
CITY OF REDMOND, OREGON

2010 STANDARD SPECIFICATIONS

DESIGN STANDARDS

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I. GENERAL

These are the minimum design standards for the City of Redmond. The following standards shall be adhered to unless an exception is granted in writing by the City Engineer. Exceptions will be granted based upon a design that is the functional equivalent of the design parameters listed herein. Street standards are generally in conformance with the American Association of State Highway and Transportation Officials (AASHTO) Geometric Design of Highways and Streets” 2004 Edition. This document is referred to as AASHTO throughout these standards.

II. DESIGN PARAMETERS

A. STREET

1. General

Materials and procedures for street improvements shall conform to the City of Redmond Specifications, Ordinances of the City of Redmond and Oregon Standard Specifications for Construction. Street width, alignment and placement shall meet the requirements of the City of Redmond Development Code. Street widths are shown in Table 1, Section 8.2710 of the Development Code (reproduced below) and in Standard Drawing 2-1. Street intersections shall be as near right angles as possible except where topography requires a lesser angle, but in no case shall the acute angle be less than 60°.

Table 1 - City of Redmond Right of Way and Roadway Design and Cross-Section Standards

Functional Class	Width (ft)		Right of Way*	Travel Lanes	Sidewalks	Bike Lanes**	Parking**
	Pavement standard	Pavement (minimum)*					
Residential Alley	16 ft		20 ft	n/a	none	shared	none
Commercial Alley	20 ft		20 ft	n/a	none	shared	none
Local Residential	36 ft		60 ft	2***	5 ft.	shared	both sides (unstriped)
	28 ft*		60 ft	2***	5 ft.	shared	one side (unstriped)
	24 ft*		60 ft	2***	5 ft.	shared	none
Local Industrial	40 ft	38 ft	60 ft	2***	5 ft.	shared	optional (unstriped)
Industrial Collector	40 ft	38 ft	80 ft	2	5 ft.	6 ft.	none
Minor Collector	40 ft	36 ft****	60 ft	2	5 ft.	shared	both sides (8 ft)
Major Collector	36-50 ft	36 ft****	80 ft	2	5 ft.	6 ft.	none
Minor Arterial (3-lane)	50 ft	48 ft	100 ft	3	7 ft.	6 ft.	none
Minor Arterial (5-lane)	74 ft	72 ft	100 ft	5	7 ft.	6 ft.	none

Notes:

*May be constructed only in conjunction with the creation of covenants, conditions and restrictions (CCR’s) and the establishment of a homeowners association (HOA) for the development. The CCR’s shall provide that the primary responsibility for parking enforcement shall be the HOA, with the City of Redmond also being acknowledged in the CCR’s as a beneficiary for such parking enforcement as a violation of the land use decision and/or city code .

** In certain cases, bike lanes may be reduced to 5 ft, parking may be reduced to 7 ft, and travel lanes to 11 ft at the discretion of the City Engineer

*** Unstriped travel lanes

**** 36 ft in existing built-out areas

***** All streets less than 28 feet wide shall be no longer than 300 feet in length, unless such streets include at least one (1) parking bay per lot, located along each lot frontage for the entire length of such street, up to the maximum block length. Streets 300 feet or less in length shall not have any direct driveway access. In no case shall any street less than 28 feet wide intersect with any other street less than 28 feet wide.

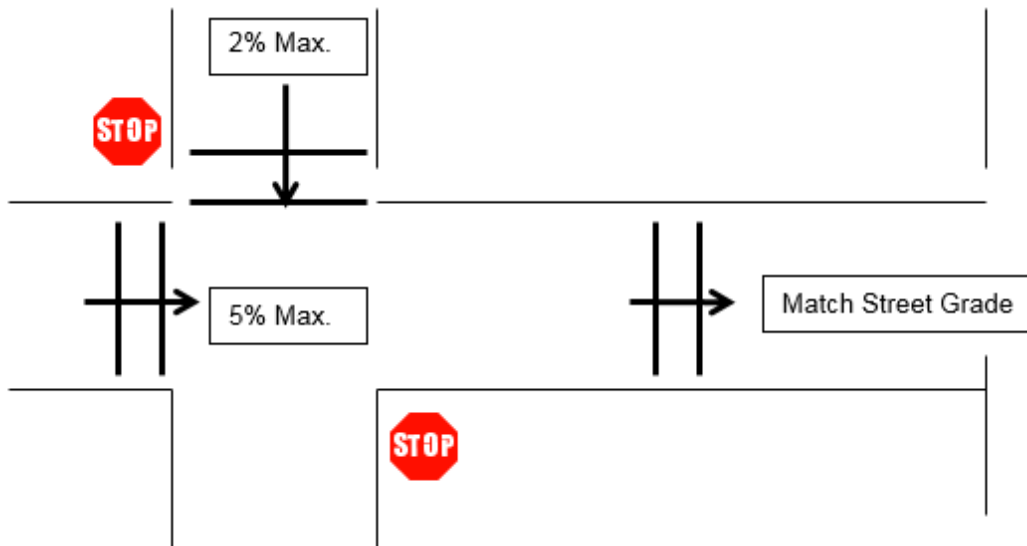
2. Slope

Minimum longitudinal slope for drainage control at the gutter line for all streets is 1.0%. A minimum slope of 0.5% may be allowed by the City Engineer where 1% is not practical. A written request is required justifying the need for a variation and describing what will be done to insure that constructed street grades are not less than design and storm drainage requirements are met.

Maximum street grades are as follows (see also Standard Drawing 2-1):

Arterials, Major and Industrial Collectors	6%
Minor Collectors, Industrial Streets	8%
Local Street	10%

Maximum street grade may be increased up to 2 percent with City Engineer's approval. Note that Draft Public Rights of Way Accessibility Guidelines (PROWAG) specify maximum cross slopes of pedestrian street crossings which will control the longitudinal grade of the street at intersections. In accordance with PROWAG Section 302.6, the maximum cross slope of the pedestrian crossing for stop or yield controlled streets shall be 2 percent. For streets without stop or yield control, the maximum cross slope is 5 percent (R302.6.1). Cross slopes of midblock pedestrian street crossings are permitted to match the grade of the street (R302.6.2).



To insure that cross slopes are not exceeded during sidewalk ramp construction, maximum slope through intersections shall be 2% in accordance with Standard Drawing 2-27. Detailed slope and elevation information shall be provided for sidewalk ramps and curb returns and shall conform to Draft Public Rights of Way Accessibility Guidelines (PROWAG) published by the Department of Justice. Note that the minimum continuous and unobstructed clear width of a pedestrian access route shall be four feet (PROWAG R302.3). The maximum cross slope of the walkway shall be two percent (PROWAG R302.6). Pedestrian access routes running parallel to a street may run at the same grade as the street, but cannot exceed the street grade (PROWAG R302.5). Options for ramp layout at intersections are provided in the standard drawings. Slopes and widths of landings, wings and other components must comply with Section R304 of PROWAG. It is recommended that design slopes be set lower than the PROWAG maximum to allow for discrepancies during construction.

