene Pipe (HDPE):** HDPE pipe with diameters of 4 inches through 63 inches shall conform to the requirements of AWWA C-906. Joints shall be joined by thermal heat fusion and shall conform to the requirements of ASTM D-2683 for socket-type fittings, ASTM D-3261 for butt-type fittings, or ASTM F-1055 for electrofusion-type fittings.

c. Workmanship and Pipe Installation

~~(a)~~1. All pipe shall be laid to the specified lines and grades. The minimum depth of the pipe cover shall be as specified in ~~Section 401.2.02.j, “Sanitary Pipe Design, Pipe Cover.”~~Section 401.2.02.l, “Pipe Cover.” Pipes shall not be deflected either horizontally or vertically beyond the limits established and recommended by the pipe manufacturer.

~~(b)~~2. Pipeline shall be laid to a grade that results in the minimum number of high points, based on terrain and economic considerations. Abrupt transitions and sharp peaks shall be avoided.

~~(c)~~3. All tees, elbows, or other fittings shall be produced by the pipe manufacturer and shall be properly braced, anchored, or blocked.

~~(d)~~4. Automatic air and vacuum release valves with a bleed-off port shall be installed at all high points or locations in the pipeline where air pockets would be expected to accumulate. Valves shall be installed in a vault~~, as shown in Detail No. W-3060 of these standards~~, so as to provide accessibility for service and repair. Sumps shall be required for holding excess liquid discharged from the bleed-off port.

401.5.00 CONSTRUCTION SPECIFICATIONS

401.5.01 General Provisions

The specifications detailed here, together with the standards established by the Oregon DEQ, the U.S. Environmental Protection Agency, and any other applicable requirements of the City, shall govern the character and quality of material, equipment, installation, and construction procedures for mainline sanitary sewer work of gravity-flow systems.

401.5.02 Scheduling

a. The contractor shall plan their construction work in conformance with ~~Section 101.8.02~~Section 101.8.02, "Scheduling."

b. Newly installed sanitary sewer lines shall not be placed in service until necessary testing is complete and system has been approved by the City's authorized representative.

401.5.03 Environmental Protection, Erosion Prevention, and Sediment Control

The contractor shall take all appropriate measures and precautions to minimize the work's impact on the environment and shall control erosion, as outlined in Section 101.9.00, "Environmental Protection, Erosion Prevention, and Sediment Control."

401.5.04 Interferences and Obstructions

Various obstructions may be encountered during the course of the work. The contractor shall follow the guidelines established in Section 101.8.05, "Interferences ~~and~~, Obstructions, Abandoned Utilities."

401.5.05 Abandon Sewer Facilities

a. **Sanitary Sewer Pipe**: Sanitary sewer pipe facilities to be abandoned shall be cut off and completely removed at 48-inches minimum below finish grade, unless specifically stated otherwise. Sanitary sewer pipe to be abandoned shall be removed

or completely filled with a flowable, Controlled Low-Strength Material (CLSM) as directed by the City's authorized representative.

b. **Manholes**: Manholes to be abandoned shall have manhole frame, cover, grade rings, cone section or flat slab top removed and manhole sections cut and removed at 48-inches minimum below finish grade, unless specifically stated otherwise. The manhole base shall be rubblized or perforated to prevent the entrapment of water. The remaining portion of manhole shall be backfilled with Class B material in accordance with Section 6, "Trench Excavation and Backfill."

401.5.06 Contaminated Soil or Hazardous Material

If during construction contaminated soil or ~~with~~ hazardous materials or chemicals are encountered, the Contractor shall follow the procedures specified in Section 101.9.02, "Contaminated Soils or Hazardous Materials."

401.5.~~06~~07 Trench Excavation, Preparation, and Backfill

Trench excavation, preparation, and backfill shall conform to the requirements of Section 6, "Trench Excavation and Backfill."

401.5.~~07~~08 Preservation, Restoration, and Cleanup

Cleanup of all construction debris, excess excavation, and excess materials and complete restoration of all fences, mailboxes, ditches, culverts, signposts, and similar items shall be completed according to Section 101.8.16, "Preservation, Restoration, and Cleanup."

401.5.~~08~~09 Bores

Bores shall conform to the requirements of ~~Section 301.11.08,~~Section 301.10.09, "Bores."

401.6.00 TESTING PROCEDURES

401.6.01 General

a. ~~**Testing Order:**~~ **Locate Wire Testing:** Prior to paving, the contractor shall notify the City's authorized representative that the sanitary sewer locate wire is ready for testing. City personnel shall connect to the locate wire and attempt to locate sanitary sewer main line and services. The sewer main line and sewer services shall be located from at least two connection points to be considered to have adequate coverage. The contractor will be required to locate and repair any gaps in the locate wire coverage. Failed sections shall be retested until adequate coverage is obtained.

b. **Testing Order:** Prior to the start of sanitary system testing, all manholes shall be re-numbered as assigned by the City's authorized representative. All testing shall reference the City assigned manhole numbers.

~~a.~~Sanitary systems and appurtenances shall pass a deflection test and an air test before acceptance, and shall be free of visible leakage. Information about air testing may be

obtained from the City's authorized representative. Individual joints on pipe 54 inches in diameter or larger may be tested by an approved joint-testing device. All details of testing procedure shall be subject to approval of the City's authorized representative. Testing of sanitary systems shall be conducted in the following order.

1. Deflection testing of pipelines.
2. Air pressure testing of pipelines.
3. Video-inspection of pipelines.
4. Vacuum testing of manholes

~~b.~~c. If repair work is required on a section of the system, that portion of the system shall be retested in the testing order given above.

~~c.~~d. Deflection testing, air pressure testing, and video-inspection shall be done only after backfill has passed the required compaction test(s) based on AASHTO T-180 and roadway base rock has been placed, compacted, and approved.

~~d.~~e. The sanitary system must pass deflection testing, air pressure testing, and video-inspection before paving of overlying roadways will be permitted.

~~e.~~f. Vacuum testing of manholes shall be performed only after paving is completed and approved~~.~~, or finish grading is completed and approved for manholes installed outside of paved areas. If paving occurs around existing manholes, those manholes shall be vacuum tested and repaired, as needed, in accordance with Section 401.6.03.a, "Vacuum Testing" after paving is completed and approved.

401.6.02 Gravity System Testing

~~a.~~ **Cleaning Before Test:** Before testing and City inspection of the system, the contractor shall plug the closest downstream manhole, ball and flush, and clean all parts of the system. The contractor shall remove all accumulated construction debris, rocks, gravel, sand, silt, and other foreign material from the system at ~~or near~~ the ~~closest downstream~~ plugged manhole~~. If necessary, the contractor~~ using a vacuuming process. At no time, shall ~~use mechanical rodding, bucketing or vactor equipment~~any material be flushed into the downstream city sewer system. When the City's authorized representative inspects the system, any foreign matter still present shall be ~~flushed and~~ removed from the system~~. ***Contractor shall provide screening; no material shall be flushed into*** by repeating the ***downstream city sewer system.***~~

~~b.~~a. cleaning process. **Test Equipment:** The contractor shall furnish all necessary test equipment and perform the tests in a manner satisfactory to the City's authorized representative. Any arrangement of test equipment shall be permitted that will provide observable and accurate measurements of air leakage under the specified conditions. Gauges for air testing shall be calibrated with a standardized test gauge.

~~c.~~b. **Deflection Test for Flexible Pipe:** Sanitary sewers constructed of flexible pipe shall be deflection-tested by pulling an approved mandrel through the completed pipeline.

The diameter of the mandrel shall be 95% of the nominal pipe diameter, unless otherwise specified by the City's authorized representative. The mandrel shall be a rigid, nonadjustable, odd-numbered leg (9 legs minimum) mandrel having an effective length of not less than its nominal diameter. Testing shall be done manhole-to-manhole ~~and~~ after the line has been completely balled and flushed with water~~,~~ and after compaction tests of backfill have been completed and accepted. Testing shall be conducted in the presence of the City's authorized representative. The contractor will be required to locate and repair any sections that fail the test and to retest those sections. All repairs shall follow, and be in compliance with, the manufacturer's recommendations.

~~d.~~c. **Air Pressure Testing**

1. **General:** After the system is complete, including service connections and backfilling, the contractor shall conduct a low-pressure air test. The contractor shall provide all equipment and personnel for the test. The method, equipment, and personnel shall be subject to approval of the City's authorized representative. Testing shall be conducted in the presence of the City's authorized representative. The City's authorized representative may, at any time, require a calibration check of the instrument used. The pressure gauge shall have minimum divisions of 0.10 psi and an accuracy of 0.0625 psi (one ounce per square inch). All air shall pass through one control panel.

2. ~~2.~~ **Safety Precautions:** All plugs used to close the sewer for the air test must be capable of resisting the internal pressures and must be securely braced. All air-testing equipment must be placed above ground. No one shall be permitted to enter a manhole or trench where a plugged line is under pressure. All pressure must be released before the plugs are removed. The testing equipment must include a pressure-relief device designed to relieve pressure in the line under test at 10 psi or less, and must allow continuous monitoring to avoid excessive test pressure. The contractor shall use care to prevent~~-~~ the air inlet from flooding with infiltrated groundwater. The contractor shall inject air at the upper plug if possible. Only qualified personnel shall be permitted to conduct the test.

3. ~~3.~~ **Method:** Air testing shall be by the time pressure drop method, as follows:

   (a) ~~(a)~~ Clean the lines to be tested and remove all debris.

   (b) ~~(b)~~ Wet the lines before testing (optional).

   (c) ~~(c)~~ Plug all open ends with suitable test plugs; brace each plug securely.

   (d) ~~(d)~~ Check the average height of groundwater over the line. Add air slowly to the section of the system being tested until the internal air pressure is 3.5 psi higher than the average pressure of groundwater (0.433 psi for each foot of average water depth over the line).

(e) After the internal test pressure is reached, allow at least two minutes for the air temperature to stabilize, adding only the amount of air required to maintain pressure.

(f) After the temperature stabilization period, disconnect the air supply.

(g) Determine and record the time (in seconds) required for the internal air pressure to drop from 3.5 psi to 2.5 psi.

(h) Compare the time recorded in step (g) above with the time required, as determined below.

4. ~~4.~~ **Passing test:** A passing test shall be based on meeting or exceeding the requirements below. The test method depends on the type of pipe material. If a line fails to meet the requirements, the contractor shall repair or replace all defective materials or workmanship.

(a) ~~(a)~~ Concrete pipe

Air pressure drop method: The tested section, when tested by the air pressure drop method, will be acceptable if the time required for the pressure to drop from 3.5 psi to 2.5 psi is not less than the time (T) in seconds (Table 4.5) computed by the following formula:

$$T = K/C$$

~~where~~ Where: K = $0.011 \times d^2L$.

C = 1 or $0.0003882 \times dL$, whichever is greater.

d = inside diameter of pipe (inches).

L = length of pipe (feet).

(b) ~~(b)~~ PVC, HDPE, and ductile iron pipe

The minimum duration for the prescribed low-pressure exfiltration pressure drop between two consecutive manholes shall not be less than that shown in ~~**Tables**~~**Table** 4.6 or **Table** 4.7. The ~~tables~~Tables list test duration values for pressure drops of 1.0 psi and 0.5 psi in excess of groundwater pressure above the top of the sewer pipe. Values accommodate both an allowable average loss per unit of surface area and an allowable maximum total leakage rate.

(c) ~~(c)~~ Record the diameter (inches), length (feet), end manhole number, time, pressure drop, and groundwater level of the test on an inspection form. The form shall become part of the permanent record for the project.

Table 4.5. AIR TESTING OF CONCRETE PIPE

Pipe Length (ft)	Pipe Diameter (inches) 4.0 Time (sec)	6.0 Time (sec)	8.0 Time (sec)	10.0 Time (sec)	12.0 Time (sec)	15.0 Time (sec)	18.0 Time (sec)	21.0 Time (sec)	24.0 Time (sec)	30.0 Time (sec)	36.0 Time (sec)
10	1.8	4.0	7.0	11.0	15.8	24.8	35.6	48.5	63.4	99.0	142.6
20	3.5	7.9	14.1	22.0	31.7	49.5	71.3	97.0	126.7	198.0	285.1
30	5.3	11.9	21.1	33.0	47.5	74.3	106.9	145.5	190.1	297.0	427.7
40	7.0	15.8	28.2	44.0	63.4	99.0	142.6	194.0	253.4	396.0	570.2
50	8.8	19.8	35.2	55.0	79.2	123.8	178.2	242.6	316.8	495.0	712.8
60	10.6	23.8	42.2	66.0	95.0	148.5	213.8	291.1	380.2	594.0	855.4
70	12.3	27.7	49.3	77.0	110.9	173.3	249.5	339.6	443.5	693.0	997.9
80	14.1	31.7	56.3	88.0	126.7	198.0	285.1	388.1	506.9	792.0	**1020.1**
90	15.8	35.6	63.4	99.0	142.6	222.8	320.8	436.6	570.2	**850.1**	*same. after 72 ft.*
100	17.6	39.6	70.4	110.0	158.4	247.5	356.4	485.1	633.6	*same. after 86 ft.*	
110	19.4	43.6	77.4	121.0	174.2	272.3	392.0	533.6	**680.1**		
120	21.1	47.5	84.5	132.0	190.1	297.0	427.7	582.1	*same. after 108 ft.*		
130	22.9	51.5	91.5	143.0	205.9	321.8	463.3	**595.1**			
140	24.6	55.4	98.6	154.0	221.8	346.5	499.0	*same. after 123 ft.*			
150	26.4	59.4	105.6	165.0	237.6	371.3	**510.0**				
160	28.2	63.4	112.6	176.0	253.4	396.0	*same. after 144 ft.*				
170	29.9	67.3	119.7	187.0	269.3	420.8					
180	31.7	71.3	126.7	198.0	285.1	**425.0**					
190	33.4	75.2	133.8	209.0	301.0	*same. after 172 ft.*					
200	35.2	79.2	140.8	220.0	316.8						
210	37.0	83.2	147.8	231.0	332.6						
220	38.7	87.1	154.9	242.0	**340.0**						
230	40.5	91.1	161.9	253.0	*same. after 215 ft.*						
240	42.2	95.0	169.0	264.0							
250	44.0	99.0	176.0	275.0							
260	45.8	103.0	183.0	**283.4**							
270	47.5	106.9	190.1	*same. after 258 ft.*							
280	49.3	110.9	197.1								
290	51.0	114.8	204.2								
300	52.8	118.8	211.2								
310	54.6	122.8	218.2								
320	56.3	126.7	225.3								
330	58.1	130.7	**226.7**								
340	59.8	134.6	*same. after 322 ft.*								
350	61.6	138.6									
360	63.4	142.6									
370	65.1	146.5									
380	66.9	150.5									
390	68.6	154.4									
400	70.4	158.4									
410	72.2	162.4									
420	73.9	166.3									
430	75.7	**170.0**									
440	77.4	*same. after 430 ft.*									
450	79.2										
460	81.0										
470	82.7										
480	84.5										
490	86.2										
500	88.0										

Table 4.6. AIR TESTING OF PVC, HDPE, AND DUCTILE IRON PIPE – 1.0 PSIG PRESSURE DROP[1].

Specification Time Required for a 1.0 psig Pressure Drop for Size and Length of Pipe Indicated for Q = 0.0015*

Pipe Diameter	Minimum Time	Length for Minimum Time	Time for Longer Length	Specified Minimum for Length (L) Shown (min:sec)							
(inches)	(min:sec)	(feet)	(sec)	100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	3:46	597	0.380L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	0.854L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.647L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	31:10	72	25.852L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	34:00	66	30.768L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46
42	39:48	57	41.883L	69:48	104:42	139:37	174:30	209:24	244:19	279:13	314:07
48	45:34	50	54.705L	91:10	136:45	182:21	227:55	273:31	319:06	364:42	410:17

*Q is the allowable leakage rate in cubic ft/min/ft^2 of inside surface area of pipe.

1. Data from the UNI-Bell® PVC Pipe Association.

Table 4.7. AIR TESTING OF PVC, HDPE, AND DUCTILE IRON PIPE – 0.5 PSIG PRESSURE DROP[1].

Specification Time Required for a 0.5 psig Pressure Drop for Size and Length of Pipe Indicated for Q = 0.0015*

Pipe Diameter	Minimum Time	Length for Minimum Time	Time for Longer Length	Specified Minimum for Length (L) Shown (min:sec)							
(inches)	(min:sec)	(feet)	(sec)	100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	1:53	597	0.190L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	398	0.427L	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12
8	3:47	298	0.760L	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42
10	4:43	239	1.187L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54
12	5:40	199	1.709L	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50
15	7:05	159	2.671L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02
18	8:30	133	3.846L	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51
21	9:55	114	5.235L	9:55	13:05	17:27	21:49	26:11	30:32	34:54	39:16
24	11:20	99	6.837L	11:24	17:57	22:48	28:30	34:11	39:24	45:35	51:17
27	12:45	88	8.653L	14:25	21:38	28:51	36:04	43:16	50:30	57:42	64:54
30	14:10	80	10.683L	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07
33	15:35	72	12.926L	21:33	32:19	43:56	53:52	64:38	75:24	86:10	96:57
36	17:00	66	15.384L	25:39	38:28	51:17	64:06	76:55	89:44	102:34	115:23
42	19:54	57	20.942L	34:54	52:21	69:49	87:15	104:42	122:10	139:37	157:04
48	22:47	50	27.352L	45:35	68:23	91:11	113:58	136:46	159:33	182:21	205:09

*Q is the allowable leakage rate in cubic ft/min/ft^2 of inside surface area of pipe.

1. Data from the UNI-Bell® PVC Pipe Association.

~~c.~~d. **Video Inspection of Gravity Systems:** All sanitary systems shall be video-inspected and approved prior to City acceptance. Video inspection shall take place after trench backfill and compaction has been completed and accepted, and channels have been poured in manholes. All pipes shall be thoroughly ~~flushed~~cleaned in accordance with Section 401.6.02.a, "Cleaning Before Test" immediately prior to the video inspection; only that water remaining from ~~flushing~~cleaning shall be present in the system. Video inspection shall be continuous from manhole to manhole without breaks or interruptions in the recording. The camera shall have the ability to tilt up to 90 degrees and rotate 360 degrees on the axis of travel. An inspection of all lateral connections shall be conducted using the tilt capabilities of the camera. A 1/2-inch target ball shall be placed in front of the camera. ~~Observed~~There shall be no observed infiltration and observed sags must be less than 0.5 inch.

The City's authorized representative shall be notified and shall be present during video-inspection of the system, unless otherwise approved by the City's authorized representative. A copy of the video and a written video inspection report, on a City-approved form, shall be supplied to the City's authorized representative. The video shall be recorded in color ~~and in VHS~~ CD or ~~CD~~DVD format. Video shall include a visual footage meter recording. Problems revealed during the inspection shall be noted on the video and in the written report. After repairs have been made, the line shall be re-inspected and re-tested. If excessive foreign material, in the opinion of the City's authorized representative, is encountered during video inspection, the line shall be ~~balled and flushed~~cleaned in accordance with Section 401.6.02.a, "Cleaning Before Test" and re-video inspected.

401.6.03 Manhole Testing

Sanitary sewer manholes shall be tested for acceptance after the trench is backfilled, compaction requirements are met, the road base rock is installed and the street paved, and chimney seals or concrete manhole closure collars are installed. If the manholes pass the tests but the castings were disturbed by construction and must be reinstalled, the manholes shall be retested.

a. **Vacuum Testing:** All manholes being constructed or rehabilitated shall be vacuum-tested. The test shall consist of plugging all inlets and outlets. The test head shall be placed at the inside of the top of the cone, and shall include grade rings and casting. The seal shall be inflated in accordance with the manufacturer's recommendations. A vacuum of 10 inches of mercury shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to 9 inches. The manhole shall pass if the time for the vacuum reading to drop to 9 inches meets or exceed the values listed in ~~**Table 4-8.**~~**Table 4.8**. The contractor shall repair all manholes that fail to pass the vacuum test; manholes shall be retested to verify the repair.

Table 4.8. VACUUM TESTING OF MANHOLES

Depth of Manhole (feet)	Diameter of Manhole		
	48 Inch	60 Inch	72 Inch
	Allowable Time (seconds)		
8	20	26	33
10	25	33	41
12	30	39	49
14	35	46	57
16	40	52	65
18	45	59	73
20	50	65	81
22	55	72	89
24	59	78	97
26	64	85	105
28	69	91	113
30	74	98	121

b. **Hydrostatic Testing:** When, in the opinion of the City's authorized representative, the groundwater table is too low to visually detect leaks, manholes may be hydrostatically tested. The test shall consist of plugging all inlets and ~~outlets~~an outlet, then filling the manhole with water to a height determined by the City's authorized representative. Leakage in each manhole shall not exceed 0.2 gallons per hour per foot of head above the invert. Leakage will be determined by refilling to the rim using a calibrated or known volume container. A manhole may be filled 24 hours before the test, if desired, to permit normal absorption into the pipe walls to take place. The contractor shall repair all manholes that fail to pass the leakage test; manholes shall be retested to verify the repair.

~~401.6.04~~ **401.6.04 Pressure Main Testing**

Field testing of the force main and appurtenances shall be completed by a hydrostatic test that meets the following requirements. Contractor shall be responsible for making all necessary provisions for conveying water to the points of use and for disposal of the test water, including temporary taps and plugs.

a. Prior to the start of the hydrostatic test, all trenching shall be backfilled, compacted, and accepted per the requirements of ~~Chapter 6,~~Chapter 6, "Trench Excavation and Backfill."

b. When concrete thrust blocks are used, the hydrostatic test shall be conducted after at least five days elapse from when the concrete thrust blocking was installed. If high-early cement is used for the concrete thrust blocking, the time may be cut by two days.

c. Seal pipe ends and secure pipe with temporary thrust restraint, as required, to maintain line and grade and to prevent damage.

d. Fill the test section with water and allow it to stand at two-thirds of the test pressure for a minimum of 12 hours. All air shall be purged from the pipeline before it is checked for leaks or pressure or acceptance tests are performed on the system~~.~~.

e. Furnish all equipment and materials and perform testing in conformance with ~~Section 501.9.01~~Section 501.9.01, "Hydrostatic Testing."

f. If a large amount of water is required to increase the pressure during testing, entrapped air, leakage at joints, or a broken pipe can be suspected. In such cases, tests shall be discontinued until the source of trouble is identified and corrected.

g. Visible leaks in the ~~wetwell~~wet well and vaults shall be eliminated regardless of the leakage amount.

401.7.00 SANITARY SEWER LINE ACCEPTANCE POLICY

The City of Wilsonville will accept new sanitary installations or systems built to the "Public Works Standards," providing that the following conditions are met.

401.7.01 Legal Recordings

Dedication of any required easements or rights-of-way have been recorded with the County Recorder and the Engineering Department receives a reproducible copy of the recorded documents.

401.7.02 Project Completion

After completion of construction of the total project, and after all testing has been satisfactorily completed, project closeout shall proceed as outlined in ~~Section 101.8.17.a~~Section 101.8.17, "Project ~~Completion~~Closeout."

401.7.03 Maintenance Period

a. The Contractor or Applicant shall be responsible for providing Maintenance Assurance for Public Improvements as outlined in ~~Section 101.8.17.b~~Section 101.8.18, "Maintenance ~~Assurance~~and Warranty." Public sanitary ~~improvements shall be warranted for a minimum of one year; public landscape~~ improvements shall be warranted for a minimum of two years.

b. At any time during the warranty period, the City's authorized representative has reason to believe the public sanitary improvements have defects that were the result of faulty workmanship or flaws in construction material, the responsible party shall be required, at that party's own cost, to video-inspect the sewer line and repair any problems or faults revealed during video inspection by replacing those sections. The video inspection shall be done during the winter, if possible, or during the wet weather months, to identify all leaks.

~~c.~~ Before the end of the Construction Maintenance period, the City's authorized representative shall inspect the project for any remaining deficiencies. If the deficiencies that remain are determined to be the responsibility of the contractor or the applicant, the contractor or applicant shall then make such repairs.