3. Sight Distance

All streets shall be designed to the following values for adequate safe stopping sight distance at the design speed, according to AASHTO, Table 3-1

15 MPH	80'
20 MPH	115'
25 MPH	155'
30 MPH	200'
35 MPH	250'
40 MPH	305'
45 MPH	360'
50 MPH	425'

4. Vertical Curves

The minimum centerline vertical curve length shall be as determined by AASHTO formulas given below. In general, minimum curve lengths shall be no less than three times the design speed of the roadway. For example, the minimum curve length for a local street designed for 25 mph shall be 75 feet.

The minimum lengths of vertical curves shall be calculated from the following relationships.

	<u>CREST CURVES</u>	<u>SAG CURVES</u>
S > L	$L = 2S - \frac{2158}{A}$	$L = 2S - \frac{400 + 3.5 S}{A}$
S < L	$L = \frac{AS^2}{2158}$	$L = \frac{AS^2}{400 + 3.5 S}$

WHERE: A = Algebraic difference in grades, percent
 S = Design sight distance, feet
 L = Length of Vertical curve, feet.

Based on AASHTO Equations 3-43 and 3-44 for eye height=3.5 feet and object height=2.0 feet

Careful consideration shall be required when K values exceed 167 as this will create flat sections at high and low points of the curve that may not drain well.

$$K=L/A$$

L = Length of vertical curve
 A = Total change in grade, %

5. Horizontal Curves

The minimum horizontal curve radius shall be designed using AASHTO's side friction factor method for low-speed urban streets and superelevation distribution method 2. Minimum curve radius for various design speeds and cross slopes are shown in the following table:

Street Classification	Design Speed	Crown	Superelevation		
	(mph)		-0.02	0.02	0.03
Major Arterial	45	1039	794	750	711
Minor Arterial	40	762	593	561	533
Collector	35	510	408	389	371
Industrial	35	510	408	389	371
Local	25	198	167	(b)	(b)

Notes:

- (a) From Table 3-16, A Policy on Geometric Design of Highways and Streets, AASHTO 2004.
- (b) Superelevation permitted only with approval of City Engineer
- (c) The use of superelevation above 0.04 ft./ft. will require approval of the City Engineer.
- (d) Refer to AASHTO Table 3-16 for minimum radius for superelevation rate higher than 0.04 ft/ft and other design speeds.

6. Superelevation Rate

Superelevation is to be used only as a design element to enhance drivability of horizontal curves on arterial and collector streets. The use of superelevation for other purposes, or on local streets, will require the approval of the City Engineer, will be handled on a case by case basis and will not exceed 2%. The maximum design superelevation for collectors and arterials shall generally be 0.040 ft/ft and minimum superelevation shall be 0.020 ft/ft. Plans incorporating superelevation shall show left and right gutter on the profile and the scale shall be such that these can be distinguished.

7. Superelevation Runoff

The designer must be concerned with three profiles in the development of a superelevated section: left gutter, centerline and right gutter. Superelevation shall be obtained by rotating two of these profiles around the third stable profile, usually the centerline, which reflects the overall design.

Particular attention must be paid to the impact on drainage characteristics resulting from superelevation. No more than 25% of a transition section may be placed on the horizontal curve. No transition section shall be less than 100' in length. The minimum transition section lengths shall be determined in accordance with the AASHTO Policy on Geometric Design of Highways and Streets 2004 Edition, Chapter 3 Transition Design Controls. AASHTO Exhibit 3-32 provides runoff length for various design speeds, number of lanes and superelevation rates. Select examples are provided in the table below for a road section with two 12 foot lanes and a superelevation rate of 4 percent (AASHTO Exhibit 3-32).

DESIGN SPEED	MIN. LENGTH
50 mph	96'
45 mph	89'
40 mph	83'
35 mph	77'
30 mph	73'
25 mph	69'

8. Reverse Curves

On all streets having a design speed of greater than 30 mph there shall be a minimum 100' tangent section between reverse horizontal curves. Reverse curve signing shall be shown on the plans.

9. Compound Horizontal Curves

Compound horizontal curves should be avoided on streets having a design speed of greater than 30 mph. If a compound curve is necessary, the ratio of the flatter radius to the sharper radius should not exceed the following:

31 - 49 mph design speed	2 : 1
50 + mph design speed	1.5 : 1

Where the ratio exceeds these limits, a suitable length of spiral or a circular arc of intermediate radius shall be inserted between the two curves.

10. Road Crown

Collector and arterial streets shall be designed with either a crowned or a superelevated section through curves. A shed section on collector and arterial streets is not acceptable. On other classes of streets with design speeds less than 30 mph, shed sections are permissible. Shed section cross slope shall not be greater than 2%. Slopes less than 2% require approval by the City Engineer. Where a non-standard street width is designed, the crown shall be based on a 2% side slope.

11. Offset Intersection

Minimum distance between offset intersections shall be 165 feet, measured from center line to centerline of the intersection.

12. All Weather Service Road Standard

All weather service roads shall meet requirements of Standard Drawing 2-5.

13. Curb Radius

The minimum curb radius shall be as follows:

Arterial - Arterial	35'
Local-Local	15'
Local-Collector	20'
Local-Arterial	25'
Collector-Collector	25'
Collector-Arterial	35'
Industrial	35' *

*(35' radius with parking eliminated within 40' of intersection measured from curb return)

When evaluating curb radius, designers should consider the location of sidewalk ramps and attempt to line up crosswalks with sidewalks to maintain a straight walking path across

intersections. A reduced curb radius may be allowed in areas with high pedestrian traffic to improve crosswalk alignment and visibility. Curb radius less than standard must be approved by the City Engineer.

Where a radius larger than 35' is desired, a 3-centered symmetric compound curve shall be used. Three-centered symmetric compound curves shall be designed only on right-of-way sufficiently large to accommodate 12' minimum between curb face and the property line. The radii of the 3-centered symmetric compound curve shall be 120'-40'-120'. The offset of the 40' radius shall be determined by the design vehicle as follows:

<u>Design Vehicle</u>	<u>Offset</u>
SU	2'
BUS	3'
WB-40	4'
WB-50	5'

14. Street Striping

Street striping shall be designed in accordance with the current ODOT Traffic Line Manual. See Standard Drawing 2-1 for striping requirements by road classification.

15. Street Signs

Street signage must conform with the latest edition of the Manual on Uniform Traffic Control Devices. Sign posts shall meet requirements of Standard Drawings 2-24 to 2-26. The Contractor shall verify the correctness of all street sign legends and names immediately prior to installation.

16. Cluster Postal Delivery Boxes

Cluster box locations shall be shown on the plans. US Postal Service must agree on location and type of delivery boxes. Cluster Postal Delivery Boxes should be constructed on residential streets in an area that minimizes impact on abutting properties.

Accessibility: Cluster mailboxes shall meet accessibility requirements in the Americans with Disabilities Act (ADA) and Public Right of Way Accessibility Guidelines (PROWAG):

- a. Provide a 72 inch wide concrete pad adjacent to cluster mailboxes with turning space that conforms to Section 304 of the 2010 ADA Standards for Accessible Design.
- b. Provide a pedestrian access route to adjacent sidewalk complying with PROWAG Section R301.
- c. Provide a pedestrian access route to on street parking complying with PROWAG Section R301 within 25 feet of the mailbox.

Cluster Postal Delivery Boxes desired along arterial or collector streets should be constructed off public right of way on common ground dedicated to that purpose and provided with appropriate driveway access. Cluster Postal Delivery Boxes shall not be constructed on arterial street right of way. Cluster Postal Delivery Boxes may be constructed on collector street right of way provided that a turnout meeting the following requirements is constructed.

- a. The center of the turnout shall be located in the center of a tangent section of the Collector. This tangent section shall have a length of not less than two times the stopping sight distance for the design speed.
- b. The required right of way width shall be increased to provide for the parking bay.
- c. The bay shall not be located less than the design stopping sight distance from any intersection.
- d. The bay of the turnout shall be a minimum of 40' in length and not less than 10' in depth.
- e. Tapered approach sections into the bay shall be not less than 10:1.
- f. Curb radius in the bay shall be not less than 50' radius.
- g. There shall be adequate stopping sight distance on either end of the turnouts into the parking bay.
- h. The bay shall be signed with the following:
10 Minute Parking
No U-turns (MUTCD # R3-4a or R3-4 with R3-4p)

17. Street Lights

Street lights shall be shown on the plans and provided at the following locations:

- Intersections
- Cul de sac bulbs if over 200 feet from the intersection
- Mid-block for blocks longer than 400 feet from center of intersection to center of intersection
- High-use driveways and other locations designated by the City Engineer.

Poles and fixtures shall conform to the power provider standards. Standard cobra head fixtures shall be used unless decorative design is approved by the City Engineer or required for downtown areas.

18. Asphalt Concrete Pavement

Asphalt concrete pavement depth, classification and asphalt binder shall be as follows for various road classifications:

- Arterials: Five inches (two lifts-3 inch base, 2 inch top) of level 3, ½" dense-graded mix with PG 70 -28 asphalt binder in top lift, PG 64 -28 asphalt binder bottom lift on 5th St., 6th St., S. Canal Blvd and other arterials designated by the City Engineer. Same requirements for all other arterials except the asphalt binder shall be PG 64 -28 in both lifts.
- Collectors: Four inches (two lifts) of level 3, ½" dense-graded mix with PG 64 -28 asphalt binder on collectors with more than 1 million anticipated equivalent single axle loads over the 20-year design life. For collectors with less than 1 million equivalent single axle loads, use level 2 mix.
- Local: Three inches (one lift) of level 2, ½" dense-graded mix with PG 64 -28 asphalt binder.

19. Dead End Streets and Alleys

A turnaround must be provided on all dead end streets, alleys and all weather access roads. Cul de sac requirements for public streets are provided in Standard Drawing 2-4. Through alleys are encouraged, but where they cannot be provided and the alley is a required emergency access, either a standard cul de sac or alternate turnaround meeting the requirements of the Oregon Fire Code must be provided. Dead end alleys not required for emergency access shall have a hammerhead turnaround, but it is not required to meet Oregon Fire Code requirements.

20. Pavement Taper

When street transitions to a different pavement width, the edge of the pavement shall be tapered as follows:

Travel Lane Transition: 1: Design speed. Example: for a street with 25 mile per hour design speed, length of transition equal 25 feet for every foot of width difference.
Other than Travel Lane: 1:10

21. Driveway Spacing from Intersections

The distance from the right of way to the nearest edge of a driveway shall be in accordance with Development Code Section 8.3035(9) which includes the following table:

Roadway Classification	Minimum Access Driveway Spacing	Minimum Access Clearance Corner	Intersection Spacing
Local Street	No Restrictions	30 feet	165 feet
Minor Collector	80 feet	80 feet	330 feet
Major Collector	165 feet	165 feet	330 feet
Minor Arterial	330 feet	330 feet	¼ mile
Major Arterial	ODOT Standards	ODOT Standards	ODOT Standards

Refer to Development Code for additional details and the most current standards.

B. Stormwater

1. General

Stormwater systems in the public right of way and private property shall be designed in accordance with the latest version of the Central Oregon Stormwater Manual and City of Redmond Special Provisions listed in this section.

2. Special Provisions to Central Oregon Stormwater Manual (August 2010 Update)

- a. **Design Storm** The design storm to be used in the City of Redmond for flow control shall have a recurrence interval of 50 years (as opposed to the 25-year design storm required in Chapter 7 of the Central Oregon Stormwater Manual). Pre-development condition is defined as the condition of the site before any proposed development activities. For example; a proposed retail center may be constructed on a site that has an existing house, gravel driveway and lawn. The pre-development runoff coefficient calculations can take into account existing structures and driveways. Runoff rates and volumes from the proposed retail center site cannot exceed the rates and volumes for the house, driveway and lawn for the 50-year storm event. The flow must be discharged in a location similar to what existed before the retail development and the routing for the 100-year flow must be demonstrated.
- b. **IDF Curves** IDF curves developed for Redmond in September 2008 by MGS Engineering Consultants, Inc. shall be used for Rational Method as provided in the Central Oregon Stormwater Manual Appendix 5C. These curves and supporting data are provided in the table and graph at the end of this section.
- c. **Public/Private Stormwater Separation** Stormwater from private property shall be maintained on site whenever possible. When steeper topography (6 percent slope or greater) on single family or duplex residential developments (R1, R2, R3 and R4 Zones) makes on-site retainage difficult or impossible, that portion of the runoff from private property that cannot be maintained on site may be allowed to flow into the public right of way and controlled with a single stormwater system. City Engineer approval is required. Stormwater runoff from multi-family (R-5 Zone), commercial and industrial developments as well as private streets must be controlled in separate stormwater facilities on site and not combined with the stormwater system for the right of way. In all cases, designers must account for all stormwater that could flow to the public system when determining the drainage area and not limit the calculations to just the right of way area.
- d. **Preferred BMP** Sediment manholes are a preferred best management practice and should be located immediately upgradient from drywells when used in a treatment train.
- e. **Swale Lining** For swales that are not irrigated, a rock lining is required. Swales shall be lined with geotextile below 10 inches of 3" to 4" crushed rock. Irrigation is required for vegetated swales.
- f. **Loading Docks** Loading dock drainage must be collected in a blind sump or discharged to the public sanitary sewer. For discharge to the public sanitary sewer, the back 3' of the dock must be hydraulically isolated from stormwater intrusion, and have the isolated portion drain to an oil/water separator followed by a shutoff valve prior to discharge to the public system.
- g. **Proximity to City Water Supply Well** Drywells may not be placed within the 2-year time of travel zone or within a 500 foot radius from City or community water supply wells.
- h. **Drywell Detail** The slotted cover shown in Figure 7-7 Note 6 is not permitted. Refer to

Standard Drawing 3-8. For drywells outside of paved areas, a 5 foot by 5 foot concrete pad, 6 inches thick is required around the manhole frame and cover.