~~d. The Landscape Maintenance assurance shall be released two years after acceptance of construction, providing the landscaping meets the 90% survival level (see Section 301.13.02, "Landscape Inspection for Warranty").~~

SECTION 5

WATER SYSTEM DESIGN AND CONSTRUCTION STANDARDS

501.1.00 ENGINEERING

501.1.01 Introduction

This section outlines design and construction requirements for all public water system improvements. These provisions and technical specifications set forth the requirements of the City of Wilsonville for constructing water system improvements. Interpretations of such provisions and their application in specific circumstances shall be made by the City's authorized representative~~. Refer to Section 1~~, unless specifically stated otherwise. Refer to Section 1 of the "Public Works Standards" for general provisions and requirements.

501.1.02 Extension of Public Water Systems

a. Except as ~~otherwise provided~~to meet minimum fire flow requirements, the extension or upsizing of the public water systems in excess of 8 inches in diameter or as shown in the Wilsonville Water System Master Plan to serve any adjacent parcel or tract of land, shall be done by~~, and at the expense of,~~ the property owner or permit applicant and may be subject to applicable System Development Charge (SDC) credits.

b. The City reserves the right to perform the work or cause it to be performed and bill the owner for the cost of the work or to pursue special assessment proceedings.

c. The public water system shall extend to the most distant parcel boundary, to facilitate future extension, unless otherwise approved by the City's authorized representative.

d. Where public infrastructure improvements paid for by the property owner or permit applicant directly benefit adjacent properties, the property owner or permit applicant may pursue establishment of a reimbursement district per Section 3.116 of the City Code.

501.1.03 Water Plans

a. It is the design engineer's responsibility to ensure that engineering plans are sufficiently clear and concise to construct the project in proper sequence, using specified methods and materials, with sufficient dimensions to fulfill the intent of ~~the~~these design ~~guidelines in these~~ standards.

b. All ~~elevation~~elevations on design plans and record drawings shall be based on the applicable NAVD ~~datum~~88 Datum specified in ~~Section 101.7.07.a~~Section 101.7.07.a, "~~Surveying~~ NAVD 88 Datum."

~~b.~~c. Existing conditions and facilities on design plans and ~~Land Monuments."~~record drawings shall be shown in light, gray print. Proposed conditions and facilities on design plans and record drawings shall be shown in bold, black print.

~~c.~~d. All engineering water plans shall be stamped by a Professional Engineer registered in the State of Oregon. ~~Water~~At a minimum, water plans shall contain the following:

1. At least one sheet shall show a plan view of the entire project site. If the project site is sufficiently large that detailed water plans on any given sheet do not encompass the entire project site, then a sheet showing the plan view of the entire site must serve as an index to subsequent detailed plan sheets.

2. A topographic map showing existing conditions for the site, including the following:

   (a) Existing topography for the site. Plan views showing existing features may be required for a distance of up to 100 feet (or further if warranted) beyond the proposed improvement in order to prevent future grade conflicts and will be determined on a case-by-case basis by the City's authorized representative.

   (b) Adjacent streets, trails, multi-use paths, and rail lines, including ~~street~~the respective names.

   (c) Existing utilities, including franchised utilities above or below ground and drainage facilities that transport surface water onto, across, or from the project site. Existing drainage pipes, culverts, and channels shall include the invert or ~~flowline~~flow line elevations.

   (d) Existing vegetation, including denoting the type, DBH, and canopy size of trees within the construction limits.

   ~~(d)~~(e) Existing environmentally sensitive areas (e.g., ravines, swales, steep slopes, wells, springs, wetlands, creeks, lakes, etc.). For natural drainage features, show direction of flow, drainage hazard areas, and 100-year floodplain boundary (if applicable).

   (f) Adjacent existing features that are within 25 feet outside of the site boundary, including but not limited to construction activities that will potentially compromise the structural stability or condition of off-site features, such as cultivated vegetation, landscaping and trees,

buildings, fences, decks, walls, slabs, and pavements. Denote the type, DBH, and canopy size of all trees.

~~i.~~3. Plans for proposed water improvements shall include the following:

(a) Grading and erosion control plan.

~~A.~~ Finished grades, showing the extent of cut and fill by existing and proposed contours, profiles, or other designations.~~Finished grades, showing the extent of cut and fill by existing and proposed contours, profiles, or other designations.~~

(b) Plan views showing existing features may be required for a distance of up to 100 feet (or further if warranted) beyond the proposed improvement in order to prevent future grade conflicts and will be determined on a case-by-case basis by the City's authorized representative.

(c) Horizontal stationing along centerline, showing points of tangency and curvature, including centerline stationing of all intersecting streets.

~~(b)~~(d) Proposed structures, including roads and road improvements, parking surfaces, building footprints, walkways, landscape areas, etc.

(e) ~~Proposed~~Water facilities, including pipe sizes, pipe types and materials, lengths, joint restraints, and all water system appurtenances, including, but not limited to valves, hydrants, fittings, vaults, meters and thrust blocks. Notes shall be included for referencing details, cross-sections, profiles, etc.

~~(c)~~(f) Existing and proposed utilities, showing exact line and grade of all ~~proposed~~ utilities ~~at crossings with~~crossing the proposed water system.

(g) Connection details at all locations of water system appurtenances, including the size, type, spacing, and connection style of valves, bends, tees, crosses, reducers, thrust blocks and other water system appurtenances as required by the City's authorized representative.

~~(d)~~(h) Applicable detail drawings.

~~(e)~~(i) Existing and proposed property lines, right-of-way lines, survey monuments, and easements.

~~(f)~~(j) Setbacks from environmentally sensitive areas or resource areas protected within the Significant Resource Overlay Zone (SROZ~~.~~).

~~G. Plan and profile of water facilities, including pipe sizes, pipe types and materials, lengths, valve types, bends, tees, wyes, reducers, and location of thrust blocks. Notes shall be included for referencing details, cross-sections, profiles, etc.~~

~~(h)~~(k) Any proposed phasing of construction.

(l) Any additional information that the City's authorized representative deems necessary.

4. Profiles for proposed water improvements will be provided at the same horizontal scale as the plan sheets and a 1" = 5' vertical scale. Profile drawings shall be drawn below the plan view or immediately following the associated plan view sheets. Profile views showing existing features may be required for a distance of up to 100 feet (or further if warranted) beyond the proposed improvement in order to prevent future grade conflicts and will be determined on a case-by-case basis by the City's authorized representative. The profiles shall include the following:

   (a) Existing and proposed ground along the proposed water main alignment.

   (b) Water facilities, including pipe sizes, pipe types and materials, lengths, backfill material, joint restraints, and all water system appurtenances, including, but not limited to valves, hydrants, fittings, vaults, meters and thrust blocks. Notes shall be included for referencing details, cross-sections, etc.

   (c) Existing and proposed utilities, showing exact line and grade of all utilities crossing the proposed water system. The vertical separation from existing and proposed utilities shall be labeled for all proposed utility crossings.

   (d) Any additional information that the City's authorized representative deems necessary.

501.1.04 Surveying

a. The design engineer shall be responsible for establishing the location of the water line by means of reference stakes offset along the centerline of the water line. No construction shall be allowed to begin before construction staking. All staking shall be performed by or under the direction of a Professional Land Surveyor registered in the State of Oregon.

b. Stakes shall locate all public tees, crosses, bends, fire hydrants, ~~blowoffs~~blow offs, isolation valves, vaults, and booster pump stations. Maximum spacing for reference stakes is 50 feet. Stakes shall reference cuts and fills to the finished grade of the ground, asphalt, or concrete surface at that location to maintain

minimum cover requirement. The design engineer shall also be responsible for identifying and staking easements during construction.

501.2.00 WATER DESIGN ~~GUIDELINES~~STANDARDS

The following ~~is~~design standards are intended only as a guide for the design of water system improvements. All designs shall conform to the latest adopted revision of the Oregon ~~State Health Division~~ Administrative Rules, Chapter 333, "Public Water Systems," except where the City's standards exceed those of the state.

501.2.01 Pipe Location

a. Water lines are considered public, and are subject to these standards, up to the backflow prevention device or to the backside of a City of Wilsonville issued water meter. Beyond such point the contractor shall follow the adopted Oregon State Plumbing Specialty Code for domestic water services and the National Fire Protection Association (NFPA) standard 24 for private fire Service Protection piping, which is under the jurisdiction of City of Wilsonville Building Division.

b. Easements: Piped water systems shall generally be located in the right-of-way. When it is not possible or practical to install Public water distribution facilities in a dedicated public street the facilities shall be located within a water system easement granted to the City. Water system easements shall typically be exclusive and conform to Section 101.8.14, "Easements."

c. Where water lines are planned in the vicinity of sanitary sewer lines, design engineer and contractor shall follow guidelines established in Section 401.2.02.n, "Water and Sewer Lines."

d. Water mains will normally be placed on the south and east side of the street, outside the bike lane and vehicle wheel path, as indicated in the street detail drawings of these standards.

e. Valves shall be installed a minimum of 3 feet off face of curb and 6 feet off face of curb for streets with bike lanes.

f. Fire hydrants shall be located in compliance with TVF&R fire prevention ordinance. Generally, fire hydrants shall be placed as follows:

   1. The radius point of curb returns at street intersections.

   2. At the end of a water line to be extended in the future in place of a blow-off.

   3. Midblock installations are not preferred, but where necessary, place at a property line between adjacent lots.

4. Locate as shown, or as directed, to provide complete accessibility and to minimize the possibility of damage from vehicles or injury to pedestrians.

5. The maximum distance from a TVF&R approved driving surface to a fire hydrant is 15 feet.

501.2.02 Pipe Size

a. Minimum-size mains shall be 8 inches; all water mains shall be sized at 8, 12, 18, or 24 inches or as approved by the City's authorized representative. With prior approval of the City's authorized representative, 4-inch or 6-inch lines may be permitted provided there is no possibility of future extensions; 4-inch lines shall be limited to runs of less than 300 feet, no more than eight services, and no need for a fire hydrant.

b. An approved water system capable of supplying the required fire flow for fire protection shall be provided to all premises on which buildings are to be constructed.

1. For areas of single-family residential, the required fire flow shall be a minimum of 1,500 gallons per minute (gpm) while maintaining a minimum residual pressure of 20 pounds per square inch (psi~~); for~~)

2. For all other areas the required fire flow shall be a minimum of 3,000 gpm while maintaining a minimum residual pressure of 20 psi. ~~The City's authorized representative may require modifications for a particular project. In general, the following guidelines should be followed:~~

~~a. Water lines are considered public, and are subject to these standards, up to the backflow prevention device or to the backside of the residential water meter. Beyond such point the contractor shall follow National Fire Protection Association (NFPA) standards and Unified Plumbing Code (UPC) guidelines and be under the jurisdiction of City of Wilsonville Building Department.~~

3. ~~All~~The City's authorized representative may require modifications for a particular project.

c. The engineer for the project should meet with the City Engineering Department before design to discuss the size of mains and any other matters specific to the project. The City Engineer will make the final determination on the size of new water mains.

d. All water system tees and crosses shall be of the same size as the larger of the connecting water mains. The connecting water main shall not reduce to a smaller diameter to connect to a water system tee, cross, valve, or other water system fitting.

e. No fire hydrant shall be connected to a main of less than 8 inches diameter.

501.2.03 Pipe Material

Generally, all pipe shall be ductile iron (D.I.) restrained joint pipe~~, or approved equal.~~ .

a. All water mains 12~~"~~ -inch or less shall be minimum class 52 ductile iron~~.~~ pipe.

b. All water mains 18~~" or greater~~-inch to 36-inch shall be minimum class 51 ductile iron pipe.

c. All water mains larger than 36-inch shall be of material as required by the City's authorized representative.

501.2.04 Dead End Mains

a. Generally, permanent dead-end water mains will not be allowed. Water mains shall be looped wherever possible as determined by the City's authorized representative.

b. Water mains to be extended in the future shall have a fire hydrant installed at the temporary dead-end.

c. Water mains will be required to extend to the boundaries of new subdivisions.

501.2.05 Water System Appurtenances

~~c.~~a. Fittings shall be mechanical joint, unless otherwise specified.

~~d. Where water lines are planned in the vicinity of sanitary sewer lines, design engineer and contractor shall follow guidelines established in Section 402.02.l, "Water and Sewer Lines."~~

~~e. Minimum-size mains shall be 8 inches; all water mains shall be sized at 8, 12, 18, or 24 inches or as approved by the City's authorized representative. With prior approval of the City's authorized representative, 4-inch or 6-inch lines may be permitted provided there is no possibility of future extensions; 4-inch lines shall be limited to runs of less than 300 feet and no more than eight services.~~

~~f. No fire hydrant shall be connected to a main of less than 8 inches diameter.~~

~~g. Water mains will normally be placed on the south and east side of the street, outside the wheelpath, and located as indicated in the street detail drawings of these standards.~~

~~h. Dead-end mains will not normally be allowed, but when they are permitted, they shall be for lines to be extended in the future and a blowoff assembly will be required.~~

~~i. Main extensions will be required to continue to the boundaries of new subdivisions.~~

b. Vertical bends shall be avoided for 12" water lines and larger.

c. Valves 12 inches and larger shall be butterfly valves.

d. Valves shall be the same size as the connecting water main.

~~j.~~e. Valves shall be located at intersections whenever possible. In general, ~~sufficient~~spacing between isolation valves shall ~~be provided to permit shutting down any section of the line, but~~ not ~~to~~ exceed 800 feet.

~~k.~~f. Valves shall be required on all branches of tees and crosses on mainline intersections. At service line connections, valves shall be required at the service line connection only.

~~l.~~g. Valves shall be flanged by mechanical joint; valves shall be flanged to all tees and crosses.

~~m. Mechanical joint fittings at all valves and bends shall be restrained by a joint restraint system such as Megalug® retainers, or approved equal.~~

~~n. Valves 18 inches and larger shall be butterfly valves.~~

~~o. Valves shall be installed a minimum of 3 feet off face of curb.~~

~~p.~~h. Automatic air and vacuum release valves with a bleed-off port shall be installed at all high points or locations in the pipeline where air pockets would be expected to accumulate. Valves shall be installed as indicated in **Detail No.** ~~W-3060~~**WT-3090** of these standards.

~~Fire hydrants~~501.2.06 Thrust Restraint

~~q.~~ All pipe joints shall be ~~located in compliance with TVF&R fire prevention ordinance.~~

~~r.~~a. ~~Easements: When it is not possible or practical to install the main in a dedicated public street, a minimum 15-foot public pipeline easement shall be provided. Water mains shall be located in the center~~restrained by the installation of ~~the easement, unless an exception is~~restraining gaskets, as approved by the ~~City's authorized representative. The centerline of the pipe shall be at least 7½ feet from an easement side line~~pipe manufacturer.

~~s. The engineer for the project should meet with the City Engineering Division before design to discuss the size of mains and any other matters specific to the project.~~

b. All mechanical joints shall be restrained by a joint restraint system such as Megalug® Series 1100 retainers as manufactured by EBAA Iron, Inc., or approved equal.

c. Thrust blocks shall be provided for additional thrust restraint at all fire hydrants, wet tap locations, and existing water system appurtenances. In all other cases where flange connections, mechanical joint restraint systems and restrained gaskets are not feasible, thrust blocks may only be used with prior authorization by the City's authorized representative.

501.2.07 Water Service

Separate, individual water services and meters are required for domestic and irrigation water service, excluding individual single-family residences. Water services shall be connected to the main line per **Detail No. WT-3030** for ¾" – 1" water services and **Detail No. WT-3045** for 1 ½" – 2" water services. Deduct meters will not be allowed.

501.2.08 Cathodic Protection

The City's authorized representative may require cathodic protection of pipelines of certain sizes and materials or for pipe and fittings.

a. Prior to pipeline design and construction, the City's authorized representative may require soil sampling and testing for corrosivity.

b. Testing requirements shall be determined on a case-by-case basis.

c. If soil conditions are found to be possibly corrosive to buried pipe and fittings, cathodic protection measures such as bonded pipe coatings, bonded pipe joints, sacrificial anodes, alternate pipe materials, or other measures may be required by the City's authorized representative.

501.3.00 OPERATION OF VALVES IN CITY

Contractor shall request City operation of valves at least ~~24 hours~~ 2 business days in advance. At no time shall the contractor undertake to close off or open valves or take any other action that would affect the operation of the existing water system, unless specifically approved by City's authorized representative.

501.4.00 MATERIALS AND TECHNICAL SPECIFICATONS ~~– DUCTILE IRON PIPE AND FITTINGS~~

501.4.01 Push-On Ductile Iron Pipe

Push-on joint D.I. pipe shall be cement mortar lined and shall conform to AWWA C-104/ANSI A21.4 and AWWA C-151/ANSI A21.51 as manufactured by U.S. Pipe and Foundry Company, American Pipe, or approved equal. Rubber ring gaskets shall

conform to Section 501.4.06, "Gaskets," and shall be furnished with the pipe. A nontoxic vegetable soap lubricant (meeting the requirements of AWWA C-111/ ANSI A21.11) shall be supplied with the pipe in sufficient quantities for installing the pipe furnished.

501.4.02 Joints

~~a.~~ Pipe joints shall be push-on joints with joint restraints such as U.S. Pipe Tyton™, American Fastite™ or approved equal, except where specifically shown or detailed otherwise.

~~1.~~a. Fitting joints shall be mechanical joint ends, except where specifically shown or detailed otherwise.

~~2.~~b. All valves joined to tees and crosses shall be flanged by mechanical joint.

501.4.~~02~~03 Ductile Iron Fittings

Ductile iron fittings shall conform to AWWA C-110 / ANSI A21.10 and/or AWWA C-153 / ANSI A21.53. All ductile iron fittings shall be Class 350. Fittings hall be furnished with flanged or mechanical joints as specified on the plans.

501.4.04 Mechanical Joint Fittings

Mechanical joint D.I. fittings shall conform to the latest revision of AWWA C-110/ ANSI A21.10 and shall be of a class at least equal to that of the adjacent pipe. Bolts and nuts shall conform to AWWA C-111/ANSI A21.11. Mortar lining for fittings shall be the same thickness specified for pipe.

501.4.~~03 Push-On Ductile Iron Pipe~~

~~Push-on joint D.I. pipe shall be cement mortar lined and shall conform to AWWA C-104/ANSI A21.4, AWWA C-111/ANSI A21.11, and AWWA C-151/ANSI A21.51 as manufactured by U.S. Pipe and Foundry Company, Pacific States Cast Iron Company, American Ductile Iron Pipe, or approved equal. All water mains 12" or less shall be minimum class 52 ductile iron. All water mains 18" or greater shall be minimum class 51 ductile iron. Rubber ring gaskets shall conform to Section 501.4.05, "Gaskets," and shall be furnished with the pipe. A nontoxic vegetable soap lubricant (meeting the requirements of AWWA C-111/ ANSI A21.11) shall be supplied with the pipe in sufficient quantities for installing the pipe furnished.~~

~~501.4.04~~05 Flanged Ductile Iron Fittings

a. Flanged fittings shall ~~conform~~be ductile iron conforming to ANSI/AWWA C-~~207~~110/A21.10 and shall be faced and drilled Class ~~D or~~125 flanges that match ANSI B16.~~5 150 lb class for pressure ratings up to 150 psi, and either ANSI/AWWA C-207 Class E or ANSI B 16.5 150 lb class for pressure ratings between 150 psi and 275 psi~~1 fittings. Flanges shall have flat faces and attached

with bolt holes straddling the vertical axis of the pipe. ~~Bolts and nuts shall conform to AWWA C-111/ANSI A21.11. The fittings shall be cement-mortar lined to same thickness specified for pipe.~~

b. Bolts for assembly of flanged joints shall be of the size and quantity shown in the latest version of AWWA C-110. As stated in AWWA C-110, bolts shall conform to ANSI B18.2.1, Square and Hex Bolts and Screws Inch Series, Including Hex Cap Screws and Lag Screws. Nuts shall conform to ANSI B18.2.2, Square and Hex Nuts. Threads shall conform to ANSI B1.1 Standard for Unified Inch Screw Threads (UN and UNR Thread Form), Class 2A external and Class 2B internal. Bolts and nuts shall be of low-carbon steel conforming to the requirements of ASTM A-307 Standard Specifications for Carbon Steel Bolts and Studs, 60,0000 psi Tensile Strength Grade B.

c. The fittings shall be cement-mortar lined to same thickness specified for pipe.

501.4.~~05~~06 Gaskets

a. **~~Locking~~Restraining gaskets:** ~~When available for the specified D.I. pipe size, locking rubber~~Push-on joints shall utilize restraining gaskets ~~(~~as approved by the pipe manufacturer. The restraining gaskets shall consist of stainless steel locking segments vulcanized into the gasket to grip the pipe and prevent joint separation, such as ~~Romac GripRing~~™ ~~,~~ U.S. ~~Steel~~Pipe Field Lok ~~350~~®~~,~~™, American Fast-Grip®, or approved equal~~) conforming~~ Gaskets shall conform to AWWA C-111/ ANSI A21.11 and shall be ~~used (~~suitable for ~~bell ends). ~~the specified pipe size and pressures.

b. **Flanged gaskets:** Gaskets shall be suitable for the specified pipe sizes and pressures. Flanged gaskets shall ~~be~~consist of 1/8-inch thick, full-face one-piece rubber gaskets, full-cut~~,~~ with holes to pass bolts conforming to ANSI/AWWA C-207 and ANSI B16.21. Gasket material shall be free from corrosive alkali or acid ingredients.

501.4.~~06~~07 Mechanical Couplings

Mechanical couplings, clamps, or sleeves, not part of the pipe itself, shall be D.I. or steel with rubber rings or gaskets. Gaskets, bolts, and nuts shall conform to AWWA C-111/ANSI A21.11. Couplings, clamps, or sleeves shall be Dresser®, or approved equal.

501.5.00 CONSTRUCTION SPECIFICATIONS

501.5.01 General Provisions

All installation and testing of water system improvements shall conform to the latest adopted revision of the Oregon ~~Health Division~~ Administrative Rules, Chapter 333, "Public Water Systems," except where the City's provisions exceed those of the state.

501.5.02 Scheduling

a. The contractor shall plan their construction work in conformance with Section 101.8.02, "Scheduling."

b. Newly installed water lines shall not be placed in service until necessary testing and sterilization are complete and system has been approved by the City's authorized representative.

501.5.03 Environmental Protection, Erosion Prevention, and Sediment Control

The contractor shall take all appropriate measures and precautions to minimize their impact on the environment and control erosion, as outlined in Section 101.9.00, "Environmental Protection, Erosion Prevention, and Sediment Control."

501.5.04 Interferences and Obstructions

Various obstructions may be encountered during the course of the work. The contractor shall follow the guidelines established in Section 101.8.05, "Interferences ~~and~~, Obstructions, Abandoned Utilities."

501.5.05 Abandon Water Facilities

Water facilities to be abandoned shall be cut off and completely removed at 24-inches minimum below finish grade, unless specifically stated otherwise. Water valves shall be cut and completely removed from abandoned lines, unless otherwise directed by the City's authorized representative. Water mains to be abandoned shall be removed or completely filled with a flowable, Controlled Low-Strength Material (CLSM) as directed by the City's authorized representative.

501.5.06 Contaminated Soil or Hazardous Material

If during construction contaminated soil or ~~with~~ hazardous materials or chemicals are encountered, the Contractor shall follow the procedures specified in Section 101.9.02, "Contaminated Soils or Hazardous Materials."

501.5.~~06~~07 Trench Excavation, Preparation, and Backfill

Trench excavation, preparation, and backfill shall conform to the requirements of Section 6, "Trench Excavation and Backfill."

501.5.~~07~~08 Preservation, Restoration, and Cleanup

Cleanup of all construction debris, excess excavation, and excess materials and complete restoration of all fences, mailboxes, ditches, culverts, signposts, and similar items shall be completed according to Section 101.8.16, "Preservation, Restoration, and Cleanup."