- i. **Drill Holes** Drill hole construction for stormwater disposal is not permitted without written approval of the Public Works Director.
- j. **Drywell Spacing** Minimum spacing between drywells shall be 20 feet.

3. Storm Sewer Design

- a. Storm sewers shall generally conform to the same specifications as sanitary sewers (see Section II C).
- b. Flanking inlets at sags will not be required provided that the primary inlet is shown to be adequate to capture the design flow.
- c. Double-sized catch basins are normally required for inlets (Standard Drawing 3-10). A single catch basin is acceptable for the collection of water where special situations apply.
- d. Curb inlet catch basins shall be installed in arterial and major collector streets to provide better bicycle routes.
- e. Inlets shall be provided at intersections of collectors and arterials. Inlets should be provided at intersections of local streets. These inlets shall be so arranged that water is not directed through the intersection or in certain cases, around a curb return.
- f. Inlets should be provided to avoid ice formation on the roadway.
- g. Valley gutter intersections may be allowed with approval of the City Engineer in situations such as intersections of short cul-de-sacs with local streets.
- h. Storm pipe will cover to finish grade greater than 30 inches shall be:
 - PVC meeting the requirements of ASTM D3034 (for pipes less than 18 inches in diameter) or F679 (for pipes 18 inch diameter and larger) –or-
 - Polypropylene with smooth interior, annual exterior corrugations and gasketed integral bell and spigot joints meeting the requirements of ASTM F2736 for diameters of 12 to 30 inches. –or-
 - Polypropylene with smooth interior and exterior, inner annual corrugations and gasketed integral bell and spigot joints meeting the requirements of ASTM F2764 for diameters of 30 to 60 inches.

Storm pipe with cover to finish grade less than 30 inches shall be PVC meeting the requirements of AWWA C900 or C905.

4. Storm Facility Testing

Stormwater facility testing requirements shall be shown on the plans. Testing requirements vary depending on the type of facility and whether infiltration is accounted for in the design.

- a. **Information to show on plans:** For each drainage facility, provide runoff area in square feet, runoff coefficient used for calculations, peak runoff rate to the facility in cubic feet per second and gallons per minute and total runoff volume to the facility in cubic feet and gallons. For facilities with designs that account for infiltration, also provide the maximum required storage volume and design storage volume in cubic feet and gallons.
- b. **Testing Procedures:** There are three parts to the testing procedure; confirmation of storage volume, infiltration rate and ability to drain within 72 hours. Test methods vary by the type of facility and basis for design as follows:
 - 1) **Drywells:**
 - i. **Storage Volume:** Confirm the storage volume by tracking the quantity of drain

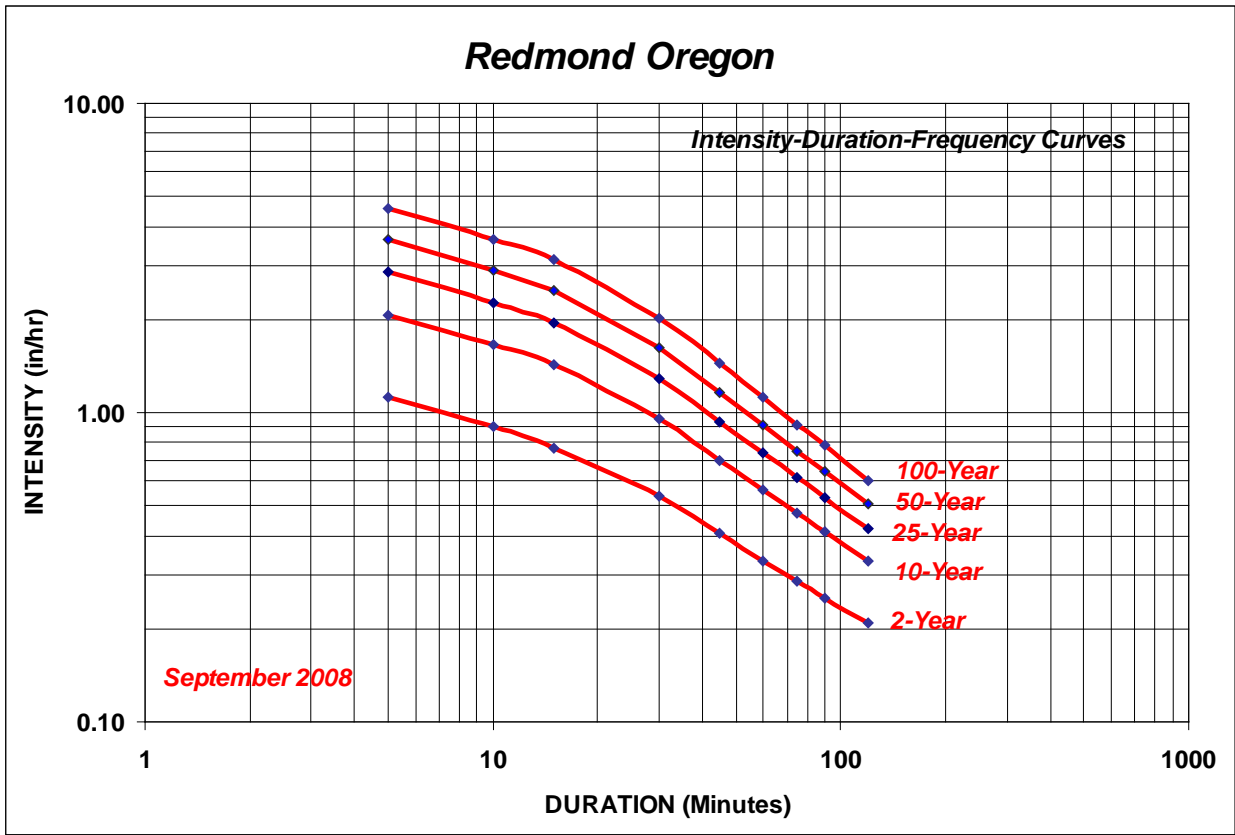
rock used with load tickets and measuring the diameter and depth of the drywell. Calculate interior volume of the drywell from the base to the bottom of the lowest pipe. Calculate the storage volume in the drain rock using a void ratio of 35 percent unless a different void ratio is provided by a materials testing lab.

- ii. **Infiltration Rate:** For drywells with a convenient hydrant, fill the drywell with water from a metered source and adjust the flow rate to maintain the level of water at the top of the barrel section or the base of the inlet pipes (whichever is lower). Measure and record the flow rate at 10 minute intervals. Maintain the flow rate necessary to keep the drywell at the top of the barrel section or pipe invert for one hour. After the one hour period, turn off the water supply and record the depth to the water surface every 10 minutes for one hour. If the drywell cannot be filled, measure the depth to the water surface and record depth and flow rate at 10 minute intervals. Stop filling after 60 minutes and measure and record the depth to the water surface every 10 minutes for one hour. If a hydrant is not readily available, a water truck is required. Place four water truck loads (3,500 to 4,000 gallons each) in the drywell within a 2-hour period. After the water has been placed, let the drywell drain and record the depth to the water surface every 10 minutes for one hour.
- iii. **72-hour Drainage:** Check 72 hours after stopping the flow to see if the drywell has emptied.

2) Ponds, swales and infiltration galleries:

- i. **Storage Volume:** For ponds, swales and other surface facilities, confirm the storage volume with as-built measurements and calculations provided by the project surveyor. For infiltration galleries, track the quantity of drain rock used with load tickets. Calculate the storage volume in the drain rock using a void ratio of 35 percent unless a different void ratio is provided by a materials testing lab.
- ii. **Infiltration Rate:** For infiltration swales and ponds in general and for infiltration galleries constructed with filter soil placed above the drain rock, measure the infiltration rate at the surface after the filter soil is placed. If the infiltration gallery is designed so that runoff enters directly into the drain rock with filter soil below, measure the infiltration rate of the soil prior to placing the drain rock. Use the single-ring infiltrometer test (Appendix D of the Central Oregon Stormwater Manual) or other test recommended by a Geotechnical Engineer.
- iii. **72-hour Drainage:** Use the Swale Flood Test described in Appendix 4E of the Central Oregon Stormwater Manual. For sloped swales and swales with check dams, introduce flow at the high end and allow it to overtop each check dam until it pools to a depth of 6 inches in the low end. Check 72 hours after stopping the flow to see if the facility has emptied. Use standpipe to monitor water level in infiltration galleries.

RECURRENCE INTERVAL	PRECIPITATION INTENSITY (in/hr)									
	DURATION (minutes)									
	(Years)	5	10	15	30	45	60	75	90	120
0.5	0.60	0.48	0.41	0.30	0.23	0.19	0.17	0.15	0.13	
2	1.12	0.90	0.77	0.54	0.41	0.33	0.28	0.25	0.21	
5	1.60	1.28	1.10	0.75	0.56	0.45	0.38	0.34	0.27	
10	2.07	1.65	1.42	0.96	0.70	0.56	0.47	0.41	0.33	
25	2.84	2.26	1.95	1.29	0.94	0.74	0.61	0.53	0.42	
50	3.61	2.87	2.48	1.62	1.17	0.91	0.75	0.65	0.51	
100	4.57	3.62	3.14	2.03	1.44	1.12	0.92	0.78	0.61	
500	7.77	6.12	5.35	3.35	2.34	1.78	1.43	1.20	0.90	



Redmond Rainfall-Intensity-Duration-Frequency Curves prepared by MGS Engineering Consultants, Inc. September 2008
 NOTE: The 6-month rainfall intensity is 2/3 of the 2-year rainfall intensity

C. SEWER

1. General

Sewer/water line separation and construction is established by Oregon State Health Department Standards. Materials and procedures for sewer facilities shall conform to the City of Redmond Standards and Specifications, D.E.Q. Specifications, and APWA Standard Specifications.

Sewer facilities shall be installed in rights of way except in those situations where, in the determination of the City Engineer, drainage basins can not be served from the right of way. In those cases an easement will be required.

Engineering firms submitting sewer plans shall include a sewer profile. The profile will include the existing ground elevation, proposed street grade, pipe diameter, material and slope, manhole, station and invert elevations and trench backfill information.

2. Sewer Main

a. Design Parameters

- 1) **Location** Sewer mains should be located in accordance with the Department of Environmental Quality and OAR Chapter 340, Division 52. Sewer mains shall be located on roadway centerline on tangent sections and as close as practicable to this configuration on curves. Gravity sewer mains from manhole to manhole shall run in a straight alignment.
- 2) **Sewer Main Stub** Stub outs for the future continuation of the sewer shall terminate at a manhole unless approved by the City Engineer due to unusual circumstances. In phased subdivisions the sewer should be extended to the next adjacent manhole as shown on the master plan to minimize the number of manholes required.
- 3) **Depth** Minimum cover for all standard sewer lines except sewer services shall be 30".
- 4) **Minimum Diameter:** For gravity sewer, the minimum size shall be 8". Size of pressure lines will be determined by the design engineer.
- 5) **Minimum Velocity:** 2 fps for gravity sewers. 3 fps for pressure and inverted siphons
- 6) **Maximum Velocity:** Velocity shall not exceed 8 fps for pressure sewers.
- 7) **Minimum Grade (Gravity):** From DEQ design criteria:

Pipe I.D.	Slope (ft/100 ft)
6"	0.60
8"	0.40
10"	0.25
12"	0.19
15"	0.14
18"	0.11
21"	0.09
24"	0.08

8) Flow Calculation

- a. **Gravity** Flow calculations will be based on Manning's equation using an n value of 0.013

- b. **Pressure** Flow calculations will be based on the Hazen and Williams equation using the following values for C:

Concrete	120
Cast iron/steel	125
PVC	135

9) Flow Estimation

Domestic waste: 120 gallons per person per day
300 gallons per dwelling unit (DU)

Commercial and Industrial: 1000 gallons per acre per day

Schools: Elementary: 10 gallons per student per day
Middle: 15 gallons per student per day
High School: 20 gallons per student per day

Infiltration: Negligible

- 10) Peak Factor:** 3.0 for flows less than 1 MGD
2.5 for flows from 1 MGD to 10 MGD
2.0 for flows greater than 10 MGD

11) Manholes

Spacing: Not more than 400' apart

Design Fall: Not less than 0.1' without prior approval by City Engineer

External Drop Manhole: Required when fall greater than or equal to 18"

Dead-end lines: End with a manhole, cleanouts are not acceptable.

Diameter: Standard diameter for pipes up to and including 15-inch diameter is 48 inches. For 18-inch and larger pipes and for unusual pipe angles, 60 inch diameter or larger manholes are required to maintain structural integrity. Submit manhole design for pipes sizes 18 inches and larger.

12) Wet Wells

Operating Capacity: The minimum operating capacity of the wet well, from first pump on to pumps off, shall be not less than 5 minutes times one pump flow rate.

Emergency Capacity: The emergency capacity, from alarm on to an overflow condition, shall be determined on a case by case basis, but in no case shall be less than 30 minutes times the peak flow rate. This 30 minute response time shall generally apply to areas not adjacent to water courses and within 10 road miles of the treatment facility.

Pump Flow Rate: A single pump flow rate should sufficiently exceed the peak inflow rate to be effective.

Pump Cycle Times: Pump cycle time, from "pump off" to "pump on" shall not be less than 10 minutes at peak flow and shall take into consideration any line back-draining requirements.