501.6.00 DUCTILE IRON PIPE—INSTALLATION

501.6.01 Suitable Conditions for Laying Pipe

a. Provide and maintain ample means and devices at all times to remove and dispose of water seepage and runoff entering the trench excavation during the process of ~~pipe laying~~laying pipe. Water in the trench shall not be allowed to enter the pipe and fittings.

b. Do not lay pipe in water or when, in the opinion of the City's authorized representative, trench conditions are unsuitable.

501.6.02 Handling

a. **Distributing Pipe:** Distribute material on the job from cars, trucks, or storage yard no faster than it can be used to good advantage. In general, distribute no more than one week's supply of material in advance of the laying.

b. **Handling Pipe and Fittings:** Provide and use proper implements, tools, and facilities for safe and proper work. Lower all pipe, fittings, and appurtenances into the trench, piece by piece, by means of a crane, sling, or other suitable tool or equipment, ~~-~~to prevent damage to the pipeline materials and protective coatings and linings. Do not drop or dump pipeline materials into the trench.

501.6.03 Cleaning Pipe and Fittings

a. Remove all lumps, blisters, and excess coating from the bell and spigot ends of each pipe. Wire-brush the outside of the spigot and the inside of the bell and wipe them clean, dry, and free from oil and grease before the pipe is laid.

b. Wipe clean all dirt, grease, and foreign matter from the ends of mechanical joint and rubber gasket joint pipe and fittings.

501.6.04 Placing Pipe in Trench

~~Pipe Bells/Joints~~

~~1.~~a. At the location of each joint, dig bell (joint) holes of ample dimensions in the bottom of the trench and at the sides, where necessary, to permit the joint to be made properly and to permit easy visual inspection of the entire joint.

b. Unless otherwise directed, lay pipe with the bell end facing in the direction of the laying.

c. For lines on ~~steep~~ slopes~~,~~ greater than 20%, face bells upgrade ~~only~~, unless otherwise directed by the City's authorized representative.

~~1.~~d. Do not allow foreign material to enter the pipe while it is being placed in the trench. At the end of each work day or during suspension of the work, securely close the pipe ends by means of a secure plug or approved equivalent.

~~2.~~e. Lay and join pipe with push-on, restrained type joints in strict accordance with the manufacturer's recommendations. Provide all special tools and devices, such as jacks, chokers, and similar items required for the installation. Lubricant for the pipe gaskets shall be furnished by the pipe manufacturer, and no substitutes shall be permitted under any circumstances.

~~3.~~f. After the first length of push-on, restrained joint pipe is installed in the trench, secure the pipe in place with approved backfill material that is tamped under and along the spring line to prevent movement. Keep the ends clear of backfill. After each section is joined, place backfill as specified in Section 6, "Trench Excavation and Backfill" to prevent movement.

g. Mechanical joint fittings vary slightly with different manufacturers. Install the furnished fittings in accordance with the manufacturer's recommendations. In general, the procedure shall be as specified here.

1. Clean the ends of the fittings of all dirt, mud, and foreign matter by washing with water and scrubbing with a wire brush. ~~When the ends of the fittings are clean, slip~~

2. Slip the gland and restraining gasket on the plain end of the pipe. If necessary, lubricate the end of the pipe to ease sliding the gasket in place. ~~Then guide~~

~~4.~~3. Guide the fitting onto the spigot of the laid pipe.

501.6.05 Cutting Pipe

a. Cut pipe for inserting valves, fittings, or closure pieces in a neat and workmanlike manner, without damaging the pipe or lining and leaving a smooth end at right angles to the axis of the pipe.

b. The contractor shall cut ductile iron pipe using a method approved by the City's authorized representative; all burrs or rough edges shall be removed before joining pipe. The contractor shall not flame-cut the pipe.

c. Dress cut ends of push-on joint pipe by beveling with a heavy file or grinder~~,~~ ~~or~~ as recommended by the manufacturer.

501.6.06 Permissible Deflection of Joints

Wherever it is necessary to deflect the pipe from a straight line either in a vertical or horizontal plane, to avoid obstructions, or where long-radius curves are permitted, the amount of deflection allowed shall not exceed the values shown in ~~**Table 5.1**~~**Table 5.1** or the manufacturer's recommendations, whichever is less.

Table 5.1. MAXIMUM PERMITTED DEFLECTION, 18-FOOT-LONG PIPE

Mechanical Joint			Push-On Joint	
Diameter (inches)	**Max. Defl. Angle (degrees-minutes)**	**Deflection[1] (inches)**	**Max. Defl. Angle (degrees)**	**Deflection[1] (inches)**
4	4° – 09¢	15	3°	10
6	3° – 33¢	13	3°	10
8	2° – 40¢	10	3°	10
12	2° – 40¢	10	3°	10

Note: Maximum deflection shall be ~~whichever is less,~~ the lesser value ~~shown in~~between the deflection table ~~or that recommended~~and recommendations by the pipe manufacturer.

[1]Safe deflection shown is for 150 psi of pressure. For higher pressure, reduce tabulated deflection 10% for each 150 psi of added pressure.

501.6.07 Alignment

Pipelines intended to be straight shall not deviate from the straight line at any joint in excess of 1 inch horizontally or 1 inch vertically.

501.6.08 Anchorage and Restraint

All pipelines 4 inches in diameter or larger shall be secured with a suitable mechanical joint restraint system (such as Megalug®~~, RomaGrip™~~,® Series 1100 as manufactured by EBAA Iron, Inc or approved equals) at all tees, plugs, caps, and bends, and at other locations where unbalanced forces exist. Where required, provide thrust ~~blocking~~restraint as specified in ~~Section 501.09.10~~Section 501.2.06, "Thrust ~~Blocking and~~ Restraint." Gaskets shall be installed in accordance with Section 501.4.~~05~~06, "Gaskets."

501.6.09 Construction of Blow-offs

Blow-offs shall be constructed as shown in **Detail No.** ~~W-3050~~**WT-3075** or ~~W-3055~~**Detail No. WT-3085** of these standards. Straddle blocks shall be constructed of reinforced concrete; the concrete mix shall be commercially produced and have a compressive strength of not less than 3,000 psi at 28 days, unless otherwise approved by the City's authorized representative. Blow-offs shall not be flushed or pressurized until a minimum of 7 days after concrete is installed. If high-early cement is used for the straddle block, the time may be cut by two days. Fire hydrants shall be installed in place of blow-offs at dead end water lines intended to be extended in the future.

501.6.10 Locating Wire Specifications

a. Install tracer wire ~~(12-gauge with blue THNN insulation)~~ beside the pipe and plastic caution tape 1-foot above the pipe crown. ~~Wire~~

b. Tracer wire connections shall ~~surface~~occur at all junctions and be connected using a solderless connection kit suitable for direct burial that joins wires mechanically and electrically and seals out moisture, GelCap or approved equal.

c. Surface tracer wire at fire hydrants, ~~valve boxes, and blowoffs~~blow-offs, and water services only. Tracer wire shall not be accessed through water valves.

d. Tracer wire shall be 12-gauge stranded or solid copper insulated High Molecular Weight Polyethylene (HMW-PE) with a blue insulated cover a minimum 45 mil in thickness and the wire UL rated for 140°F.

501.7.00 VALVES AND VALVE BOXES

501.7.01 Scope

This section covers the work necessary for furnishing and installing gate valves, butterfly valves, and valve boxes, complete.

501.7.02 Materials

a. ~~a.~~ **Gate Valves:**

1. ~~Resilient~~ Gate valves shall be resilient seated ~~gate valves~~with ductile iron body, sized 3 inches through ~~12~~8 inches, and shall conform to AWWA Standard C-509 ~~or~~and C-515 for ductile iron body valves. The manufacturer's name, the model, and the year of manufacture are to be cast on each valve.

2. Valve ends are to be flanged or mechanical joint by flanged, as shown on the plans, and conform to AWWA C-111 and ANSI Class 125. Buried service valves shall open with a counterclockwise rotation of a 2-inch operating nut.

3. All internal parts shall be accessible without removing the body from the line. The one-piece wedge shall be completely encapsulated by resilient material. The resilient sealing material shall be permanently bonded to the wedge with a rubber tearing bond meeting the requirements of ASTM D-429.

4. ~~Nonrising~~Valves shall have nonrising stems (NRS) and shall be cast bronze with integral collars in compliance with AWWA C-509 ~~or~~and C-515. The NRS shall have two O-ring seals above the thrust collar and one below. The two top O-rings are to be field replaceable (in the full open position) without removing the valve from service. Low-friction thrust bearings shall be placed above and below the stem collar. The stem nut shall be bronze and independent of the wedge.

5. Outside screw and yoke valves shall have a bronze stem attached to the disc assembly. An adjustable follower gland shall be incorporated to compress braided packing and seal the stem.

6. The waterway in the seat area shall be smooth, unobstructed, and free of cavities. The ~~cast~~ductile iron body and bonnet shall be fully coated, both interior and exterior, with a fusion-bonded, heat-cured thermo setting material meeting all the application and performance requirements of AWWA C-550.

7. Gate valves shall meet the testing requirements as presented in AWWA C-509 and C-515.

b. ~~b.~~ **Butterfly Valves:**

1. Butterfly valves shall be the rubber-seated type, suitable for direct-burial service. They shall withstand ~~150~~250 psi working pressure and a ~~150~~250 psi pressure differential across the valve. Except as noted, the butterfly valve shall conform to AWWA C-504 for Class ~~150B~~250B.

2. Valve ends are to be flanged or flanged by mechanical joint, as shown on the plans, and conform to AWWA C-111 and ANSI Class 125.

3. All joint accessories shall be furnished with valves.

4. Valves shall be equipped with an ASTM A536 ductile iron body and 304 stainless-steel circular shaft. Shaft and disc seals shall be designed for a

~~bottle~~bubble-tight seal. The valve disc shall be ~~cast~~ductile iron ~~with~~ASTM A536 and a stainless-steel edge with ~~acrylonitrile-butadiene (NBR)~~Buna N rubber seat bonded to the valve body.

5. The butterfly valve shall be furnished with a totally enclosed, integral valve operator design to withstand a minimum of 300 foot-pound input torque without damage to the valve or operator. Operators shall be fully gasketed and greased-packed and designed to withstand submersion in water to a pressure of 10 psi. Valves shall open with a counterclockwise rotation of a 2-inch operating nut. A minimum of 30 turns of the operating nut shall be required to move the disc from a fully opened position to a fully closed position.

6. Butterfly valves shall meet the testing requirements as presented in AWWA C-504.

c. ~~c.~~ **Extension Stems for Valve Operators:**

1. Where the depth of the operating nut is more than 3 feet, operating extensions shall be provided to bring the operating nut to a point 18 inches below the surface of the ground or pavement (see **Detail No. ~~W~~WT-3015** of these ~~Standards~~standards).

2. Where the depth of the operating nut is more than 6 feet, install a second rock guard plate equidistant between the first rock guard plate and the 2~~"~~-inch operating nut.

3. The extension shall be constructed of solid steel rod and approved by the City's authorized representative. Cut extensions to the proper length so the valve box does not ride on the extension when set at grade.

501.7.03 Workmanship

a. ~~a.~~ **Valves:**

1. Valves shall be installed in accordance with **Detail No. ~~W~~WT-3020** of these standards. Valves shall be flanged by mechanical joint; valves shall be flanged to all tees and crosses.

2. Before installation, the valves shall be thoroughly cleaned of all foreign material. Valves shall be inspected for proper operation, both opening and closing, and to verify that the valves seat properly.

3. Valves shall be installed so that the stems are vertical, unless otherwise directed.

4. Jointing shall conform to AWWA C-600 or AWWA C-603, whichever applies. Joints shall be tested with the adjacent pipeline. If joints leak under test, valves shall be disconnected and reconnected, and the valve or the pipeline or both shall be retested.

b. ~~b.~~ **Valve Boxes:**

1. Valve boxes shall be installed in conformance with **Detail No. ~~W~~WT-3020** of these standards.

2. Center the valve boxes and set plumb over the wrench nuts of the valves. Set valve boxes so they do not transmit shock or stress to the valves. Set the valve box covers flush with the surface of the finished pavement, as shown in **Detail No. ~~W~~WT-3020** of these standards or to another level as may be required.

3. Where the depth of the operating nut is more than 3 feet, operating extensions shall be provided in accordance to ~~Section 501.7.02.c.~~Section 501.7.02.c, "Extension Stems for Valve Operators."

4. Valve boxes shall be ~~the two-piece sliding type,~~ cast iron ~~with 6⅝ inch shaft, and shall be~~ "Vancouver~~ style of appropriate length for the installation, or as approved.~~" pattern with 18-inch tall casting. The letter W shall be cast into the top of the lid. ~~Extension pieces, if required, shall be the manufacturer's standard type for use with~~Valve riser pipe from the valve ~~box~~to the cast iron top shall be 6-inch PVC sewer pipe ASTM D3034, SDR35. The valve riser pipe shall be one-piece and have sufficient length depending on the depth to the operating nut.

5. Backfill shall be the same as specified for the adjacent pipe. Place backfill around the valve boxes and thoroughly compact it to a density equal to that specified for the adjacent trench and in such a manner that will not damage or

displace the valve box from the proper alignment or grade. Misaligned valve boxes shall be excavated, plumbed, and backfilled at the contractor's expense.

6. In non-paved areas, the valve box shall be set in a concrete collar as shown in **Detail No. ~~W~~WT-3020** of these standards.

501.8.00 FIRE HYDRANTS

501.8.01 Scope

This section covers the work necessary for furnishing and installing the fire hydrants, complete. Fire hydrants shall be installed as shown in **Detail No. ~~W-3040~~WT-3060** of these standards.

501.8.02 Hydrants

a. Hydrants shall have a nominal 5¼-inch main valve opening with 6-inch bottom connections. The main valve shall be equipped with O-ring seals and shall open when turned ~~left or~~ counterclockwise.

b. The operating nut shall be a 1½-inch national standard pentagon nut.

c. Hydrants shall be equipped with two 2½-inch hose nozzles and one 4½-inch pumper nozzle with a Storz HPHA50–45NH permanent hydrant adapter.

d. Hydrants shall conform to AWWA C-502 and ~~to the City's standards.~~have a self-lubricating rising stem. The normal depth of bury shall be 4 feet. Nozzle threads shall be American National Standard. The inlet connection shall be mechanical joint, restrained by a mechanical joint restraint system such as Megalug®, ® Series 1100 as manufactured by EBAA Iron, Inc., or approved equal.

e. Hydrants shall be Mueller Centurion, Waterous Pacer, or approved equal.

f. Hydrants shall be painted ~~with Miller Paint Acrinamel #7323 Safety Yellow, Rust-Oleum #7645 Industrial Low V.O.C. Equipment Enamel Yellow, or approved equal~~Yellow in accordance with **Detail No. WT-3060** of these standards.

501.8.03 Base Block

The base block shall be solid precast concrete pier block with nominal dimensions of 8-inch thickness and 12-inch-square base.

501.8.04 Workmanship

Construction and installation shall conform to these standards and to the provisions of AWWA C-600, except where otherwise specified.

501.8.05 Location and Position

a. Fire hydrants shall be located in compliance with TVF&R requirements. ~~Locate as shown, or as directed, to provide complete accessibility and to minimize the possibility of damage from vehicles or injury to pedestrians. The maximum distance from a TVF&R approved driving surface to a fire hydrant is 15 feet.~~ Improperly located hydrants shall be disconnected and relocated at the contractor's expense.

b. When the hydrant is placed behind the curb or sidewalk, set the hydrant barrel so that no part of the pumper or hose nozzle cap is less than 24 inches from the face of the curb or the backside of the sidewalk.

c. Set all hydrants plum ~~and~~with nozzles parallel with the curb, or at right angles to it. With the pumper nozzle facing the curb, set hydrants so that the safety flange is at least 3 inches and at most 6 inches above the finished ground or sidewalk level, to clear bolts and nuts.

d. No concrete, fencing, or other obstructions interfering with the hydrant operation shall be installed in the hydrant clear zone. The clear zone is a triangular area that extends 3 feet behind a hydrant, 5 feet on each side.

e. Bollards may be required to be placed around hydrants located in areas exposed to vehicular traffic at the direction of the City's authorized representative.

~~d.~~f. Install an approved blue bi-directional, ~~reflecterized~~reflectorized button in the center of the near travel lane using an approved fast-setting bonding agent.

501.8.06 Excavation

Do not carry excavation below the subbase grade. Refill over excavated areas with ~~gravel~~Class "B" Backfill material in accordance with Section 6, "Trench Excavation and Backfill" compact ~~the fill~~ to create a firm foundation.

501.8.07 Base Rock

Place ~~base rock~~Class "B" Backfill material in accordance with Section 6, "Trench Excavation and Backfill" on a firm, level subbase or subgrade to assure uniform support.

501.8.08 Installation of Hydrants

a. Fire hydrants shall be connected to the main with 6-inch ductile iron pipe in accordance with per the same requirements for water main pipe of Section 5. The connecting pipe shall be continuous piping with no sleeves allowed.

b. Fire hydrants installed on existing mains shall be installed with a standard wet tapping sleeve and gate valve per **Detail No. WT-3025** of these standards. Tapping sleeve shall be flange x MJ gate valve and shall match hydrant line size.

c. Fire hydrants installed with new main construction shall be connected to the main with MJ x MJ x flange tee fitting and flange x MJ gate valve.

d. Place the hydrant carefully on the base block to prevent the base block from breaking. After the hydrant is in place and is connected to the pipeline, place temporary blocks to maintain the hydrant in a plumb position during subsequent work.

501.8.09 Gravel for Drainage

Gravel for drainage shall be washed 1½" – ¾" aggregate or graded river gravel free of organic matter, sand, loam, clay, or other small particles that will restrict water flow through the gravel. Place gravel around the base block and hydrant bottom after the hydrant is blocked in place. Top of gravel shall be not less than 6 inches above the hydrant drain opening. Do not connect the drainage system to the sewer.

501.8.10 Thrust Blocking and Restraint

a. Fire hydrants shall be secured by thrust blocking. Provide reaction or thrust blocking, as shown in **Detail No.** ~~W-3040~~**WT-3060** of these standards, or as directed. Place blocking between the undisturbed ground and the fitting to be anchored. Blocking bearing surface shall be as shown in **Detail No.** ~~W~~**WT-3000** of these standards.

~~b.~~1. Place the blocking so that the pipe and fitting joints will be accessible to repairs by wrapping all joints and fittings in new plastic sheeting (minimum 8 mil thickness).

~~c.~~2. The concrete mix shall be commercially produced and have a compressive strength of not less than 3,000 psi at 28 days, unless otherwise approved by the City's authorized representative.

~~d.~~b. ~~Fire hydrant laterals~~Mechanical joint fittings at all hydrants, valves, and bends shall be ~~secured with a mechanical~~restrained by a joint restraint system such as Megalug®~~, RomaGrip™~~,® Series 1100 retainers as manufactured by EBAA Iron, Inc., or approved ~~equals.~~equal.

c. Push-on joints shall utilize restraining gaskets in accordance with Section 501.4.06.a "Restraining Gaskets."

501.8.11 Thrust Ties

~~Thrust~~Stainless Steel thrust ties may be used with concrete thrust blocking, with prior approval of the City's authorized representative, when the top of the existing ground

behind the fire hydrant is less than 2 feet above the top of the hydrant base or where unsuitable ground prevents proper anchorage.

501.9.00 HYDROSTATIC TESTING AND STERILIZATION OF NEWLY INSTALLED PIPE

501.9.01 Hydrostatic Testing

a. Contractor shall make pressure and leakage tests on all newly laid pipe; follow the procedures specified in AWWA C-600, Section 5.2, "Hydrostatic Testing." The new mains being tested shall remain isolated from the existing water system.

b. Contractor shall furnish all necessary equipment and material, make all taps in the pipes as required, and conduct the tests.

~~a.~~c. Contractor shall notify the City's authorized representative a minimum of 2 business days prior to testing. The City's authorized representative will monitor the tests and assure that all taps are installed and service pipe extended.

~~b.~~d. Furnish ~~the following~~ equipment and materials for the tests~~:~~ as shown in **Table 5.2**.

Table 5.2. HYDROSTATIC TESTING EQUIPMENT & MATERIALS

Amount	Description
2	Pressure gauges
1	Hydraulic force pump approved by the City's authorized representative
1	Suitable hose and suction, as required

~~c.~~e. Conduct the tests after the trench is backfilled ~~or partially backfilled with the joints left exposed for inspection, or when completely backfilled, as permitted~~and compacted to required specifications and approved by the City's authorized representative. Where any section of pipe has concrete thrust blocking, do not take the pressure tests until at least five days elapse after the concrete thrust blocking is installed. If high-early cement is used for the concrete thrust blocking, the time may be cut by two days.

~~d.~~f. Conduct pressure tests in the following manner, unless otherwise approved by the City's authorized representative. After the trench is backfilled or partially backfilled as specified here, fill the pipe with water, expelling all air during the filling. The minimum test pressure shall be 150 psi. For lines working with operating pressures in excess of 100 psi, the minimum test pressure shall be 1½

times the operating pressure at the point of testing~~, however,~~. The test pressure shall not exceed pipe or thrust-restraint design pressures. The duration of each pressure test shall be 2 hours, unless otherwise directed by the City's authorized representative.

1. **Procedure:** Fill the pipe with water and apply the specified test pressure by pumping, if necessary. Then valve off the pump and hold the pressure in the line for the test period. Test pressure shall not vary by more than ±5 psi for the duration of the test. At the end of the test period, operate the pump until the test pressure is again attained. The pump suction shall be in a barrel or similar device, or metered so that the amount of water required to restore the test pressure can be measured accurately.

2. **Leakage:** Leakage shall be defined as the quantity of water necessary to restore the specified test pressure at the end of the test period. No pipe installation will be accepted if the leakage is greater than the number of gallons per hour, as determined by the following formula:

$$L = \frac{SD(P)^{1/2}}{133{,}200 \text{ (where) } 148{,}000}$$

Where: L = allowable leakage (gallons per hour).

S = length of pipe to be tested (feet).

D = nominal diameter of pipe (inches).

P = average test pressure during the leakage test (psi).

3. **Correction of Excessive Leakage:** Should any test of laid pipe disclose leakage greater than that allowed, locate and repair the defective joints or pipe until leakage in a subsequent test is within the specified allowance.

4. **Valve Testing**: Once the system has passed the pressure test, the Contractor shall proceed testing each individually closed valve within the tested system. Individually closed valves shall be pressure tested for a minimum of 15 minutes using the same rate of loss criteria stated above. If any valves are found to not hold pressure, they shall be operated, repaired or replaced, and retested until they pass.

501.9.02 Sterilization

Pipeline intended to carry potable water shall be sterilized before it is placed in service. Disinfection by chlorination for pipelines shall be accomplished according to AWWA C-651, as modified or expanded below, and City requirements. Disinfection of water-storage facilities, water treatment plants, and wells shall be accomplished

according to the appropriate sections of AWWA C-652, AWWA C-653, and AWWA C-654.

a. ~~a.~~ **Flushing:** Before sterilizing, flush all foreign matter from the pipeline. Contractor shall provide hoses, temporary pipes, ditches, etc., as required to dispose of flushing water without damaging adjacent properties. The Contractor shall provide the minimum temporary blowoff/inlet sizes as shown in **Table 5.3** to adequately flush the pipeline. If flushed into a sewer system, the contractor shall provide screening and remove all accumulated construction debris, rocks, gravel, sand, silt, and other foreign material from the system at or near the closest downstream manhole; no material shall be flushed into the downstream city sewer system. Flushing velocities shall be at least 2.5 feet per second (fps). For large-diameter pipe that is impractical or impossible to flush at 2.5 fps, clean the pipeline in place from the inside by brushing and sweeping, then, flush the line at a lower velocity.

~~b.~~

Table 5.3. REQUIRED OPENINGS TO FLUSH PIPELINES

Nominal Pipe Size (inches)	Flow Required to Produce 2.5 FPS Velocity (GPM)	Minimum Inlet & Outlet Pipe Size Required (inch)
4	110	2
6	240	2
8	430	4
12	950	4
18	2140	6
24	3800	6

b. **Sterilizing Mixture:**

1. Sterilizing mixture shall be a chlorine-water solution having a free chlorine residual of 40 to 50 parts per million (ppm). The sterilizing mixture shall be prepared by injecting (a) a liquid chlorine-water mixture or (b) a calcium sodium hypochlorite and water mixture into the pipeline at a measured rate, while fresh water is allowed to flow through the pipeline at a measured rate so that the chlorine-water solution is of the specified strength.

2. The liquid chlorine-water mixture shall be applied by means of an approved solution-feed chlorinating device. Chlorinating devices for feeding solutions of the chlorine itself must provide a means of preventing the backflow of water.

3. If the calcium hypochlorite procedure is used, first mix the dry powder with water to make a thick paste, then, thin to approximately a 1% solution (10,000 ppm chlorine). If the sodium hypochlorite procedure is used, dilute the liquid with water to obtain a 1% solution. Add the 1% solution to water to obtain a final sterilizing solution of 40 to 50 ppm. ~~Table 5.2~~Table 5.4 shows the correct proportions of hypochlorite to water.

Table 5.~~2~~4. RATIO OF HYPOCHLORITE TO WATER

Product	Quantity	Water

Calcium hypochlorite[1] (65%-70% Cl)	1 lb.	7.5 gal
Sodium hypochlorite[2] (5.2% Cl)	1 gal	4.25 gal

[1]Comparable to commercial products known as HTH®, Perchloron®, and Pittchlor®.

[2]Liquid laundry bleach, such as Clorox® or Purex®.

501.9.03 Point of Application

a. Inject the chlorine mixture into the pipeline to be treated ~~at~~within 5 feet of the beginning of the line through a corporation stop or a suitable tap in the top of the pipeline. Water from the existing system or other approved source shall be controlled to flow slowly into the newly laid pipeline during the application of chlorine. The proportion of the flow rate of the chlorine mixture to the rate of water entering the pipe shall be such that the combined mixture shall contain 40 to 50 ppm of free available chlorine.

b. Valves shall be manipulated so that the strong chlorine solution in the line being treated will not flow back into the line supplying the water. Use check-valves if necessary.

c. Operate all valves, hydrants, services and other appurtenances during sterilization to assure that the sterilizing mixture is dispersed into all parts of the line, including dead ends, new services, and similar areas that otherwise may not receive the treated water.

d. Do not place the concentrated quantities of commercial sterilizer in the line before it is filled with water.

e. After chlorination, flush the water from the line (see ~~Section 501.7.05)~~Section 501.9.05, "Disposal of Flushing and Sterilizing Water") until the water through the line is equal chemically and bacteriologically to the permanent source of supply.

NOTE: When testing and sterilizing procedures are complete, remove the testing corporation stop and replace it with a threaded brass plug.

NOTE: The practice of adding a small amount of chlorine powder or tablets at each joint as the main is being laid is *not* an acceptable method of chlorinating a pipeline. The procedure does not permit preliminary flushing, nor does it distribute chlorine uniformly.

501.9.04 Retention Period

Treated water shall be retained in the pipeline long enough to destroy all non-spore-forming bacteria. With proper flushing and the specified solution strength, 24 hours is adequate. At the end of the 24-hour period, the sterilizing mixture shall have a strength of at least 10 ppm of chlorine. To minimize damage to cement mortar lining in ductile iron pipe and fittings, chlorine solution contact time shall not exceed 60 hours.

501.9.05 Disposal of Flushing and Sterilizing Water

a. Dispose of flushing and sterilizing water in ~~an~~a manner approved ~~manner~~by the City's authorized representative. If the volume and chlorine concentration is such as to pose a hazard to the City's Wastewater Treatment Plant operation, the sterilizing water shall be metered into the system~~.~~ per direction of the City's authorized representative. Notify the City of Wilsonville ~~Environmental Services~~Utility Division ~~24 hours~~2 business days before disposing of sterilizing water into the City sanitary system.

b. Do not allow sterilizing water to flow into a waterway or storm line without reducing the chlorine to a safe level via adequate dilution or another neutralizing method, as approved by the City's authorized representative.

501.9.06 Bacteriological Testing

a. City ~~Water~~Utility staff, with the assistance of the contractor's representative, will obtain water samples for ~~microbiological analysis 48~~the first of two bacteriological samples 24 hours after the contractor flushes the water line.

b. Following a 24-hour retention period, City Utility staff will obtain the second bacteriological sample.

c. Both water samples must pass the bacteriological tests before the water facilities will be accepted.

~~c.~~d. Contractor shall request the City ~~Water~~Utility staff to sample lines at least ~~24 hours~~ 2 business days in advance. Applicant shall reimburse the City for the cost of collecting and testing each water sample. Fee for water collection and testing is provided on the Engineering Department's ~~Project~~Public Works Permit.

501.10.00 WATER SERVICE CONNECTIONS

501.10.01 Scope

The work includes trench excavation and backfill, furnishing and installing service saddles, corporation or valves, meter vaults or boxes, meters, service connection piping, fittings, and appurtenances within the designated limits, testing, flushing, and other incidental work as required for a complete installation.

501.10.02 Hydrostatic Test and Leakage

Test service connections and service connection pipe in conjunction with the main, as detailed in ~~Section 501.9.00~~Section 501.9.00, "Hydrostatic Testing and Sterilization of Newly Installed Pipe."

501.10.03 Materials

a. **Service lines: ¾- and 1-inch:** Service connections shall be tapped directly into the ductile iron pipe. Corporation stops for ¾-inch (single service) and 1-inch copper service lines shall have AWWA thread inlet and compression connect outlet ~~and shall be Mueller®~~.

b. **Service lines: ~~larger than~~ 1- ½-inch~~:~~ ~~All service lines greater than 1~~ and 2-inch ~~in size~~:** Service connections h shall attach to the water main using a 2-inch tee or service saddle ~~and compression couplings~~, 2-inch gate valve and 2-inch copper tubing to the angle valve per **Detail No. WT-3045** of these standards.

c. **Meter Boxes and Covers:** Generally, meter boxes and covers are installed in landscape areas and shall be pedestrian rated per **Detail No. WT-3035** through **Detail No. WT-3037** of ~~the type indicated in **Table 5.3**, Pedestrian Rated, or approved equal.~~these standards for ¾" and 1" water meters and **Detail No. WT-3050** through **Detail No. WT-3052** of these standards for 1 ½" and 2" water meters. Occasionally, with the approval of the City's ~~Authorized Representative~~authorized representative, installation of meter boxes in driveway areas may be allowed. In these cases, meter boxes and covers shall be ~~of the type indicated in **Table 5.3**, Traffic Rated, or approved equal. All boxes shall be ordered with a 3" x 6" mouse hole precut into one end of the box~~traffic rated per **Detail No. WT-3038** through **Detail No. WT-3040** of these standards for ¾" and 1" water meters and **Detail No. WT-3053** through **Detail No. WT-3055** of these standards for 1 ½" and 2" water meters.

~~Table 5.3. METER BOXES AND COVERS~~

~~Service Line~~	~~Pedestrian Rated~~		~~Traffic Rated~~	
	~~Meter Box~~	~~Meter Cover~~	~~Meter Box~~	~~Meter Cover~~
~~¾ inch and 1-inch,~~	~~Armorcast No. P6001868x12~~	~~Armorcast No. A6001866 H1~~	~~Armorcast No. A6001946PCx12~~	~~Armorcast No. A6001969 H1~~
~~1½ inch and 2 inch~~	~~Armorcast No. P6001534 X18~~	~~Armorcast No. P6001634 H1~~	~~Armorcast No. A6001640 PCX12~~	~~Armorcast No. A6001947T~~

d. **Corporation Stops:** ~~1-inch corporation~~Corporation stops for ¾-inch and 1-inch services shall be ~~Mueller H-15008 (110 Compression) for direct taps or Mueller H-15028 (110 Compression) for saddle taps; Mueller H-15000 (Flare) for direct~~

~~taps or Mueller H-15025 (Flare) for saddle taps.~~provided per **Detail No. WT-3030** of these standards.

e. **Angle Valves:** ~~Mueller H-14255 angle curb stop. Ford~~Angle valves shall be provided per **Detail No.** ~~KV23-444W~~**WT-3030** of these standards for ¾-inch and 1-inch service lines and ~~1-inch line. Mueller No.14276 or 14277, Ford No. FV 23-777W~~**Detail No. WT-3045** of these standards for 1½-inch and 2-inch ~~line~~service lines.

f. **Copper Tube:** Copper tube used for ¾-inch to 1-inch service connections shall be soft temper Type K, conforming to ASTM B-88. Copper pipe used for 1½-inch to 2-inch service connections shall be (hard) drawn temper Type K, conforming to ASTM B-88. If sleeved in a rigid casing, use soft temper, type "K" copper tubing.

501.10.04 Workmanship

a. ~~a.~~ **Trench Excavation, Preparation, and Backfill:** Trench excavation, preparation, and backfill shall conform to the requirements of ~~Section 6~~Section 6, "Trench Excavation and Backfill~~." Backfill material in the~~. The trench shall be backfilled to within 6 inches of the service connection pipe or line. Cover over pipe shall be as indicated in **Detail No. S-2140** of these standards.

b. ~~b.~~ **Connection to Main:** The City's authorized representative shall be notified and shall be present during tapping of City water main, unless otherwise approved by the City's authorized representative. Service connections shall be installed as shown in **Detail No.** ~~W~~**WT-3030** or ~~W-3035~~**Detail No. WT-3045** of these standards~~.~~ and as follows:

1. Taps shall be made in the pipe by experienced workmen, using tools in good repair, with proper adapters for the size of pipe being tapped.

2. Line taps shall be 30° above the horizontal for ~~¾"~~¾-inch or 1~~"~~-inch service connections~~, and~~

3. Line taps shall be centered on the spring line of the pipe being tapped for 1~~½"~~½-inch or 2~~"~~-inch service connections.

4. Tap shall be made no closer than 18 inches from the outside edge of the sleeve to the beginning of the bell flare or end of the MJ fitting. ~~The City's authorized representative shall be notified and shall be present during tapping of City water main, unless otherwise approved by the City's authorized representative.~~

c. ~~c.~~ **Copper Tubing:** The copper tubing shall be cut with square ends, reamed, cleaned, and made up tightly. Care shall be taken to prevent the tube from kinking or buckling on short radius bends. Kinked or buckled sections of copper

tube shall be cut and the tube spliced with the proper brass fittings, at the contractor's expense.

d. ~~d.~~ **Installation of Meters and Meter Boxes:**

1. Meters and meter boxes or vaults shall be installed as shown in **Detail No. W-3030** or **Detail No. W-~~3035~~3045** of these standards, or as directed by the City's authorized representative.

2. City of Wilsonville ~~Water~~Utility Division shall install all meters 2 inches in diameter or less. Meters larger than 2 inches in diameter shall be installed by the contractor under the supervision of City of Wilsonville ~~Water~~Utility Division.

3. Meters shall not be installed until the entire water system is ready for operation, the system has been tested and approved, and water meter permit(s) have been obtained from the City of Wilsonville Building Division.

4. The remainder of the service connection, excluding the meter, may be installed at any time during or after construction of the main. Before the meter is connected, the angle valve shall be opened and the service line flushed of all foreign materials, and shall be properly tested and chlorinated.

5. The finish grade of the completed meter enclosure shall allow a minimum of 6 inches and a maximum of 12 inches of clearance from the top of the meter to the meter box. Meter boxes or vaults shall be set or constructed plumb, with the top set horizontally. Lightly compacted earth backfill shall be placed inside the meter boxes to the bottom of the meter stop. Grade adjustments of the meter boxes or vaults shall be made by using standard extension sections for the specified box or vault. Backfill around meter vaults shall be as specified for adjoining pipe. Provide adequate space to allow for sidewalk installation. Under no circumstances shall meter boxes be placed in the sidewalk.

6. Depending on the elevation difference between the meter and the main line water system working pressure, the City may require a backflow-prevention valve and/or a pressure reducing valve on the customer side of the meter, at the meter box. Installation shall be approved by the City's authorized representative.

501.11.00 WATER LINE ACCEPTANCE POLICY

501.11.01 Water Line Activation

The City of Wilsonville will provide water to the project when the following are complete.

a. Compliance with these standards.

b. Installation of the materials and workmanship as described herein.

c. ~~Successful~~A successful hydrostatic pressure tests, as witnessed and approved by the City's authorized representative.

d. Adequate flushing and chlorination of mains, as witnessed and approved by the City's authorized representative.

e. ~~Approval by an Oregon Health Division certified water quality laboratory~~Acceptable results of samples taken for bacteriological examination~~.~~ by an Oregon Environmental Laboratory Accreditation Program (ORLAP) accredited drinking water laboratory.

501.11.02 Locate Wire Testing

Prior to paving, the contractor shall notify the City's authorized representative that the water system locate wire is ready for testing. City personnel shall connect to the locate wire and attempt to locate water main line, services, and connections to water system appurtenances. All points of the water system shall be located from at least two connection points to be considered to have adequate coverage. The contractor will be required to locate and repair any gaps in the locate wire coverage. Failed sections shall be retested until adequate coverage is obtained.

501.11.03 Water Line Acceptance

The City of Wilsonville will accept new water installations or systems built to the "Public Works Standards," provided that the following conditions are met.

a. Dedication of any required easements or rights-of-way have been recorded with the County Recorder and the Engineering Department receives a reproducible copy of the recorded documents.

b. After completion of construction of the total project, and after all testing has been satisfactorily completed, project closeout shall proceed as outlined in ~~Section 101.8.17.a~~Section 101.8.17, "Project ~~Completion~~Closeout."

c. The Contractor or Applicant shall be responsible for providing Maintenance Assurance for Public Improvements as outlined in ~~Section 101.8.17.b~~Section 101.8.18, "Maintenance ~~Assurance~~and Warranty." Public water ~~improvements shall be warranted for a minimum of one year; public landscape~~ improvements shall be warranted for a minimum of two years.

d. At any time during the warranty period, the City's authorized representative has reason to believe the public water improvements have defects that were the result of faulty workmanship or flaws in construction material, the responsible party shall be required, at that party's own cost, to repair any faults to the public water improvements deemed necessary by the City's authorized representative.

e. Before the end of the Construction Maintenance period, the City's authorized representative shall inspect the project for any remaining deficiencies. If the deficiencies that remain are determined to be the responsibility of the contractor or the applicant, the contractor or applicant shall then make such repairs.

~~f. The Landscape Maintenance assurance shall be released two years after acceptance of construction, providing the landscaping meets the 90% survival level (see Section 301.13.02, "Landscape Inspection for Warranty")~~

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SECTION 6

TRENCH EXCAVATION AND BACKFILL

601.1.00 DEFINITIONS

a. **Trench Excavation:** Trench excavation is the removal of all material encountered in a trench to the depths shown on the plans or as directed by the City's authorized representative. Trench excavation shall be classified as either common or rock excavation.

~~(a)~~1. "Common excavation" is defined as the removal of all material that is not classified as rock excavation. The term "rock excavation" shall be understood to indicate a method of removal and not a geological formation.

~~(b)~~2. "Rock excavation" is defined as the removal of material that cannot, in the City Engineer's judgment, be reasonably excavated with equipment comparable in machine weight and rated horsepower to a hydraulic hoe excavator with a minimum weight of 45,000 pounds and a net horsepower rating of 130 to 140. Rock excavation is also the removal of material by drilling and blasting (see ~~Section 601.3.01.i~~Section 601.3.01.i, "Explosives~~,~~"" for blasting restrictions) or power-operated rock-breaking equipment. Boulders or concrete pieces larger than ½ cubic yard encountered in the trench excavation shall be classified as rock excavation if removing them requires any of the above excavation methods, in the opinion of the City's authorized representative.

b. **Trench Foundation:** The bottom of the trench ~~on which~~where the pipe bedding will lie. The trench foundation supports the pipe bedding.

c. ~~c.~~ **Pipe Bedding:** The furnishing and placing of specified materials on the trench foundation to uniformly support the barrel of the pipe, from the trench foundation to the spring line of the pipe.

d. ~~d.~~ **Pipe Zone:** The full width of the trench, from 12 inches above the top outside surface of the barrel of the pipe to the spring line of the pipe.

e. **Spring Line:** Halfway up the sides of the pipe (horizontal centerline) when the pipe is laid on the pipe bedding.

f. **Haunch:** That portion of the pipe below the spring line.

g. **Trench Backfill:** The furnishing, placing, and compacting of material in the trench between the top of the pipe zone material and the bottom of the pavement base rock, ground surface, or surface materials.

h. **Native Material:** Earth, gravel, rock, or other common material free of humus, organic matter, vegetative matter, frozen material, clods, sticks, and debris, isolated points or areas, or larger stones that would fracture or dent the structure or subject it to undue stress.

601.2.00 MATERIALS

601.2.01 Trench Foundation

Trench foundation (as defined in ~~Section 601.1.00.b)~~Section 601.1.00.b, "Trench Foundation") shall be native material in all areas except where groundwater or other conditions exist and, in the opinion of the City's authorized representative, the native material cannot support the bedding and pipe. Under those conditions, geotextile fabrics approved by the City's authorized representative shall be installed, or the unsuitable material shall be removed, as determined by the City's authorized representative, and the trench ~~backfilled with Class B backfill.~~foundation backfilled with Class B backfill in accordance with Section 601.2.03, "Trench Backfill".

601.2.02 Pipe Area

a. **Pipe Bedding:** Pipe bedding material shall be Class B backfill~~, uniformly graded from coarse to fine,~~ in accordance with Section 601.2.03, "Trench Backfill", or as approved by the City's authorized representative.

b. **Pipe Zone:** The pipe zone material shall consist of Class B backfill~~.~~ in accordance with Section 601.2.03, "Trench Backfill."

601.2.03 Trench Backfill

Above the pipe zone, trench backfill will be divided into the following classifications ~~(from ODOT SSC):~~:

a. **Class A Backfill:** Class A backfill shall be native or common material, which in the opinion of the City's authorized representative meets the characteristics required for the specific surface loading. Selected trench ~~fill~~backfill material shall contain no frozen soil, gravel, or cobbles larger than 6 inches in diameter, and shall be free of organic or other deleterious material.

b. **Class B Backfill:** Class B backfill shall be ¾"-0" granular grade crushed aggregate material, unless otherwise approved by the City's authorized representative. The aggregate shall conform to the following.

1. The aggregate shall consist of uniform-quality, clean, tough, durable fragments of rock or gravel and shall be free of flat, elongated, soft, or disintegrated pieces, or other objectionable matter occurring either free or as a coating on the stone.

2. The aggregate shall meet the requirements for fractured faces and durability as specified in ODOT SSC Section 02630.10 "Dense-Graded Aggregate."

3. Gradation and plasticity index requirements of the crushed aggregate shall be as shown for ¾"-0" rock in ~~**Table 2.7**~~**Table 2.15**, "Gradation Requirements of Granular ~~Backfill."~~Fill." Sieve analysis shall be determined according to AASHTO T-27.

4. Class B backfill material shall be approved by the City's authorized representative prior to placement.

c. **Class E Backfill**: Class E backfill shall be commercially mixed Controlled Low-Strength Material (CLSM) made up of a mixture of fly ash, cement, fine aggregate, water and admixtures, if necessary. Fine aggregate shall consist of commercial quality concrete sand. CLSM shall attain a 28-day compressive strength of 100 psi – 200 psi.

601.3.00 CONSTRUCTION

601.3.01 Excavation

a. **Clearing and Grubbing:** When clearing the right-of-way is necessary, clearing shall be completed before the start of trenching. Clearing and grubbing shall follow the procedures outlined in Section 201.5.02, "Clearing and Grubbing." Under no condition shall excavated materials be permitted to cover brush before the brush is cleared and disposed of. Excavated material shall be stockpiled where and so it does not create a hazard to pedestrian or vehicular traffic; nor shall it interfere with the function of existing drainage facilities.

b. **Erosion Control:** The contractor shall be responsible for erosion prevention and sediment control on the jobsite and shall use appropriate prevention measures as outlined in ~~Section 101.9.04~~Section 101.9.04, "Erosion Prevention and Sediment Control." The contractor shall maintain the erosion-prevention and sediment-control facilities as specified in Section 101.9.05, "Maintenance."

c. **Interferences and Obstructions:** Various obstructions may be encountered during the course of the work. The contractor shall follow the guidelines established in Section 101.8.05, "Interferences ~~and~~, Obstructions, Abandoned Utilities."

d. **Contaminated Soils:** If during construction soils contaminated ~~soil or~~ with hazardous materials or chemicals are encountered, the Contractor shall follow the procedures specified in Section 101.9.02, "Contaminated Soils or Hazardous Materials."

e. **Open Trench Limit**

1. Construction shall proceed in a systematic manner that will result in minimum inconvenience to the public. Construction staking for the work being performed shall be completed before the start of excavation.

2. The contractor shall limit their operations to a small work area per crew. The length of the excavated trench shall always be kept to a minimum. At no time shall the trenching equipment be farther than 100 feet ahead of the pipe-laying crews, unless advance written permission is given by the City's authorized representative.

3. ~~The trench~~Trenches shall be backfilled so that no section of trench is left open ~~longer than 24 hours. Before~~at the ~~contractor stops construction for the~~end of each work day, ~~trenches located in the right-of-way shall be completely backfilled,~~ unless the trench is covered with Steel Plates. Use of Steel Plates shall conform to ~~Section 101.8.02.b.5~~Section 101.8.02.b.7, "Progress of Construction."

4. Trenches with unstable trench walls shall be backfilled immediately upon verification by the City's authorized representative.

5. Trenches located outside of an active right-of-way (e.g. roadways closed to all modes of access, subdivision construction), may be left open at the request of the City's authorized representative of a sufficient length of time to perform necessary inspections. Open trenches shall be protected with the use of an adequate number of cones, construction tape, and/or construction fencing.

~~1.~~f. **Trench Width**

1. The trench width at the surface of the ground shall be kept to the minimum necessary to safely install the pipe. All aspects of excavation, trenching, and shoring shall meet current OSHA standards and regulations. In all cases, trenches must be wide enough to allow for shoring and to permit proper joining of the pipe and backfilling and compaction of material along the sides of the pipe.

2. ~~Trench~~The trench width in the pipe zone must ~~provide~~include a ~~minimum~~ clear working space outside the maximum outside diameter of the pipe~~.~~ ~~Minimum~~ as follows.

(a) For pipe less than and including a 12-inch interior diameter, the clear working space shall be 6 inches ~~for pipe up to 12-inch interior diameter; for~~ .

(b) For pipe greater than a 12-inch interior diameter, the ~~minimum~~ clear working space shall be ½ the inside pipe diameter up to a maximum of 24 inches ~~(see Table A in Detail No. S-2140 or Detail No. S-2145 of these standards). Excavation for~~.

~~2.~~(c) For manholes and other structures, the clear working space shall be wide enough to provide ~~at least~~ 12 inches between the ~~structure's surface~~face of the structure and the sides of the excavation or shoring.

See Table A in **Detail No. S-2145** for the required clear working space for each size of pipe.

3. Maximum width of the trench at the top of the pipe shall be 12 to 24 inches plus the width of the pipe bell. When required by the project design, the maximum trench width shall be shown on the plans.

4. If the contractor exceeds the maximum trench width ~~shown on the plans~~ without written authorization, the contractor shall be required to contact the design engineer or the geotechnical engineer and obtain written approval allowing installation of the pipe as specified, or contractor shall provide, at their cost, pipe of a higher strength designation, a higher class of bedding, or both, as recommended by the design engineer or the geotechnical engineer, and approved by the City's authorized representative.

5. ~~The contractor shall confine the top width of the trench to right-of-ways or easements. If~~Where circumstances require extending the trench width ~~of the trench~~at ground surface beyond the right-of-way or easement boundary, the applicant shall obtain written agreements with the affected property owner(s), and provide them to the City's authorized representative before commencing excavation.

g. **Grading**

1. The bottom of the trench shall be graded to the line and grade to which the pipe is to be laid, with proper allowance for pipe thickness and bedding material, or for greater base when specified or indicated. Before laying each section of the pipe, check the aggregate grade and correct any irregularities.