Design Line Size and Volume Requirements

Given:

Q_i	=	Peak inflow rate
Q_p	=	Design pumping rate
V_w	=	Working capacity
V_b	=	Back drain volume
V_e	=	Emergency volume for response time

Wetwell shall be designed for the sum of V_w , V_b and V_e

Conditions:

Q_p	>>	Q_i
		For 3" line: $66 \text{ gpm} < Q_p < 150 \text{ gpm}$
		For 4" line: $118 \text{ gpm} < Q_p < 270 \text{ gpm}$
		For 6" line: $265 \text{ gpm} < Q_p < 600 \text{ gpm}$
V_e	>	$(30)(Q_i)$ (minimum)
V_w	>	$(5)(Q_p)$
V_w	>	$(10)(Q_i) + V_b$

See Section 310 Sewage Lift Stations in the Standards and Specifications for additional design information and equipment specifications.

b. Waterline Crossings

When the sewer line is located above or less than 18" below a crossing waterline, the sewer line shall be constructed of pipe conforming to water pipe standards. AWWA C-900 pipe is acceptable. The minimum length of this strengthened sewer is 20'. It is intended that a section of the water class pipe be centered over the water main and connected to the sewer line with approved PVC couplings.

c. Detection Tape and Wire

Detection tape shall be installed on all non-metallic gravity sewer main. Detection tape shall be as manufactured by Allen Systems or an approved equal. One course of detection tape is required at the top of the pipe zone. Detection wire shall be installed on all pressure sewer mains, all gravity sewer mains laid on a curve and all service connections. The wire shall be a green clad 18 gauge direct bury copper, solid wire. The wire shall be attached to the top of the pipe.

d. Materials

Materials shall conform to the Standard Specifications of the City of Redmond.

e. Construction

Construction shall conform to the City of Redmond Standard Specifications and applicable Standard Drawings. Prior to installing a sewer facility in an unimproved street, the street must be brought to sub-grade to ensure that adequate bury, depth of cover, and utility separation is acquired. In the event the street is to be improved at a later date, the street shall be properly

staked to the approved design prior to the commencement of sewer line construction.

3. Sewer Services

All single family residential sewer service laterals shall be a minimum of four (4) inches in diameter and have a clean out at the property line.

All new duplex and multi-family service laterals shall be a minimum of six inches in diameter, except when higher flows require a larger line size. However, existing 4-inch service laterals with clean out may be used to serve duplex or multi-family lots with approval of City Engineer, unless flow rates are greater than the capacity of the existing line.

Commercial and industrial service laterals shall be a minimum of six inches in diameter. However, existing four (4) inch service laterals with clean out may be used, with approval of the City Engineer. Separate and independent building sewers shall be provided for buildings on separate lots or parcels. Sewer services shall be extended at minimum grade or steeper as required to provide gravity service to each building. Sewer services shall not have less than 24" of cover at the property line, 30" minimum cover in street, and shall be located as required to provide gravity service to each lot or parcel.

Pressure sewer services shall be designed by a competent professional. The pump curve with the operating point indicated shall be submitted to the City of Redmond Engineering Division so it may be ascertained that the proposed installation will not conflict with the operation of the City system. Pressure mains shall be a minimum of 3 inches in diameter and all check valves, gate valves will have the capacity to pass a 3 inch ball. It is considered prudent to specify the service line one size larger than the pump outlet.

4. Sanitary Sewer Manholes

Manholes shall be located as shown on the design plans or as directed by the City Engineer, or representative, in a manner to provide complete accessibility and to minimize the possibility of damage from vehicles or injury to pedestrians.

Location of the center of manholes in a vehicle wheel track is not acceptable. Location of the center of manholes within 5 feet of the curb line is not acceptable. Location of manholes outside of paved areas is not generally acceptable. If manholes can not be located in the pavement, then a six inch thick concrete pad 5 foot square centered on the manhole cover must be provided. Pipe stub-outs in manholes for 4" service connections generally will not be allowed, except for manholes at end of line. Service line crown elevation shall match main line crown. Internal drop manholes will not be acceptable for drops equal to or greater than 18 inches. A channel is required from service line connections to the main channel in the manhole base.

Angle between inlet and outlet lines of sewer manholes less than 90° shall be avoided, but if necessary, the invert of the inlet line shall be at or above the crown of the outlet line, but not to exceed 18 inches. Channel construction must allow access for City's closed circuit television camera.

5. Cleanouts

Cleanouts may not be substituted for manholes on sewer mains.

6. Access to Sewer Facilities

Where manholes lie outside of the paved right of way, an access road, with dedicated right of way or easement, shall be constructed to provide all weather access to the manhole. This access road shall meet all weather service road standards (See Standard Drawing 2-5) or be paved. Support facilities such as, but not limited, to drainage structures, vehicular turnaround with 38 foot turning radius, or a pad-lockable gate may be required on any manhole location outside of the paved right of way. An exception to the requirement for an access road will be made when no manholes are located in the easement area.

7. Sampling Manholes

A sanitary sewer sampling manhole located at a point accessible at all hours to City personnel is required for each commercial, industrial, or institutional user's service lateral. The sampling manhole shall be constructed upgradient from any discharge into the public sewer system. The manhole shall conform to Standard Drawing 3-6. The sampling manhole shall be constructed, owned and maintained by the property owner. The manhole may be located at the sewer connection within public right of way. Privately owned sampling manholes within public right of way are subject to revocable right of way approval [City Code 4.337(1)]. At the option of the property owner, the sampling manhole may be located on private property within an easement that provides unobstructed access to City personnel. If manholes cannot be located in the pavement, then a six inch thick concrete pad 5 foot square centered on the manhole cover must be provided.

D. WATER

Materials and procedures for water facilities shall conform to the Standard Specifications of the City of Redmond, Oregon Health Division Administrative Rules, and AWWA standards. Water facilities shall be installed in public rights of way except in those situations where, in the determination of the City Engineer, service areas and/or pressure levels will be better served by an alternate design. In those cases an easement will be required.

1. Main Line

a. Minimum Size

The minimum size for mainline shall be 8 inches except in industrially zoned areas where the minimum main size is 12 inches. Lines must be sized to provide the following required fire flows:

Residential	1,500 gpm
Commercial	2,500 gpm
Industrial	3,500 gpm

All main lines shall end with a fire hydrant for maintenance purposes. Hydrant lines may be 6" if total length is less than 400 feet. Hydrant runs longer than 400 feet will require 8" line. A fire flow analysis will be required to determine the size for lines longer than 400 feet.

b. Required Information on Drawings

All drawings that include water and sewer mains submitted for review by the City Engineer shall have the street station and offset, size, number, and type of fittings specified at the location they occur. Specifying only the deflection angle of the line, e.g. 30°, is not acceptable.

c. Location

Water mains are normally located 12 feet from roadway centerline with a minimum 10 foot horizontal separation from parallel underground utilities unless written approval of the City Engineer is obtained. Separation from sewer lines shall be in accordance with OAR 333-61-0050 (see City Standard Drawing 1-2).

d. Service Lines

A separate water service, including meter, shall be required for each lot of record. Refer to the most current version of the City of Redmond's "Water Service and Meter Installation Manual" for approved fittings, boxes and meters as well as installation requirements.

Service lines are to terminate in an approved meter box. Service lines shall be constructed, complete and with all incidentals to the terminus of the meter box as shown in drawing 4-5, to be located directly behind the sidewalk or, if there is no sidewalk, directly behind the curb. An approved meter shall be installed in the meter box. Any services larger than 1" shall be provided with a saddle or tee at the main.

A back flow prevention device, as approved by the Oregon State Health Division and the City of Redmond, shall be installed on all new services larger than 1" diameter and all fire service lines. Backflow devices shall be installed at the property line unless otherwise approved by the City Engineer.

e. Valves

Valves in water mains shall be located in the street right-of-way, preferably in intersections unless otherwise approved. Maximum distance between valves is 1,000 feet on transmission mains and 500 feet on distribution mains. Valves will be provided so as to minimize the number needed to be closed to isolate sections of line and minimize the number of customers impacted by shutdowns. A cross will normally require 3 or 4 valves, and a tee 2 or 3 valves. Valves are required on the end of lines for future extension. Valves shall be installed on flanged tees or crosses, unless otherwise approved by City Engineer. No valve shall be located closer than 3 feet from existing or proposed gutter line. All valves shall conform to AWWA Standards. All intersections shall have approved valving. Butterfly valves shall be used on all waterlines 10" or larger; or where 18" of cover to the top of a gate valve body cannot be obtained. Where valves are located outside of paved areas they shall be provided with a concrete collar not less than 30" square. Valve clusters may be set in a single collar provided there is not less than 12" from the edge of the valve to the edge of the collar.

f. Detection Tape and Wire

Detection wire and tape shall be installed on all non-metallic main line, non-metallic service line, angled or meandering service lines. Note that ductile iron pipe is the only currently approved material for water mainlines. Detection tape shall be as manufactured by Allen Systems or an approved equal. One course of detection tape shall be installed 12" above the pipe. Detection wire shall be a Blue 18 gauge UF bury solid copper wire located within 6" of the top of the pipe. The wire shall have electrical continuity and a lead shall be brought to within of the surface in valve stacks. Wherever there is a splice, it shall be repaired according to manufacturer's recommendation.

g. All Weather Access

Where water facilities requiring maintenance access lie outside paved right of way, a paved access pad sufficient for service equipment to operate without blocking the traveled way shall be provided. Where water facilities (such as fire hydrants and valves) lie away from paved right of way, an all weather access road shall be constructed to provide all weather access to the facilities. This access road shall meet all weather service road standards (See Standard Drawing 2-5) or be paved. Support facilities such as, but not limited to, drainage structures, vehicular turnaround with a 38 foot radius, or a pad-lockable gate may be required on any water facility location.

h. Thrust Restraint

Thrust restraint shall be provided for water fittings. Internal pipe joint restraints, such as Field-Lok gaskets and external joint restrains, such as Mega-lugs, are generally preferred to concrete thrust blocks. Plans shall show the required restrained pipe length in accordance with the table below. When concrete thrust blocks are necessary, plans shall include Standard Drawings 4-3 and 4-4 for thrust blocks.

2. Meters

Approved water meters and meter boxes are described in the most current Water Service and Meter Installation Manual.

3. Fire Hydrants

a. General

Each hydrant shall be connected to the main with a 6-inch branch controlled by an independent 6-inch gate valve bolted to a flanged tee. On hydrant lines over one hundred (100) feet long, a second valve shall be required within 10 feet of the hydrant. No other lines are allowed to be connected to this 6 inch fire hydrant line unless the line is upsized to 8 inches and flow calculations have been provided that show the line can provide the required fire flow and peak domestic flow simultaneously.

b. Location

Hydrants shall be placed at maximum 400' intervals. Any other spacing requires approval of the Redmond Fire Marshall. Hydrants shall be located as shown on the plans or as directed by the City Engineer, in a manner to provide complete accessibility and to minimize the possibility of damage from vehicles or injury to pedestrians. The hydrant barrel shall be set as shown in the standard drawings.

On hydrant runs exceeding that shown on Standard Drawing 4-13, design and installation shall be such that the hydrant can be excavated and repaired without danger of the hydrant valve blowing off the line or causing the main line to be taken out of service. This requirement may result in the installation of a second hydrant valve at the mainline tee, or joint and fitting restraints. Hydrant valves shall be located reasonably close to the hydrant as indicated in the drawings so as to be obvious in the event of an emergency.

c. Staking

All hydrants shall have two reference points (swing ties) indicating the face of hydrant and tops of curb and face of curb. These reference points are the responsibility of the Design Engineer and he/she shall be responsible for position of such prior to construction.

d. Concrete Pad

A concrete pad shall be installed around the barrel as specified in Section 404.3.00 of the Standard Specifications of the City of Redmond.

e. Bollards

All hydrants located in areas vulnerable to traffic shall be protected by bollards as shown in Standard Drawing 4-14. The design and location shall be approved prior to installation.

E. UTILITIES

1. Prohibition on Cutting Recently Constructed Streets

No open cut for utilities will be allowed within 2 years of completion of a street construction project, unless approved by City Engineer. If permitted within two years of pavement installation, additional paving and/or improved backfill will be required. This may include, removal to centerline or full width of street, full street overlays, grinding and inlay or controlled density backfill.

2. Utility Conduit

Where any utility is not completely installed by the time of the sub-grade inspection, provisions such as utility conduit placed under all areas to be improved, shall be implemented to protect the improvement. This installation shall be acceptable to the affected utility and the City of Redmond. Conduit banks shall be spaced no greater than 300' apart and not less than one per block.

3. Shared Trenches

Underground utilities shall not be located closer than 10 feet horizontally from any water or sewer main. With special permission from the City Engineer this separation may be reduced, but should never be less than 5 feet. Utility crossings of water or sewer mains shall be as close to perpendicular as practicable.

4. Utilities in Public Rights of Way

a. General

Utility companies shall construct facilities in City of Redmond public rights of way in strict accordance with City of Redmond Standards and Specifications. Utility companies and their agents shall cooperate with the City of Redmond Engineering Division to provide for City inspection of their facilities during construction to insure that City of Redmond facilities are not damaged during construction. If a city facility is damaged during construction, it shall be repaired or reconstructed to current City standards. Public Utility easements shall be required adjacent to all city street rights of way for power, communication and gas lines.

b. Plan Submittal

Utility companies must submit plans and profiles of any proposed work in City of Redmond Public rights of way for review by the City of Redmond Engineering Division. These plans must be approved by the City of Redmond before start of construction. Emergency work requiring immediate action shall be exempted from this requirement. All existing underground utilities shall be shown on these plans and shall have been field located by the appropriate utility company through the "one call" network. Failure to field locate existing utilities on the plans will be cause for the City to deny permission to work in the public right of way.

5. Trench Patching in Paved Right of Way Areas

Trench backfill and patching in pavement areas shall conform to Section 212 of the Standards and Specifications.

6. Trench Backfill

Trench backfill shall conform to Section 101 of the Standards and Specifications.

F. IRRIGATION

1. General

Irrigation laterals shall be installed in culvert pipe to the outside limits of public and utilities improvements in right of ways. The construction shall conform to the requirements of the Irrigation Company and the City of Redmond. Where requirements may conflict or differ, the requirement providing the highest level of control, security, and/or integrity shall govern the construction.

2. Materials

Pipe used for irrigation in City right of way shall meet the requirements of AWWA C900 or C905.