2. The trench bottom shall form a continuous and uniform bearing surface and support the pipe on solid and undisturbed ground at every point between bell holes, except that the grade may be disturbed for removing lifting tackle.

h. **Rock Excavation**

1. Where the bottom of the trench encounters ledge rock, boulders, or large stones that meet the definition of "rock excavation," rock excavation shall be performed to create six inches of clearance on each side and below all pipe and accessories.

2. Excavations below subgrade in rock shall be backfilled to subgrade with Class B backfill material, in accordance with Section 601.2.03, "Trench Backfill" and compacted to not less than 90% of its maximum dry density as determined by AASHTO T-180.

i. **Explosives**

Explosives shall not be used in the City of Wilsonville without prior written approval from the City Engineer.

601.3.02 Installation ~~(see trench detail drawing of these standards)~~

a. **Shoring**

1. The contractor shall provide all materials, labor, and equipment necessary to adequately shore trenches to protect the work, existing property, utilities, pavement, etc., and to provide safe working conditions in the trench.

2. Cribbing or sheeting that extends below the spring line of rigid pipe or below the crown elevation of flexible pipe shall be left in place, unless a satisfactory means can be demonstrated for reconsolidating bedding or side support that would be disturbed by removing the cribbing or sheeting.

3. If a movable box is used instead of cribbing or sheeting and the bottom cannot be kept above the spring line of the crown elevation of the flexible pipe, the bedding or side support shall be carefully reconsolidated behind the movable box before backfill is placed.

4. The use of horizontal strutting below the barrel of pipe, or the use of pipe as support for trench bracing, will not be permitted.

b. **Dewatering**

~~a.~~1. The contractor shall provide and maintain ample means and devices for promptly removing and disposing of all water entering the trench excavation while the trench is prepared for pipe laying, during the laying of the pipe, and until the backfill is placed and compaction is complete.

~~b.~~2. Groundwater shall be controlled to keep it from softening the bottom of the excavation. Dewatering systems shall be designed and operated to prevent removal of the natural soils and to keep the groundwater level outside the excavation from being reduced to an extent that would damage or endanger adjacent structures or property.

~~c.~~3. Dewatering systems shall be discharged to a ~~stormwater~~storm water detention/retention facility unless otherwise approved by the City's authorized representative.

4. Sediments shall be settled and filtered before discharge. All settling systems shall be engineered and adequately sized for site conditions. In general, settling and filtering options, which shall be approved by the City's authorized representative, include but are not limited to:

   (a) Containment in a pond structure until water is clear. Place the pump in a gravel bed at the bottom of the pond.

   (b) Pumping to a Baker tank or other settling tank with sampling ports.

   (c) Filtering through a sieve or other filter media.

   (d) Manufactured bags or other systems. These systems do not always work on fine clay soils and will be allowed for use only where approved.

   (e) Application of a polymer/flocculant where its use has been approved.

5. Filtering devices need to be inspected frequently to make sure they are functioning properly.

6. Filtering devices shall be filled in or otherwise removed when they are no longer necessary.

c. **Grade~~:~~**

~~c.~~ The contractor shall excavate the trench a minimum of 6 inches plus the pipe wall thickness below the specified pipe grade, or as established by the

geotechnical engineer. The subgrade on which the bedding is to be placed shall be firm, undisturbed, and true to grade.

d. **Trench Foundation**

1. When in the judgment of the geotechnical engineer or the City's authorized representative, the existing material in the bottom of the trench is unsuitable to support the pipe, the contractor shall excavate below the pipe, as directed.

2. The contractor shall backfill the trench to the subgrade of the pipe bedding with Class B backfill ~~material~~in accordance with Section 601.2.03, "Trench Backfill", over the full width of the trench, and shall compact in layers not exceeding 6 inches deep.

3. Fill material shall be compacted to not less than 90% of its maximum dry density, as determined by AASHTO T-180.

e. ~~e.~~ **Pipe Bedding**

1. Class B backfill ~~material~~in accordance with Section 601.2.03, "Trench Backfill", shall be placed under all pipes.

2. Pipe bedding consists of leveling the bottom of the trench on the top of the foundation material and placing bedding material to the horizontal centerline of the pipe, unless otherwise specified.

3. Granular base shall be placed in the trench to a depth of 6 inches, loose, for the full width of the trench. The contractor shall spread the bedding smoothly to the proper grade so the pipe is uniformly supported along the barrel.

4. The contractor shall excavate bell holes at each joint to permit proper assembly and inspection of the entire joint. Bedding under the pipe shall provide firm, unyielding support along the entire pipe length.

5. Contractor shall be aware of the importance in proper placement and compaction of backfill material placed below the spring line of the pipe (haunch area). Proper backfilling ensures that adequate stability and support is provided to the pipe during final backfilling of the pipe zone. Backfill material shall be worked under the haunches by hand to ensure intimate contact between the backfill material and the pipe.

f. **Backfill in Pipe Zone**

1. After the pipe is in place and ready for backfilling, place Class B backfill, in accordance with Section 601.2.03, "Trench Backfill", to a minimum depth of 12 inches over the top of the pipe. The material shall be placed at

approximately the same rate on each side of the pipe, so that the elevation of the aggregate on each side of the pipe is always equal.

2. Particular attention shall be given to the backfilling and tamping procedure to assure that there are no unfilled or ~~noncompacted~~uncompacted areas ~~under~~around the pipe.

g. **Trench Backfill**

1. Backfill shall be placed in the trench in such a way as to **not** permit material to freefall until the top of the pipe is covered by at least 2 feet of material. Under no circumstances shall the contractor allow sharp, heavy objects to drop directly onto the pipe or pipe zone material around the pipe.

2. If the required compaction density cannot be obtained, the contractor shall remove the backfill from the trench and recompact. The process shall be repeated until the contractor establishes a procedure that will provide the required density. The contractor will then be permitted to proceed with backfilling and ~~compacting~~compaction of the rest of the pipeline under the approved compaction procedure.

3. Within the public right-of-way, trench backfill shall consist of ~~granular fill meeting~~Class B backfill.

~~3.~~4.The City's authorized representative may approve the ~~requirements~~use of ~~Section 201.3.01, "Granular Fill."~~ Class E backfill, CLSM, material for trench backfill above the pipe zone.

h. **Native or Select (Class A) Backfill**

1. Backfill the entire depth of the trench above the pipe zone with excavated trench materials placed in 12-inch layers. Remove all cobbles and stones 2 inches in diameter and larger from material used for backfill in the upper 12 inches of the trench.

2. Compact each layer using mechanical tampers or vibratory compactors to 85% of its maximum dry density, as determined by AASHTO T-180. Bring the fill to the required surface grade, and ~~compact~~compactde so that no settlement will occur.

i. **Granular (Class B) Backfill**

1. Granular backfill material shall meet the requirements of Section 201.3.01, "Granular Fill." Granular backfill shall be tested at a minimum of every 200 feet of trench length and at depths specified by the City's authorized representative.

2. ~~The aggregate~~ Compact the trench backfill material within 2 feet of road base rock grade ~~shall be compacted~~ to not less than 95% of its maximum dry density, as determined by AASHTO T-180. ~~Backfill~~ Compact trench backfill material placed more than 2 feet from road base rock grade ~~shall be compacted~~ to not less than 90% of its maximum dry density.

APPENDIX A

BICYCLE AND PEDESTRIAN FACILITIES

A.1.00 INTRODUCTION

The purpose of this appendix is to outline the design and construction requirements for bicycle and pedestrian improvements in the City of Wilsonville. The City regards facilities for bicyclists and pedestrians as important parts of the overall transportation system and not just recreational facilities, and shall continue to improve and expand pedestrian and bicycle facilities, with a focus on improved connectivity between major activity centers while minimizing conflicts with other modes of transportation.

Bicycle and pedestrian facilities are addressed in the City of Wilsonville's TSP, the 1993 Bicycle and Pedestrian Master Plan (BPMP), and the 1994 Parks and Recreation Master Plan (PRMP).

A.1.01 Bicycle and Pedestrian Facility System

To encourage bicycling and walking in the City, it is critical to provide safe and convenient systems that connect residential, commercial, and industrial destinations. Therefore, major and minor collector and arterial street design shall include bicycle facilities on or near the streets. Sidewalks shall be provided on (preferred) or near all streets. The multi-use path system shall be expanded to provide off-street pathways and trails for convenience, safety, and recreation. Finally, the citywide bicycle and pedestrian facility system shall connect with existing and potential routes outside of the City limits. To this end, the City shall continue to coordinate with other cities, counties, the state, and Metro to further a regional approach to bicycle and pedestrian issues.

A.1.02 Playgound Facilites

Playground facilities shall be designed in conformance to the Consumer Product Safety Commission Handbook for Public Playgound Safety, or latest edition.

A.2.00 DESIGN OF BICYCLE AND PEDESTRIAN FACILITIES

A.2.01 General Design, Location, and Easement Requirements

a. **Design:** The design of all bicycle and pedestrian facilities within the City of Wilsonville shall be in conformance with applicable AASHTO, ODOT, and ADA requirements and standards, as provided in the 1999 AASHTO publication, "Guide for the Development of Bicycle Facilities," the 1995 ODOT publication, "Oregon Bicycle and Pedestrian Plan," and ADAAG guidelines, or latest editions. Any deviation from the AASHTO, ODOT, ADA, or City standards shall require written approval from the City Engineer.

b. **Location:** Bicycle and pedestrian facilities shall be installed on the basis of the City of Wilsonville's TSP, BPMP, and PRMP. In case of conflict, however, the BPMP takes precedence in matters dealing with off-street facilities.

c. **Right-of-Way and Easements**

1. All public-owned bicycle facilities shall be constructed within a public right-of-way or easement. When a bicycle facility must be constructed outside the public right-of-way, an appropriate easement shall be granted to the City for construction and maintenance of the facility; the location and width of the easement shall be approved by the City's authorized representative. A temporary construction easement may also be required.

2. All new development or redevelopment within the City shall provide an easement to access adjacent streets, neighborhoods, and properties, especially schools, retail, and commercial areas. The intent of the easements is to reduce the length of travel to desired destinations from residential areas, thereby promoting bicycle/pedestrian travel.

A.2.02 On-Street Design Standards

a. **Design Standards:** On-street standards for different situations are described below. It is recommended that bicycle lanes be the preferred facility design. Other facility designs should be used only if the bicycle lane cannot be constructed to the standard because of physical constraints. The alternative standards are listed in order of preference.

1. **Bicycle Lane**

(a) Bicycle lanes shall always be one-way facilities and carry bicycle traffic in the same direction as adjacent motor vehicle traffic.

(b) The design shall include 12-foot minimum travel lanes for motor vehicles with 5- to 6-foot paved shoulders, or 5-foot paved lanes where on-street parking is allowed that are striped, marked, and signed as bicycle lanes.

(c) There shall be a minimum clear riding zone of 4-feet if there is a longitudinal joint between asphalt pavement and concrete gutter. Additional widths are recommended where substantial truck traffic is present, on grades, or where motor vehicle speeds exceed 35 miles per hour.

(d) This shall be the basic standard applied to bicycle lanes on all arterial and collector streets in the city. Bicycles lanes shall not exceed 6 feet in width.

2. **Shoulder Bikeway:** This design includes a 12-foot minimum travel lane for motor vehicles with 5- to 6-foot paved shoulders that are striped but not marked as a bicycle lane. This should only be used in rural situations when it is

determined by the City's authorized representative that a marked bicycle lane is inappropriate.

3. **Shared Roadway:** This design features 14- to 16-foot travel lane widths for both motor vehicles and bicycles. This standard should be applied to all arterial and collector streets only when sufficient pavement width is not available for a separate bicycle lane. On arterial and collector streets, bicycle route signage is required to alert motorists to the potential presence of bicyclists.

b. **Drainage Grates**

1. Drainage grate inlets and utility covers are potential problems for bicyclists. When a new roadway is designed, all such grates and covers shall be kept out of bicyclists' expected path.

2. On new construction, curb inlets shall be used wherever possible to completely eliminate the exposure of bicyclists to grate inlets.

3. Grates and utility covers shall be adjusted flush with the surface, including after a roadway is resurfaced.

4. Grates shall be identified with a pavement marking, as indicated by the MUTCD, Part 9, or latest edition. Drainage grate inlets shall be bicycle-safe (as required by ORS 810.150) and hydraulically efficient.

c. **Railroad Crossings**

1. Railroad-highway/multi-use path grade crossings should meet at right angles. The greater the approach angle deviates from 90^{o}, the greater the potential for a bicyclist's wheel to be trapped in the railroad flangeway.

2. Where the crossing angle is less than 45^{o}, consideration shall be given to widening the outside lane, shoulder, or bicycle lane to allow bicyclists adequate room to cross the tracks close to a 90^{o} angle.

3. In the case of multi-use path crossings, centerline stripes shall be provided to encourage a right-angle approach. Where these options are not possible, commercially available compressible flangeway fillers shall be installed.

4. The roadway approach shall be at the same elevation as the rails.

5. Warning signs and pavement markings shall be installed in accordance with the MUTCD, Part 9.

A.2.03 Off-Street Design Standards

Standards for off-street facilities are as follows:

c. **Bicycle/Pedestrian (Multi-use) Path:** Multi-use paths are facilities on exclusive rights-of-way or easements. These facilities are physically separated from the roadway and are designed to exclude motor vehicle traffic, except at crossings. Separation shall be obtained by a barrier or by a minimum of 5 feet of open space. It is the City's policy not to illuminate multi-use paths.

1. **Width of Multi-use Paths**: Paths shall have a minimum width of 10 feet for two-way multi-use traffic and 12 feet where high multi-use traffic is expected. In addition, a minimum 2-foot clear distance on both sides of the path is required, although a 3-foot side clear distance is preferred. The maximum gradient for side clear areas shall be 6H:1V.

2. **Overhead Vertical Clearance:** Overhead vertical clearance shall be a minimum of 8 feet. However, vertical clearance shall be a minimum of 10 feet where vehicular traffic is expected and in under-crossings or tunnels.

3. **Horizontal Curves and Sight Distance**

   (a) Multi-use path horizontal curves shall have a minimum 35-foot centerline curve radius.

   (b) Corner sight distance shall be a minimum of 25 feet.

   (c) When substandard radius curves must be used on multi-use paths because of right-of-way, topographical, or other considerations, standard curve warning signs and supplemental pavement markings shall be installed in accordance with the MUTCD, Part 9. The negative effects of substandard curves can be partially offset by widening the pavement through the curve and removing objects that impair sight distance.

4. **Drainage:** The minimum pavement cross slope shall be 2%. Curves shall be banked with the low side on the inside of the curve. Paths constructed along hillsides shall have an interceptor ditch of suitable dimension on the uphill side.

5. **Super-elevation Rate:** For most multi-use path applications, the super-elevation rate (i.e., a raised elevation of one side of the path) will vary from a minimum of 2% (the minimum necessary to encourage adequate drainage) to a maximum of 5% percent (beyond which maneuvering difficulties by slow bicyclists and adult tricyclists might be expected). The minimum super-elevation rate of 2% will be adequate for most conditions and will simplify construction.

6. **Grade**

   (a) Grades on multi-use paths shall be kept to a minimum, especially long inclines, and are recommended to be no greater than 5%.

   (b) Where terrain dictates, grades over 5% and less than 500 feet in length are acceptable only when consideration has been given to sight distance and

stopping distances. In areas of generally steep terrain, it may be desirable to meander path alignments to attain reasonable grades for steep slope ascent.

(c) In no case shall a "down-hill" approach grade of the intersection of a multi-use path to a sidewalk or street exceed 5% for the last 50 feet unless provisions have been made to provide satisfactory sight vision between the two intersecting facilities.

(d) Grade changes on pathways shall provide for a minimum pedal clearance of 6 inches. If use by pedestrians is expected, ADA requirements must be met.

7. **Structures**

(a) Multi-use paths constructed along hillsides or next to drainage ditches steeper than 3H:1V shall be protected with an approved handrail system in conformance with Detail No. R-1150 of these standards.

(b) Bridges designed exclusively for bicycle and pedestrian traffic shall be designed for pedestrian live loadings. Bridge width shall be the total of the path width plus the side clear distances (see Section A.2.02.a.1). Bridge decks shall be designed with bicycle safe expansion joints. Decking boards shall be placed transverse to the direction of normal bike travel and shall be coated with a nonskid surfacing material approved by the City's Public Works Department.

(c) Where gravel driveways cross the path, a 5-foot paved apron shall be provided to minimize the transfer of gravel to the pathway.

8. **Pavement Design**

(a) Subgrades shall be sterilized with a suitable non-environmentally hazardous herbicide that is approved by the City of Wilsonville Public Works Operations Division, in cooperation with the Environmental Services Division, to prevent subsequent intrusion of hardy weeds, vines, or other plant material into or upheaving through path surfaces.

(b) Additional asphalt, base rock, and subgrade reinforcement shall be provided in path sections projected to bear heavy maintenance vehicle traffic. No less than one additional inch of asphalt shall be provided in these areas.

(c) The wearing surface of AC pavement shall conform to ODOT SSC Section 00745, "Hot Mixed Asphalt Concrete" for Level 1 HMAC. Pavement design shall be a minimum of 3 inches of AC pavement over a 4-inch thick base consisting of ¾"-0" crushed aggregate backfill, meeting requirements of Section 201.3.01, "Granular Fill." Base rock shall be compacted to 95% of the maximum dry density as determined by AASHTO T-180. Base rock shall be placed over a firm subgrade stripped as per Section 201.5.02, "Clearing and Grubbing."

(d) PCC pavement shall be an acceptable path surface alternative. The surface shall be cross-broomed and crack-control joints shall be saw-cut, not troweled. Minimum design thickness shall be 4 inches of PCC over a 4-inch base consisting of ¾" - 0" crushed aggregate backfill, meeting requirements of Section 201.3.01, "Granular Fill." Base rock shall be compacted to 95% of the maximum dry density as determined by AASHTO T-180. Base rock shall be placed over a firm subgrade stripped as per Section 201.5.02, "Clearing and Grubbing."

(e) Location of expansion and contraction joints in PCC multi-use paths shall be as specified in Detail No. R-1080 of these standards. All expansion joints, paving joints, driveway intersections, and railroad crossings shall be designed to maintain a smooth riding surface.

(f) Pathways shall be protected from root intrusion as per Section 201.2.22.d, "Root Barriers."

9. **Public Easements and Rights-of-Way:** The City, through the development application process, may require the granting of a public easement for multi-use paths. Where it is deemed to be in the best interests of the City, a dedication of right-of-way may be required in lieu of an easement. Bike path easements and rights-of-way shall be no less than 15 feet wide, or wider as determined by the City in accordance with the following:

a) Where terrain dictates cut or fill sections to meet path design requirements, additional width shall be required only to the extent necessary for sideslopes.

b) Where utility needs, drainage requirements or independent bike paths create multi-use opportunities, additional width shall be required only to the extent necessary for the multi-use.

j. **Recreational Trail:** This is an ADA accessible surface with a usable width of 3 to 12 feet conforming to the ADA Standards for Accessible Design requirements. It is the City's policy not to illuminate recreational trails**Controlled Low-Strength Material (Class E) Backfill**

1. Controlled Low-Strength Material (CLSM) shall meet the requirements of Section 601.2.03.c, "Class E Backfill."

2. Backfill the trench above the pipe zone with CLSM to the bottom of the proposed surfacing. No compaction of the CLSM is allowed.

3. Use steel plates to protect the CLSM from traffic a minimum of 24 hours. After 24 hours, the CLSM may be paved. Use of Steel Plates shall conform to Section 101.8.02.b.7, "Progress of Construction."

d. - Page Intentionally Left Blank -

e.8. Landscaping

1. Landscaping shall be provided along multi-use paths and recreational trails. Selection of trees, shrubs, and ground cover should include low-maintenance varieties that are drought tolerant and require little pruning. Shrubs should be low growing (under 3 feet at mature height). Location and placement of plant materials should not result in growth over or onto the path surface.

2. All proposed plant materials shall be approved by the City of Wilsonville. All landscaping, signs, and other potential obstructions shall be set back a minimum of 1 foot from the edge of the pathway surface. No exposed rock shall be permitted within 2 feet of the pathway surface. All exposed earth within 2 feet of the pathway surface shall be planted with grass, sod, or covered with 2" of barkdust.

3.(a) A number of important design considerations should be reviewed when selecting materials and planning planting schemes. Trees are of primary concern regarding location and variety. Specifically, placement and selection of trees should evaluate the following:

(a)i. Tree rooting characteristics - to avoid potential path surface upheaval.

(b)ii. Tree size - trees shall be of satisfactory caliper to permit a minimum vertical clearance of 8 feet to the lowest branch. The clearance shall be a minimum of 10 feet where vehicular traffic is expected.

(c)iii. Tree placement - to avoid creating hiding areas or permitting foliage to block path lighting, trees shall be located a minimum of 10 feet from path lighting fixtures.

f. **Root Control:** Pathways shall be protected from root intrusion as per Section 201.2.22.d, "Root Barriers."

A.2.04 Sidewalks

a. The location, design, and construction of sidewalks shall be in conformance with Section 201.2.22, "Sidewalks," and Detail No. R-1080 of these standards.

b. Special Design Standards: The physical environment shall be enhanced to encourage bicycling and walking by following these standards:

1. Minimum sidewalk width shall be in conformance with Section 4.178(.01) of the Wilsonville Code.

2. Issues should be addressed to encourage walking by providing a more pleasant environment. Urban design features to provide pedestrian amenities such as street trees, furniture, kiosks, trash receptacles, directional signage, and bicycle amenities such as bike racks, shall be provided when required by the City.

3. Pedestrian facilities shall be consistent with the ADA Standards for Accessible Design.

A.2.05 Signing and Marking

a. All pathways and bicycle route shall be clearly identified and posted with signs are a common method for identifying bicycle routes. Signing and marking of bikeways are important in providing safety to users and shall be in conformance with the MUTCD, Part 9.

b. On multi-use paths, adequate signing and marking shall be used to alert users to potential hazards and to convey regulatory messages to bicyclists, pedestrians, and motorists at highway intersections. In addition, guide signs, such as to dictate directions, destinations, distances, route numbers, and names of crossing streets, shall be used in the same manner as they are used on highways.

c. On multi-use path areas where limited sight vision or curves exist, or where heavy volumes of bicycles or nighttime riding is expected, a 4-inch wide yellow centerline stripe shall be used. Four-inch wide white edge lines (or fog lines) shall be used where nighttime bicycle traffic is expected. Skid-resistant pavement marking materials shall be used over materials that become slippery when wet.

A.3.00 TRAFFIC CONTROL

a. At intersections where bicycle traffic exists or is anticipated, bicycles shall be considered in the timing of the traffic signal cycle, as well as the traffic detection device.

b. To check the clearance interval, a bicyclist's speed of 10 miles per hour and a perception/reaction/braking time of 2.5 seconds shall be used. Detectors for traffic-actuated signals shall be sensitive to bicycles and shall be located in the bicyclist's expected path, including left-turn lanes. Where programmed visibility signal heads

are used, they shall be checked to ensure that they are visible to bicyclists who are properly positioned on the road.

c. The MUTCD, Part 9, and the Oregon Supplement shall be consulted for guidance on signs and pavement markings. Where bicyclists are expected to use different patterns than motorists, direction signing shall be used to advise bicyclists of this special routing. At intersections, bicyclists proceeding straight through and motorist turning right must cross paths. It is recommended to use striping and signing configurations that encourage these crossings in advance of the intersection, in a merging fashion.