III. DRAWINGS

A. SUBMITTAL

For information concerning the process of submitting plans, see Section 04 of the Development Provisions.

B. PLAN SCALE & SIZE

The drawing scale shall be such as to clearly show the proposed improvements and any conflicts with existing or proposed improvements. Where clarity is not compromised, it is preferred that street, sewer and water be combined on one drawing to better disclose the potential for utility conflicts. Plan views shall incorporate a grid to assist in the determination of distance and elevation of improvements. The preferred scale for combined drawings showing multiple facilities is 1" = 20'. Depending on the amount of information shown on the drawings, the scale may be increased to 1" = 40'. Smaller scales will not be accepted. All construction drawings submitted shall be 22" by 34" or 24" by 36" overall size.

C. INFORMATION REQUIRED ON PLANS

1. General

- a. Vicinity map
- b. North arrow, preferably to top or right of each sheet
- c. Project title or name
- d. Sheet Index
- e. Quantities for Engineering Fees
 - 1) Size and total lineal feet of sewer main
 - 2) Size and total lineal feet of water main
 - 3) Size and total lineal feet of fire service lines
 - 4) Size and total number of water services/sewer services
 - 5) Size and total number of water meters
 - 6) Size and total number of manholes
 - 7) Total number of fire hydrants
 - 8) Lineal feet of all streets and alleys
- f. Approval signature block including Public Works Director, City Engineer, Redmond Fire Department, Central Oregon Irrigation District and all Utility Providers impacted by project.
- g. Owner/Developer name, address, and phone number
- h. Consulting Engineer/Surveyor name, address, and phone number
- i. Any associated City or County Land Use application number
- j. Indicate City benchmark used to establish control
- k. Existing topography
- l. Location of all utilities and roads, existing and proposed
- m. Rights of way, property lines, and any easements
- n. Provide the following notes on all plan sets.
 1. Provide the following notes on all **public improvement plan** sets.
 - a. City Engineers signature does not grant approval for construction to begin.
 - b. Inspection of public and site grading/drainage improvements will be

performed by the City of Redmond Engineering Department with the exception of plumbing code/permit improvements.

- c. Excavation shall conform to the provisions of OAR 952-001-0090.
 - d. All materials and workmanship shall conform to the current City of Redmond Public Works Standards and Specifications requirements.
 - e. Contractor is required to notify the City of Redmond 24 hours in advance of commencing construction and to coordinate inspections until project is deemed complete by the Engineering Department.
 - f. Access to existing properties/residences affected by construction activities shall be maintained at all times by the contractor. Emergency access and coordination of Redmond Emergency Services shall be required.
 - g. Survey monuments, controls or property corners which are disturbed or destroyed by construction activities shall be re-established, restored and/or replaced at the contractor's expense.
 - h. Public street lights and utility layout shall be installed per approved construction plans. Public street lights shall be constructed, installed and completed prior to City acceptance of project.
 - i. Contractor shall coordinate installation of public street lights with the local power company. All costs related to street light installation including but not limited to base, pole, conduit and wiring shall be provided by the property owner/project developer.
 - j. Contractor is responsible for contacting the Oregon Utility Notification Center or LOCATE prior to excavation. Contractor shall verify location and elevation of existing utilities.
 - k. The location of proposed drywells/UICD's shall not conflict with existing domestic water wells or existing and planned City municipal water wells.
 - l. Topography survey is based on City Datum _____ located at _____
_____.
 - m. All necessary changes to design plans, revealed during construction, must be approved by the Design Engineer and City of Redmond.
 - n. Plan approval does not assume liability or responsibility for errors and omissions in the design and/or construction plans.
2. Provide the following on all **private improvement plan** sets.
- a. Inspection of public and site grading/drainage improvements will be performed by the City of Redmond Engineering Department with the exception of plumbing code/permit improvements.
 - b. Contractor is required to notify the City of Redmond 24 hours in advance of commencing construction and to coordinate inspections until project is deemed complete by the Engineering Department.
 - c. Where applicable, all materials and workmanship shall conform to the current City of Redmond Public Works Standards and Specifications requirements.

- d. Access to existing properties/residences affected by construction activities shall be maintained at all times by the contractor. Emergency access and coordination of Redmond Emergency Services shall be required.
- e. Survey monuments, controls or property corners which are disturbed or destroyed by construction activities shall be re-established, restored and/or replaced at the contractor's expense.
- f. Topography survey is based on City Datum _____ located at _____.
- g. All necessary changes to design plans, revealed during construction, must be approved by the Design Engineer and City of Redmond.
- h. Plan approval does not assume liability or responsibility for errors and omissions in the design and/or construction plans.

2. Streets

- a. North arrow, preferably to top or right of page
- b. Vertical and horizontal curve data
- c. Indicate roadway centerline and stationing along centerline
- d. Indicate slopes of centerline, and gutter lines if necessary
- e. Indicate curb return radius
- f. Indicate grades at the ends and midpoint of the curb returns
- g. Detailed design of each curb ramp showing slopes of all ramps and landings with spot elevations as necessary and in conformance with Public Right of Way Accessibility Guidelines.
- h. Indicate drainage system and location and size, in square foot, of drainage area served by every dry well
- i. Indicate the location of utilities, existing and proposed
- j. All relevant street system details
- k. Demonstrate that streets may be extended thru adjacent properties if so desired
- l. Show location, direction, size, type and of MUTCD number of all permanent street signing
- m. Show location and size of any postal delivery boxes to be placed on public right of way
- n. Existing street lights within one block radius of project boundary
- o. Location of street lights to be installed by local power company

3. Stormwater – See Chapter 3 Central Oregon Stormwater Manual

- a. Location of manholes, inlets and storm line
- b. Stationing of structures relative to street stationing
- c. Invert and rim elevations at junction and sediment manholes and inlets
- d. Inlet type, size, rim elevation
- e. Swale and pond edge, slope, contours, inlets, outlets, surfacing, overflow, outlet protection
- f. All relevant storm system details.
- g. A profile demonstrating that sufficient cover will be maintained and showing finished street where applicable.
- h. Drainage report including narrative, basin map and other figures, calculations, downstream analysis and other required submittals as appropriate
- i. Wellhead protection areas within project.

4. Sanitary Sewer

- a. Location of manholes, sewer line
- b. Location of gravity grease interceptors and sampling manholes as required
- c. Stationing along sewer line
- d. Entering and exiting invert elevations at manholes
- e. Sewer is designed and extended to provide service to adjacent properties
- f. All relevant sewer system details
- g. Sewer cleanout locations
- h. A profile demonstrating that sufficient cover will be maintained and showing finished street where applicable

5. Water

- a. Location of valves, fittings and fire hydrants, and water lines
- b. Stationing along waterline
- c. Water system is designed to provide service to adjacent properties
- d. All relevant water system details.
- e. A profile demonstrating that sufficient cover will be maintained and showing finished street grade where applicable.

6. Construction Cost Estimate and Fees

An estimate of probable cost must be provided to determine plan review and inspection fees. Final plans will not be approved until fees have been paid.