A.4.00 SUPPORT FACILITIES

In addition to improving public facilities and routes to connect destinations, the City requires basic design considerations for bicyclists and pedestrians when they arrive at their destination. City requirements for the following support facilities can be found in the BPMP and City zoning code:

- On-site Bicycle and Pedestrian Circulation for all New Developments.
- Bicycle and Pedestrian Paths.
- Bicycle Parking Requirements.
- Bicycle Lockers or Other Secure Parking Facilities
- Locational Standards for Bicycle Parking.

APPENDIX B

LANDSCAPE REQUIREMENTS:
STORM WATER QUALITY AND QUANTITY FACILITIES

B.1.00 INTRODUCTION

a. Successful revegetation is critical to the function of water quality and quantity facilities, and vegetated corridors. Plantings improve water quality and provide habitat and aesthetic benefits.

b. The purpose of this appendix is to assist design professionals and the development community in successfully planning, designing, and implementing landscape plans for water quality and quantity facilities and vegetated corridors. The information should not be used simply as a boilerplate applied to all sites. Instead, it should be used to guide design decisions to promote successful planting efforts. Each design will be unique and must consider the individual opportunities and constraints offered by each site.

B.2.00 LANDSCAPE GUIDELINES

The designer must consider four major components while developing landscape plans for water quality and quantity facilities: hydrology, soils, plant materials, and maintenance.

Understanding the future hydrologic conditions at the treatment facility is critical to designing a successful planting plan. Identifying and correcting poor soil conditions and selecting and placing appropriate plant materials are also substantially important for planting success. Finally, landscape design and planting plans should not interfere with a facility's engineering function or create maintenance problems. These four components are discussed in detail below:

B.2.01 Hydrology

a. Varying hydrologic conditions complicate landscape design. Water levels change seasonally and also with local storm events. Treatment facilities are often inundated during the wet season and early growing season, but then dry out during the summer. These conditions must be understood and accounted for in the planting plan. Selected plants must be adapted to variable moisture regimes.

b. Construction documents prepared by a Landscape Architect registered in the State of Oregon are required. Construction documents detail the design and provide good control; good control assures the project is installed as designed.

Proper installation provides predictable hydrologic conditions and thus increases the chances for successful planting.

B.2.02 Soil

a. Plants require appropriate soil conditions to grow. On completion of earthwork, the landscape contractor is commonly left with soils that are high in clay or minerals and devoid of topsoil and organic material, or soils high in noxious weed content.

b. Site preparation is necessary to improve the soil and remove undesirable plant materials and seeds. Before planting, clearing and grubbing (see Section 201.5.02, "Clearing and Grubbing") may be required to remove rhizomes and seed banks where noxious weeds are present. Topsoil should be stripped and stockpiled for reuse whenever possible, but noxious weed conditions may require that topsoil is stripped and removed from the site.

c. Where topsoil has been removed, is not adequate, or does not exist, scarify the subgrade and import 4 inches of topsoil, unless noted otherwise. Imported topsoil should be tested for the following characteristics to assure it will provide a good growing medium for the selected plants:

1. Texture – relative proportions of soil separates (sand, silt, and clay).

2. Fertility – nutrient content and fertility status of the soil.

3. Microbial – presence of microbial organisms in the soil.

d. Incorporate 2 inches of garden compost into imported topsoil. Where topsoil is present and is weed free, incorporate 2 inches of garden compost into the top 4 inches of the native soil. Incorporate other amendments, conditioners, and bio-amendments as needed to provide a soil capable of supporting the specified plants. Traditional fertilization techniques (applying N-P-K) are detrimental to the soil and should be avoided when using native plants.

B.2.03 Plant Materials

a. Plant selection must consider soil types, hydrologic conditions, and shade requirements. Dense planting with small stock is preferred to sparse planting with large stock. Native plant stock is recommended because many species are adapted to hydrologic conditions common in water treatment facilities and generally require minimal maintenance. Ornamental stock can be useful for blending treatment facilities into surrounding landscapes, but is discouraged in areas that will not receive additional maintenance.

b. Plantings shall be installed between February 1 and May 1 or between October 1 and November 15. When plantings must be installed outside these

times, additional measures may be needed to assure survival. Additional considerations for preparing planting plans include:

1. Plant Massing: Plantings should be placed in groups ranging from three to seven of the same species to encourage massing. Groupings may be larger, depending on the size of the facility. Groupings of different species can be placed next to each other, as long as the species are appropriate for the given hydrologic conditions.

2. Plant quantities' shall comply with the following minimum acceptable design standard:

   (a) Evergreen trees: 3 per 1000 square feet, minimum height 6 feet.

   (b) Deciduous trees: 2 per 1000 square feet, minimum caliper 1 to 1-1/2 inch at 2 feet above base.

   (c) Shrubs: 30 per 1000 square feet, minimum container 1 gallon or equivalent.

   (d) Wetland plants: 1 per 2 square feet of pond emergent plant zone.

3. Planting Restrictions

   (a) Do not place deep rooting trees and shrubs (e.g., willow) on top of pipe alignments.

   (b) Falling leaves will fill the pond and clog drainage structures. However, it is desirable to place trees, particularly evergreens, next to the south and west perimeter of standing water, to provide shade and thereby reduce water temperatures.

4. Seeding: Seed mixes and application rates for wet, moist, and dry zones are provided in **Tables B.4** and **B.5**. Alternative mixes may be approved by the City.

5. Mulching: Trees, shrubs, and groundcovers shall be adequately mulched with an appropriate material (e.g., compost, bark dust) to retain moisture and discourage weed growth around newly installed plant material.

B.2.04 Maintenance

Providing a low maintenance planting design should be a goal for every facility. However, all treatment facilities will require some degree of maintenance to help assure that facilities function as designed. Third parties (e.g., volunteer groups, homeowner associations) can provide additional maintenance if a more refined aesthetic is desired. The following maintenance issues should be addressed during project design and through the maintenance period:

a. Access: Access roads shall be provided as outlined in Section 301.4.04, "Access Road Design."

b. Irrigation: A method for irrigation shall be installed and used during the plant establishment period, unless a natural water source is available and is an approved substitute by the City. Watering shall be provided to assure survival through the dry season.

c. Weed Control: The removal of noxious weeds including Himalayan blackberry (Rubus discolor), reed canarygrass (Phalaris arundinacea), teasel (Dipsacus fullonum), Canada thistle (Cirsium arvense), and others will be necessary through the maintenance period, or until a healthy stand of desirable vegetation is established.

d. Plant Replacement: Plants that fail to meet the acceptance criteria must be replaced during the maintenance period (see Section 301.13.02, "Landscaping Inspection for Warranty – Stormwater Quality/Quantity Facilities"). Before replacing a plant, the cause for loss shall be determined. On determining the cause, correct the problem (e.g., amend soil, provide wildlife protection, modify species selection) and then replace the plant(s).

e. Erosion Control: Where seeding is used for erosion control, refer to Section 101.9.04, "Erosion Prevention and Sediment Control."

f. Wildlife Protection: Appropriate measures shall be taken to discourage wildlife browsing. Biodegradable plastic mesh tubing, or other substitute approved by the City, shall be placed around individual trees and shrubs to prevent browsing by wildlife, including beaver, nutria, deer, mice, and voles.

B.3.00 RECOMMENDED PLANT SPECIES

a. This section outlines commonly available native plants suited for various hydrologic regimes and illustrates typical planting schemes for water quality and quantity facilities, and vegetated corridors. The schemes provide a foundation from which to begin planting design, but they may require modification in response to individual site characteristics. Consulting a professional landscape architect, ecologist, or horticulturist knowledgeable about native plants and water quality and quantity facility design is highly recommended when preparing planting plans.

a. Water quality facilities and vegetated corridors generally feature three types of planting zones with respect to hydrology during the growing season:

1. Wet (standing or flowing water/nearly constant saturation; anaerobic soils).

2. Moist (periodically saturated; anaerobic and/or aerobic soils).

3. Dry (infrequent inundation/saturation, if any; aerobic soils).

b. Open water, typically 3 feet or more deep, is also common in treatment facilities, particularly in forebays and extended wet ponds. These areas are rarely vegetated, except by floating aquatics that generally volunteer on their own.

d. Specific plant sizes may be required as part of the development approval process, but shall not be less than three to five gallon container stock for trees; one gallon container stock for shrubs; and conservation plugs for emergents. Live stakes shall be used for willow plantings. Live stakes may be used for other species that take readily from cuttings (e.g., Douglas spirea, red-osier dogwood). Conservation plugs are also known as leach tubes and styro-blocks. They typically have soil intact around deeply developed roots systems. They are the preferred alternative for most emergent stock. Rhizomes, tubers, bare root, and potted stock are also acceptable, but they may require additional planting quantities and higher densities to achieve design intent. Plant size and stock may be tailored to meet availability issues and the individual requirements of each site.

e. **Tables B.1, B.2,** and **B.3** list commonly available plants for wet, moist, and dry zones, respectively. The zones are used later in the planting schemes to depict different planting zones within the different water treatment facilities. Plants other than those listed in the following tables may be used with City approval.

Table B.1. PLANTS FOR WET AREAS

Botanical Name	Common Name	Spacing	Preferred Light	Comments
Trees				
Salix sp.	Willow species	3-5' O.C.	Sun, part shade	
Shrubs				
Cornus sericea	Red osier dogwood	3-4' O.C.	Sun, part shade	Highly adaptable
Spirea douglasii	Douglas spirea	2-3' O.C.	Sun	Tolerates prolonged inundation
Herbaceous				
Alisma plantago-aquatica	Water plantain			
Beckmannia syzigachne	American sloughgrass			
Bidens cernua	Nodding beggar's tick	1-2' O.C.	Sun	
Bromus carinatus	California bromegrass			
Carex densa	Dense sedge	12" O.C.	Sun	
Carex comosa	Beared sedge	12" O.C.	Sun	Tolerates variable water regimes
Carex obnupta	Slough sedge	12" O.C.	Shade or part shade; will tolerate sun	Tolerates variable water regimes
Carex stipata	Sawbeak sedge	12" O.C.	Part shade	
Deschampsia caespitosa	Tufted hairgrass			
Deschampia caespitosa	Tufted hairgrass			
Elecoharis spp.	Spikerushes	12" O.C.	Sun	Tolerate prolonged inundation
Elymus glaucus	Blue wildrye			
Festuca rubra v. rubra	Native red fescue			
Iris tenax	Oregon iris			
Juncus effuses	Soft rush			
Juncus ensifolius	Daggerleaf rush	12" O.C.	Sun	
Juncus acuminatus	Tapertip rush	12" O.C.	Sun	
Juncus oxymeris	Pointed rush	12" O.C.	Sun	
Lysichitum americanum	Skunk cabbage			
Sagittaria laifolia	Wapato	12" O.C.	Sun	Favors prolonged inundation (to 6")
Scirpus acutus	Hardstem bulrush	18-24" O.C.	Sun	Favors prolonged inundation
Scirpus microcarpus	Small-fruited bulrush	12" O.C.	Sun, part shade	Tolerates prolonged inundation (to 6")
Scirpus tabernaemontanii	Softstem bulrush	18-24" O.C.	Sun	Favors prolonged inundation
Sparganium emersum	Simplestem bur-reed	12-18" O.C.	Sun, part shade	
Aquatics				
Nuphar luteum ssp.	Pond lily	3' O.C.	Sun	

Table B.2. PLANTS FOR MOIST AREAS

Botanical Name	Common Name	Spacing	Preferred Light	Comments
Trees				
Alnus rubra	Red alder	6-10' O.C.	Sun	Highly adaptable; nitrogen fixer
Acer macrophyllum	Big leaf maple	12-18' O.C.	Sun	
Cornus stolonifera	Redtwig dogwood			
Crataegus douglasii	Black hawthorn	6-10' O.C.	Sun	
Fraxinus latifolia	Oregon ash	10-15' O.C.	Sun, part shade	
Thuja plicata	Western red cedar	12-18' O.C.	Park shade, shade	
Shrubs				
Acer circinatum	Vine maple	10 O.C.	Part sun, shade	
Lonicera involucrata	Twinberry	5' O.C.	Part shade	
Oemleria ceraisformis	Indian plum	5-8' O.C.	Shade	Tolerates fluctuating water table
Physocarpus capitatus	Pacific ninebark	5-8' O.C.	Part shade	
Rosa nutkana	Nootka rose	5' O.C.	Sun	
Rosa pisocarpa	Swamp rose	5' O.C.	Part shade	
Rubus spectabilis	Salmonberry	5' O.C.	Sun, part shade	Prefers slightly drier soils
Sambucus racemosa	Red elderberry	5-8' O.C.	Part shade	
Symphoricarpos albus	Snowberry	5' O.C.	Sun, shade	Prefers well drained soils
Herbaceous				
Aster chilensis ssp. Hallii	Common California aster	3' O.C.	Sun	
Aster subspicatus	Douglas's aster	3' O.C.	Sun	
Cammasia quamash ssp.	Common camas	12" O.C.	Part shade	Bulb; prefers drier soil
Carex aperta	Columbia sedge	12" O.C.	Sun	
Carex deweyana	Dewey's sedge	12" O.C.	Sun, part shade	
Carex obnupta	Slough sedge	12" O.C.	Part shade	
Carex stipata	Sawbeak sedge	12" O.C.	Part shade	
Gualtheria shallon	Salal	3-4' O.C.	Part shade, shade	Prefers moist, well-drained soils
Juncus tenuis	Slender rush	12" O.C.	Sun	
Juncus patens	Spreading rush	1-2' O.C.	Sun Part shade	
Polystichum munitum	Sword fern	3-4' O.C.	Part sun, shade	Prefers moist, well drained soils
Scirpus microcarpus	Small-fruited bulrush	12" O.C.	Sun, part shade	Prefers moister soils

Table B.3. PLANTS FOR DRY AREAS

Botanical Name	Common Name	Spacing	Preferred Light	Comments
Trees				
Alnus rubra	Red alder	6-10' O.C.	Sun	Highly adaptable; nitrogen fixer
Corylus cornuta	Hazelnut	6-10' O.C.	Sun	
Prunus emarginata	Bitter cherry	6-10' O.C.	Sun	Shade intolerant
Quercus garryana	Oregon white oak	10-15' O.C.	Sun	
Pseudotsuga menziesii	Douglas fir	10-15' O.C.	Sunm, part shade	
Shrubs				
Amelanchier alnifolia	Western serviceberry	5' O.C.	Sun, part shade	
Holodiscus discolor	Oceanspray	9' O.C.	Sun, part shade	
Ribes sanguineum	Red flowering currant	6' O.C.	Sun, part shade	
Rosa gymnocarpa	Baldip rose	6' O.C.	Sun	
Rubus parviflorus	Thimbleberry	5' O.C.	Part shade	
Sambucus racemosa	Red elderberry	5' O.C.	Part shade	
Symphoricarpos albus	Snowberry	5' O.C.	Sun/shade	
Herbaceous				
Achillea millefolium	Western yarrow		Sun	1 lb/acre
Arctostaphylos uva-ursi	Kinnikinnick	12-18" O.C.	Sun/shade	
Bromus carinatus	Native California brome		Sun	10 lb/acre
Elymus glaucus	Blue wildrye		Sun	9 lb/acre
Festuca rubra v. rubra	Native red fescue			
Fragaria vesca	Wood strawberry	1' O.C.	Part shade	
Gualtheria shallon	Salal	3-4' O.C.	Part shade Shade	Prefers moist, well-drained soils
Lupinus bicolor	Two-color lupine		Sun	8 lb/acre
Lupinus latifolius	Broadleaf lupine		Sun	8 lb/acre
Lupinus polyphylus	Large-leafed lupine		Sun	8 lb/acre
Mahonia aquifolium	Tall Oregon grape	4-6' O.C.	Sun, part shade	
Mahonia nervosa	Cascade Oregon grape	3-4' O.C.		
Mahonia repens	Creeping Oregon grape	2-3' O.C.		
Solidago canadensis	Canada goldenrod		Sun	2 lb/acre

B.4.00 SEED MIXES

The seed mixes indicated in **Tables B.4** and **B.5** shall be used to overseed in water quality and quantity treatment facilities, and vegetated corridors. One seed mix is prescribed for use in wet and moist zones, and one for dry zones. Alternative mixes may be approved by the City. Broadcast application is discouraged to prevent wind drift of the

smaller, native seeds. Lower rates may be used in areas where seeding is intended to augment other plantings (e.g. the bottom of water quality swales).

Table **B.4. WET/MOIST AREA SEED MIX**

Scientific Name	Common Name	% Mixture
Elymus glaucus	Blue Wildrye	47
Hordeum brachyantherum	Meadow Barley	40
Deschampsia caespitosa	Tufted Hairgrass	10
Glyceria occidentalis	Western Mannagrass	2
Beckmannia syzigachne	American Sloughgrass	1

*Pro Time 840 Native Wetland Mix. Application rate: 20 – 40 lbs/acre

Table B.5. DRY AREA SEED MIX

Scientific Name	Common Name	% Mixture
Elymus glaucus	Blue Wildrye	60
Hordeum brachyantherum	Meadow Barley	30
Bromus carinatus	Native California Brome	10

*Pro Time 400 Native Grass Mix. Application rate: 15 – 30 lbs/acre

B.5.00 PLANTING SCHEMES

The following schemes provide general recommendations for plant placement in water quality facilities and buffers. These are guidelines only; planting plans must be individually tailored to unique conditions at each site. The City's Storm Water Master Plan (2001) also provides guidance for species selection and spacing.

B.5.01 Water Quality Swale

Water quality swales should generally be vegetated with emergents in the swale bottom, with emergents, groundcovers, and shrubs on the sideslopes, and with groundcovers, shrubs, and trees on the adjacent dry areas. Typically, the swale bottom is wet, the lower 8 to 12 inches of the sideslopes are moist, and areas 12 inches above the bottom of the swale are dry.

B.5.02 Extended Dry Pond/Extended Wet Pond

Extended dry ponds and extended wet ponds should be vegetated similarly to water quality swales. Emergents should be placed in the pond bottom, emergents, groundcovers, and shrubs on the sideslopes, and groundcovers, shrubs, and trees on the adjacent dry areas. The hydrologic planting zones will vary in the facilities, but typically, wet areas occur at or below the permanent pool elevation,

moist areas occur between the permanent pool elevation and maximum pool elevation, and dry areas occur above the maximum pool elevation.

B.5.03 Constructed Wetland

Constructed wetlands should feature dense emergent plantings in the wet zones, which are typically composed of deep and shallow emergent areas. Floating aquatics and emergents capable of surviving extended or permanent inundation may also be placed in the permanent pool areas. The moist zones should be planted with emergents, groundcovers, shrubs, and trees, and the dry zones with groundcovers, shrubs, and trees.

B.5.04 Vegetated Corridors

Three types of vegetated corridors are described below: headwater forests, riparian forests, and forested wetlands. Upland and wetland habitats are present in all three types; local topography and drainage patterns dictate where the habitats occur.

a. **Headwater Forest:** Headwater forests are densely wooded and wet throughout most of the year. Steep valley slopes prone to landslides drain the top of the watershed to the stream below. Perennial to intermittent flows may occur, depending on local conditions. Channels range from shallow to deeply entrenched, with rock and large woody debris common throughout. A mixture of wetland and upland species may occur in this community, depending on local drainage and topography. The headwater forest should be planted with 200 trees per acre (three species min.), 300 shrubs per acre (four species min.), and 1,000 emergents per acre (two species min.).

b. **Riparian Forest:** Riparian forests are moderately to densely wooded floodplains beside a stream. Landscape character ranges from flat with open floodplain to moderately steep with U-shaped valleys and upland terraces. They are frequently inundated during the rainy season and moist to dry during the summer. Hydrologic conditions vary. Channels with large woody debris are typically moderately to deeply incised with flat floodplains. Wetland species are the norm, but upland species do occur where microtopography allows. The riparian forest should be planted with 170 trees per acre (two species min.), 300 shrubs per acre (four species min.), and 2,000 emergents per acre (three species min.).

c. **Forested Wetland:** Forested wetlands are densely wooded, wet in the winter, and frequently dry out in the summer. The landscape is flat to gently rolling and may be perched above the stream in some areas. Frequently flooded with low-velocity overbank flows or rainwater results in shallow groundwater interaction or surface water influence into June in normal rainfall years. Stream channels range from shallow to deeply entrenched, depending on local conditions. A natural levee is common along the stream. The forested

~~wetland should be planted with 200 trees per acre (two species min.),300 shrubs per acre (three species min.), and 4,000 emergents per acre (three species min.).~~

APPENDIX C

INFILTRATION REQUIREMENTS, SITE CHARACTERIZATION, AND SITE SUITABILITY CRITERIA

C.1.00 INTRODUCTION

a. This appendix specifies the site characterization and site suitability criteria that must be considered for siting infiltration treatment facilities.

b. For infiltration treatment facilities site selection and design decisions, a geotechnical and hydrogeologic report shall be prepared by a qualified engineer with geotechnical and hydrogeologic experience. A comparable professional, acceptable to the City, may also conduct the work if it is under the seal of a Professional Engineer registered in the State of Oregon. The design engineer shall utilize a team of certified or registered professionals in soil science, hydrogeology, geology, and other related fields. A member of this design team shall be considered/designated the site professional (as referenced in this Appendix C).

C.2.00 SITE CHARACTERIZATION

Applicant shall conduct a site characterization study prior to siting and designing infiltration treatment facilities. Information gathered during initial geotechnical investigations shall be used for the site characterization. Key data and issues to be characterized include, but are not limited to, the following.

C.2.01 Surface Features Characterization

a. Topography within 500 feet of the proposed facility. The plan shall show existing ground contours (shaded) and proposed ground contours at a minimum 2-foot contour interval. Slopes steeper than 6H:1V shall be identified.

b. Anticipated site use (residential, commercial, or industrial).

c. Location of water supply wells within 500 feet of proposed facility.

d. Location of ground water protection areas and/or 1 , 5 , and 10-year time of travel zones for municipal well protection areas.

e. A description of local site geology, including soil or rock units likely to be encountered, the groundwater regime, and geologic history of the site.

f. Site location relative to identified flood plain or floodway.

g. Site location relative to surface water features, such as waterways, wetlands, etc.

C.2.02 Subsurface Characterization

a. Subsurface explorations (test holes or test pits) shall be performed to a depth of at least five times the maximum design depth of ponded water proposed for the infiltration treatment facility.

b. Continuous sampling (representative samples from each soil type and/or unit) to a depth below the base of the infiltration facility of 2.5 times the maximum design ponded water depth, but not less than 6 feet.

1. For basins, at least one test pit or test hole per 5,000 square feet of basin infiltrating surface (in no case less than two per basin).

2. For trenches, at least one test pit or test hole per 50 feet of trench length (in no case less than two per trench).

c. Prepare detailed logs for each test pit or test hole and a map showing the location of the test pits or test holes. Logs must include at a minimum, depth of pit or hole, soil descriptions, depth to water, presence of stratification.

C.2.03 Soil Testing

Soil characterization for each soil unit (soils of the same texture, color, density, compaction, consolidation and permeability) encountered should include:

a. Grain-size distribution (ASTM D-422 or AASHTO T-311).

b. Textural class (USDA).

c. Percent clay content (include type of clay, if known) as determined by hydrometer testing (ASTM D-422 or AASHTO T-88).

d. Cation exchange capacity (CEC) and organic matter content for each soil type and strata. Where distinct changes in soil properties occur, to a depth below the base of the infiltration treatment facility of at least 2.5 times the maximum design water depth, but not less than 6 feet. Consider if soils are already contaminated, thus diminishing pollutant sorptive capacity.

e. For soils with low CEC and organic content, deeper characterization of soils may be required by the City (refer to Section D.3.00, "Site Suitability Criteria").

f. Color/mottling.

g. Variations and nature of stratification.

~~C.2.04 Infiltration Rate Determination~~

1. ~~Determine the representative infiltration rate of the unsaturated vadose zone based on field infiltration tests and grain size/texture determinations. Field infiltration rates shall be determined using infiltration test methods as presented in the King County Surface Water Design Manual or comparable reference; infiltration testing shall be done in the soil stratum at the design elevation of the bottom of the infiltration facility.~~

2. ~~Site testing shall be performed to verify infiltration rate estimates based on soil size distribution and/or texture. As a minimum, one soil grain-size distribution analysis (ASTM D-422 or AASHTO T-311) per soil stratum in each test hole shall be performed within 2.5 times of the maximum design water depth, but not less than 6 feet.~~

3. ~~The infiltration rate is needed for routing and sizing purposes and for classifying the soil for treatment adequacy.~~

~~C.2.05 Infiltration Receptor~~

~~Infiltration receptor (unsaturated and saturated soil receiving the stormwater) characterization shall include:~~

a. ~~Installation of ground water monitoring wells, unless the highest ground water level is known to be at least 50 feet below the proposed infiltration facility. Use at least three wells per infiltration treatment facility, or three hydraulically connected surface and ground water features. This will establish a three dimensional relationship for the ground water table. The monitoring wells will:~~

   1. ~~Monitor the seasonal ground water levels at site through a minimum of one wet-season.~~

   2. ~~Consider the potential for both unconfined and confined aquifers, or confining units, at the site that may influence the proposed infiltration facility as well as the ground water gradient. Other approaches to determine ground water levels at the proposed site could be considered if pre-approved by the City Engineer or the City's authorized representative.~~

   3. ~~Determine the ambient ground water quality, if there is a concern identified by the City.~~

b. ~~Estimate the volumetric water holding capacity of the infiltration receptor soil. This is the soil layer below the infiltration treatment facility and above the seasonal high-water mark, bedrock, hardpan, or other low permeability layer. This analysis should be conducted at a conservatively high infiltration rate based on vadose zone porosity, and the water quality runoff volume to be infiltrated. Along with an analysis of ground water movement, this will be~~

used in determining volumetric limitations that would adversely affect drawdown.

c. Depth to ground water table and to bedrock/impermeable layers.

d. Seasonal variation of ground water table based on recorded well water levels and observed mottling.

e. Existing ground water flow direction and gradient.

f. Lateral extent of infiltration receptor.

g. Horizontal hydraulic conductivity of the saturated zone to assess the aquifer's ability to laterally transport the infiltrated water.

h. Impact of the infiltration rate and volume at the project site on ground water mounding, flow direction, and water table; and the discharge point or area of the infiltrating water. A ground water mounding analysis shall be conducted at all sites where the depth to seasonal ground water table or low permeability stratum is less than 15 feet and the runoff to the infiltration treatment facility is from more than one acre. The site professional can consider conducting an aquifer test or slug test and the type of ground water mounding analysis necessary at the site.

C.3.00 SITE SUITABILITY CRITERIA

This section specifies the site suitability criteria that must be considered for siting infiltration treatment facilities. When a site investigation reveals that any of the nine applicable criteria cannot be met, appropriate mitigation measures must be implemented so that the infiltration treatment facility will not pose a threat to safety, health, and the environment.

C.3.01 Setbacks

Setback requirements shall be in compliance with City regulations, uniform building code requirements, and/or state regulations. Also evaluate on-site and off-site structural stability due to extended subgrade saturation and/or head loading of the permeable layer, including the potential impacts to downgradient properties, especially on hills with known side-hill seeps.

The following setbacks are provided as guidance.

a. From drinking water wells, septic tanks or drainfields, and springs used for public drinking water supplies. Infiltration treatment facilities upgradient of drinking water supplies and within 1, 5 and 10-year time of travel zones must comply with Oregon Health Division requirements.

b. From building foundations (a minimum of 20 feet downslope and 100 feet upslope).

c. From the top of slopes steeper than 10% (setback a minimum of 50 feet from crest of slope)

C.3.02 Ground Water Drinking Water Protection Areas

A site shall be deemed not suitable if the infiltrated stormwater will be in violation of OAR 340-044-0014.

C.3.03 High Vehicle Traffic Areas

Infiltration treatment facilities may be considered for runoff from areas of industrial activity and the high vehicle traffic areas described below, if appropriate pretreatment (including oil removal) is provided to ensure that ground water quality standards will not be violated and that the infiltration treatment facility will not be adversely affected.

High Vehicle Traffic Areas are defined as:

a. Commercial or industrial sites subject to an expected ADT $\geq$ 100 vehicles/1,000 square feet gross building (trip generation); and

b. Road intersections with an ADT of $\geq$ 25,000 on the main roadway, or $\geq$ 15,000 on any intersecting roadway.

C.3.04 Soil Infiltration Rate/Drawdown Time

a. Infiltration rates short-term and long-term:

1. For treatment purposes the short-term soil infiltration rate should be 2.4 in./hour, or less, to a depth of 2.5 times the maximum design pond water depth, or a minimum of 6 feet below the base of the infiltration treatment facility. This infiltration rate is also typical for soil textures that possess sufficient physical and chemical properties for adequate treatment, particularly for soluble pollutant removal (see criteria # 6, soil and physical and chemical suitability for treatment). It is comparable to the textures represented by Hydrologic Groups B and C. Long-term infiltration rates up to 2.0 inches/hour can also be considered, if the infiltration receptor is not a sole-source aquifer, and in the judgment of the site professional, the treatment soil has characteristics comparable to those specified in criteria #6 to adequately control the target pollutants.

2. The long-term infiltration rate should also be used for maximum drawdown time and routing calculations.

b. Drawdown time:

It is necessary to empty the maximum ponded depth (water quality volume) from the infiltration basin within 24 hours from the completion of inflow to the storage pond in order to meet the following objectives:

1. Restore hydraulic capacity to receive runoff from a new storm.

2. Maintain infiltration rates.

3. Aerate vegetation and soil to keep the vegetation healthy.

4. Enhance the biodegradation of pollutants and organics in the soil.

C.3.05 Depth to Bedrock, Water Table, or Impermeable Layer

The base of all infiltration basins or trench systems shall be ≥ 5 feet above the seasonal high-water mark, bedrock (or hardpan) or other low-permeability layer. A minimum separation of 3 feet may be considered if the ground-water mounding analysis, volumetric receptor capacity, and the design of the overflow and/or bypass structures are judged by the site professional to be adequate to prevent overtopping and to meet the site suitability criteria specified in this section.

C.3.06 Soil Physical and Chemical Suitability for Treatment

The soil texture and design infiltration rates should be considered along with the physical and chemical characteristics specified below to determine if the soil is adequate for removing the target pollutants. The following soil properties must be carefully considered in making such a determination:

a. CEC of the treatment soil must be ≥ 5 millequivalents (meq) CEC/100 g dry soil (USEPA Method 9081). Consider empirical testing of soil sorption capacity, if practicable. Ensure that soil CEC is sufficient for expected pollutant loadings, particularly heavy metals. Lower CEC content may be considered if it is based on a soil loading capacity determination for the target pollutants that is accepted by the City Engineer or the City's authorized representative.

b. Depth of soil used for infiltration treatment must be a minimum of 18 inches.

c. Organic content of the treatment soil as determined by ASTM D-2974: Organic matter can increase the sorptive capacity of the soil for some pollutants. The site professional should evaluate whether the organic matter content is sufficient for control of the target pollutant(s).

d. Waste fill materials should not be used as infiltration media nor should such media be placed over uncontrolled or non-engineered fill soils.

e. Engineered soils may be used to meet the design criteria in this section. Field performance evaluation(s), using acceptable protocols, would be needed to determine feasibility, and acceptability by the City Engineer or the City's authorized representative.

C.3.07 Seepage Analysis and Control

Determine whether there would be any adverse effects caused by seepage zones on nearby building foundations, basements, roads, parking lots or sloping sites.

C.3.08 Impact of Roadway Deicers

Potential impact of roadway deicers on potable water wells must be considered in the siting determination. Mitigation measures must be implemented if infiltration of roadway deicers can cause a violation of ground water quality standards.

C.3.09 Verification Testing of the Completed Facility

Verification testing of the completed full-scale infiltration treatment facility is recommended to confirm that the design infiltration parameters are adequate to manage the design volume and meet the pollutant capture objectives of the infiltrating soil. The site professional should determine the duration and frequency of the verification testing program for the potentially impacted ground water. The ground water monitoring wells installed during site characterization may be used for this purpose. Long-term in-situ drawdown and water quality monitoring for a two-year period, would be preferable.

APPENDIX D

STORMWATER QUALITY FACILITIES DESIGN

D.1.00 INTRODUCTION

The purpose of this appendix is to outline the design and construction guidelines for water quality facilities in the City of Wilsonville. These guidelines may be used to comply with the water quality facility design standards in Section 301.5.00, "Water Quality Facility Design." It is the responsibility of the design engineer to determine the appropriate design criteria that ensures compliance with the City of Wilsonville design standards, in combination with other federal, state, and local laws and ordinances.

Safety of stormwater quanlity facilities shall be in conformance with Section 301.3.09.c, "Safety."

D.2.00 FILTRATION

D.2.01 Biofiltration Swale

a. Hydraulic design criteria

1. Design storm = water quality storm

2. Minimum hydraulic residence time = 9 minutes.

3. Maximum water design depth = 0.5 feet.

4. Minimum freeboard = 1.0 foot (for facilities not protected from high flows).

5. Manning *n* value = 0.24.

6. Maximum velocity = 2.0 feet per second based on 25-year flow.

b. Design criteria

1. Provide an energy dissipater at the entrance to the swale as per Section 301.3.08, "Outfall Protection," or a swale inflow spreader as shown in Detail No. S-2225 of these standards. It shall be designed to reduce velocities and spread the flow across the treatment cross-section.

1. Intermediate flow spreaders may be required.

2. Minimum length = 100 feet.

3. Minimum slope = 0.5%.

4. Minimum bottom width = 2 feet.

5. Maximum treatment depth (measured from top of gravel) = 0.5 feet.

6. Maximum sideslope:

    (1) In treatment area = 4H:IV

    (2) Above treatment area = 3H:IV

7. Use 2"-¾" gap-graded river aggregate placed 2½ to 3 inches deep on jute matting placed over 6 inches of topsoil, or use another base-stabilization method approved by the City's authorized representative. Extend river aggregate, jute, and topsoil to top of treatment area.

8. If the swale slope is less than 1.5%, an underdrain shall be installed using a perforated pipe, or equivalent. Amend the soil if necessary to allow effective percolation of water to the underdrain. Underdrains can be made of 6 inch diameter Schedule 40 PVC perforated pipe with 6 inches of drain gravel over the pipe. The gravel and pipe must be enclosed by geotextile fabric. Slopes greater than 2.5% need check dams (riprap) at vertical drops of 12-15 inches.

9. Retaining walls are not allowed in the treatment area.

10. Provide an approved outlet structure for all flows.

11. All exposed areas shall be protected with jute matting or an alternative approved by the City's authorized representative

12. Plant vegetation consistent with the requirements of Appendix B, "Landscape Requirements, Water Quality and Quantity Facilities."

D.2.02 Sand Filter

a. Design Criteria

1. The design of sand filters is based on Darcy's Law[1]:

$$A = Q \div (k \times i)$$

where A = area of sand filter.

Q = peak flow rate (from hydrograph).

k = sand permeability (3.5 feet/day).

i = hydraulic gradient (see below).

$$i = (h + L) \div L$$

where h = height of water column over sand filter.

L = thickness of sand filter.

2. No drainage shall be allowed directly to the filter; it must first go through a catch basin, inlet, sedimentation manhole, or similar large debris collection device.

3. The sand filter shall infiltrate the entire water quality volume without overflow.

4. The drawdown period for sand filters shall not exceed 24 hours.

5. The sand filter shall consist of an inlet structure, a sand bed, underdrain piping, and a basin liner. Criteria for these components are given below.

b. Inlet Structure

The inlet structure shall spread the flow of incoming water uniformly across the surface of the filter medium during all anticipated flow conditions. At a minimum, the inflow spreader shall meet the requirements as provided in Section 301.3.08, "Outfall Protection," or the swale inflow spreader as shown in Detail No. S-2225 of these standards. It shall be designed to reduce velocities and spread the flow across the treatment cross-section. Flow shall be spread in a manner that prevents roiling or otherwise disturbing the filter medium.

[1] A safety factor of 2 is applied to the equation.

c. Sand Bed – Filter Medium

1. The length-to-width ratio shall be 2:1 or greater.

2. The sand bed configuration may be either of the two configurations as shown in Detail No. S-2270 of these standards. All depths shown are final compacted depths. The effects of consolidation and compaction must be taken into account when placing medium materials. The surface of the filter medium shall be level.

3. The filter bed medium shall consist of clean, medium to fine sand, with no organics, frozen pieces, or other deleterious materials. Sand used as a filter medium shall be certified by a certified testing laboratory as meeting or exceeding the gradation requirements in **Table D.1**. Sieve analysis shall be determined according to AASHTO T-27.

Table D.1. GRADATION REQUIREMENTS FOR FILTER BED MEDIUM

Sieve Size	Percent Passing
3/8 inch	100
No. 4	95-100
No. 8	80-100
No. 16	45-85
No. 30	15-60
No. 50	3-15
No. 100	< 4

d. Sand Bed With Gravel Filter (see Detail No. S-2270 of these standards)

1. The top layer shall be a minimum of 18 inches of sand meeting gradation requirements of **Table D.1**.

2. The sand shall be placed over a non-woven geofabric material, meeting the specifications provided in **Table D.2**, covering a layer of ½- to 2-inch washed drain rock. The finished depth of this drain rock shall be sufficient to provide a minimum of 2 inches of cover over the underdrain piping system.

3. No gravel is required below the underdrain piping system.

Table D.2. GEOFABRIC MATERIAL SPECIFICATIONS

Property	Test Method	Specification
Unit Weight	–	8 oz/sy (minimum)
Filtration Rate	–	0.08 inch/sec (minimum)
Puncture Strength	ASTM D-751 (modified)	125 lb (minimum)
Mullen Burst Strength	ASTM D-751	400 psi (minimum)
Tensile Strength	ASTM D-1682	200 lb (minimum)
Equivalent Opening Size	US Standard Sieve	80-120

e. Sand Bed Using Trench Design (see Detail No. S-2270 of these standards)

1. The top layer shall be a minimum of 12 inches of sand meeting gradation requirements of **Table D.1**.

2. The sand shall be placed over a non-woven geofabric material, meeting the specifications provided in **Table D.2**, covering a layer of ½- to 2-inch washed drain rock. The finished depth of this drain rock shall be sufficient to provide a minimum of 2 inches of cover over the underdrain piping system.

3. The piping and gravel shall be underlain with drainage matting meeting the specifications provided in **Table D.3**.

Table D.3. DRAINAGE MATTING MATERIAL SPECIFICATIONS

Property	**Test Method**	**Specification**
Unit Weight		20 oz/SY
Flow Rate (fabric)		180 gpm/SF (minimum)
Permeability	ASTM D 2434	0.124 cm/sec
Grab Strength (fabric)	ASTM D 1682	Dry Lg 90 Dry Wd 70 Wet Lg 95 Wet Wd 70
Puncture Strength (fabric)	COE CW 02215	42 (minimum)
Mullen Burst Strength	ASTM D 117	140 psi (minimum)
Equivalent Opening Size	US Standard Sieve	80 – 120
Flow Rate (drainage core)	Drexel Universal Test Method	14 gpm/ft. width

f. Underdrain Piping

1. The underdrain piping system shall consist of appropriately sized perforated pipes (minimum 4-inch diameter). The pipe used in this system shall be schedule 40 polyvinyl chloride (PVC) material, or an approved equal. Flexible perforated pipe will not be approved. Lateral spacing shall not exceed 10 feet.

2. The underdrain laterals shall be placed with positive gravity drainage to the collector pipe

3. The collector pipe shall have a minimum 1% grade toward the discharge point.

4. All laterals and collector pipe shall have cleanouts installed, accessible from the surface without removing or disturbing filter media.

g. Basin Liner

1. An impermeable liner is required for all sand filter systems. The liner shall comply with the requirements provided in Appendix E, "Water Quality Facility Liners."

2. Geomembrane liners shall meet the requirements provided in Section E.4.03, "Geomembrane Liners." They shall be placed on a smooth, compacted bed of sand, minimum 6 inches thick, graded as necessary to facilitate the hydraulic performance designed into the facility.

D.3.00 PONDS

D.3.01 Wet Ponds

a. Hydraulic design criteria

1. Permanent pool volume = 0.55 ´ WQV (Water Quality Volume).

2. Minimum water quality detention/retention volume = 1.0 ´ WQV.

3. Water quality drawdown time = 48 hours.

4. To calculate orifice size, use the following equation:

$$D = 24 \times [(Q / (\pi C_d [2gH]^{0.5})]^{0.5}$$

where D = orifice diameter (inches).

Q (cfs) = WQV(cf)/(48 hr ´ 60 min/hr ´ 60 sec/min).

C_d = orifice coefficient (0.62 for square-edged entrance).

g = gravitational constant (32.2 ft/sec^2).

H = ⅔ temporary detention height (feet) to orifice centerline.

5. Maximum depth of permanent pool = 6 feet.

6. Maximum depth of water quality pool (not including permanent pool) = 2.5 feet.

7. Provide an emergency spillway sized to pass the 100-year storm event or an approved hydraulic equivalent. The emergency spillway shall be located in existing soils when feasible and shall be armored with riprap embedded in concrete, or other approved erosion protection extending to the toe of the embankment (see Detail No. S-2275 of these standards).

8. Provide for a basin dewatering system with a 24-hour maximum drawdown time.

b. Design Criteria

1. The pond configuration, as well as the inlet and outlet locations, shall maximize water travel time through the facility.

2. The pond shall be designed using the following surface-area-to-depth relationship (for the volume required by a permanent pool):

70% of the surface area @ 2- to 6-foot depth

30% of the surface area @ 0- to 2-foot depth

The maximum depth of the permanent pool shall be 6 feet. The 0-to-2-foot depth shall be distributed evenly around the perimeter of the pond.

3. The facility shall be divided into at least two cells. The first cell (forebay) shall contain approximately 10% of the design surface area.

4. The construction of wets ponds and maintenance accessibility shall be in conformance with Section 301.2.03, "Design Criteria," Section 301.3.09, "Detention/Retention Facility Protection," and Section 301.4.04, "Access Road Design."

5. The slopes in the treatment and surrounding areas of the pond shall be 3H:1V or flatter, unless approved by the City's authorized representative. **Note:** If steeper slopes are desired, the site shall be fenced as described in Section 301.5.02.b.4, "Fencing." The applicant shall provide calculations and geotechnical data indicating adequate slope stability. Calculations and data shall be provided from a Professional Engineer registered in the State of Oregon whose area of expertise is geotechnical engineering.

6. The average length-to-width ratio shall be at least 3:1. This ratio is critical to prevent "short-circuiting," where water passes directly through the facility without being detained for any time.

7. If a riser pipe outlet is used, it shall be protected by a trash rack and antivortex plate. If an orifice plate is used, it shall be protected with a trash rack with at least 10 square feet of open surface area. In either case, 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 in progress.

c. Dead Storage

1. The dead (permanent) storage volume, V_{pond}, is equivalent to the post-development runoff.

2. Calculating runoff volume using the SBUH method can be approximated by the following equation:

$$V = 25.9 \times A \times \%I + 27.7 \times A$$

where V = runoff volume (cubic feet).

A = total contributing land area (acres).

%I = percent of land area that is impervious (i.e., if the land is 20% impervious, enter 20 in the equation)

D.3.02 Extended Wet Pond

a. Hydraulic design criteria

1. Permanent pool volume = 0.55 × WQV.

2. Minimum water quality detention/retention volume = 1.0 × WQV.

3. Water quality drawdown time = 48 hours.

4. To calculate orifice size, use the following equation:

$$D = 24 \times [(Q / (\pi C_d [2gH]^{0.5})]^{0.5}$$

where D = orifice diameter (inches).

Q (cfs) = WQV(cf)/(48 hr × 60 min/hr × 60 sec/min).

C_d = orifice coefficient (0.62 for square-edged entrance).

g = gravitational constant (32.2 ft/sec^2).

H = ⅔ temporary detention height (feet) to orifice centerline.

5. Maximum depth of permanent pool = 2 feet.

6. Maximum depth of water quality pool (not including permanent pool) = 2.5 feet.

7. Provide an emergency spillway sized to pass the 100-year storm event or an approved hydraulic equivalent. The emergency spillway shall be located in existing soils when feasible and shall be armored with riprap

embedded in concrete, or other approved erosion protection extending to the toe of the embankment (see Detail No. S-2275 of these standards).

8. Provide for a basin dewatering system with a 24-hour maximum drawdown time.

b. Design criteria

1. Minimum of two cells, with the first cell (forebay) at least 10% of the design surface area. The forebay shall also constitute 20% of the treatment volume. Where space limits multicell design, use one cell with a forebay at the inlet to settle sediments and distribute flow across the wet pond.

2. Maximum sideslopes in basin treatment area = 3H:IV

3. Overexcavate by a minimum of 20% to allow for sediment deposition.

4. Minimum freeboard = 1 foot from 25-year design water surface elevation.

5. Retaining walls are not allowed in the treatment area.

6. Provide an approved outlet structure for all flows.

7. The construction of wet ponds and maintenance accessibility shall be in conformance with Section 301.2.03, "Design Criteria," Section 301.3.09, "Detention/Retention Facility Protection," and Section 301.4.04, "Access Road Design."

D.3.03 Extended Dry Pond

a. Hydraulic design criteria

1. Permanent pool depth = 0.4 feet.

2. Permanent pool is to cover the entire bottom of the basin.

3. Minimum water quality detention/retention volume = 1.0 ´ WQV.

4. Water quality drawdown time = 48 hours.

5. To calculate orifice size, use the following equation:

$$D = 24 \acute{} [(Q / (\rho C_d [2gH]^{0.5})]^{0.5}$$

where D = orifice diameter (inches).

Q (cfs) = WQV(cf)/(48 hr ´ 60 min/hr ´ 60 sec/min).

~~C_d = orifice coefficient (0.62 for square-edged entrance).~~

~~g = gravitational constant (32.2 ft/sec^2).~~

~~H = ⅔ temporary detention height (feet) to orifice centerline.~~

~~6. Maximum depth of water quality pool (not including permanent pool) = 4 feet.~~

~~7. Provide an emergency spillway sized to pass the 100-year storm event or an approved hydraulic equivalent. The emergency spillway shall be located in existing soils when feasible and armored with riprap embedded in concrete, or other approved erosion protection extending to the toe of the embankment (see Detail No. S-2275 of these standards).~~

~~b. Design criteria~~

~~1. Minimum of two cells, with the first cell (forebay) at least 10% of the design surface area. The forebay shall also constitute 20% of the treatment volume. Where space limits multicell design, use one cell with a forebay at the inlet to settle sediments and distribute flow across the wet pond.~~

~~2. Minimum bottom width = 4 feet~~

~~3. Maximum sideslope in basin treatment area = 4H:IV.~~

~~4. Minimum freeboard = 1 foot from 25-year design water surface elevation.~~

~~5. Retaining walls are not allowed in the treatment area.~~

~~6. An approved outlet structure shall be provided for all flows.~~

~~7. The construction of dry ponds and maintenance accessibility shall be in conformance with Section 301.2.03, "Design Criteria," Section 301.3.09, "Detention/Retention Facility Protection," and Section 301.4.04, "Access Road Design."~~

~~D.4.00 WETLANDS – CONSTRUCTED TREATMENT WETLANDS~~

~~a. Hydraulic design criteria~~

~~1. Permanent pool volume = 0.55 ´ WQV.~~

~~2. Water quality detention/retention volume = 1.0 ´ WQV.~~

~~3. Water quality drawdown time = 48 hours.~~

4. To calculate orifice size, use the following equation:

$$D = 24 \times [(Q / (pC_d[2gH]^{0.5})]^{0.5}$$

where D = orifice diameter (inches).

Q (cfs) = WQV(cf)/(48 hr × 60 min/hr × 60 sec/min).

C_d = orifice coefficient (0.62 for square-edged entrance).

g = gravitational constant (32.2 ft/sec^2).

H = ⅔ temporary detention height (feet) to orifice centerline.

5. Maximum depth of permanent pool = 2.5 feet.

6. Maximum velocity through the wetland should average less than 0.01 feet per second for the water quality flow. Design should distribute flow uniformly across the wetland.

7. Provide an emergency spillway sized to pass the 100-year storm event or an approved hydraulic equivalent. The emergency spillway shall be located in existing soils when feasible and shall be armored with riprap embedded in concrete, or other approved erosion protection extending to the toe of the embankment (see Detail No. S-2275 of these standards).

8. Provide for a basin dewatering system with a 24-hour maximum drawdown time.

b. Design Criteria

1. Minimum of two cells, with the first cell (forebay) at least 10% of the surface area. The forebay shall also constitute 20% of the treatment volume. Where space limits multicell design, use one cell with a forebay at the inlet to settle sediments and distribute flow across the wet pond.

2. Permanent pool depth to be spatially varied throughout wetland.

3. Provide a perimeter zone 10 to 20 feet wide that is inundated during storms.

4. Maximum sideslopes for wetland planting = 5H:IV.

5. Maximum sideslopes for nonwetland planting = 3H:IV.

6. Overexcavate by a minimum of 20% to allow for sediment deposition.

7. Minimum freeboard = 1 foot from 25-year design water surface elevation.

8. Retaining walls are not allowed in the treatment area.

8. The construction of wetlands and maintenance accessibility shall be in conformance with Section 301.3.09, "Detention/Retention Facility Protection," and Section 301.4.04, "Access Road Design."

9. Provide an approved outlet structure for all flows.

D.5.00 INFILTRATION

D.5.01 Infiltration Trench

Design criteria

a. The design of infiltration trenches is based on Darcy's Law[2]:

$$A = 2.0 \times Q \div (f \times i)$$

Where A = area of trench bottom (square feet).

Q = design flow rate (cfs).

f = infiltration rate of soil or infiltration media (ft/se).

i = hydraulic gradient (see below).

$$i = (h + L) \div L$$

where h = height of water column over infiltration media.

L = distance from surface to bottom of trench

b. The infiltration trench shall infiltrate the entire water quality storm without overflow.

c. Infiltration facilities shall not be accepted in soils with a tested infiltration rate of less than 0.50 inches per hour.

d. There shall be no less than 3 feet of undisturbed depth of infiltration medium between the bottom of the facility and any impervious layer (hardpan, solid rock, high groundwater levels, etc.).

[2] A safety factor of 2 is applied to the equation.

e. Drawdown time (time for the trench to empty water from the water quality storm) shall not exceed 24 hours.

f. Infiltration trenches shall meet the following setback requirements for downstream slopes: minimum of 100 feet from slopes of 16%; add 5 feet of setback for each additional percent of slope up to 30%; 200-foot setback for slopes of 30%; infiltration trenches shall not be used where slopes exceed 30%.

g. All infiltration trenches shall have an overflow installed that is capable of transporting the design capacity of the water delivery system through the facility to an approved stormwater receiving system if the facility infiltration capacity is exceeded. An approved stormwater receiving system is a stream, lake, or pond, or a storm sewer or drainage ditch. Overflows shall be designed with appropriate erosion control devices.

h. Each trench shall have one slotted observation pipe (4 inch) that extends to the bottom of the trench, at a point approximately halfway along the trench. The observation pipe shall have a threaded or hinged cap or plug.

i. Drain medium shall have filter fabric between the medium and native soils or backfill meeting specifications established in Table D.2.

j. Infiltration areas shall be clearly marked before site work begins to avoid soil disturbance during construction. No vehicular construction traffic, except that specifically used to construct the facility, shall be allowed within 10 feet of infiltration trench areas.

k. An certified soils scientist (ARCPACS certification), or suitably trained person working under the supervision of a Professional Engineer registered in the State of Oregon, shall inspect the soil after the system is excavated and before trenches are filled with drain medium, to confirm that soils remain in suitable condition to perform at anticipated infiltration rates.

D.5.02 Infiltration Basin

Design criteria

a. The design of infiltration trenches is based on Darcy's Law[3]:

$$A = 2.0 \times Q \div (f \times i)$$

Where A = area of trench bottom (square feet).

Q = design flow rate (cfs).

f = infiltration rate of soil or infiltration media (ft/sec).

i = hydraulic gradient (see below).

$$i = (h + L) \div L$$

where h = height of water column over infiltration media.

L = distance from surface to bottom of trench

b. The infiltration basin shall infiltrate the entire water quality storm without overflow.

c. Infiltration basins shall meet the following setback requirements for downstream slopes: minimum of 100 feet from slopes of 10%; add 5 feet of setback for each additional percent of slope up to 30%; 200-foot setback for slopes of 30%; infiltration trenches shall not be used where slopes exceed 30%.

d. All infiltration basins shall have an overflow installed that is capable of transporting the design capacity of the water delivery system through the facility to an approved stormwater receiving system if the facility infiltration capacity is exceeded. An approved stormwater receiving system is a stream, lake, or pond, or a storm sewer or drainage ditch. Overflows shall be designed with appropriate erosion-control devices.

e. Any imported drain medium shall have filter fabric between the medium and native soils or backfill.

f. Two staff gauges shall be installed, at opposite ends of the bottom of the basin, to enable maintenance staff to measure the depth of accumulated silts.

[3] A safety factor of 2 is applied to the equation.

g. Infiltration areas shall be clearly marked before site work begins to avoid soil disturbance during construction. No vehicular traffic, except that specifically used to construct the facility, shall be allowed within 10 feet of infiltration basin areas.

h. A certified soils scientist (ARCPACS certification), or suitably trained person working under the supervision of a Professional Engineer registered in the State of Oregon, shall inspect the soil after the system is excavated and before the basin is filled with drain medium, to confirm that soils remain in suitable condition to accept anticipated infiltration.

i. Infiltration facilities shall not be accepted in soils with a tested infiltration rate of less than 0.50 inches per hour.

j. There shall be no less than 3 feet of undisturbed depth of infiltration medium between the bottom of the facility and any impervious layer (hardpan, solid rock, high groundwater levels, etc.).

k. Drawdown time (time for the basin to empty water from the water quality design storm) shall not exceed 24 hours.

APPENDIX E
WATER QUALITY FACILITY LINERS

E.1.00 INTRODUCTION

The purpose of this appendix is to provide guidelines for the design and construction of water quality facilities in the City of Wilsonville.

E.2.00 WATER QUALITY FACILITY LINERS

Liners are intended to reduce the likelihood that pollutants in stormwater will reach groundwater when water quality facilities are constructed. In addition to groundwater protection considerations, some facility types require permanent water for proper functioning. An example is the first cell of a wet pond.

Treatment liners amend the soil with materials that treat stormwater before it reaches more freely draining soils. The liners have slow rates of infiltration, generally less than 2.4 inches per hour (1.7×10^{-3} centimeters per second [cm/s]), but not as slow as low-permeability liners. Treatment liners may use in-place native soils or imported soils. Low-permeability liners reduce infiltration to a very slow rate, generally less than 0.02 inches per hour (1.4×10^{-5} cm/s).

These types of liners should be used for industrial or commercial sites that have a potential for high pollutant loading in stormwater runoff. Low-permeability liners may be fashioned from compacted till, clay, geomembrane, or concrete. Till liners are preferred because of their general resilience and ease of maintenance.

E.2.01 General Design Criteria

a. **Table E.1** shows recommendations for the type of liner generally best suited for use with various water quality facilities.

b. Liners shall be evenly placed over the bottom or sides of the treatment area of the facility, as shown in **Table E.1**. Areas above the treatment volume that are required to pass flows greater than the water quality flow (or volume) need not be lined. However, the lining must extend to the top of the interior sideslope and be anchored, if it cannot be permanently secured by other means.

Table E.1. RECOMMENDED LINERS FOR STORMWATER FACILITIES

Type of Facility	Area to Be Lined	Recommended Liner
Presettling basin	Bottom and sides	Low-permeability liner or treatment liner. (If basin will intercept seasonal high groundwater table, treatment liner is recommended.)
Wet pond	First cell: bottom and sides to water quality design water surface	Low-permeability liner or treatment liner. (If wet pond will intercept seasonal high groundwater table, treatment liner is recommended.)
	Second cell: bottom and sides to water quality design water surface	Treatment liner
Combined detention/ water quality facility	First cell: bottom and sides to water quality design water surface	Low-permeability liner or treatment liner. (If facility will intercept seasonal high groundwater table, treatment liner is recommended.)
	Second cell: bottom and sides to water quality design water surface	Treatment liner
Constructed treatment wetland	Bottom and sides, both cells	Low-permeability liner. (If facility will intercept seasonal high groundwater table, treatment liner is recommended.)
Sand filtration basin	Basin sides only	Treatment liner
Sand filter vault	Not applicable	No liner needed
Media filter (in vault)	Not applicable	No liner needed
Wet vault	Not applicable	No liner needed

c. For low-permeability liners, the following criteria apply:

1. Where the seasonal high groundwater elevation is likely to contact a low-permeability liner, liner buoyancy may be a concern. A low-permeability liner shall not be used unless evaluated and recommended by a Professional Engineer registered in the State of Oregon whose area of expertise is geotechnical engineering.

2. Where the design calls for grass to be planted over a low-permeability liner, a minimum of 6 inches of good topsoil or compost-amended native soil (2 inches compost tilled into 6 inches native till soil) must be placed over the liner in the area to be planted; 12 inches of cover is preferred.

E.2.02 Interference With Seasonal Groundwater

If a treatment liner will be below the seasonal high-water level, the liner's pollutant-removal performance must be evaluated by a qualified professional, and the liner's placement must be found as protective as if the liner were above the level of the groundwater. A qualified professional shall be either a Professional Engineer registered in the State of Oregon whose area of expertise is geotechnical engineering, a Certified Engineering Geologist registered in the State of Oregon, or a Professional Hydrogeologist registered in the State of Oregon.

See Sections E.3.00, below, and E.4.00 for more specific design criteria for treatment liners and low-permeability liners.

E.3.00 WATER QUALITY TREATMENT LINERS

Design Criteria

a. A 2-foot-thick layer of soil with a minimum organic content of 5% and a minimum CEC of 5 milliequivalents/100 grams can be used as a treatment layer beneath a water quality or quantity facility.

b. To demonstrate that in-place soils meet the above criteria, one sample per 1,000 square feet of facility area shall be tested. Each sample shall be a composite of subsamples taken throughout the depth of the treatment layer (usually 2 to 6 feet below the expected facility invert).

c. Typically, sidewall seepage is not a concern if the seepage flows through the same stratum as the bottom of the stormwater facility. However, if the treatment soil is an engineered soil or has very low permeability, the potential to bypass the treatment soil through the sidewalls may be significant. In those cases, the stormwater facility sidewalls should be lined with at least 18 inches of treatment soil, as described above, to prevent untreated seepage. This lesser soil thickness is based on unsaturated flow as a result of alternating wet and dry periods.

d. Organic content shall be measured on a dry-weight basis using ASTM D-2974.

e. CEC shall be tested using EPA laboratory method 9081.

f. Certification that imported soil meets the organic content and CEC criteria above shall be provided to the local approval authority by a soils-testing laboratory.

g. Animal manures used in treatment soil layers must be sterilized because of the potential for bacterial contamination of groundwater.

E.4.00 LOW-PERMEABILITY LINER OPTIONS

This section specifies the design criteria for four low-permeability liner options: compacted till liners, clay liners, geomembrane liners, and concrete liners.

E.4.01 Compacted Till Liners

a. Liner thickness shall be 18 inches after compaction.

b. Soil shall be compacted to 95% of the maximum dry density, as determined by AASHTO T-180.

c. A different depth and density sufficient to retard the infiltration rate to 2.4×10^{-5} inches per minute (1×10^{-6} cm/s) may also be used instead of Criteria 1 and 2.

d. Soil should be placed in 6-inch lifts.

e. Gradation requirements of the soil shall be as indicated in **Table E.2**. Sieve analysis shall be determined according to AASHTO T-27.

Table E.2. SOIL GRADATION REQUIREMENTS, COMPACTED TILL LINERS

Sieve Size	Percent Passing
6 inch	100
4 inch	90
No. 4	70-100
No. 200	20

E.4.02 Clay Liners

a. Liner thickness shall be 12 inches.

b. Clay shall be compacted to 95% of the maximum dry density, as determined by AASHTO T-180.

c. A different depth and density sufficient to retard the infiltration rate to 2.4×10^{-5} inches per minute (1×10^{-6} cm/s) may also be used instead of the above criteria.

d. The slope of clay liners must be restricted to 3H: IV for all areas requiring soil cover. Otherwise, the soil layer must be stabilized by another method so that

soil does not slip into the facility. Any alternative soil-stabilization method must take maintenance access into consideration.

e. Where clay liners form the sides of ponds, the interior should not be steeper than 4H:1V, irrespective of fencing. This restriction is to ensure that anyone falling into the pond can climb out.

f. Specification requirements of the clay soil shall be as indicated in **Table E.3**.

Table E.3. SPECIFICATIONS FOR SOIL IN CLAY LINERS

Property	**Test Method**	**Unit**	**Specification**
Permeability	ASTM D-2434	cm/sec	1×10^{-6}
Plasticity Index of Clay	ASTM D-423 & D-424	percent	Not less than 15
Liquid Limit of Clay	ASTM D-2216	percent	Not less than 30
Clay Particles Passing	ASTM D-422	percent	Not less than 30
Clay Compaction	ASTM D-2216	percent	95% of Max. Dry Density, AASHTO T-99

E.4.03 Geomembrane Liners

a. Geomembrane liners shall be ultraviolet (UV) light resistant and have a minimum thickness of 30 mils. A thickness of 40 mils shall be used in areas of maintenance access or where heavy machinery must operate over the membrane.

b. Geomembranes shall be bedded according to the manufacturer's recommendations.

c. Liners shall be installed so that they can be covered with 12 inches of top dressing forming the bottom and sides of the water quality facility, except for liner sand filters. Top dressing shall consist of 6 inches of crushed aggregate covered with 6 inches of native soil. The aggregate layer is to mark the location of the liner for future maintenance. As an alternative to crushed aggregate, 12 inches of native soil may be used if orange plastic safety fencing or another highly-visible, continuous marker is embedded 6 inches above the membrane.

d. If possible, liners should be of a contrasting color so that maintenance workers are aware of any areas where a liner may become exposed when maintaining the facility.

e. Geomembrane liners shall not be used on slopes steeper than 5H:1V to prevent the top dressing material from slipping. Textured liners may be used on slopes up to 3H:1V, provided that a Professional Engineer registered in the State of Oregon, whose area of expertise is geotechnical engineering, recommends that the top dressing will be stable for all site conditions, including maintenance.

E.4.04 Concrete Liners

a. Portland cement liners are allowed irrespective of facility size, and shotcrete may be used on slopes. However, specifications must be developed by a Professional Engineer registered in the State of Oregon who certifies the liner against cracking or losing water retention ability under expected conditions of operation, including facility maintenance operations. Maintenance equipment can weigh up to 80,000 pounds when fully loaded.

b. AC may not be used for liners because of its permeability to organic pollutants.

c. If grass is to be grown over a concrete liner, slopes must be no steeper than 5H: IV to prevent the top dressing from slipping.

~~APPENDIX F~~

~~City of Wilsonville FORMS~~

MINIMUM EROSION PREVENTION AND SEDIMENT CONTROL MONITORING REQUIREMENTS

All Sites

1. A person with knowledge and experience in construction storm water controls and management practices shall conduct the inspections. The Grading and Erosion Control Plan shall identify the person(s) and/or title of the personnel that will conduct the inspections and provide a contact phone number for such person(s).

Active Sites

2. Frequency of inspections shall be daily during storm water runoff or snowmelt runoff and at least once every seven (7) calendar days and within 24 hours after any storm event of greater than 0.5 inches of rain per 24-hour period.

Inactive Sites

3. During inactive periods of greater than seven (7) consecutive calendar days, inspections shall only be required once every two (2) weeks.

4. Prior to discontinuing activities at the site, any exposed area shall be stabilized to prevent erosion. Stabilization may occur by applying appropriate cover (mulch, erosion control blanket, soil tackifier, etc.) or establishing adequate vegetative cover.

5. When a site is inaccessible due to adverse weather conditions, inspections shall not be required. Adverse weather condition shall be recorded on the inspection sheet.

6. Prior to leaving an inactive site or in anticipation of site inaccessibility, existing erosion and sediment control measures shall be inspected to ensure that they are in working order. Any necessary maintenance or repair shall be made prior to leaving the site.

Written Records

7. All visual inspections must document the following information:

    a. Inspection date, inspector's name, weather conditions, and rainfall amount for past 24 hours (inches). (Rainfall information can be obtained from the nearest weather recording station.)

    b. List observations of all BMPs: erosion and sediment controls, chemical and waste controls, locations where vehicles enter and exit the site, status of areas that employ temporary or final stabilization control, soil stockpile area, and non-stormwater controls.

    c. At representative discharge location(s) from the construction site conduct observation and document the quality of the discharge for any turbidity, color,

sheen, or floating materials. If possible, in the receiving stream, observe and record color and turbidity or clarity upstream and downstream within 30 feet of the discharge from the site. For example, a sheen or floating material could be noted as present/absent, if observation is yes, it could indicate concern about a possible spill and/or leakage from vehicles or materials storage. For turbidity and color an observation would describe any apparent color and the clarity of the discharge, and any apparent difference in comparison with the receiving stream.

d. If significant amounts of sediment are leaving the property, briefly explain the corrective measures taken to reduce the discharge and/or clean it up and describe efforts to prevent future releases. The EPSC Plan shall be amended accordingly.

e. If a site is inaccessible due to inclement weather the inspection shall include observations at a relevant discharge point or downstream location, if practical.

8. All inspection records for an active site shall be kept on-site or be maintained with the permittee, and shall made available to the City's authorized representative upon request.

9. A written record of inspections for an inactive site shall be maintained with the permittee and made available to the City's authorized representative upon request.

10. Retention of all inspection records shall be for a period of one year from project completion.

CERTIFICATE OF INSURANCE

This Certificate of Insurance is issued to the terms, conditions and coverage of Policy No. _____ issued to _____

at _____

by _____. Date of Expiration _____

This Certificate of Insurance is not intended to affirmatively or negatively alter, extend or rescind any of the existing terms, conditions or coverage of the above-mentioned policy.

TYPE OF INSURANCE	LIMITS OF LIABILITY		
		EACH OCCURRENCE	AGGREGATE
GENERAL LIABILITY Comprehensive Form	Bodily Injury		
Manufacturer's & Contractor's Liability Broadform Property Damage	Property Damage		
Owner & Contractor's Protective Blanket Contractual Products/Completed Operations	Bodily Injury & Property Damage Combined		
Automotive	Personal Injury		
Automotive Comprehensive Form	Bodily Injury & Property Damage Combined		
Excess Liability Umbrella Form	Bodily Injury & Property Damage Combined		
WORKER'S COMPENSATION	Statutory		

_____

_____ DATE: _____

_____ SIGNATURE: _____

Note: A standard certificate of insurance form such as the Accord form may be substituted for this form.

~~End~~

CITY OF WILSONVILLE
30000 SW TOWN CENTER LOOP E
WILSONVILLE, OR 97070

ENGINEERING PROJECT PERMIT SHEET

ENGINEERING DEPARTMENT

PERMIT NUMBER: _____ PARCEL NUMBER: _____

APPLICANT'S SECTION **(APPLICANT IS TO COMPLETE ITEMS 1-7)**

1. NAME OF PROJECT: _____

2. OWNER/DEVELOPER: _____

3. OWNER'S ENGINEER: _____

4. CONTRACTOR: _____
   NAME PHONE OCCB BUSINESS LICENSE

5. PROJECT'S CONTACT PERSON: _____

6. **ESTIMATED CONSTRUCTION COST:** _____
   PLAN CHECK FEE**: (Paid)** _____
   REVISED ESTIMATED PROJECT COST: _____
   REVISED PLAN CHECK FEE**:** _____
   PENALTY PLAN CHECK FEE**:** _____

7. I, _____ (owner) do hereby agree by my signature below to the preliminary fee as stated above for the plan review fee knowing said fee is based upon the preliminary cost estimate as stated and is subject to change and hereby agree that a response on the above mentioned project may not be verbally or in writing by the Engineering Department until 10 days from the signature date by the owner or his authorized agent. I further agree to comply with the above description plans and specifications as herewith approved by the Engineering Department and also with all rules, regulations, ordinances and resolutions pertaining to construction within Public R.O.W. or dedicated easements.

_____
OWNER/DATE

8. **PLANS REVIEW EXPIRATION NOTICE**

Ninety (90) days has elapsed since the construction plans you submitted on the above date were approved resulting in the expiration of your plan review approval. Enclosed you will find a copy of your construction plans. Prior to beginning construction on this project the construction plans shall be reviewed for finalization. A revised plan review application shall be completed and the fee paid prior to the review.

_____
ENGINEERING DEPARTMENT/DATE

PERMIT NUMBER: _____

BALANCE PLAN CHECK DUE

9. **FEE SUMMARY:**

TOTAL PLAN CHECK FEE	-
	-
PUBLIC WORKS PERMIT FEE	
TITLE FEE	-
MANHOLE INSERT FEE	-
STREET SIGN FEE	-
TOTAL FEES DUE	
ADDITIONAL FEES PAID	

PROJECT COSTS:	**COST**	**DESCRIPTION**
A). WATER SYSTEM:		
B). WASTEWATER SYSTEM:		
C). STORMWATER SYSTEM:		
D). ROADWAY AREA:		
E). STREET LIGHTS:		
F). OTHER:		

10. **PERMIT ISSUED**

I _____ do hereby agree by my signature below to assure that myself and all subcontractors under my direction and working on the above project shall have a valid City business license and hereby agree to forfeit all fines and penalties for failure of same. Such forfeiture will be with-held from my payment or retainage or added to the total cost of the permit. I have read and understand the City's "Public Work Standards".

_____ _____

ENGINEERING DEPARTMENT/DATE CONTRACTOR/DATE

11. **CONSTRUCTION WORK HOURS**

Pacific Standard Times	Daylight Savings Time
Monday - Friday: 7:00 am to 8:00 pm	Monday - Friday: 7:00 am to 9:00 pm
Saturday: 9:00 am to 6:00 pm	Saturday: 9:00 am to 7:00 pm

No noise originating on construction, demolition, and/or grading are allowed before or after the times listed, or at any time on Sunday, without the written consent of the Building Official or City Engineer, and may be subject to citation.

TRACKING FOR EASEMENTS AND ROW DEDICATIONS

(note: this may not be the same as owner/developer)
Name of Grantor

(from item 1, page 1)
Project Name

Mailing Address

(from item 1, page 1)
County

City, State, Zip

(from item 1, page 1)
Tax Lot, Section, Township, Range

(from item 5, page 1)
Contact Person and Telephone #

CITY Contact Person

Type of Easement: *(drop down)*

(Drainage, Pipeline, PUE, Sidewalk, Sidewalk and PUE, Slope, Street Dedication, Deed of Deduction, Conservation, Stormwater Maintenance Covenant, Temporary Construction)

Type of Ownership: *(drop down)*

(Partnership, Limited Partnership, Corporation, Individual, Limited Liability Company)

DATE	ACTION/COMMENTS	BY
	Completed document and Preliminary Title Report received	
	Legal description verified	
	Location and map verified	
	Other Action taken	
	Document sent to Legal Dept. for review	
	► *(route to Legal)*	
	Legal Dept. signs "Approved as to Form"	
	Legal Dept. "Approved as to Legal Description"	
	► *(route to mayor/city manager)*	
	Mayor/City Manager signs off:	
	► *(route to city Recorder)*	
	City Recorder signs off:	
	Original document sent for recording	
	► *(Notify or send copy of transmittal letter to Engineering)*	
	Recording Number _____ and **Date** _____	
	Copy of recorded document sent to: Engineering	
	Economic Development Director	
	Original document placed in Vault, File	Date

~~**APPENDIX G**~~

~~**City of Wilsonville**~~

~~**STANDARD DETAIL DRAWINGS**~~